Chapter 2
Economic Development and Environment

2.1 Introduction

The Indian economy is characterized by extraordinary contrasts. On the one hand, it is the fourth largest economy in the world in terms of purchasing power parity. It has been growing at an average rate of more than 8% per annum since 2003–2004, and the annual per capita income is increasing at the rate of about 7%. On the other hand, about one-third of the total population of the country survives on less than US$1 per day. Both sides of the picture are leading to degradation and depletion of the environment and natural resources. Similarly, the country has elaborate statutes, regulations, institutional frameworks, and policies for environmental conservation and preservation. The complexity and magnitude of environmental problems are increasing at a very high pace due to weak monitoring and enforcement and lack of capabilities (Gupta, 2001). These contrasts are posing a question about the sustainability of the present growth trajectory from both economic and environmental points of view.

This chapter intends to provide a critical account of India's development history from independence and, more particularly, after the early 1990s. In 1991, India altered its development strategy from an inward-oriented development path to a path that integrates the economy with the global economy. Note that, though the development strategy has been changed drastically, the regulatory and institutional framework for environmental protection and conservation has not been updated according to the changed scenarios. As a prelude to examining alternatives for environmental regulations, this chapter analyzes recent economic and environmental trends.

The chapter is organized as follows. Section 2.2 shows a picture of the country. Section 2.3 provides an account of the macroeconomic developments in the country since independence. Regional disparity and the poverty situation in the country are discussed in Section 2.4. Section 2.5 depicts the trend in natural resource depletion and environmental degradation that is occurring in the country. Section 2.6 questions the present trajectory of economic development followed in India and

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provides estimates of growth rate of per capita genuine and conventional wealth. The last section (Section 2.7) offers some concluding remarks.

2.2 Country Profile

2.2.1 Geographical Profile

Indian civilization is one of the oldest in the World, spanning more than 4,000 years and projecting a unique assimilation of various cultures and heritage. It is a land of spiritual integrity and philosophy. Unity in diversity is its magnificent facet, which had been fused by the feeling of national fervor. Religious tolerance and cultural amalgamation shape its unique national character.

2.2.2 Physiographic Conditions

India, with an area of only 2.4% of the world's total land area, supports around 16.7% of the world's human population and around 18% of the world's livestock population (ESPASSA, 2008). It is the second most populous country in terms of humans and first in terms of cattle population. Its total geographic area is about 329 million hectares. It is situated to the north of the equator. It lies between 8°04′ and 37°06′ N latitude and 68°07′ and 97°25′ E longitude. The Indian Ocean in the south, the Arabian Sea in the west, the Bay of Bengal in the east, and the Himalayas in the north bound it. India's total land area is about 3.3 million km^2. The coastline, encompassing the mainland, Lakshadweep Islands, and the Andaman and Nicobar Islands, is 7,516.6 km. It occupies a major portion of the South Asian subcontinent.

The country's mainland is broadly classified into four regions: the Northern Mountains, which include the great Himalayas; the vast Indo-Gangetic plains; the Southern (Deccan) Peninsula bounded by the Western and Eastern Ghats; and the coastal plains and islands. About 69% of its total geographic area is dry-land (arid, semiarid, and dry subhumid), and the country is divided into 10 biogeographic zones.

India is primarily a tropical country but due to great altitudinal variations almost all climatic conditions from hot deserts to cold deserts exist. There are four seasons: (1) winter (December–February), (2) summer (March–June), (3) southwest monsoon (June–September), and (4) postmonsoon (October–November). The southwest monsoon is the principal rainy season for almost the entire country and contributes almost 80% of the precipitation. The distribution of the southwest monsoon ranges from over 2,500 mm in the western coast and extreme northeastern sector to within 25–50 mm in the extreme tips of the peninsular region. Most of central India receives rainfall of over 1,000 mm, and in the northern plains the rainfall varies

between 500 and 750 mm. The mean annual temperature varies from 10 to 28°C. The mean summer and winter temperatures show significant variation in the northern sectors (<10°C); the southern sectors however, show <5°C variation in mean summer and mean winter temperature.

2.2.3 Sociocultural Conditions

The total population of India is 1,027,015,247 persons, comprised of 531,277,078 males and 495,738,169 females as per the census of March 2001. The population has grown at the rate of 1.93% per annum during 1991–2001. The crude birth and death rates according to the 2001 census are 24.8 and 8.9, per 1000 respectively. The sex ratio (i.e., number of females per thousand males) of population was 933, rising from 927 in the 1991 census. The total literacy rate was 65.38%.

The country includes various ethnic groups, religions, and languages. All the five major races – Australoid, Mongoloid, Europoid, Caucasian, and Negroid – find representation among the people of India. As per the 2001 census regarding religion, about 81% of population of the country is Hindu followed by 13.4% Muslims. The followers of other religions such as Christians, Sikhs, Buddhists, Jains, and others also live in the country with dignity. There are 22 national languages that are constitutionally recognized, and Hindi is the official federal language of the country. Besides these languages, about 844 different dialects are practiced in different areas of the country.

2.2.4 Indian Polity and Governance

India obtained freedom on 15 August 1947. India is the largest democracy in the world. It has a multiparty political system. It is governed by a written constitution. Its constitution came into force on 26 January 1950 and since then democracy has been flourishing. The fact is that India has repeatedly been able to mount general elections since it gained freedom from British rule in 1947, on a scale never before been witnessed in history. It has a strong and independent judiciary and press. The Supreme Court of India is the apex body of the Indian legal system, followed by other high courts and subordinate courts. India retained civil society and state institutions that have provided stability.

India is a federal country. It has 28 states and 7 union territories. It has a three-tier federal system of governance, and the responsibilities of governance are shared between the union government, the state governments, and the local governments (rural and urban local bodies). The Indian Constitution allocates the division of responsibilities on all matters between the different tiers of government.

2.3 Macroeconomic Growth

On the eve of independence, 14 August 1947, Pt. Jawaharlal Nehru, the First Prime Minister of India, reminded the nation that the tasks ahead included "the ending of poverty and ignorance and disease and inequality of opportunity." These were the basic foundations that laid down India's development strategy, which has been articulated through the five-year and annual plans put together by the Planning Commission. India's development strategy, prior to 1991, can be summarized in the following points (Srinivasan, 2006a):

1. The commanding heights of the economy were entrusted to the public sector, although a large share of GDP and even larger share of employment were generated by the private sector. Import substitution across the board and industrialization were identified as core strategies to achieve the given objectives of economic growth and poverty alleviation.
2. Given the scarcity of resources, it was thought that state could better utilize its resources. The government appropriated a large share of the savings of the economy for its own use, largely for public investment before 1980s and for public consumption thereafter.
3. India followed the strategy of steering the private sector to conform the priorities and targets of 5-year plans through direct controls. The instruments of controls were quantitative rather than of taxes and subsidies. Moreover, these controls were exercised on a discretionary, case-by-case basis, rather than through a set of rules. Producers were insulated from domestic and international competition.

During the first three decades of planning during 1950–1980 the GDP increased at the rate of 3.75% per year. In that period per capita GDP increased slightly more than 1.5% per year from a situation of literary stagnancy during the colonial period. A closer look at the performance of the economy reveals continuing growth in terms of GDP during the first three five-year plans. The growth was interspersed during the period of 1965–1980 in general and during the decade of the 1970s in particular. GDP grew 4.1% between 1950–1951 and 1964–1965, 3.1% between 1964–1965 and 1980–1981. Table 2.1 explains the macroeconomic growth story of India in terms of selected indicators since 1950–1951.

