CHAPTER 9

CHALLENGES AND OUTLOOK

Challenges and Outlook

9.1 Introduction

Pakistan entered the twenty first century with some progress towards sustainable development accompanied by a large number of environmental challenges. A major factor that mars progress is the degradation of the environment in the country. There is undoubtedly a growing realization among policy planners and decision makers that economic development, environmental protection and improvement of the quality of life are interdependent and go hand in hand. As shown through past trends in chapter 2, overemphasis on economic growth alone has already taken its toll and inflicted serious damage on the environment, posing enormous challenges. Having analysed the past and prevailing environmental trends in previous chapters, this chapter highlights future scenarios and prospects and discusses the critical challenges that the country faces in the second decade of this century in the wake of climate change.

9.2 Projected Trends and Scenarios

9.2.1 Socio-economic

9.2.1.1 Population and urbanization

Pakistan is the sixth most populous country in the world (GOP, 2011a). With an annual population growth rate of 2.03 percent, it is expected that Pakistan will become the fifth largest nation on earth in population terms by 2050 (GOP, 2012). Table 9.1 gives the population projections for Pakistan up to 2030. The medium variant means shows the population increase at a balanced pace. The high and low variants give the scenarios for changes that would occur at a high fertility or a low fertility paces. Constant fertility variant describes changes under a stable fertility assumption.

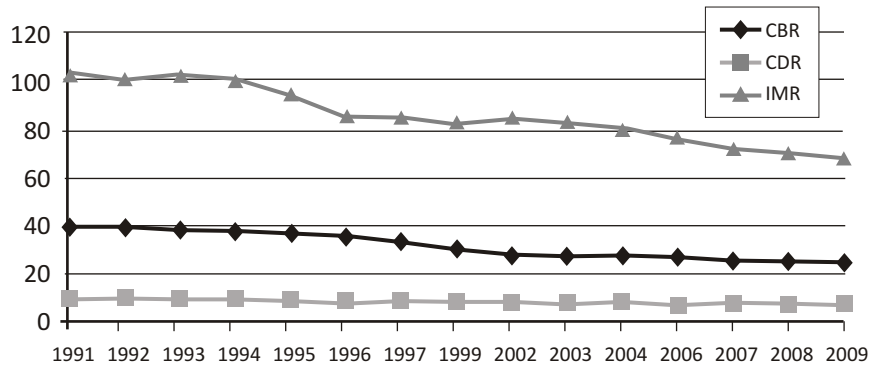
Table 9.1 Pakistan: Population Projections 2010-2030 (Thousands)

Year	Medium variant	High variant	Low variant	Constant-fertility variant
2010	184 753	184 753	184 753	184 753
2015	205 504	207 325	203 683	207 918
2020	226 187	231 276	221 098	234 354
2025	246 286	255 820	236 751	263 398
2030	265 690	280 054	251 345	294 812

Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2008 Revision*

Comparing the five-year periods of 2010-15 and 2025-30, United Nations (2009a) projects that life expectancy in Pakistan would increase from 68 to 71.9 years at birth. The population growth rate would decrease to 1.52 percent, and total fertility rate to 2.70 percent. The crude birth rate (CBR), crude death rate (CDR) and infant mortality rate (IMR) are projected under this scenario to decline to 21.4, 5.6 and 42.2 per 1,000 respectively (Fig. 9.1). Thus Pakistan is to experience the last stage of demographic transition whereby both fertility and mortality are on the decline. It poses a demographic challenge whereby there is an opportunity for the country in the near future to reap the widely acclaimed "Demographic Dividend" as a result of an increase in working age population (Box 9.1).

Fig. 9.1 Pakistan: Trends in Crude Birth Rate, Crude Death Rate and Infant Mortality Rate per 1,000

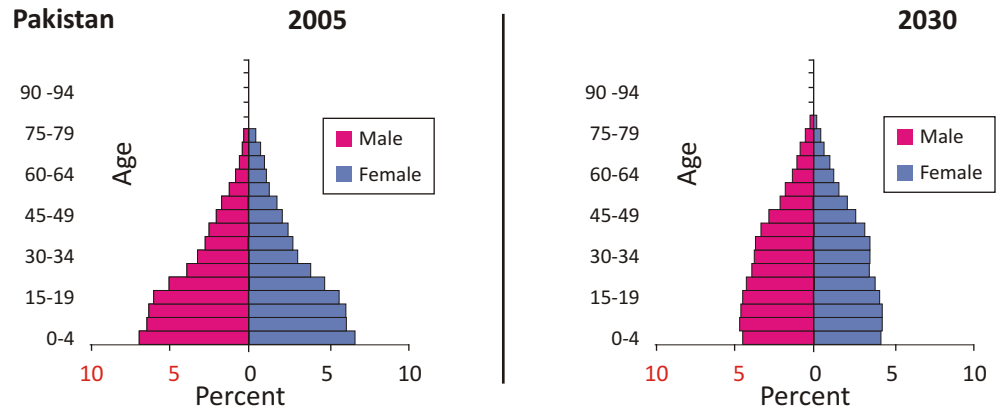


Source: Planning and Development Division

With half the share of total population (52 percent) born in the late 80s to early 90s, the proportion of working age population (15-64 years) in Pakistan has already reached almost 60 percent. The share of working age population will increase with time (Fig. 9.2) and reach a peak in 2045 to 68 percent (GOP, 2010a).

The growing population of Pakistan will also be accompanied by an increasing number of urban dwellers. Most projections (United Nations, 2009b) indicate that the rate of urbanization in Pakistan will continue to increase. This is due to the built-in momentum of high growth rates in the past. According to some base case projections, the year 2030 will be a major landmark in Pakistan's demographics, as for the first time in its

Fig. 9.2 Pakistan: Population Age and Sex Structure for 2005 and 2030



Source: GOP, 2007

Box 9.1 Pakistan's Demographic Challenge

Despite a fall in the population growth rate in recent years, the total population of Pakistan will increase substantially in the next few decades due to a heavy demographic base. Every year Pakistan adds the equivalent of a New Zealand to its population; every two years, a Switzerland; every three years, a Greece; every four years, a Chile or a Netherlands; and every five years, an Australia. While it adds these populations, it does not add the assets and institutions of these countries. Therefore, this increase in population, if not utilized effectively in terms of demographic dividend could be one of the most important factors causing various environmental problems, including the scarcity of resources such as land, forest, water and biodiversity, and may contribute further to water and air pollution.

Source: GOP, 2011a

history, the urban population of the country will constitute 50 percent of the total (GOP, 2010a), after which it will become predominantly urban. There are, at present, nine cities with a population exceeding one million and 75 cities with a population between 100,000 and a million. Some of these cities are located closely, forming clusters. For example, the Gujranwala-Sialkot-Gujrat cluster has a population of 2.6 million and has specialized in engineering and surgical goods development. The cluster has also shown social capital development as the chambers of commerce in Sialkot have constructed an airport in the middle of the cluster through private initiative (GOP, 2011a). These cities, if allowed to develop as centres of trade, commerce and leisure, could become the drivers of growth and productivity, offering opportunities for economic betterment, sustainable development, and a better quality of life.

Current zoning and building regulations are not containing urban sprawl where cities are expanding into peri-urban rural areas. Thus encroachment of rich agricultural land is taking place and delivery of urban services is becoming difficult. Moreover this sprawl is environmentally unfriendly as cities are spreading at the expense of nature, and for the provision of services more and more energy is needed. The current regulations favour the rich over the poor because they promote single-family homes, private transport, large parks and other amenities at the expense of commerce (retail, offices, and warehouses) and more inclusive housing such as flats. It is important to change this mind-set and encourage the emergence of people-friendly and commerce-friendly cities. Since cities are the melting pot for immigrants, their dynamics on innovation and entrepreneurship also needs to be harnessed.

9.2.1.2 Economic Growth

The long-term perspective plan of Pakistan - Vision 2030 (GOP, 2007) provides the following scenario of economic growth:

- Pakistan's per capita GDP (at constant market prices of 2005) will nearly quadruple by 2030, advancing from Rs.43,000 in 2005 to Rs.164,000 in 2030. This is based on average annual growth rates of 7 and 1.4 percent in GDP and population respectively.
- The share of *manufacturing will* rise from the current 18 percent in 2005-06 to nearly 30 percent by 2030.
- The share of agriculture in GDP is predicted to decline to 10 percent by 2030, as happens in newly industrialized countries. Nevertheless the agriculture sector is envisaged to continue growth through:
    - Doubling of the output of several crops, pulses, oilseeds, horticulture, livestock and fisheries production exclusively through productivity increase;

- Diversification to high value agriculture and value added products;
- Increased cropping area by 1 percent per annum by developing water resources and improving culturable wastelands;
- Increased production and appropriate application of fertilizers especially phosphate fertilizers and micronutrients by at least 2-3 times by 2030;
- Increased supply of farm power from existing 0.25 HP per cultivated hectare to 2HP along with the requisite accessories, training, and repair facilities; and
- Structural transformation of agriculture from small-scale subsistence farming to diversified and commercialized agriculture.

- A comprehensive infrastructure programme, the National Trade Corridor Initiative has already been launched to overhaul the entire logistics chain, physical connectivity and processes (motorways, expressways, railways, ports and shipping and airports) and to improve efficiency to bring it at par with international standards.

