CHAPTER 2

RESOURCE USE AND PRODUCTIVITY IN AFRICA: SOME STYLIZED FACTS

A. INTRODUCTION

This chapter presents key stylized facts on resource use and efficiency in Africa, which are crucial for understanding the nature and scale of the sustainable development challenges facing the region. The analysis is based primarily on the framework of Material Flow Accounting and Analysis (MFA), which measures resource flows in physical units — usually in metric tons per year — and tracks resource use from the extraction and production stages to the period of final use and waste disposal (see box 1). As discussed in chapter 1, MFA is increasingly being used for policy formulation and analysis, because it quantifies the interplay between economic activities and the environment in a manner that is comparable across countries and time (Haberl and Weisz, 2007). This Report is the first comprehensive, comparative and quantitative study on the levels, trends, and composition of resource use in Africa using this method. The analysis considers four major types of resources: biomass (from agriculture, forestry, fishery and hunting); fossil fuels (coal, oil and gas); metal ores; and non-metallic minerals (industrial and construction minerals).[3] As in most MFA studies, it does not consider water resource use and its impact on sustainability, though this is a very important issue for Africa (see the annex to this chapter). This chapter supplements the MFA with a land use indicator, namely the Human Appropriation of Net Primary Production (HANPP), as in Africa patterns of land use conversion are a key aspect of resource use. Finally, the chapter also provides facts on Africa's contribution to global GHG — a consequence of growing resource use — and on the impact of climate change in the region.

B. STYLIZED FACTS ON RESOURCE USE AND PRODUCTIVITY IN AFRICA

The key stylized facts on resource use and productivity in Africa identified in the data analysis are as follows:

The level of domestic material extraction per capita in Africa is very low compared to the global average.

In the period from 1980 to 2008, the levels of domestic material extraction per capita in Africa were very low (table 2). In 2008, the average domestic material extraction per capita in Africa was 5.4 tons, which is quite low compared to the global average of 10.2 tons. There are nevertheless major differences between

Box 1. Measuring sustainability: Material Flow Accounting and Analysis, and Human Appropriation of Net Primary Production

Several methods have been developed in order to understand the influence of economic activities on the environment, as well as to assess the magnitude and effects of an economy's throughput. These include Material Flow Accounting and Analysis (MFA) and Human Appropriation of Net Primary Production (HANPP). This Report presents some of the first Africa-wide applications of these methods.

Material Flow Accounting and Analysis

Material Flow Accounting and Analysis (MFA) is conceptually based on the notion that the economy is an open subsystem embedded within the larger Earth system. Its development was a response to the need to assess the scale of an economy's throughput and the negative environmental impacts (e.g. climate change) derived from material and energy consumption. The first material flow accounts started to be developed in the beginning of the 1990s in Austria and Japan. Since then, MFA has grown rapidly as a field of scientific and policy interest, and major efforts have been undertaken to harmonize methodological approaches (OECD, 2008).

In order to create economy-wide material flow accounts and undertake analysis on a national scale, two main boundaries are determined. The first boundary delimits the economic subsystem from the larger natural system. The second boundary sets the limits with respect to other national economies, thus distinguishing the flows of imported and exported materials.

In general, MFA considers four major types of resources, which are accounted in terms of their weight (measured in tons):

(a) Biomass (from agriculture, forestry, fishery and hunting)

(b) Fossil fuels (coal, oil, gas and peat)

(c) Minerals (industrial and construction minerals)

(d) Metal ores

In this fashion, different resource-use indicators can be constructed from material flow data:

(a) Domestic extraction (DE), which includes all the raw materials extracted within a country's territory

(b) Domestic Material Consumption (DMC), which is calculated as DE plus imports minus exports

(c) Physical Trade Balance (PTB), which is calculated as imports minus exports

Material flow data is consistent with the System of National Accounts (SNA). The relationship between material and economic variables allows quantifying, for example, resource efficiency (i.e. GDP/DMC). This is a suitable indicator to monitor decoupling processes.

Box 1 (contd.)