A massive balance of payment crisis emerged in 1966, headed by a drought in 1965 and resulting need for heavy imports of food. India approached the IMF and World Bank for financial assistance, and as usual their condition was liberalization of the economy. But due to internal political compulsion, the controls were intensified rather than liberalized. Government intervention in agriculture to support the green revolution through various subsidies and price controls increased and was perpetuated by vested interests.

The 1980s witnessed relatively higher growth rates of GDP and per capita GDP.

During the period of 1980–1981 to 1990–1991, the GDP grew at the rate of 5.6% per year. The population growth rate declined from about 2.2% per year from 1950–1980 to 2% per year during the 1980s. Per capita GDP growth rate during the

Table 2.1 Selected macroeconomic indicators for India (%)

	1950s	1960s	1970s	1980s	1990–1991	1991/1992 to 1997/1998	1996–1997 to 2003/2004	2002/2003 to 2006/2007	2007–2008 (AE)
Real GDP growth	3.6	4.0	2.9	5.6	5.3	5.7	5.2	8.7	8.7
Agriculture and allied	2.7	2.5	1.3	4.4	4.0	3.7	0.9	4.9	2.6
Industry	5.8	6.2	4.4	6.4	5.7	7.0	4.1	8.3	8.6
Manufacturing	5.8	5.9	4.3	5.8	4.8	7.5	3.9	9.1	9.4
Services	4.2	5.2	4.0	6.3	5.9	6.4	7.8	10.2	10.6
Real GDCF/GDP	12.5	16.9	19.4	20.2	24.4	22.5	24.1	31.4	NA
ICOR	3.5	4.3	6.6	3.6	4.6	4.0	4.6	3.6	NA
Nominal GDCF/GDP	10.8	14.3	17.3	20.8	26.0	23.9	24.5	33.0	NA
GDS/GDP	9.6	12.3	17.2	19.0	22.8	22.7	24.1	32.7	NA
Saving-investment gap/GDP	−1.2	−2.0	−0.1	−1.8	−3.2	−1.2	−0.4	−0.3	NA
WPI inflation (average)	1.2	6.4	9.0	8.0	10.3	9.6	4.6	5.5	4.1

Source: Mohan (2008)

decade doubled relative to the last three decades. Moreover, in the 1980s, all major sectors saw higher growth rates. Industrial growth was 6.3% per year, manufacturing growth was 6.7% per year, agriculture grew by 3.2% per year, and the growth rate in services was 6.7% per year.

Note that during the 1980s, and more particularly in the second half of the decade, the process of relaxation of controls started, i.e., a process of relaxation of controls here and an increase in incentives of subsidies there was the strategy of the decade (Srinivasan, 2004). The government deserted the fiscal prudence of the previous three decades and, borrowing at home and abroad, financed the fiscal deficits. The gap in public sector savings and expenditure widened from about −3.7% of GDP in the first three decades to more than −8.2% of GDP in 1990–1991. This debt-led growth story ended in a macroeconomic and balance of payment crisis in 1991. At the time of crisis, the foreign exchange reserves were not enough to support imports for even two weeks, the external debt was several times that of the reserves, and the fiscal deficit of the central government and inflation were in double digits.

In 1991, a new economic policy was introduced with a view to bring about major changes in the economy's structure and policy regime. Ray (1997a) articulates the main objective of the new economic policy as (1) integration of India's local economy with the global economy through a predominant and dynamic private sector free from unnecessary state controls in most spheres of economic activities, (2) having a dynamic external sector where there is virtual free trade and free flow of investments to and from India, and (3) state intervention in the production of goods and services only where externalities make private sector operations very inefficient in addition to the normal range of public goods like defense, law, and order, among others. However, the state must play an active role in relieving extreme poverty and ensure access to basic needs like, health and education by the poor.

As a result of the new economic policy in 1991, the growth impulses appeared to have gathered momentum. The rate of growth in GDP rebounded from 1.5% in 1991–1992 to about 7.8% in 1996–1997. Subsequently the growth rate fluctuated until 2002–2003. Since 2003–2004, there has been a distinct strengthening of the growth momentum, and in the last two years it has averaged to about 9.5% per year (Mohan, 2008).

To understand the macroeconomic growth story it is interesting to analyze saving and investment trends. From the data one finds that gross domestic savings (GDS) have increased continuously from an average of 9.6% of GDP during the 1950s to about 35% of GDP in 2006–2007. Similarly, over the same period, gross domestic capital formation (GDCF, investment) has increased from 10.8% of GDP during the 1950s to about 36% of GDP in 2006–2007. The noticeable feature of these trends is that Indian economic growth is financed predominately by domestic savings (Mohan, 2008). The share of foreign savings in the financing of India's growth, which also can be termed as current account deficit, is very modest, and when it tried to reach about 2% of GDP, the economy faced a severe balance of payment crisis, as can be observed from the experience of 1960s and 1980s.

However, the long-term upward trends in savings and investment have been scattered with phases of stagnation. In India's growth history, it is also worth noticing that capital resources have been employed productively. Except for the decade of 1970s, the incremental capital output ratio (ICOR) has stayed close to about four (Mohan, 2008).

Post-reform macroeconomic performance can be attributed to again adopting fiscal prudence. During that period, public investments were used to try to keep the fiscal deficit under control. The data on public and private investments reveal that public investment crowds private investment in India, thereby raising questions about the long-run sustainability of the growth process. Note that public investment has started to increase since 2003–2004, reversing the declining trend that started in mid-1980s.

So far we have discussed the aggregate story. It would be interesting to see the sectoral composition of growth dynamics in this context. In India, the agriculture sector employs about 56% of the total labor force. The share of the sector in terms of employment was about 70% at the time of independence. However, the share of the sector in terms of GDP has been continuously declining from more than 50% in 1950–1951 to less than 20% in 2006–2007. Table 2.1 also provides the annual growth rates of different sectors of the economy since 1950–1951.

In the preceding discussion, we observe that both before reforms and after reforms the major policy initiatives were limited to the industrial sector. The industry-first approach was taken throughout the period of India's development. The desired objective of higher and sustained GDP growth rates can be achieved by reversing the balance between public and private ownership, and by opening up industry to foreign investment, international trade, and competition so that industry can perform its expected role as the leading sector. It is also thought that higher growth in the industrial sector can help in transferring labor from agriculture to industry. In this scenario, the notion that the agricultural or rural sector can play the leading role is not entertained (Kalirajan and Sankar, 2001).

Note that the government recognized the need for agricultural reform and its importance from the very beginning of reform. The Ministry of Finance's Discussion Paper on economic reforms (1993) proclaims that: "No strategy of economic reform and regeneration in India can succeed without sustained and broad-based agricultural development." It sets out the critical areas for reform, which include reduction of input subsidies, restructuring of public investment on agriculture, upgrading of quality of research and extension services, resurrection of private investment in the sector, strengthening of the institutional credit system, and land reform in several states. However, no major policy reform initiatives were taken for the sector. For example, subsidized supply of chemical fertilizers encouraged farmers to substitute chemical fertilizers for organic manures. As a result, the share of organic manure in the value of intermediate inputs, at 1980–1981 prices, fell from 8.7% in 1960–1961 to 3.1% in 1995–1996. This substitution, along with overuse of groundwater for irrigation (because of extremely low prices for electricity with zero marginal prices for kilowatt hour of energy in many states), heightened the environmental problems (Kalirajan and Sankar, 2001).

The historical review of India's growth story also reveals that periods of slow overall growth have invariably been characterized by slow agricultural growth even in the years when the weight of agriculture in GDP has decreased remarkably. Despite the recent improvements in the agriculture sector, given the dependence of Indian agriculture on monsoons, the immediate need is to make improvement in irrigation facilities through public investment coupled with institutional support (Mohan, 2006).

Moreover, the structural composition of the economy shows that the share of the industrial sector in GDP was about 24% and the share of the service sector was about 56% in recent years. This skewed structural growth should not be considered an indicator of the maturity of the economy, but mainly a lack of industrialization and infrastructural development (Sengupta, 2006).