The new Framework for Economic Growth (GOP, 2011a) also recognizes that Pakistan's real GDP needs to grow at an annual average rate in excess of 7 percent. However, the Framework acknowledges that the country cannot jump immediately to these high rates of growth from the current low growth rate of about 3 percent per annum. Therefore, at the first stage, it envisages to revive the economy to its short-term potential GDP growth rate of about 5-6 percent per year. Nevertheless, it also suggests deep and sustained reforms in areas such as managing the public sector, developing competitive markets, urban management and connecting people and places as a way forward for accelerating growth to above 7 percent (GOP, 2011a).

As seen above, the economic growth rate in Pakistan has been projected to continue at high rates of output growth. Such growth is critical in creating employment, alleviating poverty and making resources available for infrastructure and human resource development, and for increasing access to basic amenities. However, this will also increase the pressure on environmental resources.

9.2.1.3 Incomes and Quality of Life

In terms of quality of life, Pakistan is committed to achieving *inter alia*, Millennium Development Goal 1 (MDG 1) on poverty alleviation, as shown in table 9.2. Poverty reduction based on national poverty line was on track up to 2005-06. However, prospects for further reduction were overshadowed by the world economic crisis.

Health is another indicator of quality of life. Investments in the health sector in Pakistan are viewed as an

Table 9.2 Pakistan: Achievements in MDG 1 Eradication of Extreme Poverty and Hunger

Indicators	Definition	90-91	2000-01	2004-05	2005-06	MTDF Target 2009-10	MDG Target 2015
Proportion of population below the calorie based food plus non-food poverty line	head-count index based on the official poverty line of Rs. 673.54 per capita per month in 1998-99 prices consistent with attainment of 2350 calories per adult equivalent per day	26.1	34.5	23.9	23.3	21	13

Source: Planning & Development Division

integral part of the Government's poverty alleviation endeavour. An improvement in the overall health sector indicators of a country has important ramifications for the quality of life of its citizens as well as for its economic development through the channels of productivity enhancement and poverty alleviation.

Hopefully, the achievement of MDGs will considerably improve the health profile of Pakistan. It is a priority area (GOP, 2005a), and the country is committed to meeting health related goals up to 2015 by launching new policy initiatives through health intervention programmes and strategies. The aim is to reduce the under-five mortality rate to 52 per 1,000, infant mortality rate to 40 per 1,000, and maternal mortality ratio to 140 per 100,000 by 2015 (GOP, 2010a). The targets of Vision 2030 are to reduce infant mortality rate to 15 per 1,000 and life expectancy at birth to 75 years; to increase the proportion of 1-year old children to be immunized against measles to 85 percent, and the proportion of births attended by skilled health personnel to 90 percent by 2015 (GOP, 2010a).

Uneven spatial distribution of the population has impacts on the quality of life. In Pakistan, about 85 percent of the population is located in 20 percent of the area east of the Indus River and in close proximity to the border with India. Additionally, the urban centres accommodate more than one third of the population, of which a little over 50 percent live in eight largest cities. These cities are confronted with a myriad of challenges: urban poverty, congestion, pollution, inadequate and deficient infrastructure, social conflict, strife and discontent and ecological degradation. Meanwhile, the small and medium sized towns are losing vitality due to the emigration of their elite and educated citizens and an absence of investment and infrastructure for the expansion of local commerce. As such, they are constrained to contribute their full potential towards national development.

Hence, sound urban policies must be evolved to address the variant nature of issues confronting large as well as small towns and cities. Pakistan's Planning Commission's Task Force on urban development and the new Growth Framework (GOP, 2011a & b) have emphasized the need for an urban policy that can transform cities as engines of growth. A policy that enables the attraction and management of resources with optimal use of land where people work, live, shop, and entertain; building of infrastructure (roads, schools, hospitals, sewerage lines, water and other utilities); and efficient delivery of services (health, education, and sanitation). It should also promote coordination across various levels of government. Moreover, it should assure that the new Growth Strategy does not affect the pristine environment and areas of important historical and ecological values. Finally, an important MDG target, in terms of quality of life, is improvement of the lives of slum dwellers (inhabitants of Katchi Abadis or squatter settlements in Pakistan) many of which have already been regularized to meet the target.

9.2.2 Resources

The demand on natural resources and environmental amenities in Pakistan is bound to increase sharply with time due to the expanding demographic base and economy, increased industrialization, improved infrastructure, food and energy security, and elevated standards of living, all of which carry significant implications for the environment and natural resources. One can clearly see the pressures from growth projection and strategies of economic growth highlighted above on energy, land, water, fertilizer and material resources consumption.

9.2.2.1 Land, forest and biodiversity

Without major interventions, the rate of land degradation is likely to continue. Maintaining let alone

improving the situation regarding per capita land availability will be difficult as the population continues to increase and agricultural land is lost to urban, industrial and transport infrastructure. The tough challenge is the optimization of land use for competing needs. Given the limited scope for expanding cropland, future food production will rely heavily on the intensification of agriculture and use of fertilizer and pesticides. Past trends in freshwater supply indicate that irrigated land may not expand much further due to depletion of aquifers and growing competition with other land uses. Moreover, high rates of fertilizer and pesticide use may not translate into corresponding expected increases in yield, due to erratic and sometimes non-optimal applications, which may cause concomitant negative environmental impacts.

Forest destruction has gone too far to prevent irreversible damage and it will take many generations to replace the lost forests with plantations. If continued, deforestation will further aggravate the widespread incidence of desertification, soil erosion, siltation, flooding and biodiversity loss, and will be among the major contributors to droughts and potential threats from climate change. Forest plantation efforts are likely to intensify. The sustainable forest and agricultural management policies that were introduced in the 1990s will continue to be implemented and may show more promising results.

In the Forestry Sector, Pakistan is committed to increase forest cover from existing 5.2 percent to 6 percent by the year 2015. An increase of one percent implies that an additional 1.051 million ha area has to be brought under forest cover by 2015. This will include all state lands, communal lands, farmlands, private lands and municipal lands. In terms of the MDG target with respect to protected areas established to conserve rapidly declining wildlife species in their natural environment, Pakistan has committed to improve and enhance its existing network of protected areas in terms of quality and quantity from 11.25 percent in 2001 to 12 percent by 2015 (GOP, 2009). For further details on land, forest and biodiversity see chapter 3 on Terrestrial Ecosystems.

9.2.2.2 Aquatic Resources

Among resources, the most dramatic rise in demand is for fresh water. The demand for safe drinking water is anticipated to increase enormously in the coming years in the wake of growing population. Although agriculture will continue to be the largest consumer of water, the fastest increase in water demand will occur in the urban and industrial sectors, where water use is projected to double over the next 30 years. Demand of water for other uses is also increasing rapidly, whereas the country has reached water stress levels of about 1,000 cubic metres according to Vision 2030 and some estimates of WAPDA as the current use of water is that much per capita (Table 9.3).

Table 9.3 Pakistan: Looming Water Scarcity

Year	Population (Millions)	Water Available Per Capita (cubic meters)
1951	34	5650
2003	146	1200
2010	168	1000
2025	221	800

Source: GOP, 2007

The country's current storage capacity at 9 percent of average annual flows is also very low compared with the world average of 40 percent (GOP, 2010b). Without additional storage, the Vision 2030 predicted an increase

in shortfall by 12 percent alone over the present decade (GOP, 2007) and in the future, water scarcity may be exacerbated by potential climate change (GOP, 2010b). Increasing storage capacity is thus an important part of the water strategy, and it is planned to increase storage capacity by 22 billion cubic meters (7 BCM for replacement of storage lost to silting/sedimentation, and 15 BCM of new storage) in order to meet the projected requirements of 165 BCM. The larger storage will be complemented by a number of small dams and other measures for recharging underground reservoirs.

Water has not been treated as a "precious commodity" in Pakistan (GOP, 2007) as minimal water charges are levied on treated domestic water as well as on agricultural water. There is no restriction on extraction of ground water for any purposes. Under this scenario, conservation of water resources does not get due importance. Increased groundwater utilization for domestic and agricultural purposes has adversely affected groundwater quality particularly in the irrigated areas with a large proportion of tube wells now pumping hazardous sodaic water. Due to greater dependence on this resource and pumping for meeting the ever-growing agricultural requirements, currently observed water table declines may also enhance in many areas in future. The looming water scarcity requires enhancing efficiency by all water users, apart from re-cycling and re-use. Currently a major programme underway is lining of the water channels. This will improve water availability at the farm gate, but will have a negative impact on the recharge of underground aquifers.

Target 10 of MDG 7 deals with the sustainable access to safe drinking water and basic sanitation. Presently, only about 48 percent of the population of Pakistan has access to proper sanitation and 91 percent to safe drinking water, whereas the targets for 2015 are 90 percent and 93 percent respectively. Even though there has been an improvement in water supply coverage, the MDG target of 90 percent for sanitation poses a daunting challenge (GOP, 2007a) and would be difficult to achieve.