Human Appropriation of Net Primary Production

The Human Appropriation of Net Primary Production (HANPP) is another indicator that is often used to capture the impact of human activity on the ecosystem. It is defined for a given land area and is based on the notion that the amount of land, as well as the intensity of land use by humans, reduces the amount of resources (specifically biomass) left for other species in the food chain. This indicator is composed of two elements:

(a) Amount of harvested biomass

(b) Human-induced productivity changes derived from land conversion

HANPP, in this sense, measures the extent to which plant harvest and land conversion alter the availability of Net Primary Production (NPP) — the net amount of biomass produced each year by plants — in ecosystems (Haberl, Erb and Krausmann 2010). In other words, there are two ways through which NPP of biomass is appropriated by humans: directly through harvest, and indirectly through changes in productivity associated with processes of land conversion, such as land cover change and human-induced land degradation. Harvest is the fraction of HANPP which comprises all assets for human survival on earth, namely food, fodder, fibres, biofuels and wood products. In turn, the second component of HANPP — the amount of biomass appropriated through human-induced productivity changes — generally reflects productivity losses and hence inefficiency in land use. This second component represents the amount of appropriated NPP that does not enter the socio-economic system and has no further societal use. High fractions of productivity losses are generally associated with less efficient land use systems, often as a result of climatic constraints that go hand in hand with low agricultural inputs, such as fertilizers, irrigation and pesticides. Human-induced soil degradation is a crucial factor when it comes to productivity losses and is closely related to unsustainable land use practices.

The relationships between HANPP and its components are useful in various manners. The ratio of harvest per unit of HANPP serves as an indicator of efficiency. In turn, the ratio of productivity losses to harvest is a stringent indicator for the efficiency of the land use system. Increasing the harvested fraction and minimizing land change productivity losses can therefore help in limiting the expansion of agricultural systems into sensitive natural ecosystems (e.g. forests and drylands) by increasing the harvest output of already existing agricultural land. This is particularly crucial for countries where food security will be jeopardized in the coming decades and which are currently facing high productivity losses.

HANPP also allows accounting for trade. Embodied HANPP (or eHANPP) is the amount of net primary production consumed within a country. In this sense, it accounts for the domestic appropriation (extraction) plus imports minus exports. Embodied HANPP is a means for calculating the magnitude of all organic flows produced in the global production chain of traded biomass.

Table 2. Domestic material extraction per capita, 1980–2008

Country	1980	1985	1990	1995	2000	2005	2008
Algeria	7.5	8.7	7.9	7.8	8.5	10.0	10.4
Cameroon	4.9	5.4	4.9	4.4	4.7	4.5	4.2
Côte d'Ivoire	3.1	2.9	2.7	2.8	2.8	2.6	2.7
Egypt	3.5	5.0	5.0	5.5	6.2	6.2	7.3
Ethiopia	6.9	6.4	5.9	4.6	4.4	4.8	4.8
Kenya	5.4	5.1	5.2	4.3	3.5	3.8	3.4
Madagascar	7.2	6.6	6.0	5.3	4.6	4.0	3.7
Malawi	2.2	2.2	1.8	1.7	2.1	1.8	2.0
Mali	6.5	4.7	5.3	5.5	6.1	6.4	6.2
Morocco	5.9	5.7	5.2	4.6	5.1	7.2	6.9
Nigeria	3.8	3.3	3.6	3.7	3.7	3.8	3.6
Senegal	4.6	4.6	4.6	4.8	4.8	5.2	5.1
Seychelles	4.8	4.5	5.1	5.1	6.1	6.7	6.6
South Africa	16.5	16.9	16.1	15.0	14.0	14.2	14.4
Sudan	7.1	7.0	6.3	6.6	7.6	7.7	7.4
Togo	3.9	3.5	4.0	3.1	3.0	3.1	3.2
Africa	**5.9**	**5.7**	**5.4**	**5.2**	**5.2**	**5.4**	**5.4**
World	8.6	8.4	8.5	8.4	8.7	9.5	10.2

Source: UNCTAD (2012b).

African countries. For example, Algeria and South Africa had per capita extraction levels of 10.4 and 14.4 tons respectively, which are higher than both the African and the global average. However, countries such as Côte d'Ivoire and Malawi had per capita extraction levels of 2.7 and 2.0 tons respectively (lower than the African average).

Domestic material extraction in Africa has increased by 87 per cent over the past three decades, but has declined in per capita terms.