India's per capita energy consumption is very low in comparison to its counterpart country China. In India the per capita energy consumption was only 439 kg of oil equivalent (Kgoe) in 2003 as compared to 1,090 Kgoe in China, 7,835 Kgoe in the United States and the world average of 1,688 Kgoe. The *National Action Plan on Climate Change* (Government of India, 2008) shows that over the period of time energy intensity measured in terms of energy requirement to produce one unit of GDP was continuously declining, and in 2005 it was 0.16 – much lower than the developed and counterpart developing countries (see Fig. 1.3.2 in the Action Plan document). However, the figure of energy intensity should not be taken at face value. The figures are an indicator of inadequate access to commercial energy by a large section of the population and inadequate development of infrastructure and industrial sectors (Sengupta, 2006). Table 2.2 presents the data on selected energy indicators for 2003.

The other area that requires immediate attention in India is the infrastructure sector. According to the Planning Commission, to achieve 9% per year growth during the 11th Five Year Plan the infrastructure investment ought to grow at the rate of 8% per year from the prevailing level of about 4.6% per year. This implies that the government should take utter care so that investment in infrastructure from both public and private sectors comes forward in the desired direction and magnitude.

2.4 Poverty and Regional Disparities

Notwithstanding its recent macroeconomic performance, India is still among the poorest countries in the world. A quick look at the figures for population below the poverty line using the head count ratio, a most important development indicator, shows that in India about 300 million people survive on less than US$1 per day in 2000. About 25% of the national population earns less then US$0.40 per day. Per the report of the National Commission of Enterprises in the Unorganized Sector (NCEUS), 77% of Indians live on less than Rupees 20 per day. Moreover, India has very high rate of malnutrition among children under the age of 3.

Table 2.2 Selected energy indicators for 2003

Countries	GDP per capita (PPP $2,000)	Poverty ratio (national poverty line)[a]	TPCES intensity of GDP (Kgoe/PPP 2,000$)	Electricity intensity of GDP (Kwh/PPP 2,000$)	Share of industry in GDP (%)	TPCES per capita (Kgoe)	Electricity consumption per capita (Kwh)
China	4,838	4.6	0.23	0.29	53	1,090	1,379
India	2,732	28.6	0.16	0.20	26	439	553
USA	35,487	–	0.22	0.37	23	7,835	13,066
World	8,180	–	0.21	0.31	28	1,688	2,429

TPCES total primary commercial energy supply
Source: Sengupta (2006)
[a]The figure for India is from National Sample Survey 1999–2000 and for China the figure for 1998

Poverty can be defined as a state in which individuals or groups of people are unable to satisfy the basic needs of life. Since poverty is a very contentious issue, different countries have varied definitions and approaches for measuring it. As per the Planning Commission in India, the poverty line in rural areas is drawn with an intake of 2,400 calories in rural areas and 2,100 calories in urban areas. Moreover, there are issues relating to price indices for updating the poverty lines. Note that in the 1990s the designs of household expenditure surveys changed, and as a result of that a problem of potential noncomparability over the surveys has emerged. Given all these issues, the researchers have had to make several strong assumptions in the measurement of poverty; they obviously differed in their methodologies and reached varying conclusions about the estimates of the population below the poverty line in the country.

The Planning Commission has estimated that 27.5% of the population was living below the poverty line in 2004–2005, compared to a poverty rate of 51.3% in 1977–1978 and 36% in 1993–1994. As noted earlier, researchers have provided differing estimates of the population below the poverty line; however, it is fair to say that all of them agree that the poverty ratio did not increase in the 1990s and differ only on the rate of decline and whether the rate of decrease was higher in 1980s or 1990s. For example, two recent papers by Dev and Ravi (2007) and Himanshu (2007) have analyzed recent trends in poverty and inequality and have come to broadly similar conclusions. That is, the pace of poverty reduction accelerated (sharply according to Himanshu) between 2000 and 2005 relative to the reduction between 1994 and 2000, but Sundram (2007) found that in terms of persons, with the Planning Commission poverty lines, in rural India, the head count ratio (HCR) declined by 4.8% points or 0.8 points per year or at 2.7% per annum between 1994 and 2000 and by 0.9 points per year or at 3.4% per annum between 2000 and 2005, indicating a small increase in the pace of poverty decline in the first 5 years of the 21st century. In urban India, however, in terms of HCR for persons, Sundram finds a clear slowdown – from 0.78 points per year between 1994 and 2004 to just 0.3 points per year between 2000 and 2005. But using an alternative poverty line, Sundram (2007) finds that a slightly faster pace of poverty reduction between 2000 and 2005 is reversed, with a small reduction in the pace of poverty reduction from 2.8% per annum to 2.5% per annum. His estimates with alternative poverty lines also reinforce the result of a slower reduction in urban poverty between 2000 and 2005 relative to that between 1994 and 2000. Table 2.3 presents the poverty estimates provided by Sundram. His estimates are based on the household expenditure survey data related to 55th and 61st round of National Sample Survey Organization (NSSO).

Poverty in terms of income or consumption does not express the true picture of destitution. In addition, poverty can be looked at as having different dimensions, viz., UNDP's Human Development Index (including health, access to nutrition and water, life expectancy, and education, among other factors), social exclusion, marginalization, etc. These all in one way or other are linked with the environment and natural resources. Unaccounted for benefits, which singly or in combination ecosystems provide, are the means for obtaining adequate nourishment, avoiding

Table 2.3 Estimate of head ratios of households and persons with planning commission and alternative poverty lines: all-India: 1993–1994 to 2004–2005 [head count ratio (%)]

	Households			Persons		
	1993–1994	1999–2000	2004–2005	1993–1994	1999–2000	2004–2005
Planning commission's definition of poverty lines						
Rural	28.0	23.3	18.8	31.8	27.0	22.7
Urban	22.7	18.1	16.6	28.1	23.4	21.9
Alternative definition of poverty lines						
Rural	30.3	25.1	21.7	34.2	28.9	25.5
Urban	21.3	17.8	17.4	26.4	23.1	22.8

Planning commission poverty lines: 1993–1994: rural, 205.84; urban, 281.33, 1999–2000: rural, 327.56; urban, 454.11; and 2004–2005: rural, 356.30; urban, 538.60
Alternative poverty lines: 1993–1994: rural, 211.30; urban, 274.88; 1999–2000: rural, 335.46; urban, 451.19; and 2004–2005: rural, 371.29; urban, 546.20
Note 1. Alternative poverty lines have been updated by reference to CPI for agricultural laborers for rural India and CPI for industrial workers for urban India
Note 2. All estimates for 1993–1994 are on mixed reference period and estimated from Unit Record Data
Source: Sundram (2007)

Table 2.4 High poverty states of India

State	% of India's poor in 1999–2000	% of population in 2001
Uttar Pradesh (including Uttaranchal)	20.4	17
Bihar (including Jharkhand)	16.4	10.7
Madhya Pradesh (including Chhattisgarh)	11.5	7.9
Maharashtra	8.8	9.4
West Bengal	8.2	7.8
Orissa	6.5	3.6
Total	71.8	56.4

Source: ESPASSA (2008)

diseases, acquiring clean and safe air, water, and shelter and many other sociocultural activities.

One striking fact in the post-reform growth of India is that there was significant widening of regional disparities in growth and poverty reduction across states. For example, in the early 1960s the per capita Gross State Domestic Product (GSDP) of richer states such as Punjab, Maharashtra, and Gujarat was, on average, about 80% higher than the average per capita GSDP of the bottom four states, viz., Bihar, Uttar Pradesh, Orissa, and Madhya Pradesh. This disparity increased to 125% by the early 1970s. During the 1980s, the disparity between the states marginally declined to 100%; however, it jumped to 200% toward the end of the 1990s (Rao, 2008).