Despite the generally arid nature of Pakistan's climate, 10 percent (780,000 ha) of the total surface area of the country is covered by wetlands, which are of global importance (GOP, IUCN and WWF, 2000). Due to growing population pressures and habitat loss exacerbated by climate change, the wetlands are facing increasing pressures. It is feared that these wetlands may not be able to take on much additional pressure and their productivity will need to be preserved, enhanced and sustained.

As most fishing areas reach their maximum potential and production from capture fisheries dwindles, aquaculture production has become an increasingly important industry in the country. There has been an improvement in Mangrove forest area coverage due to plantation but degradation of coastal and marine resource may not halt and may slow down due to the introduction of protective measures. For further details on aquatic resources see chapter 4 on Aquatic Ecosystem.

9.2.2.3 Food

Increasing food availability alone will not overcome the problem of well-being and malnutrition unless other basic needs such as provision of safe drinking water, improved health care and basic education are made available to all as part of an overall strategy. Besides making progress in food output, access and affordability has to be enhanced to achieve food security for all. Vision 2030 (GOP, 2007) estimates that nearly half the population in Pakistan suffers from varying degrees of outright malnutrition, as well as mild and moderate under-nutrition. The most vulnerable are children, women and the elderly, especially among the lower 30 percent income group.

While the share of agriculture in GDP may decline with time, as happens in newly industrialized countries,

continued growth of the agriculture sector is envisaged by the Government because it plays such a vital role in sustaining food security. In spite of a worryingly high population growth, Vision 2030 predicts that Pakistan's rich and productive resource base, augmented by the enterprising spirit of its farmers, and scientists, will not only help achieve food, feed and fibre security, but also produce exportable surpluses (Table 9.4). The limiting factors in meeting the challenge of producing more food, however, will be the availability of productive land and supply of fresh water, especially in arid areas.

Table 9.4 Pakistan: Targets of Major Agricultural Products in Vision 2030

Crops and Livestock	2004-05 (Benchmark)	Production Targets		
		2009-10**	2015***	2030****
Wheat	21.6	25.4	30	33.0
Rice	5.0	6.3	7.5	8.5
Cotton (Lint)*	14.6	17.0	20.7	21.5
Sugarcane	45.3	56.7	63.4	NA
Fruits	6.0	7.0	10.8	NA
Oil Seeds	5.8	7.5	8.12	NA
Meat	2.8	3.1	4.2	NA
Milk	29.4	43.3	52.2	NA
Fisheries	573.6	725	NA	NA

*Million Bales **MTDF 2005-2010 ***MINFAL 2015 **** Production based on Regression Analysis of 16 years data (1990-2005)

Source: GOP, 2007

The food balance sheets for the last fourteen years indicate that the overall per capita availability of food items has only been marginally maintained (Table 9.5), during which the population grew by 20.1 percent, from 124.5 million in 1995 to about 170 million in 2009. Lately there have been slow rise in total meat and cereal production/consumption (wheat, rice, maize, millet sorghum, barley). However, increases have been recorded in milk, eggs and edible oil. The current average daily availability per capita of cereal remained around 2441 calories against the average requirement of 2350 calories per capita per day (GOP, 2010a).

Based on the pattern of existing food production and availability, and desirable changes to the National Food Basket, on a pattern recommended by FAO, the consumption requirements per capita of major food

Table 9.5 Pakistan: Food Availability Per Capita

Items	year/ units	1949-50	1979-80	1989-90	1999-00	2003-04	2005-06	2006-07	2007-08	2008-09 (E)	2009-10 (T)
Cereals	Kg	139.3	147.1	160.7	165	150.7	151.4	148.8	166.3	166.1	159.8
Pulses	Kg	13.9	6.3	5.4	7.2	6.1	7.9	7.2	7.2	6.1	7.2
Sugar	Kg	17.1	28.7	27	26.4	33.6	25.3	32.2	31.5	25.6	30.8
Milk	Ltr	107	94.8	107.6	148.8	154	162.6	170.1	172.1	175.2	176.2
Meat	Kg	9.8	13.7	17.3	18.76	18.8	19.7	20.6	20.1	20.8	21.6
Eggs	Dozen	0.2	1.2	2.1	5.1	4.6	5.2	5.4	5.3	5.7	6.0
Edible Oil	Ltr	2.3	6.3	10.3	11.1	11.3	12.7	12.8	13.3	13.4	13.3
Calories per day		2078	2301	2324	2416	2381	2386	2349	2470	2456	2441
Protein per day		62.8	61.5	67.4	67.5	67.8	69.5	69.0	72	72.5	72.9

Source: Planning and Development Division T: Targets E: Estimates

commodities were worked out in Vision 2030. This shows that the country would require lesser cereals in the future, but an increase in pulses, meat, oils, vegetables and fruits and dairy products. In terms of malnutrition, the targets for 2015 for Pakistan are to reduce the prevalence of underweight children less than 5 years of age below 20 percent and reduce the proportion of population below the minimum level of dietary energy consumption up to 13 percent.

9.2.2.4 Energy

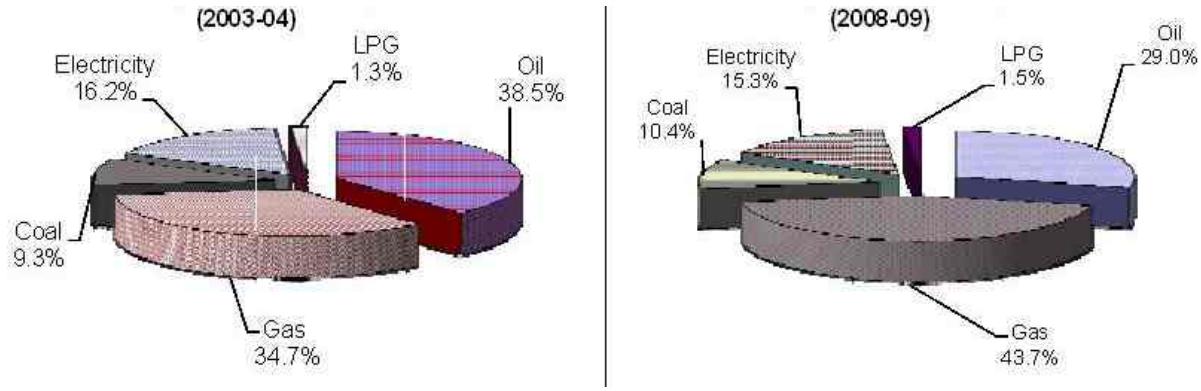
According to the Energy Security Action Plan (GOP, 2005b), the primary commercial energy demand in Pakistan is projected to rise 6.5 fold from about 55 million tons of oil equivalent (mtoe) in 2005 to 360 mtoe by 2030. The corresponding requirements of power generation capacity have been projected to increase more than eight fold from about 19,500 MW in 2005 to 162,500 MW in 2030 (GOP, 2005b, 2007). These projections are based on the assumption that GDP (in terms of constant US dollars of 2005) will increase from $109.5 billion in 2005 to $750 billion in 2030, while the population increase over the same period will be from 153.5 million to 230 to 260 million people. Accordingly, the per capita commercial energy and electricity consumption in Pakistan is projected to increase from 0.36 toe and 400 kWh in 2005 to 1.5 toe and 2,000 kWh in 2030, while the corresponding change in energy intensity of the economy will be from 0.51 toe/1,000 $ to 0.48 toe/1,000 $.

The use of traditional fuels (fuel wood, crop residues and animal wastes) is expected to decline with time due to increased availability of commercial fuels like Liquefied Petroleum Gas (LPG) and natural gas, which are more convenient. However, this decline will require a reduction in the prevalence of poverty.

In terms of commercial energy, consumption of cleaner fuel has increased between 2003 and 2009 (Fig. 9.3). However, the future may be different, whereby Pakistan is expecting energy notches because of expected increased use of fossil fuels, particularly coal (Fig. 9.4). Even hydro resources generated through large dams can have significant environmental impacts. Increased energy use is often incompatible with the absolute need to stabilize carbon emissions. Abatement strategies would need to be based on renewable energy for power and better efficiency and co-generation in the manufacturing industry.

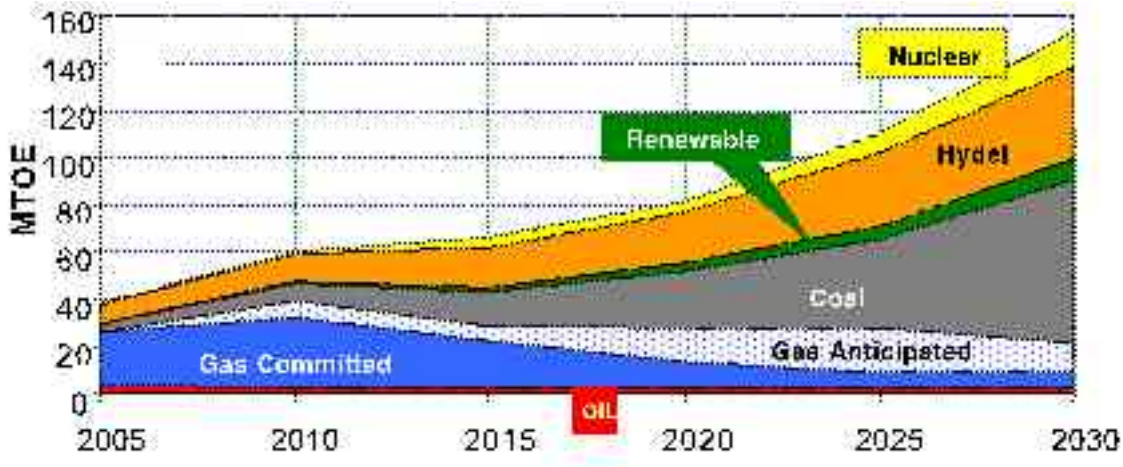
Coal mining and coal combustion for power generation will have severe local, regional and global environmental impacts. The Thar coalfield is being developed in an environmentally sensitive manner, taking

Fig. 9.3 Pakistan: Energy Consumption by Source for 2003-04 and 2008-09



Source: Hydrocarbon Development Institute of Pakistan

Fig. 9.4 Pakistan: Indigenous Energy Supply Projections



Source GOP 2007

into account the best international practices, appropriate control devices and practices to limit the emissions of particulates and noxious gases. Carbon capture and sequestration will need to be actively pursued to make coal use more eco-friendly. The target set by Vision 2030 is to attain 90 percent carbon dioxide capture, and 95 percent storage permanence at less than 10 percent increase in the cost of energy services (GOP, 2007).