Although Africa has very low levels of domestic material extraction per capita, total domestic material extraction in the region increased from 2.8 billion tons in 1980 to 5.3 billion tons in 2008, representing an approximately 87 per cent increase in resource use over the past three decades (table 3).[4] It should be noted that a large part of this increase occurred after 1995. Furthermore, the increase in material extraction is evident in all material categories, as well as in most countries in the

Table 3. Global and African material extraction, 1980–2008

	Global extraction (billions of tons)	Global extraction (1980=100)	African extraction (billions of tons)	African extraction (1980=100)	Africa's share in global extraction (%)
1980	37.9	100.0	2.8	100.0	7.5
1985	40.5	106.8	3.2	111.7	7.8
1990	44.8	118.1	3.4	121.2	7.7
1995	47.9	126.3	3.7	130.9	7.7
2000	52.7	138.8	4.2	148.5	8.0
2005	61.6	162.3	4.9	173.8	8.0
2008	68.1	179.6	5.3	186.8	7.8

Source: UNCTAD (2012b).

region. It is interesting to note that the absolute increase in material extraction in Africa is in line with trends in material extraction at the global level, although the growth in extraction in the former has been slightly faster than in the latter. Consequently, Africa's share in global extraction increased marginally from 7.5 per cent in 1980 to 7.8 per cent in 2008.

While there has been an absolute increase in domestic material extraction in Africa, per capita extraction decreased by about 8 per cent over the past three decades due largely to high population growth. Interestingly, Africa also experienced deindustrialization during this period of declining per capita extraction. The share of manufacturing in Africa's GDP fell from 12 per cent in 1980 to about 10 per cent in 2008. The decline in the share of manufacturing in GDP is more pronounced in West Africa, where it fell from 17 per cent to 5 per cent. Central Africa also experienced a significant decline, from 12 per cent to 6 per cent over the same period (UNCTAD and UNIDO, 2011).

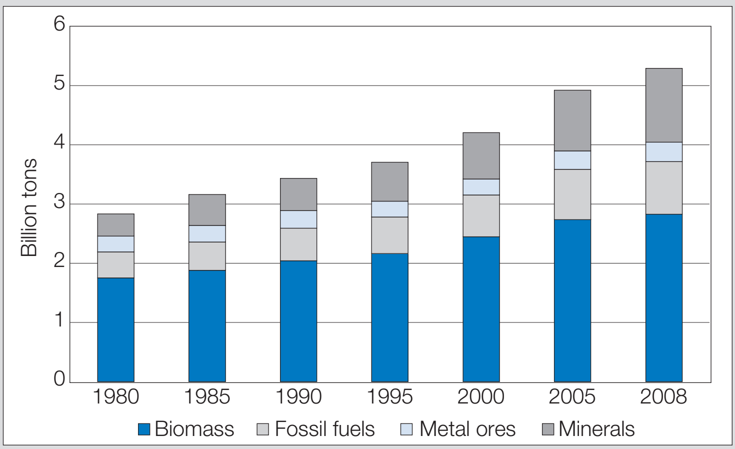
Biomass accounts for over half of the material extraction in Africa, but the share of non-renewable resources in total material extraction has increased from 38 per cent in 1980 to 47 per cent in 2008.

In terms of the categories of materials extracted, biomass (from agriculture, forestry and fishing) is the most dominant, accounting for 53 per cent of overall material extraction in Africa in 2008. However, there has been a significant change in the composition of material extraction in Africa in recent years, with non-renewable resources playing a relatively more important role in extraction than in the past.

Figure 6 illustrates the development of domestic extraction of used biomass, minerals, fossil fuels and metal ores in the region between 1980 and 2008. While there has been a significant increase in biomass extraction since 1980, its share in the total extraction fell from 62 per cent in 1980 to 53 per cent in 2008, due largely to a rapid increase in the extraction of minerals and fossil fuels in the region. As a result of this development, the share of non-renewable resources (fossil fuels, minerals and metals) in total extraction increased from 38 per cent in 1980 to 47 per cent in 2008. Despite the declining share of biomass in African domestic extraction, its share of 53 per cent is quite high when compared to the 28 per cent share of biomass in global material extraction, in 2008.