The majority of India's poor continue to be located in rural areas despite a declining trend in official income-based poverty estimates. State-wise, nearly 72% of India's poor and half of her population are located in the following six states: Uttar Pradesh (including Uttaranchal), Bihar (including Jharkhand), Madhya Pradesh (including Chhattisgarh), Maharashtra, West Bengal, and Orissa (see Table 2.4).

In the official data on the below-poverty-line population for the year 1993–1994, seven states – Bihar, Orissa, Uttar Pradesh, Madhya Pradesh, Maharashtra, Assam, and West Bengal – had a poverty ratio (% of population in poverty) in excess of the all-India average for rural areas (37.2%). Not only is the distribution of poverty spatially uneven in India, but the gap in terms of poverty incidence between the poor and the affluent states in the country is growing over time (ESPASSA, 2008).

Table 2.5 provides data on the incidence of rural and urban poverty at three points in time for the five highest and lowest poverty states. This table reveals that there is considerable stability over the three points of time in which states happened to have a high or low poverty ratio (Srinivasan, 2004).

Sengupta (2006) describes regional disparities in terms of development indicators, including energy consumption. In his paper, annexure tables 2.2–2.6 show the variation in the pattern of energy consumption in terms of the share of household with electrical connections, the share of fuel in average monthly per capita expenditure, the share spent on efficient commercial energy for lighting and cooking across the states, and how the variation is linked to the poverty incidence in a state.

Table 2.5 Regional disparity in poverty

High poverty states				Low poverty states			
Rural		Urban		Rural		Urban	
	1987–1988				1987–1988		
Orissa	58.7	Bihar	51.9	Punjab	12.8	Himachal Pradesh	7.2
Bihar	53.9	Karnataka	49.2	Haryana	15.3	Assam	11.3
West Bengal	48.8	Madhya Pradesh	47.3	Himachal Pradesh	16.7	Punjab	13.7
Tamil Nadu	46.3	Uttar Pradesh	44.9	Andhra Pradesh	21.0	Delhi	15.1
Madhya Pradesh	42.0	Orissa	42.6	Gujarat	28.6	Haryana	18.4
	1993–1994				1993–1994		
Bihar	58.0	Madhya Pradesh	48.1	Punjab	11.7	Assam	7.9
Orissa	49.8	Orissa	40.6	Andhra Pradesh	15.9	Himachal Pradesh	9.3
Assam	45.2	Tamil Nadu	39.9	Gujarat	22.2	Punjab	10.9
Uttar Pradesh	42.3	Karnataka	39.9	Kerala	25.4	Delhi	16.1
West Bengal	41.2	Andhra Pradesh	38.8	Haryana	28.3	Haryana	16.5
	1999–2000				1999–2000		
Orissa	47.8	Orissa	43.5	Punjab	6.0	Himachal Pradesh	4.6
Bihar	44.0	Madhya Pradesh	38.5	Haryana	7.4	Punjab	5.5
Assam	40.3	Bihar	33.5	Himachal Pradesh	7.5	Assam	7.5
Madhya Pradesh	37.3	Uttar Pradesh	30.8	Kerala	9.4	Delhi	9.2
West Bengal	31.7	Andhra Pradesh	27.2	Andhra Pradesh	10.5	Haryana	10.0

Source: Srinivasan (2004)

These tables not only explain the disparities across states but also indicate the challenge the country will face in the future if the transition from traditional to commercial and cleaner fuels is to be completed in the next decade or so. The *National Action Plan on Climate Change* shows that there is a positive and significant relationship between per capita commercial and clean energy fuels and the human development index using the cross-country figures for the year of 2004 (Fig. 1.2.1 in the Action Plan, Government of India, 2008).

This spatial variation in incidence and depth of income poverty is the outcome of a highly uneven performance by the states of India in reducing poverty over time. The factors identified as having contributed to poverty reduction include favorable initial conditions of human and physical resource development as well as equitable access to physical and human infrastructure (Datt and Ravallion, 1998).

2.5 Depletion of Natural Resources and Environmental Degradation

Inclusion of the environment in conventional two-sector macroeconomic models comprising production and consumption activities reflects interaction between economic activities and the environment. The environment contributes to economic activities in three ways: by providing direct consumption goods such as some food items for consumption and raw material for various production activities; by providing sink facilities to absorb the waste generated during the various economic activities; and by providing various amenity values that add to human welfare or utility. Note that these functions performed by the environmental sector are interlinked. For example, deforestation for the purpose of consumption and production activities reduces the availability of the resource for other purposes. The sink facilities provided by the forests get reduced and amenity values are also decline. That is, like manmade resources the environment is also a scarce resource.

In Section 3, it is observed that since the inception of the development planning process, India has been able to maintain some continuing positive growth rate in aggregate as well per capita income and has been progressing at an impressive pace since 1991, when it changed its development strategy. In a world of finite resources, the present pattern of growth is consistent only with the abundant availability of natural resources, but as growth puts more strain on resources, environmental scarcity increases and raises questions about the sustainability of the growth trajectory.

Recognizing that environment is an important factor input both in consumption and production activities, it is useful to provide an account of the resource damage that is occurring in the country over the period of time in terms of monetary values. The presentation in monetary values helps in formulating rational economic policy.

The *World Development Indicators* (WDI) provides estimates of the damage caused since 1970 by the depletion and degradation of various exhaustible and

renewable resources in terms of monetary values and as a proportion of national income. The estimates are available for the extraction of various minerals and metals, energy resources such as oil and gas, coal and lignite, deforestation, and for atmospheric degradation. In the last category the estimates are available for the damages caused by CO_2 emissions and by particulate matter.

Figure 2.1 summarizes estimates of the damages since 1970 as a proportion of gross national income from the depletion of exhaustible resources such as mineral, oil and gas, and coal resources, depletion of forest resources and damages due to the proxy of global pollutant CO_2 emissions produced in the country and a local pollutant particulate matter. The figure shows that the rate of depletion of mineral resources is increasing in the twenty-first century. Similarly, the rate of depletion of energy resources is also increasing. With respect to both of the exhaustible resources, damages as a proportion of gross national income (GNI) are increasing, suggesting that the intensity of resource use of the economy is increasing.

The WDI provides data on the damages due to particulate matter (PM) since the early 1990s. In Figure 2.1, it may be observed that damages as a proportion of GNI are diminishing over the period of time. This may be because in India there is a comprehensive program of environmental regulation which focuses generally on atmospheric pollution related to local pollutants; in addition, environmental awareness in the public in general and the urban public in particular is increasing. A similar trend may be observed with respect to CO_2 emissions, and this may be due to declining energy intensity in the economy (Table 2.2).

In India, the land under forest cover is about 18% of total land area; actual forest cover with crown density is only about 11%. Over a period of time, there has been considerable depletion of forest cover in the country. Between 1995 and 1997, more than 17,000 km^2 of forestland was lost. Concerned about these losses, the Supreme Court in 1996 directed that all ongoing activities in any forest area in any state should be stopped forthwith (Mandal and Rao, 2005). It is interesting to note that the depletion in forest resources measured as a proportion of GDP is declining over

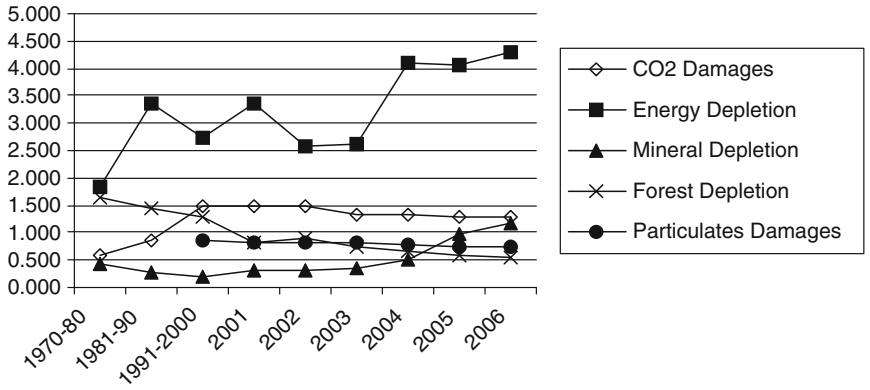

Fig. 2.1 Natural resource damages (% of GNI)
Source: authors' calculations based on WDI data

the period of time and increases momentum in the 1990s. This may be attributed to judicial intervention and subsequent state alertness with respect to the national wealth.