9.2.3 Pollution Trends

Economic growth in Pakistan implies a shift to higher productivity activities. Thus, with a shift towards industry, the share of the agriculture sector in output and employment is expected to decline. This implies an increasing use of energy including fossil fuel, which is a major source of pollution. Since growth of the industrial sector invariably occurs in clusters, in and around major cities, the shift to industry and services could therefore involve migration of labour force from rural areas to urban locations. This would increase urban congestion and traffic, as well as put additional pressure on water supply, sanitation and waste collection systems, the net result of which could be enhanced pollution. Moreover, despite a declining agricultural share in GDP, higher agricultural growth is envisaged which may require increased use of agrochemicals, again contributing to pollution.

With the growth in economy, the overall material inputs are expected to expand. The pollution load in terms of discharges in all the natural spheres will also inevitably increase, with a corresponding high cost to human health. With unchanged policies and technologies, emissions from power plants, industries and traffic will grow exponentially. However, improved policies, together with investments in low-polluting technologies, could more or less stabilize emissions at their 1990 levels.

9.2.3.1 Air Pollution

The continuous growth in energy consumption and reliance on energy sources with high carbon content, such as coal and oil, could enhance the production of greenhouse gases such as CO_2. Since transport and power generation, the fastest growing sectors, will remain the prime consumers of energy, improvement of energy efficiency and the implementation of initiatives for the development of mass transport systems will help to reduce growing emission trends. It is estimated that the concentration of all suspended particulate matter (SPM) may increase 1.4 times by 2020 and 3.0 times by 2030 over that in 1990 under the business-as-usual

scenario. Inventories of anthropogenic sulphur dioxide and NOx emissions are subject to uncertainty. However, introduction of basic emission control technologies would cut emissions, but large costs would be involved in the process.

The Government's response to vehicular pollution to improve ambient air quality has been to promote CNG as a cleaner alternative. The Government's MDG target for the number of vehicles using CNG (which previously used diesel and petrol) was 920,000 whereas the current estimate for 2009-10 is 2.4 million (GOP, 2010a). Therefore, Pakistan has already met its MDG target well in advance. This achievement has been made possible by the tremendous growth in the number of vehicles that are converting to CNG due to the Government's resolve regarding the development of the CNG sector as a cleaner and economical energy alternative. For further details on air pollution please see Chapter 5 on the Atmosphere.

9.2.3.2 Solid Waste

The former Ministry of Environment (now Climate Change Division) undertook a study during 1996 (GOP, 1996) on "Data Collection for Preparation of National Study on Privatization of Solid Waste Management in Eight Selected Cities of Pakistan". The study revealed that the rate of waste generation on average from all types of municipal controlled areas varied from 0.283 kg/capita/day to 0.613 kg/capita/day in the selected cities. The projected population of the country for the year 2015, in the medium variant growth is around 205 million. This would result in an estimated projection of solid waste of about 58000-92000 tons per day at low or average generation rate or 21-34 million tons per year.

The Asian Development Bank (ADB) has estimated that roughly 48,000 tons of solid waste is generated every day in Pakistan (ADB, 2008). About 50-60 percent of this is collected and unsafely disposed at the dumping sites located at the periphery of all major cities. Most of the recyclable solid waste such as paper, plastic, metal, glass, rubber, and rags is collected every morning by the scavengers under very unhygienic conditions. A large amount of local government budget (rough estimate is about 40 percent) is used for the collection and transportation of solid waste. At present, Pakistan is in the process of establishing sanitary landfills for the safe disposal of solid waste. In the absence of sanitary landfills most of the solid waste collected by the local government is finally burned at dumping sites, adding to the problem of air pollution.

Disposal of hazardous waste will also pose a major challenge in the future because hazardous wastes generated by manufacturing, hospitals and health-care facilities, and nuclear power and fuel processing plants are projected to more than double within 10 to 15 years. Industries dispose some of the most toxic and persistent pollutants, including heavy metals and synthetic organic chemicals into land and water bodies. This indiscriminate disposal of toxic waste by industries is causing contamination of fresh water, groundwater, and prime arable land. Leaching of heavy metals at the dumping sites is one of the major sources of groundwater contamination. Open burning of toxic industrial waste at low temperatures is causing carcinogenic pollutants with adverse health implications. In the last few years in Karachi and Lahore, a few accidents occurred where people died or got injured due to direct exposure to the industrial toxic waste indiscriminately thrown on the streets of industrial areas (Khan, 2010). The situation is likely to continue unless strict remedial actions are undertaken.

9.2.3.3 Water Pollution:

Water pollution, both of inland water as well as the coastal and marine environment may also get worse in Pakistan (See Chapter 4 on Aquatic Ecosystem). About 92 percent of the untreated urban and industrial

wastes find their way into inland water bodies and the sea, and will continue to constitute a major threat to human health. Weak enforcement of National Environment Quality Standards (NEQS), lack of cost effective indigenous technology and resource constraints are the predominating factors of not treating wastewater. The most important element is the lack of concern of municipal authorities to address this issue. Some Water and Sanitation Agencies (WASAs) have planned treatment plants for Rawalpindi, Lahore, Faisalabad and Multan with the assistance of ADB, but financing for the projects has not yet been made available. Another constraint is the non-availability of locally manufactured cost effective pollution control technologies.

In view of untreated waste, and increased agrochemicals getting into water bodies, the excessive nutrient and eutrophication problems, especially in lakes, may enhance in future. Overall, the pollution load under the business-as-usual scenario is likely to double by 2025 as can be seen in table 9.6.

Table 9.6 Pakistan: Estimated Pollution Loads by Parameters Discharged into Inland Water Bodies

Wastewater Discharges Heads	Concent-rations (mg/l)	2010		2025	
		Yearly Load (Million Ton Per Year)	Daily Load (Ton Per Day	Yearly Load (Million Ton Per year)	Daily Load (Ton Per Day)
Total annual wastewater discharges (MCM)		2,280	6.2*	4,560	12.5*
Total BOD_5	530	1.2	3,286	2.4	6,625
Total COD	1050	2.4	6,510	4.8	13,125
Total TDS	500	1.1	3,100	2.3	6,250

*indicates million tons

Source: Khan, 2010

Threats of heavy metal pollution particularly mercury associated with long-term nuclear waste dumping and oil spills caused by tanker accidents may continue. This could affect not only the overall quality of coastal waters but also damage marine ecosystems and fishery resources.

9.3 Policy Outlook

To address and resolve the environmental problems in Pakistan, the Government is implementing various policies and programmes, many of which have come out of the National Environment Action Programme (NEAP) of the former Ministry of Environment. In this regard, the National Environment Policy prepared under NEAP serves as an overarching framework for various interventions in the area of the environment. Some key policies and programmes that have stemmed from NEAP are: Air and Water Quality Monitoring, Clean Drinking Water for All, Pakistan Wetlands Programme, National Sanitation Policy, Sustainable Land Management to Combat Desertification in Pakistan, Environmental Rehabilitation and Poverty Reduction through Participatory Watershed Management in Tarbela Reservoir and Energy Efficiency and Renewable Energy.

The policy environment with respect to sustainable development is likely to continue to improve. Economic development and environmental quality, which were once thought to be mutually exclusive, will continue to be intertwined, reducing the environmental burden of consumption and production. However, financial

resources and access to environmental technology will continue to form two major constraints in the implementation of policies for sustainable development. The pressure on financial resources has particularly increased in Pakistan due to War on Terror, which resulted in an economic cost of US$ 68 billion up to 2011 (Box 9.2).