The increase in biomass extraction in Africa from 1.7 to 2.8 billion tons between 1980 and 2008 is mainly driven by an increase in the category of animal feed, particularly grazing activities, which accounted for 58 per cent of biomass extraction in 2008. The largest extractions for feed in absolute terms are in countries with savannah areas, where livestock breeding accounts for a high share in total land use. For example, Ethiopia, Nigeria and Sudan extracted 257, 133 and 228 million tons respectively in 2008, which is 36 per cent of total grazing and 21 per cent of total biomass extraction in Africa. Although biomass is the dominant form of

Figure 6. Material extraction in Africa, by category, 1980–2008



Source: UNCTAD (2012b).

domestic extraction in the region, its share of domestic extraction varies across African countries. For example, while biomass is the dominant form of extraction in Ethiopia, Kenya, Nigeria and Sudan, in countries such as Algeria, Egypt and Morocco, non-metallic minerals dominate other material categories in terms of domestic extraction (table 4).

Africa's share of global material trade fell, despite a significant increase in trade volume.

The volume of Africa's material trade in physical terms rose from almost 260 million tons in 1980 to 506 million tons in 2008 (table 5). During the same period, the physical trade volume of most of the other world regions rose more rapidly,

Table 4. Material extraction in selected African countries, by material category, 2008 (millions of tons)

	Biomass	Fossil fuels	Metals	Other minerals
Algeria	53.0	145.3	2.1	156.7
Cameroon	59.6	4.6	37.4	0.2
Côte d'Ivoire	37.4	3.4	1.1	10.3
Egypt	161.1	76.1	1.9	333.1
Ethiopia	358.0	0.0	0.9	20.7
Kenya	109.7	0.0	0.1	21.7
Madagascar	66.1	0.0	0.1	5.8
Malawi	24.2	0.1	0.0	4.5
Mali	72.8	0.0	10.3	6.8
Morocco	66.4	0.0	2.5	147.9
Nigeria	347.7	129.5	0.4	67.9
Senegal	37.6	0.0	0.2	22.5
Seychelles	0.1	0.0	0.0	0.5
South Africa	178.6	254.7	140.4	127.6
Sudan	261.5	23.9	0.7	19.9
Togo	12.7	0.0	3.0	2.8
Africa	**2,827.4**	**887.4**	**329.0**	**1,245.6**
World	18,827.3	12,710.4	6,614.2	29,966.8

Source: UNCTAD (2012b).

resulting in an increase in global trade volume by a factor of 2.6. Thus, Africa's share in global trade volume decreased from 6.5 per cent in 1980 to 4.9 per cent in 2008. It is interesting to note that Africa's share of global trade measured in physical terms is higher than its share measured in monetary terms, which was 3.3 per cent in 2008. Both imports and exports increased during the period, but imports grew by a factor of 2.6 while exports grew by a factor of 1.8. Furthermore, African countries imported around 301 million tons of biomass, fossil fuels, metals and non-metallic minerals, while they exported around 711 million tons of materials. Although physical imports as well as exports rose in absolute terms in all material categories, Africa lost global market shares in exports in all material categories and in imports — except biomass (which increased) and fossils fuels (which stagnated) — due to higher increases in trade in other world regions.

Fossil fuels are the dominant material export and import of Africa.

Fossil fuels, dominated by petroleum (crude oil), hard coal, and for a short time natural gas, are African countries' main exports in physical terms. After a decrease during the first half of the 1980s, exports of fossil fuels reached a peak in 2005, and amounted to 534 million tons in 2008 (figure 7a). The share of fossil fuels in total exports increased from 72 per cent in 1980 to 75 per cent in 2008, which is well above the global average of 50 per cent. In physical terms, all African countries account for about 10.5 per cent of fossil fuels supply to the world market. This represents a decline in Africa's share relative to the situation in 1980, when the region accounted for 13.2 per cent of global supply. Metals, clearly dominated by

Table 5. Physical trade volume in Africa and the world, 1980–2008

	Global trade volume (billions of tons)	Global trade volume (1980=100)	African trade volume (billions of tons)	African trade volume (1980=100)	Africa's share of global trade volume (%)
1980	4.0	100	0.3	100	6.5
1985	3.9	96	0.2	91	6.2
1990	5.0	124	0.3	102	5.2
1995	6.1	152	0.3	121	5.1
2000	7.6	189	0.4	156	5.3
2005	9.6	232	0.5	188	5.1
2008	10.3	257	0.5	195	4.9