Figures 2.2–2.6 present resource damage as a proportion of GNI with respect to per capita income. It is thought that the fundamental reason behind the depletion and degradation of natural resources is economic activity; thus per capita income may be considered as the best proxy for production and consumption activities. As the economy is growing, the relative damage with respect to particulates and deforestation is declining (Figs. 2.5 and 2.6).

Figure 2.2 shows that there is an inverted U-shaped relationship between damages as a proportion of GNI and per capita income in India, an environmental Kuznets curve (EKC) type of relationship. The EKCs explain that in the beginning of economic development, environmental damage increases, but as the economy

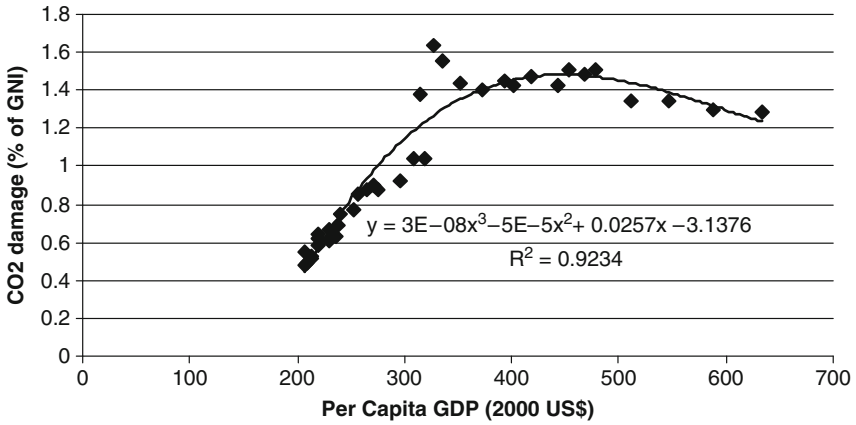

Fig. 2.2 CO_2 emissions damage versus per capita GDP
Source: authors' calculations based on WDI data

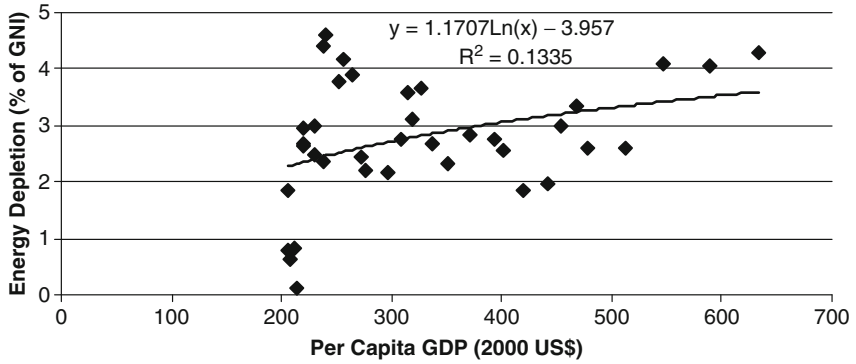

Fig. 2.3 Energy depletion versus per capita GDP
Source: authors' calculations based on WDI data

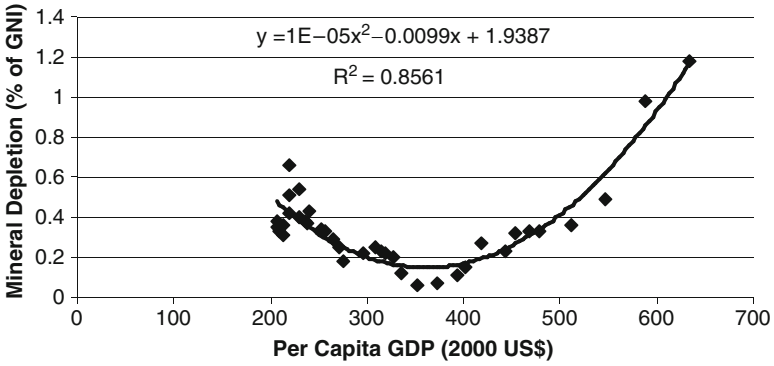

Fig. 2.4 Mineral depletion versus per capita GDP
Source: authors' calculations based on WDI data

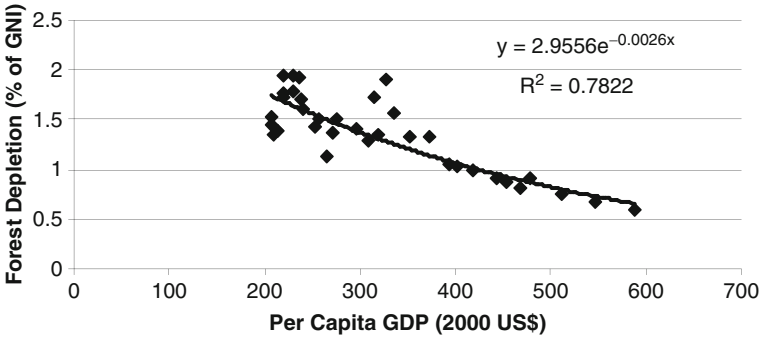

Fig. 2.5 Forest depletion versus per capita GDP
Source: authors' calculations based on WDI data

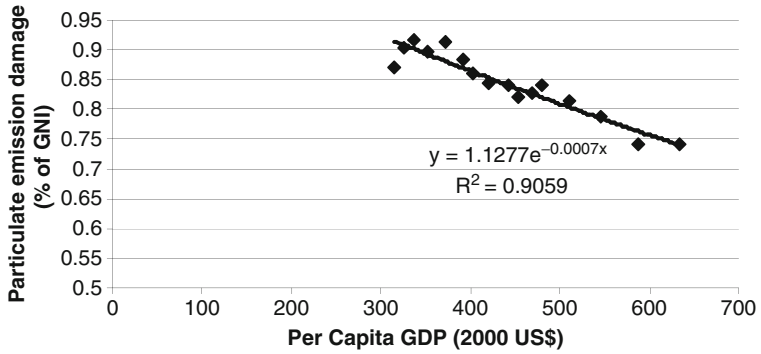

Fig. 2.6 Particulate emissions damage versus per capita GDP
Source: authors' calculations based on WDI data

matures the damage starts to decline. Note that the EKC are tried to observe between absolute damages or pollution/emission levels and per capita income. On the basis of the figure it may be argued that in India the carbon intensity of the economy increased at the initial levels of development; that is, the carbon intensity of the economy increases until the per capita gross income reaches about US$450 (at year 2000 prices) and after that it starts to decline. India attains the turning point at a much lesser level of per capita income, not only in comparison to her counterpart developing countries but even to most of the developed countries. Note that it is possible with the increasing CO_2 emission in absolute terms, however, it reflects a responsible behavior of the Indian economy toward the global problem of climate change given her development priorities.