Box 9.2 War on Terror and Sustainable Development in Pakistan

Since 9/11, Pakistan has been at the epicentre of the global "War on Terror". In terms of the economic impact, the fall out on Pakistan has been immense. As a front line state in the global "War on Terror", it is estimated that the cost to Pakistan of this war between 2001 and 2010 was over US$ 50 billion. It was around 6 per cent of GDP in 2009-10. The direct and indirect costs to the economy have risen from $ 2.7 billion in 2001-02 to $ 17.8 billion in 2010-11 and are most likely to rise further. A comparison of the costs for 2001-02 and 2010-11 are given below:

Estimated Cost of War on Terror 2001-2011

Years	Billion $	Billion Rs.	% Change
2001-02	2.669	163.9	-
2002-03	2.749	160.8	3.0
2003-04	2.932	168.8	6.7
2004-05	3.410	202.4	16.3
2005-06	3.986	238.6	16.9
2006-07	4.670	283.2	17.2
2007-08	6.940	434.1	48.6
2008-09	9.180	720.6	32.3
2009-10	13.560	1136.4	47.7
2010-11*	17.830	1528.0	31.5
	67.926	**5036.8**	

*Estimated on the basis of 8 months actual data
Source: MoF, M/o Foreign Affairs Joint Ministerial Group

This has affected Pakistan's exports, prevented the inflows of foreign investment, affected the pace of privatization programmes, slowed the overall economic activity, reduced import demand, reduced tax collection, caused expenditure over-run on additional security spending, and badly impacted the tourism industry. Thousands of jobs could have been created if economic activity had not slowed. Thousands of jobs were lost because of the destruction of the tourism industry. In addition, there has been destruction of physical infrastructure (military and civil), a massive surge in security related spending and migration of thousands of people from war affected areas as well as associated rise in expenditures to support internally displaced persons.

Pakistan's investment-to-GDP ratio has nose dived from 22.5 per cent in 2006-07 to 13.4 per cent in 2010-11 with serious consequences for the job creating ability of the economy. Going forward, Pakistan needs enormous resources to enhance the productive capacity of the economy. The security situation is the key determinant to the future flow of investments in and promotion of sustainable development in Pakistan. Pakistan's environmental future demands an end to this war before long.

Source: GOP, 2011b

9.3.1 Policy Challenges

The findings of Environment and Climate Change Outlook Report of Pakistan consistently show that the challenges related to sustainability have been intensifying with the continuous deterioration of environmental trends in the country. Lack of financial resources and technology, inadequate capacity, unsustainable consumption and production, population increase, poverty and inequity, are the key problems.

In addition, knowledge gap, inadequate research and development, and lack of consumer traditions, also pose critical shortcomings. Other policy (regulatory, incentive based, social and institutional) gaps include:

- Lack of a conducive environment for business and industry to strive for continuous improvements towards resource efficiency, least possible use of resources and toxic materials, striving for zero waste and carbon neutrality for the companies and their supply chains;
- Lack of an enabling policy framework for internalization of social and environmental costs into private and public choices through a combination of policy levers;
- Lack of rigorous demand for, and supply of, sustainable products and services in the market;
- Lack of main streaming the sustainable use and management of natural resources in the decision-making process of governments, private sector and civil society organizations;
- Lack of sustainable public procurement policies and measures;
- Limited awareness amongst people of the impacts of their consumption choices; and
- Limited development of institutional capacity through knowledge management, technology transfer, education, training, and awareness raising.

The failure to avoid environmental degradation can be tracked in the weak capacities of institutions, overlapping institutional mandates and lack of effective policy enforcement. The principal environmental challenge in this century is therefore effective implementation of policies through institutional strengthening and capacity building both in cross-sectoral and sectoral arena.

The implementation of appropriate policies and programmes, the enactment of laws, rules and standards for enforcing policies, and the creation of delivery mechanisms for implementing plans, and enforcement by institutions provide credibility and stability to the environmental regime. Challenges in this respect lie in how the government can provide clear signals and incentives to all agencies and actors responsible for promoting sustainable production and consumption (Box 9.3).

Effective implementation of environmental legislation remains one of the biggest challenges. It needs to be resolved by bridging the gaps between intent and action. The most daunting challenge for the Government is not only to guide the overall development process along a sustainable path, but also to promote vertical coordination between its various tiers at national, provincial and local levels, as well as ensuring horizontal coordination between the key sectors of economy. The process of plan formulation demands: a) intensive deliberations on those aspects of sustainable development most relevant to national priorities; and b) extensive participation of the public in giving their views and suggestions on adoption of appropriate means to achieve sustainability.

An essential aspect of such plans, and one often omitted in practice, is the examination of cross-sectoral issues as budgetary priorities, trade and investment policies, specific technology needs, research and development, and roles of transnational corporations and international capital flows. Comprehensive analytical procedures for prior and simultaneous assessments of the impacts of decisions on social and environmental aspects of sustainability need to be applied not only at the project and sectoral levels, but also in the analysis of programmes and policies including macro-economic policies.

Sectoral planning also needs revamping. It should closely analyse the links between the sector in question and the rest of the economy. For example, energy planning should take into account the needs of transport,

Box 9.3 Pakistan: Pursuit of Sustainable Production and Consumption

In promoting sustainable patterns of production and consumption, Pakistan's efforts are concentrated on the conservation of resources and minimizing waste. The Economic Framework of Growth and the National Environmental Policy specifically identify areas such as agriculture, transport and industry where there is a vast potential for improvement. During the last decades Pakistan has formulated and implemented projects in all these areas. In the agricultural sector for example efforts have been concentrated on promoting water efficiency.

Industry in tangible terms started implementation of environmental solutions in the early 90s after the protest of civil society representatives against the hazardous environmental conditions in Kasur owing to tanneries operations. The Embassy of the Kingdom of the Netherlands is the leading bilateral funding agency for financing industry-environment projects in Pakistan. The Federation of Pakistan Chambers of Commerce and Industry (FPCCI), the Pakistan Tanners Association (PTA), All Pakistan Textile Processing Mills Association, the Pakistan Sugar Mills Association, and the Pakistan Pulp, Paper, and Board Mills Association are the main industries implementing those environmental improvement projects in the last ten years. The Performance of the PTA is by far the most effective among the industry sectors. These associations implemented large number of cleaner production and energy efficiency measures in their respective industry sectors. Due to a successful implementation of such measures piloted through projects and programmes, cleaner production and energy efficiency disciplines are well established in the industry sector of Pakistan. Implementation of wastewater treatment plants, Environmental Management Systems, and Corporate Social Responsibility remain the function of large exporting and progressive industrial units.

This success shows that there are possibilities to reduce the resources intensities of production - at least for those impacts that are at the threshold of sustainability. This can be achieved by reducing the material/resource intensity through the application of policy measures such as eco-efficiency standards, which will decouple the economic growth and production from materials, land and energy use, whereby the rate of their use will be less than the growth of GDP.

The eco-efficiency of consumption in Pakistan should also involve framing and implementation of right policies as well as involvement of all stakeholders, Government, business and entrepreneurs and most importantly consumers and civil society. Appropriate policies will provide individual consumers to make environmentally friendly choices, sensitizing the end-users on the social benefits of their choices, while wider participation and confidence of stakeholders can ensure success of the policies. Businesses, governments, civil society and consumers all have the power to affect change, sometimes in ways that are not traditionally perceived to be their role. Consumers may feel a moral responsibility to live sustainably, however they cannot do so without effective support from governments, NGOs and the businesses.

industry and agriculture, as well as input requirements of the energy sector, and economic equity impacts of energy prices, availability and security of supply. Within the sector, it should consider interrelationships among the sources of energy, for example, coal, oil, natural gas, biomass and renewables, together with their costs, environmental impacts and other trade-offs.

Another pressing challenge is the substitution of the command and control model with a more appropriate one for Pakistan. In the wake of diminishing resources, a policy model is needed based on a mix of command-and-control and market-based mechanisms, with a strong but limited government role in effective management and oversight. The role of the government in such a model is that of a facilitator rather than a provider, a prominent role played by the private sector and civil society, by a pricing reform of environmental goods and services, and improved management. This model used in some South East Asian countries appears to have great potential for Pakistan, both in terms of resolving the financial resources deficits and rapidly increasing costs of providing the infrastructure needs of a large and fast growing population (including water supply, sanitation, transportation and power).

9.3.1.1 Cross-sectoral

The biggest cross-sectoral challenge for Pakistan is to build a resilient interrelated socio-economic and ecological system that is able to respond to shocks like those that recently affected not only the national but also the global economy in terms of financial, fuel and food crises. Developing such a system will require the adoption of a strong and adaptive governance focusing on three elements: a) staying within limits, b) building system resilience and c) responding to subsystem linkages.

a. Staying within limits: Safeguarding natural assets

A tough challenge of the future for Pakistan is to reduce the ecological footprint. Entry into the twenty-first century has brought forward the key limits to economic growth in terms of natural resources such as fresh water, forests, rangelands, fisheries and biological diversity. The projections initiated by Vision 2030 on material and energy use for sustaining economic growth in Pakistan were developed under the business-as-usual scenario. According to a study, in this scenario on average more than 90 percent of the resources harvested from nature in the world are wasted in the process of producing food, machines, vehicles and infrastructure (Schmidt-Bleek 2000). Hence, if the environmental impacts of present production patterns are to be reduced, current economies have to find ways of producing equivalent outputs with about 10 percent of the current consumption rates of resources. Otherwise scarcity of resources - a likely scenario at the current rates of extraction - would not only undermine natural assets in the long term, but also lead to an increase in production costs resulting from higher commodity prices.