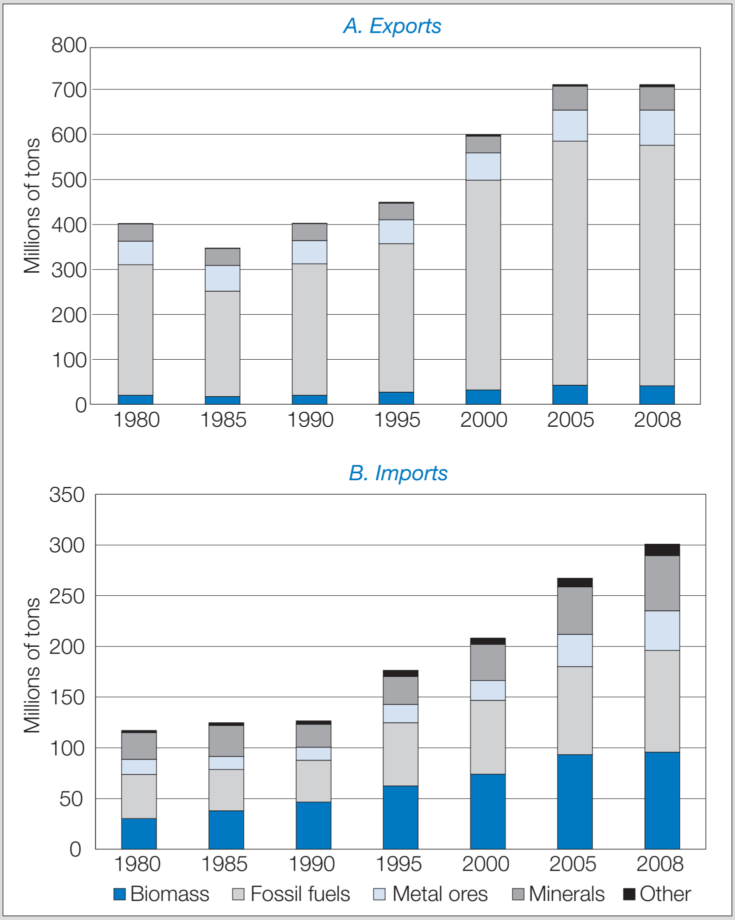
Source: UNCTAD (2012b).
Trade volume = (imports+exports)/2.

iron ores and concentrates, and followed by manganese and chromium ores and concentrates, are Africa's second-largest export flows, with around 78 million tons exported in 2008. South Africa is the dominant exporter, with around 55 million tons of exports in 2008. It is interesting to note that the share of metal exports in total exports declined from 13 per cent in 1980 to 11 per cent in 2008, due, in part, to rising exports of fossil fuels. Furthermore, Africa's share of global metal exports fell from 8 per cent in 1980 to 3.8 per cent in 2008.

Mineral exports are African countries' third-largest export group, with a volume of 52.3 million tons in 2008. The main exporter is Morocco, which mainly exports natural calcium phosphates and phosphatic chalk, followed by Egypt, Tunisia and South Africa. The share of mineral exports in Africa's total exports decreased from 10 per cent in 1980 to 7 per cent in 2008. At the global level, the share of minerals in total exports has been relatively constant, at around 12 per cent. In 2008, African countries accounted for around 4.4 per cent of global mineral exports, compared to 8.8 per cent in 1980. The last material category, biomass, has the lowest share of African exports. The region exported about 14.5 million tons in 2008, representing about 2 per cent of total exports. Fruits, timber, products made of biomass (e.g. paper and paperboards), and crops (e.g. coffee, cocoa and tobacco) are the main biomass exports.