As discussed earlier, the resource damage intensity in the economy, measured as a ratio of depletion of mineral and energy resources to GNI, is increasing not only over the period of time but with respect to per capita GDP also, as can be observed from Figures 2.3 and 2.4. This implies that as the per capita income is increasing, the depletion of exhaustible resources is increasing at a faster rate than the economy.

Regarding WDI data related to resource damages, two points are worth mentioning. First, these estimates do not include water resources and their degradation, forests as agents of carbon sequestration, fisheries, land degradation, and biodiversity loss. Moreover, the data include only two air pollutants and ignore all others. In developing countries like India, indoor air pollution is much more damaging. Second, estimates of damages were measured at the market price of the resource and, as is well established, the market prices of the resources do not reflect their true shadow prices. As a result the damage estimates understate the true damages due to resource depletion and degradation.

Land degradation is one of the major environmental problems in India. It occurs through the natural and manmade processes of wind erosion, water erosion, and water-logging. The result of such degradation is the loss of invaluable nutrients and lower food production. Poor land use practices and management are prime factors in rapid land degradation. It is estimated that about 57% of the total land is experiencing some form of degradation. The business-as-usual scenario estimates that India would lose about 40 million tonnes of major soil nutrients annually (Pachauri, 2004).

India is recognized as one of the 17 "megadiversity regions" of the world and accounts for 67% of the world biodiversity. Loss of biodiversity is a significant issue to India, since many plant and animal species are severely threatened due to destruction of their habitats and an overexploitation of resources. A large number of species are either endangered or on the verge of extinction. According to SACEP, India has 47,000 species of flowering and nonflowering plants representing about 12% of the recorded world's flora. Of these, 5,150 are endemic, 2,532 species are found in the Himalayas and adjoining regions, and 1,782 are found in peninsular India.[1]

[1] http://www.sacep.org/html/mem_india.htm, as accessed on 14 July 2008.

The availability of fresh water is going to be the most pressing problem in India over the coming decades. Urban growth, increased industrial activities, intensive farming, and the overuse of fertilizers and other chemicals in agricultural production have put more stress on water resources. Untreated water from urban settlements and industrial activities and runoff from agricultural land carrying chemicals are primarily responsible for the deterioration of water quality and the contamination of lakes, rivers, and groundwater aquifers. India receives an average annual rainfall equivalent of about 4,000 billion cubic meters (BCM). This sole source of water is unevenly distributed both spatially and temporally. The rivers of India face serious pollution problems. The quality of surface and groundwater has deteriorated significantly over the last two decades. The water quality of most of the rivers in India is not even fit for bathing, recreation, or the other social uses that have endured for thousands of years. High arsenic concentrations have been recorded from a large number of rural wells in West Bengal, India.

Increasing amounts of untreated hazardous waste are becoming a serious environmental issue in India. The waste is generated by various industrial processes, mining extraction, tailings from pesticide-based agricultural practices, and urban households. The largest quantities of hazardous waste are generated by the following industries: petrochemicals, pharmaceuticals, pesticides, paints and dyes, petroleum, fertilizers, asbestos, caustic soda, inorganic chemicals, and general engineering. The rate of generation of solid waste in urban centers has outpaced population growth in recent years with the wastes normally disposed of in low-lying areas of the city's outskirts. Daily waste generation in India varies between 0.45 and 0.89 kg/capita. According to SACEP, at present, around 7.2 million tonnes of hazardous waste is generated in the country, of which 1.4 million tonnes are recyclable, 0.1 million tonnes are incineratable, and 5.2 million tonnes are destined for disposal on land.

The increasing resource intensity of economy activities associated with environmental degradation is creating doubts about the sustenance of present growth trajectory of the economy.

2.6 Sustainability of Growth

The distortions created through the degradation and damage of our natural resource wealth perhaps impose a higher burden than any other form of distortion and present a serious challenge in achieving healthy and sustainable progress (Pachauri, 2004). Apprehensions about this trend have been further fueled by concerns related to the adverse impacts of climate change.

Modern growth theories suggest that in a world of finite resources – either manmade or natural – environmental sustainability is potentially not compatible with continuous positive economic growth. Failure to achieve environmental sustainability even becomes an obstacle in achieving long-term economic growth. Given the tradeoffs between environment and development, the issue is not to achieve maximum economic growth or total maintenance of environment, but is

to achieve optimality both in economic progress and environmental protection. The concept of sustainable development may be the guiding force.

The neoclassical growth model, which has dominated mainstream economic growth theory since the second half of the last century, ignores the role of natural resources. In the aggregate production function specification, output (e.g., GDP) is considered as a function of capital and labor, constrained by the prevailing level of technology. The model shows that the rate of economic growth is controlled by the rate of capital accumulation. The phenomenon may continue in the medium term (50–100 years), but long-term growth is limited by the growth rate of the labor force and diminishing marginal returns to capital in the absence of technological progress (Auty, 2007). The recent literature shows that the endowment of two additional forms of capital, natural capital (Sachs and Warner, 1995) and social capital (Acemoglu et al., 2002), play a significant role in a country's economic performance.

Though a complete operationalization of sustainability or achieving optimality is not possible, adopting wealth, which comprises all forms of capital – physical, social, and natural – as indicators of economic well-being for an economy, implies that sustainable development requires the creation of wealth, or at a minimum, requires that the economy's wealth does not decline over the period of time (Dasgupta, 2001). Wealth or capital is an accounting value of a country's assets. Change in capital stock is known as investment and genuine investment, I_t is defined as follows. Generally investment is equal to saving:

$$I_t = \sum (P_{it} \cdot \mathrm{d}M_{it}/\mathrm{d}t) + \sum (h_{jt} \cdot \mathrm{d}H_{jt}/\mathrm{d}t) + \sum (n_{kt} \cdot \mathrm{d}N_{kt}/\mathrm{d}t), \qquad (2.1)$$

where M_{it} is the quantity of ith manufactured asset; H_{jt} is the jth form of human capital; N_{kt} is the kth form of natural capital, and P_{it}, h_{jt}, and n_{kt} are, respectively, the accounting prices of manufactured, human, and natural capital.

Since 1999, the World Bank has been publishing estimates of genuine savings. Genuine savings are the adjusted estimates of saving adjusted not only for depreciation of manufactured capital, but also for the depletion of exhaustible resources such as minerals and hydrocarbons, renewables such as forests coupled with atmospheric resources such as emissions of carbon and particulate matter. Adjustments are also made for education expenditures. In making these estimates some crude assumptions are made with respect to prices of natural capital, estimation of natural resource rents, etc.[2] Genuine saving is calculated as gross saving plus education expenditure minus the value of depletion of natural capital and damage due to atmospheric pollution.

Figure 2.7 shows the various estimates of savings in India since 1970. The gross saving in 1970 was about 15% of GNI, and the estimates of genuine saving were about 8%. The estimates of gross saving were increasing during the 1970s and 1980s. At the beginning of the 1990s these estimates were around 22% of GNI, but the estimates of genuine savings remained almost unchanged, hovering around 8%

[2]For details on these assumptions see Hamilton and Hassan (2003).