The major challenge is thus to recognize the natural limits to resource use and adjust national economies accordingly, while at the same time promote efficiency in the use of water, energy and materials, curb growing profligacy in the use of resources, and reflect the cost of natural resources losses and growing pollution in national income accounts.

b. *Building System Resilience*

Building system resilience is closely linked to the Globalization Challenge. Globalization offers both challenges and opportunities to system resilience in promoting development. It has forced Pakistan to introduce new regulatory mechanisms and bring fundamental changes in its production regimes by adopting 'Good

Practices' in production and processing. This could be used as an avenue to strengthen competitiveness and attract investments. However, the final three years of the twentieth century provided new lessons in reliance on investments - that foreign direct investment and financial inflows could change direction overnight, causing instability. The Asian Economic Crisis of 1997 portrayed this reality when rapid economic growth in some countries crashed without warning, fuelling pessimism over sustainable development. The experiences gained from the crisis clearly demonstrated that the enormous economic benefits of financial movement could sometimes be tempered by erratic behaviour in financial flows. This does not, of course, dilute the case of Pakistan for openness to international financial markets, rather it warrants the need for building system resilience of financial inflows through careful, orderly and well-sequenced adoption of policies. Similarly, it is important to monitor openness in trade to ensure that it does not lead to mining of resources and that it assists in promoting the sustainability of the development process.

c. *Responding to System linkages*

Findings in this report have clearly demonstrated that neglect of system linkages in Pakistan like between ecological dimensions and the development process have led to critical strains on the environment and natural resources, which in turn are affecting the economic growth and development itself. The case of water diversion in the upper Indus and its serious impacts on downstream floodplains and Indus Delta is a case in point. Dealing with these imbalances through system linkages is critical for the country if it is to meet key persistent and emerging challenges, such as poverty reduction, water-, energy- and food-security, and climate change. It has to be realised that these challenges are not isolated but closely interlinked. Addressing these challenges will require recognizing the linkages and adopting inclusive, holistic and integrated approaches to increase the resilience of socio-economic systems. It is crucial to understand that extending affordable services to rapidly growing urban populations while ensuring that rural areas are not left behind, accelerating industrialization while pursuing a second green revolution to meet the food demand of present and future generations, and reversing the negative impact of human activities on the global climate while adapting to the changes that are already happening, require a shift to a different development paradigm. It demands putting people and the environment at the centre of economic growth strategies.

9.3.1.2 Sectoral Challenges

The most important sectoral challenges in Pakistan pertain to food, water and energy security. The country is already importing wheat, and unless productivity is boosted, it will continue to rely on imports to meet the increasing demand. Given the increasing volatility of international markets, this would impose a huge and politically untenable cost to Pakistan. In this respect, the food crisis experienced in 2008 was probably a small warning compared to what lies ahead. With new agricultural land and water in short supply, the solution would be to conserve irrigation water and modernize the old irrigation infrastructures. Without water productivity gains, the worst case scenarios are likely to materialize (FAO, 2009).The challenge in terms of food security is to formulate a production strategy that will anticipate population increases, the known limits of intensification of agriculture and aquaculture, and the complementarities of national food systems. An associated challenge to food security is the promotion of sustainable agriculture, through integrated pest management and nutrient management aimed at reducing the use of pesticides and fertilizers. Similarly, sustainable land, water and biodiversity management should be a priority. Institutional reforms should involve the reform of land tenure systems, as well as the development of national land-use plans, and the preparation of guidelines on appropriate use of land resources. Policy reforms, among others, need to cover issues such as required reductions in agricultural subsidies, establishment of water charges in order to manage demands, and definition of standards for irrigation efficiency.

Pakistan has not managed its water resources with care and is already water-stressed (supply of 1,000 cubic metres per capita). The development of an eco-efficient water infrastructure with a clear vision of the future is vital for tackling water security issues. Integrated water resource planning with other infrastructures, such as sewage, energy, transport and disaster preparedness structures would be imperative. In order to be effective, the water infrastructure would also need to enhance storage capacity, promote water conservation by checking system losses, and enhance water efficiency, particularly by using efficient irrigation technologies such as sprinklers and precision levelling, and raising users' awareness and demand management. In order to optimize system functioning, water cycle intervention would also be needed. Through technology and inclusive planning, water can be managed in an integrated manner, following its natural cycle. A major challenge would be to remove the subsidies in order to end wasteful consumption and stop the deteriorating trend of water quality, particularly as a result of increasing discharges of sewage and industrial and hazardous wastes.

To pursue energy security in Pakistan, the main challenge is to ensure that energy supplies are available, affordable and sustainable. This will mean undertaking a broad range of measures such as conserving energy and increasing energy efficiency; rationalizing pricing and taxation systems; improving energy sector governance; and diversifying energy supplies, in particular by making greater use of alternative and renewable sources. In terms of environmental sustainability, there are two main challenges: (i) to reduce the energy intensity of the economy, while decoupling economic growth from energy consumption and (ii) decoupling energy consumption from environmental impacts by shifting towards more environmentally friendly energy sources (ESCAP, 2007).

a. Land, forestry, and biodiversity

The challenges posed by land degradation are serious as a result of erosion and desertification. Excessive use of inputs resulting from pricing and subsidy policies has been the main cause of environmental degradation. In other areas, mining of soil nutrients, erosion and deforestation are the major causes. The rapidly increasing demand for meat and livestock products and the resulting pressure of livestock is damaging the range resources. There is a need for sustainable management of the land resource base to meet the needs of the present and future generations.

In the forestry sector, adoption of improved practices for forest development and management is a major challenge. Their transfer on a field scale, especially on private land is seriously constrained by the lack or scant availability of extension services. This is a critical deficiency in the implementation of programmes aimed at meeting the challenges posed by excessive deforestation. Although the importance of participatory forest management, involving local people in the success of community plantation and other development schemes, has been increasingly recognized in recent years, this approach has been confined to limited areas. Similarly, in integrated watershed management and afforestation efforts, the potential role of village communities and NGOs need to be utilized more effectively.

A major challenge to biodiversity conservation is that the ecosystems are degrading fast and losing their capacity to deliver goods and services to support the local livelihoods. Related to this, no serious actions have been planned so far to maintain and enhance resilience of the components of biodiversity to adapt to climate change. The scientific and technical capacity and human resources for the implementation of the Convention on Biological Diversity (CBD) has somewhat improved over time in Pakistan. However, it has still not reached the threshold level necessary for making significant progress on implementation of the Convention. Biodiversity concerns are being gradually addressed in policies and programmes of various sectors. The

progress so far has been slow mainly because of lack of adequate capacity and partly because of the fact that many of the concepts are new (GOP, 2010b). The country has made reasonable progress on the 2010 global biodiversity targets. The main challenge in this area is the database, which is not organized in accordance with the programme of work of the CBD. Another lacuna is the lack of a systematic plan of work for the improvement of the status of species and their habitats listed in the Convention on International Trade in Endangered Species (CITES) appendices.

b. Urbanization and Industrialization

Cities are increasingly becoming centres of national growth and hubs of economic activity, knowledge and influence, and are thus generating cultural change involving new sets of relationships within society. Urban centres are also generally several times more productive than rural areas because of the clustering of innovation, knowledge and infrastructure. The main challenge is to provide the cities in Pakistan with the needed infrastructure commensurate with the rapidly increasing urban population, so as not to strain the already precarious environmental situation. It is also important to channel on-going urbanization towards a positive influence on economic efficiency as well as on the size and shape of cities and their relationship with the rural hinterland.

The old fashioned local governments of cities have also become increasingly inadequate in responding to the challenges of fast expanding urban economic activities. The major cities of Pakistan are places where tiers of government, big business, transnational corporations, political parties, communities and rural migrants meet. They are the microcosms of the national situation, so what happens there, determines the national destiny. However, the existing urban governments of most cities in Pakistan, with a few exceptions, are essentially the same as they were a generation ago, when they were one third of their current size. The needs of modern cities demand a higher level of management by a corps of managers who are familiar with new tools and technologies that can be applied to the modern city. They need to have the knowledge of alternative communication technologies, environmental economics, urban finance, geographic information systems, water and power systems, alternative transport systems, traffic management and skills in conflict resolution.

A major challenge in industrialization is to acquire low-waste and no-waste technology. A related task would be to modify the existing system of regulations and industrial policy to make them hospitable to the establishment of a sustainable industrial system. This industrial renaissance could be geared up gradually by meeting two main challenges in the transition period: (i) manufacturing products with less material inputs per unit and (ii) choosing industrial processes with the lowest environmental risks and toxicity. The overarching challenge is to establish a regulatory regime that encourages principles and policies that result in price signals, which could give the products of industrial ecology the competitive edge in the marketplace. An integral part of this challenge is to make intelligent technological choices, in other words, alternatives that promote sustainable development. Such technologies should include systems hardware, software and services, create products that are environmentally beneficial, reduce human and ecological risks, and enhance cost effectiveness and process efficiency.