In terms of material imports, fossil fuels are the dominant material imports of African countries, with a relatively constant share of between 33 and 37 per cent of total imports (figure 7b). This is low compared to the world average share of 50 to 55 per cent of fossil fuels in total imports. All African countries together import about 100 million tons of fossil fuels, which is around 2 per cent of global imports of fossil fuels. South Africa is the largest demander of fossil fuels in Africa, importing principally petroleum (crude oil), products such as hydrocarbons and plastics in primary forms, and, since 2005, increasingly natural gas too. Together with Morocco and Egypt, the second- and third-biggest demanders of fossil fuels in Africa, the three countries import around 57 million tons, representing about 57 per cent of Africa's imports of fossil fuels. Biomass is the second most important material import of African countries and has a rapidly growing share of imports. While in 1980 around 26 per cent of the imports of African countries were biomass, in 2008 the share was 32 per cent, which is high compared to a relatively constant world average share of biomass imports in total imports of around 16 per cent. Africa is currently demanding 6 per cent of globally traded biomass. Biomass includes a wide range of commodities and trade products, such as food and

Figure 7. Physical exports and imports of African countries, by material category, 1980–2008 (millions of tons)



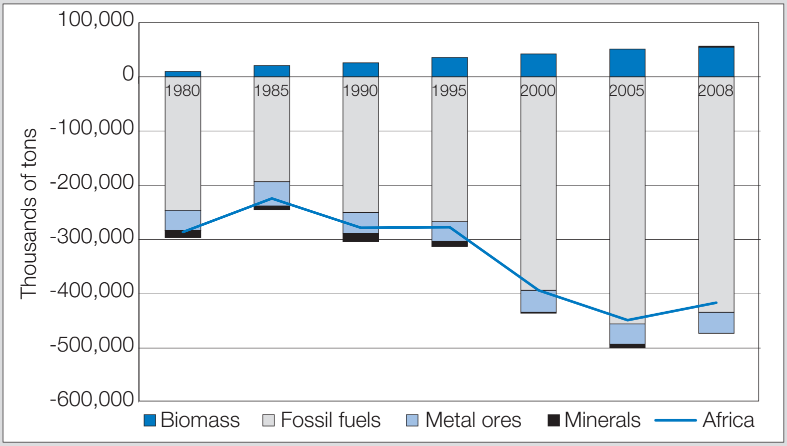
Source: UNCTAD (2012b).

beverages, animals including meat and products from animals, animal feedstuffs, forest products, fibres, fats and oils, and products mainly from biomass materials such as cellulose and paper. During the past three decades, Africa's main biomass imports in physical terms have been cereals, followed by biomass products (mainly vegetable fats and oils), timber and sugar crops. The dominant importers of cereals are the northern African countries, mainly Algeria, Egypt, Morocco and Tunisia. The third-largest material category in Africa's imports is non-metallic minerals. However, although the absolute amount of non-metallic mineral imports increased from 26 to 54 million tons, the share in total imports fell from 22 per cent to 18 per cent, which is still high compared to the world average share of non-metallic minerals in total imports of around 11–12 per cent. Africa is thus demanding around 4.6 per cent of globally traded non-metallic minerals. The main imported commodities in this category are cement and mineral fertilizers. Metals are the least important material in Africa's imports, although in absolute terms, imports of metals increased from 15 million to 39 million tons between 1980 and 2008, mainly due to increasing imports of iron and steel. Metal imports account for a fluctuating share of between 10 and 13 per cent, which is low compared to the world average share of metal imports in total imports of 20 per cent in 2008 and 16 per cent in 1980. In 2008, African countries imported about 1.9 per cent of globally traded metals.

Africa is a net exporter of non-renewable resources and a net importer of renewable resources.

An examination of physical trade balances (PTBs)— defined as imports minus exports — indicates that African countries are net suppliers of resources to the world. In 2008, net exports of materials by the region were 409 million tons, compared to 284 million tons in 1980. Figure 8 shows that the increase in net exports has been quite high since 2000, reflecting the significant increase in demand for Africa's resources by non-African developing countries such as Brazil, China and India (UNCTAD, 2010a). In terms of material composition, Africa is a net importer of renewable resources (biomass) and a net exporter of non-renewable resources. However, within the non-renewable resources material category, it is a net exporter for fossil fuels and metals and not for non-metallic minerals. In general, the PTBs of Africa is a reflection of its endowment, production and consumption structure. The region is endowed with significant amounts of fossil fuels and mineral resources, and so its production and exports are dominated by resources and resource-based products. The region accounts for 41 per cent of world reserves of cobalt, 56 per cent of reserves of diamond, 34 per cent of reserves of gold, 10 per cent of reserves of oil, 12 per cent of reserves of chromites, and 53 per cent of reserves of phosphate rock. It also accounts for significant amounts of the world output of other resources (table 6).