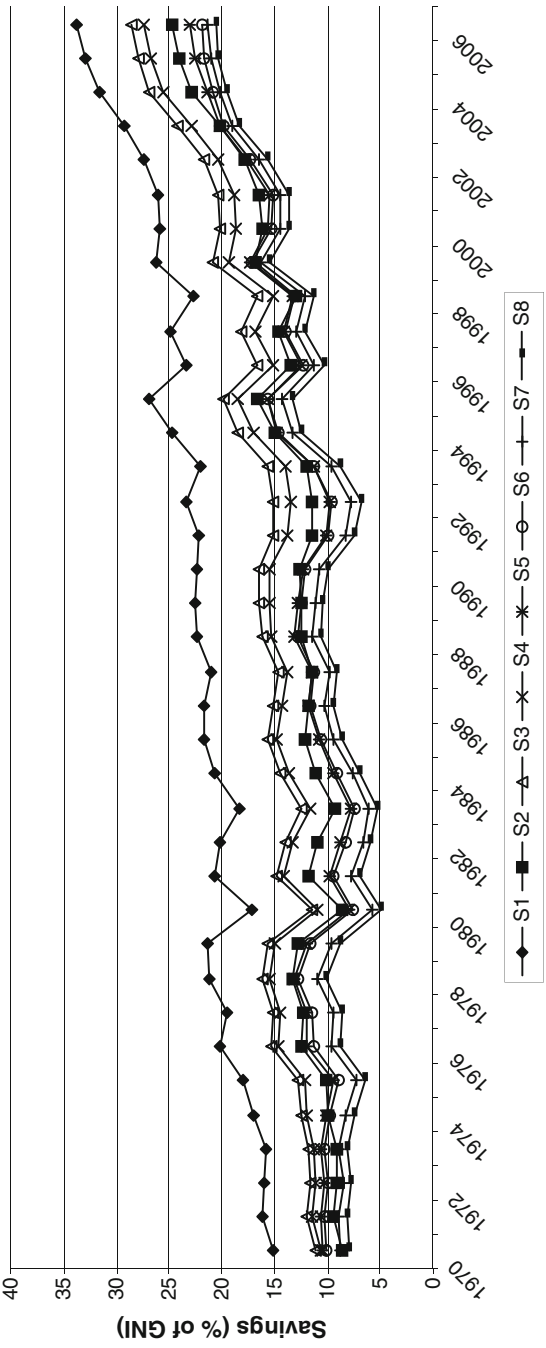

Fig. 2.7 Measures of genuine savings or investment as percentage of GDP
Note: S1: gross saving; S2: S1 − depreciation of manufactured capital; S3: S2 + education expenditure; S4: S3 − CO_2 emissions damages; S5: S4 − energy depletion; S6: S5 − mineral depletion; S7: S6 − forest depletion; and S8: S7 − particulate emission damages
Source: authors' calculations based on WDI data

of GNI. As explained earlier, we find that in 2006 the estimates of gross saving reached at the level of 33% of GNI and genuine saving estimates were about 21%. The growth in genuine savings may be caused by various factors, such as change in the development strategy in 1991 that caused an increase in gross savings and an increase in education expenditures, a complete ban on green felling in 1996 by the Supreme Court of India, the declining carbon intensity of the economy and reduction in particulates due to the introduction of CNG in public transport in Delhi, improvement in environmental regulatory performance, and increasing environmental awareness. But the issue of concern is the increasing resource and energy use intensity of the economy. Ayres (2008) calls for a radical change in the development trajectory. He says that nations should change their development path from one which favors increasing energy and resource use to increase productivity of manufactured capital and labor to one that concentrates on increasing resource productivity.

Figure 2.8 scatters genuine saving as a percent of national income against income measured as GDP per capita. The first point to note is that India never observed a negative genuine savings rate; however, the savings rate experienced a downturn during some years when compared with the adjunct previous year. Second, there is a clear upward trend in the scatter; as the economy's health improves, genuine saving increases. This result is very striking, as Hamilton and Hassan (2003) find that many countries under US$1,000 per capita income have negative genuine saving rates.

According to Hartwick's rule, known as "invest resource rents," a nation should invest all rent earned from exhaustible resources currently extracted in productive assets in order to have a sustainable consumption path. Figure 2.9 explores the question of whether India is consuming or investing natural resource rents by scattering genuine saving rates against the share of exhaustible resources, viz., mineral and hydrocarbons in GNI. If the country is investing all rents earned from

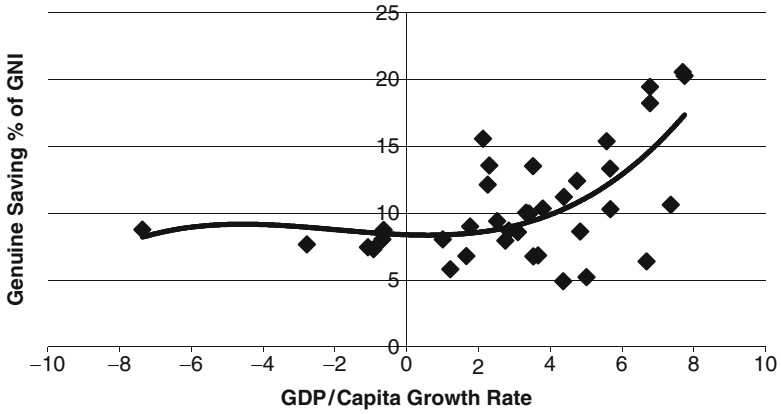

Fig. 2.8 Genuine saving versus GDP per capita growth rate
Source: authors' calculations based on WDI data

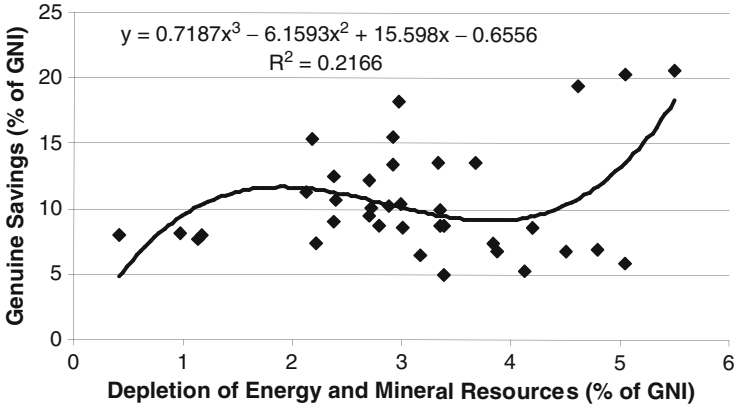

Fig. 2.9 Genuine saving versus depletion of energy and mineral resources
Source: authors' calculations based on WDI data

the extraction of these resources, then scatter in the figure should exhibit no trend and the Indian economy, according to Hartwick's rule, is on the sustainable path.

Arrow et al. (2004) are of the view that a society can be on the sustainable consumption path if it is able to maintain or increase its productive base. They define productive base as the stock of all society's capital assets at time *t*, inclusive of manufactured capital assets, human capital, and natural capital. It also depends on the level of technological progress. As defined earlier, they consider genuine investment as change in productive base. Note that maintaining a productive base does not imply maintaining any particular set of resources at any given time since there is substitutability between different kinds of assets. The growth rate of genuine wealth can be computed by dividing the figures of genuine investment or savings by the ICOR in an economy. To compute the figures at a per capita level – that is, to make adjustments for population growth – the population growth rate is subtracted from the figures for genuine wealth. The figures of per capita growth rate in genuine wealth are adjusted for the growth rate in technology and/or institutions measured as the growth rate of total factor productivity (TFP).[3]

Note that in India capital accumulation is to a large extent financed by domestic savings; therefore, there is no major difference between figures for genuine saving and genuine investment. In the computation of genuine wealth figures, unlike Arrow et al. (2004), we use the actual figures of ICOR rather than presumed figures. In India, except for the decade of 1970s, the ICOR has hovered around 4, and this conventional measure of capital intensity includes only manufactured capital. To account for human and natural capital, therefore, we increase the observed ICOR by 1. Moreover, for making adjustments for TFP growth rate, we use the estimates

[3]For the methodology on estimation of genuine per capital wealth growth rate and its adjustment factors see Arrow et al. (2004).

provided by Kumar and Managi (2008). In their study, the estimates are produced over the period of 1963–2000 for a large number of countries. For estimating TFP, unlike other previous studies, their study considers three inputs – labor, capital, and energy to produce GDP and the emissions of carbon and sulfur.