9.4 The Climate Change: A mammoth Challenge

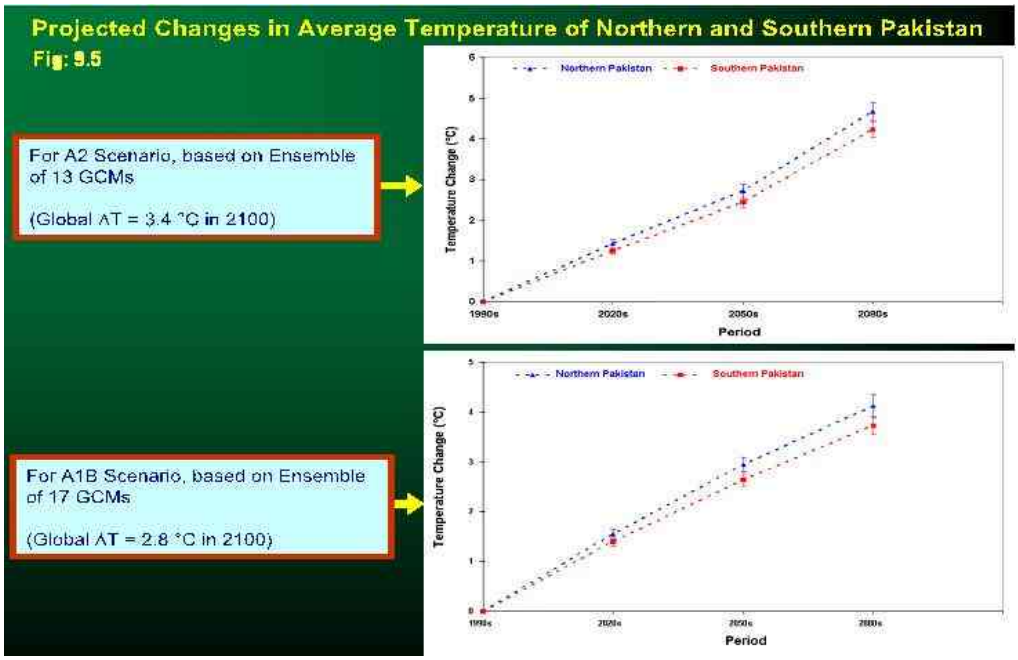
9.4.1 Past and Projected Trends

During the last century, the average annual temperature over Pakistan increased by 0.6 °C, in agreement with the global trend, with the temperature increase over northern Pakistan being higher than over southern

Pakistan (0.8 °C versus 0.6 °C). Precipitation over Pakistan also increased on the average by about 25 percent (GCISC, 2009a). Figures 9.5 and 9.6 show the future climate trends (temperature and precipitation) in Pakistan.

Studies based on the ensemble outputs of several Global Circulation Models (GCMs) project that the average temperature over Pakistan will increase in the range 1.3-1.5°C by 2020, 2.5-2.8°C by 2050, and 3.9-4.4°C by 2080, comparing to an increase of 2.8-3.4°C in the average global surface temperature by 2100. Precipitation is projected to increase slightly in summer, and decrease in winter, with no significant change in annual precipitation (Fig. 9.6). Furthermore, it is projected that climate change will increase the variability of monsoon rains and enhance the frequency and severity of extreme events such as floods and droughts (GCSIC, 2009b).

Fig. 9.5 Pakistan: Projected changes in Average temperature of Northern and Southern Pakistan



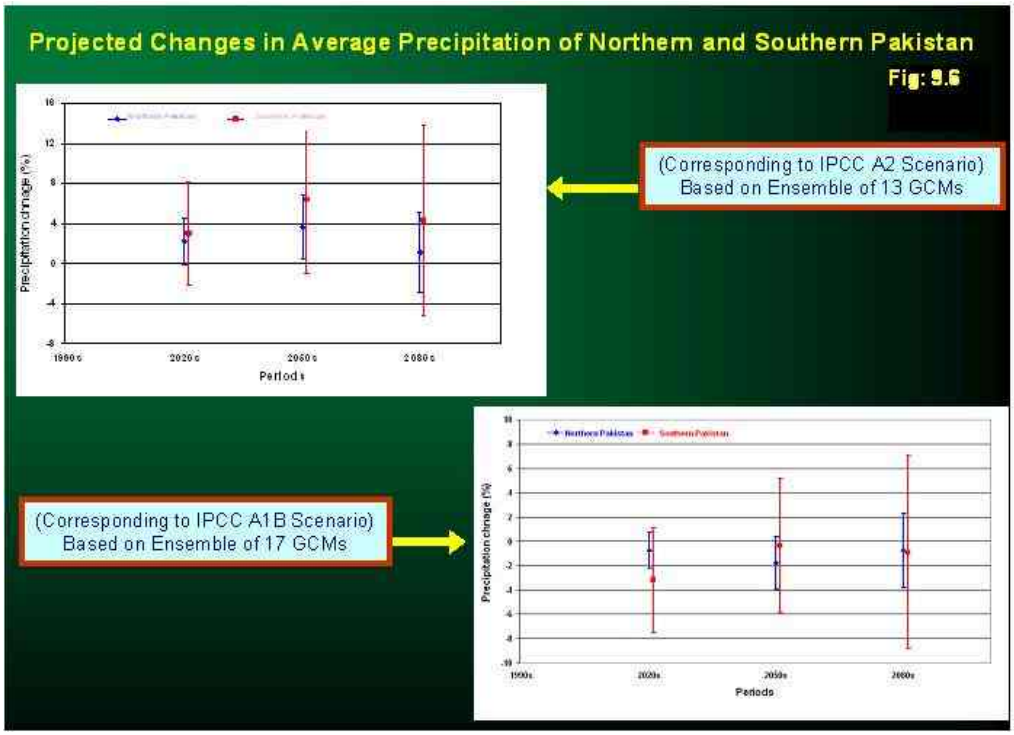
Source: GCSIC 2009a

Extreme weather events have already enhanced in Pakistan. An analysis of data from 52 meteorological stations in Pakistan over a 40-year period (1961-2000) showed that the frequency of highest daily temperature and heaviest rainfall events have increased in the passing decades. At the turn of the century, the country experienced the worst drought in its history. The first decade of the 21st century also saw several extreme weather events including the history's worst flood in 2010. This flood resulted from a rain intensity reaching 300 mm over a 36-hour period resulting in the highest water levels in 110 years in the Indus River in the northern part of the country. This unprecedented flood submerged one-fifth of the country and affected more than 20 million people.

9.4.2 Impacts of Climate Change

Pakistan is one of the most vulnerable countries to climate change despite contributing very little to global greenhouse gas emissions. Maplecroft's (2011) Index of vulnerability to climate change ranks Pakistan 16th among 170 nations of the world. The country has moved up in the vulnerability index since 2010, when it was

Fig. 9.6 Pakistan: Projected changes in average precipitation of Northern and Southern Pakistan



Source: GCSIC, 2009a

rated 29th. Climate change is likely to affect many sectors and across ecosystems. The vulnerabilities of Pakistan have enhanced because of its warm climate, preponderance of arid and semi-arid lands, and dependence of its rivers on the Hindukush-Karakoram-Himalayan glaciers, which are reported to be receding due to global warming. The largely agrarian economy of the country is highly climate sensitive, and increasingly at risks because of variability in monsoon rains, floods and extended droughts. Compounding these problems are the expected increased risks to the coastal areas (particularly to Karachi, Pakistan's largest city and the hub of its industrial activity and international trade) and the Indus deltaic region due to sea level rise and increasing cyclonic activity; to the mountainous regions due to Glacier Lake Outburst Floods (GLOFs) and landslides; to the country's scanty forests (about 5 percent of the land area is under forest cover) due to forest fires as well as reduced regeneration under rapidly changing climate conditions; to human health due to heat strokes, diarrhoea, cholera and vector borne diseases and to human settlements due to floods and cyclones (GOP, 2010).

Economically the detrimental impacts of climate change will be widespread and have bearing not only on water security, food security and energy security but also impinge on agriculture, forests, livestock, and fisheries, the sectors vital for Pakistan's economy. In terms of the social dimension, climate change will cause displacement of people, and result in loss of their income due to enhanced extreme natural events such as floods and droughts or sea level rise. It could jeopardize hundreds of jobs, may result in inflation of food prices and increase the number of people at risk of food insecurity and hunger. It could also trigger migration and civil unrest. Climate change is also likely to have serious impacts on biophysical conditions through a change in the ecology and habitats, quantity and quality of land, soil, water and biotic resources and ocean temperature and salinity. It may exacerbate occurrence of weeds and pests, which in turn may enhance environmental changes. These and other key concerns have been discussed in detail in Chapter 7, Combating Climate Change.

Community-level surveys in three selected areas (Badin District in Sindh, Rajanpur in the Punjab and Khuzdar in Balochistan) show that communities have already experienced significant changes in climate. The findings of the surveys (Oxfam, 2009) depict that environmental problems in the three districts are serious, and climate change is enhancing these or is likely to exacerbate them in the future. The findings of the study are summarized below.

Changes in Physical and Climate Related Parameters:

- There has been an increase in the incidence, frequency, and intensity of extreme weather events: more intense and heavier rainfall in coastal areas, more intense cyclones, more intense flooding in flood-prone areas along the Indus, and more pronounced droughts in the arid areas of Khuzdar.
- In coastal areas, because of excessive water withdrawal from Indus the sea has intruded inland. The problem will be aggravated due to sea level rise.
- In most areas, rainfall patterns have become erratic, making it difficult for communities to predict local rainfall patterns.
- Summers have become hotter and winters much warmer across the areas studied. As a result, the duration of the cropping period has shrunk perceptibly in southern Punjab and Balochistan, with a forward shift in sowing time and an earlier harvest. In some areas, communities have noticed some degree of cooling during the monsoon season over the last 30 years.

Environmental changes exacerbated by climate changes:

- Fish and prawn catches in coastal areas (freshwater fisheries) have shrunk due to seawater intrusion and the increase in sea surges and cyclones (which bring seawater into land depressions far inland). This implies that high-sea fishing remains the only solution, but few communities can afford the necessary equipment.
- In coastal areas, groundwater quality has deteriorated (become brackish).
- In the drought-prone areas of Khuzdar, the groundwater table is falling very rapidly.
- There has been widespread land degradation from salinity in coastal areas.

Socio-economic Impacts:

- The area of rangeland available for the open grazing of livestock has shrunk, and the quality of grassland has deteriorated due to the scarcity of water resources.
- The traditional coping mechanisms, which were used to deal with water shortages, declines in fish catch, and reduced agricultural produce, are no longer enough to counter the immense impact of climate change.
- Seasonal emigration has been observed in the areas studied, implying that incomes from traditional sources are no longer enough to support families.

9.4.3 Response and Outlook

Pakistan has already acceded to the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol. As a follow up to these international commitments, the country has undertaken substantial climate related work. It announced and implemented the CDM National Operational Strategy (GOP, 2006) as a signal for country's entry into the global carbon market. Moreover, Pakistan's commitments to combat

climate change also find expression in its national policy frameworks such as the Climate Change Policy of Pakistan, Framework for Economic Growth, One UN programme on Environment, National Environmental Policy as well as the National Energy Conservation Policy. The Framework for Economic Growth (long-term growth strategy) of Pakistan giving special importance to climate change pledges to promote sustainable and climate resilient economic growth.

In terms of institutional development, the Cabinet Committee on Climate Change was formulated in 1995 to provide a policy coordination forum for dealing with climate change. In 2004 this was changed to the Prime Ministers Committee on Climate Change, which also aimed at establishing high-level inter-ministerial linkages and proved to be extremely effective in initiating the country's entry into the global carbon market. The Climate Change Division has also been created recently, which is the designated national focal point for UNFCCC and the Kyoto Protocol. The Division has been coordinating with other concerned agencies and institutions on various technical aspects, Mitigation and adaptation are two key aspects of policy response to climate change in the country. In terms of mitigation, Pakistan is presently a small GHG emitter but its emissions are bound to increase considerably as the country strives to develop and provide adequate amounts of energy to support its growing developmental needs. The country therefore wishes to contribute to the global GHG mitigation efforts without compromising on its basic minimum energy and food needs consistent with its socio-economic developmental requirements, energy security considerations, and existing financial and technological constraints. In terms of mitigation, the low carbon development scenarios projected for the country under one study (GOP and UNFCCC, 2011) estimates additional investment costs of mitigation ranging between $8 to $17 billion by 2050**,** as progressively cleaner coal and a higher percentage of renewable energy technologies are employed. According to the study, it is considered feasible to reduce emissions by 40 percent from the BAU scenario by employing cleaner technologies.

A number of adaptation measures are being promoted or envisaged related to water resources, agriculture and livestock, coastal areas and the Indus Deltaic Region, and for enhancing forests and other vulnerable ecosystems. A preliminary study's (GOP & UNFCCC, 2011) findings show that adaptation costs will be too high, ranging from US$ 7 to US$ 14 billion per year. Developing countries like Pakistan do not have the resources to meet such huge adaptation costs and need the help of developed countries, who made commitments under the Bali Action Plan to help developing countries adapt to climate change.

Climate change imperatives also call for the integration of climate considerations into development policies. The challenge of aligning climate action with development policy demands focus on co-benefits. This refers to the realization of multiple objectives within a strategy that targets the reduction of greenhouse gases. Since many environmental protection measures have socio-economic benefits, policies and actions that can provide win-win situations need to be identified and prioritized in this regard.

9.5 Conclusions

The challenges related to sustainability have been intensifying in Pakistan with the continuous deterioration of the environmental trends in the country. There gravity is likely to intensify due to lack of financial resources and technology, inadequate capacity, unsustainable consumption and production, population increase, poverty and inequity. The most serious problem that has emerged recently is the challenge of climate change. Dealing with climate change is no longer an option for the country; it has become an unavoidable reality in the wake of increasing symptoms exhibited through cataclysmic floods and droughts. The potential impacts of climate change identified are wide-ranging and are likely to affect all dimensions of development with impacts across many sectors and ecosystems.

Overall whether climate or other environmental challenges, they call for action from all sections of society including the Government, private sector, major groups and civil society. The Government with limited financial resources will need to focus on involvement of the private sector, improving policies as well as decentralization and devolution of power. It will also need to strive for enhancing cooperation on the issues of global commons such as climate change. The private sector will have to play a more positive role through environmental investments, innovation and incorporation of environmental considerations in their operation. A crucial role needs to be played by major groups and educated citizens as agents of change through participation, advocacy, partnership and communication.

Policies and institutional reforms by the Government will form the critical components of Pakistan's environmental future. Without a conducive policy environment and a favourable incentive structure, few innovations will take place. Substitutions from existing to cleaner technologies will be rare, in the absence of international technology transfer especially when they involve high costs. Policies and institutional reforms by the Government will form the critical components of Pakistan's environmental future. Until policy makers price scarce natural resources and environmental assets more realistically, the efficiency with which they are used will not improve. Policy makers will also need to: (i) phase out environmentally harmful subsidies; (ii) define property rights more clearly and (iii) increasingly privatize the provision of water supplies, sanitation, waste treatment, protected area management and transport infrastructure to be financed through user charges that increasingly reflect the long-term marginal cost of supply.

Finally, implementation of a sustainable development agenda cannot succeed in developing countries like Pakistan without developed countries meeting their commitments made at Rio - firstly to enhance the flow of financial resources, secondly, to transfer environmentally sound technology at concessional terms and thirdly sharing of information and capacity building to promote sustainable development. The principle of 'common but differentiated responsibilities' invoked at Rio demand immediate fulfilment of these commitments by the international community.

Refrences

(2007). Energy Security and Sustainable Development in Asia and the Pacific. United Nations publication, Sales No. E.08.II.F.13.

Food and Agriculture Organization of the United Nations, International Water Management Institute and Asia-Pacific Water Forum (2009). Revitalizing Asia's Irrigation to Sustainably Meet Tomorrow's Food Need. United Nations.

GCISC (2009a). Sheikh, M. M. Manzoor, N. Adnan, M. Ashraf, J. and Khan, A.M. Climate Profile and Past Climate Changes in Pakistan. Research Report No. GCISC-RR-01, Global Change Impact Studies Centre, Islamabad.

GCISC (2009b). Islam, S. Rehman, N. Sheikh, M.M. and Khan, A.M. Climate Change Projections for Pakistan, Nepal and Bangladesh for SRES A2 and A1B Scenarios using outputs of 17 GCMs used in IPCC-AR4. Research Report No. GCISC-RR-03, Global Change Impact Studies Centre, Islamabad.

Government of Pakistan (2011a). Pakistan Framework for Economic Growth. Planning Commission, Islamabad.

Government of Pakistan (2011b). Task Force Report on Urban Development. Planning Commission, Islamabad.

Government of Pakistan (2010a). Pakistan Economic Survey 2009-2010. Ministry of Finance, Economic Advisor Wing, Islamabad

Government of Pakistan (2010b). Final Report of the Task Force on Climate Change. Planning Commission, Islamabad

Government of Pakistan (2009). Fourth Report - Pakistan National communication to CBD Secretariat. Ministry of Environment, Islamabad

Government of Pakistan (2007). Pakistan in the 21st Century: Vision 2030. Planning Commission, Islamabad.

Government of Pakistan (2007a). Pakistan Economic Survey 2006-2007. Ministry of Finance, Economic Advisor Wing, Islamabad

Government of Pakistan (2005a). Medium Term Development Framework 2005-2010. Planning Commission, Islamabad.

Government of Pakistan (2005b). Energy Security Action Plan. Planning Commission, Islamabad

Government of Pakistan (1996). Data Collection for Preparation of National Study on Privatization of Solid Waste Management in Pakistan.

GOP and UNFCCC (2011). National Economic and Environmental Development Study (NEEDS), unfccc.int/files/adaptation/application/pdf/pakistanneeds.pdf

Khan, A. (2010). Evolution of Industrial Environmental Management in Pakistan. Report Prepared for the Ministry of Industries, Islamabad

Maplecroft - Global Risks Portfolio and services (2011). Maplecroft's Climate Change Risk Atlas.

Oxfam (2009). Climate Change, Poverty and Environmental Crisis in the Disaster Prone Areas of Pakistan. Pakistan Programme Office, Islamabad

Schmidt-Bleek, F.B. (2000). Factor 10 Manifesto.

United Nations (2009a). World Population Prospects, The 2008 Revision. Population Division, Department of Economic and Social Affairs, New York

United Nations (2009b). World Urbanization Prospects, The 2008 Revision. Population Division, Department of Economic and Social Affairs, New York