Figure 2.10 shows the trend in the growth rate of per capita genuine wealth and conventional wealth (manufactured assets). This figure provides some important insights into the question of sustainability of the Indian growth trajectory. First, both per capita conventional and genuine wealth have continuously increased since 1970. Second, during the study period of 37 years, conventional wealth increased at the rate of mere 1.06% per year and the growth rate of per capita genuine wealth was virtually near zero – only 0.07% per year. For the period 1970–2000, the growth rates of per capita conventional and genuine wealth were 0.55% and −0.34% per year, respectively; however, Arrow et al. (2004) observed that the growth rate in per capita genuine wealth was 0.54% per year. The difference in these two estimates may be attributed to the use of different parameters for manufactured capital intensity and TFP growth rate.

Third, the growth rate of per capita conventional wealth was negative until 1977 and then became positive; however, it was negative in 1982, 1987, 1991, and 1992. The growth rate of genuine wealth was negative till 1992 and then it became positive. However, it was positive in 1988 and 1989. These preliminary estimates reveal that the development trajectory followed by the country before 1991 was not sustainable. During the 1980s, although the country observed a positive growth rate in manufactured assets, the growth rate of decline in human and natural assets was more than enough to offset the positive growth rate of manufactured capital.

Fourth, the discussion in Section 3 reveals that although India took four decades to come out of a situation that the economist Raj Krishna called Hindu rate of growth, the growth rate of GDP achieved in the 1990s was also not sustainable since

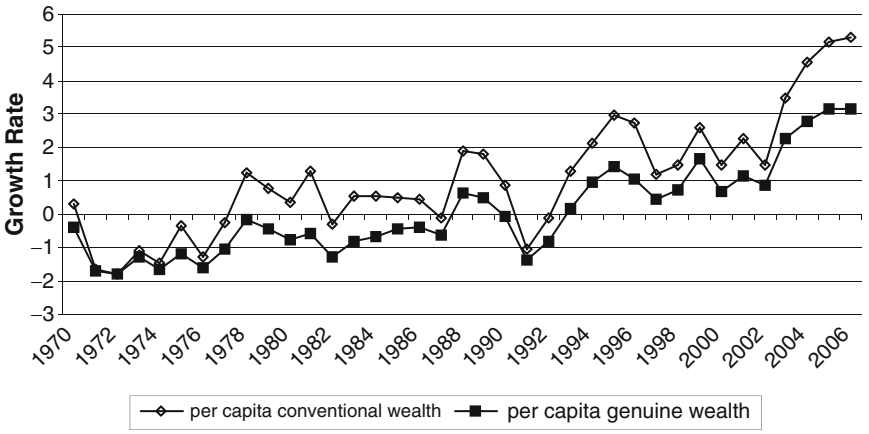

Fig. 2.10 Growth rate of per capita conventional and genuine wealth
Source: authors' calculations based on WDI data

the per capita genuine wealth was declining. It is only from the first quinquennium of the 21st century that the growth rate in income may be considered as sustainable. During 2001–2006, the growth rates of per capital conventional and genuine wealth were 3.7% and 2.23% per year.

Lastly, the point that deserves special attention is that the trend in the difference in the growth rates of these two measures of per capita wealth – conventional and genuine – is increasing over time. Until the mid-1970s, the difference in the growth rates was negligible, but it began to increase and reached about 2 by 1981. During the decades of the 1980s and 1990s it varied between 0.33 and 1.7. Since 2001, we observe that the difference in these two growth rates is continuously increasing and in 2006 it was 2.12. The increasing difference in the growth rates of the different measures of wealth implies that if both the growth rates are positive and there is substitutability between the two, the economy may continue to grow. If there is limited substitutability between natural capital and manufactured capital, it is doubtful that the present growth trajectory will be sustained.

Increasing populations are considered a major reason for the destruction and depletion of natural resources, and this consideration is relevant to the Malthusian approach to environmental accounting. It is true that since populations are increasing and aggregate genuine wealth is not increasing, wealth will be shared among more people. Hamilton (2002) examines the effect of population growth on genuine saving estimates. Figure 2.11 scatters the growth rate of per capita wealth against the population growth rate and shows that there is an inverse relationship between the two factors: as the population growth rate exceeds the rate of 2% per year, the growth rate of per capita genuine wealth becomes negative and the growth path becomes unsustainable. In India, the population growth rate is declining; at present it is about 1.37% per annum. The dependency ratio is also declining.

The preceding discussion on the sustainability of income or welfare should be read with caution. As indicated earlier, in the estimates of genuine saving or investment, all natural resources are not accounted for. For example, these estimates

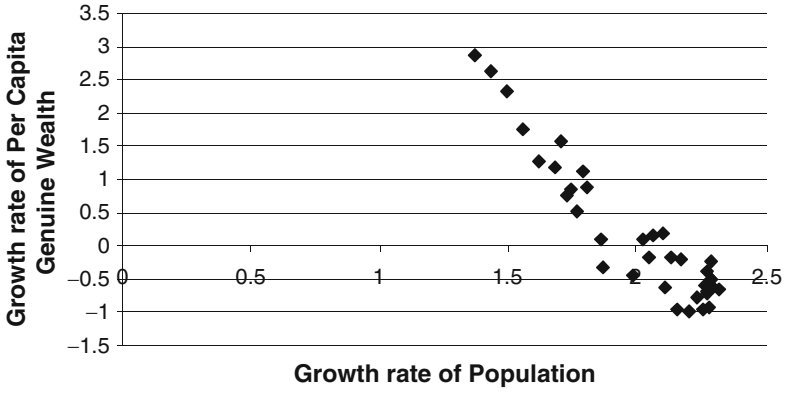

Fig. 2.11 Growth rate of per capita genuine wealth versus growth rate of population
Source: authors' calculations based on WDI data

do not account for the degradation of land resources–except for forests that are being logged. In India, agricultural land is subject to utter degradation. About 57% of the total land area is under some form of degradation, and this sector employs about 60% of the total labor force of the country. Similarly, the depletion and degradation of water resources are not accounted for in these estimates of genuine wealth. In the last two decades, the water quality of almost all of the rivers, large lakes, ponds, and streams throughout the country has been degraded to the extent that today that these water sources are not even of bathing quality. There are many other forms of natural resource degradation that must be accounted for in estimates of genuine wealth as they are lowering the amenities available to humans.

In the estimation of the growth rate of per capita genuine wealth, it is assumed that there is substitutability between different forms of assets. These estimates miss critical bottlenecks that limit the substitution possibilities. For example, in rural India it is often not possible for people to find an appropriate substitute if their water holes vanish and the local woodlands recede (Dasgupta, 1993).

Of course, due to economic activities, environmental degradation is taking place throughout the country. However, note that the regional distribution of natural resources and the level of economic development are not similar across states. The poverty distribution in India coincidently is linked with the distribution of ecosystems and their health in the country (ESPASSA, 2008). As noted earlier, economic regional disparity in the postliberalization regime is increasing. Most of the manufactured capital formation is taking place in those states which are economically better off than poor states and that house most of the natural resources.

2.7 Conclusions

India is the largest democracy in the world and is the fourth largest economy in the world in terms of purchasing power parity. However, about one-third of the total population of the country survives at less than US$1 per day. These two facts lead to degradation and depletion of the environment and natural resources. Similarly, the country has elaborate statutes, regulations, institutional frameworks, and policies on almost every conceivable topic from hazardous waste to public liability to forests and wildlife. However, monitoring and enforcement capabilities are weak. This chapter overviews the complexity and magnitude of environmental problems in addition to general economic performance. These contrasts raise questions about the sustainability of the present growth trajectory from both economic and environmental points of view.

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