Figure 8. Physical trade balances of all African countries, 1980–2008



Source: UNCTAD (2012b).

The level of domestic material consumption (DMC) per capita in Africa is about half the global average (10.4 tons per capita), and has decreased slightly from 5.6 tons per capita in 1980 to 5.3 tons per capita in 2008.

DMC per capita in Africa is very low compared to the global average. In 2008, per capita DMC in the region was 5.3 tons, compared to the global average of 10.4 tons per capita. Furthermore, there has been no significant change in DMC per capita in the region, due largely to high population growth. While average per capita DMC in Asian and Latin American countries increased during the period under consideration, it decreased slightly in Africa — from 5.6 tons in 1980 to 5.3 tons in 2008. In fact, since 1995, Africa's average per capita DMC has been the lowest, compared to all other regions of the world. Within Africa, there are countries that have very high DMC per capita. For example, Seychelles and South Africa have higher DMC per capita than the global average. Figure 9a suggests that countries with a higher per capita income have higher DMC per capita. With regard to material categories, biomass accounts for a large part of the DMC per capita in most countries in the region. However, in countries such as Algeria, Egypt, Morocco and Seychelles, non-metallic minerals seem to dominate in terms of DMC per capita (figure 9b).

Table 6. Africa's share of global production and reserves of selected minerals

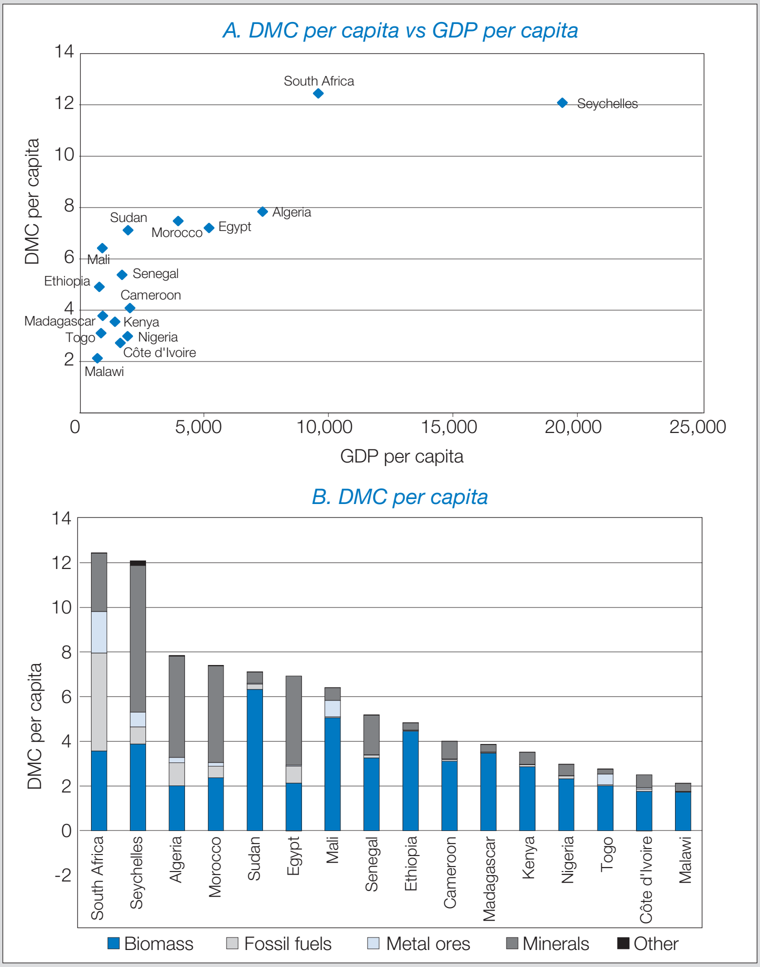
Mineral	Share of world reserves (%)	Share of world production (%)	Main African producers
Aluminium	3	4	Mozambique, Egypt, South Africa
Cement	-	4	Algeria, Egypt, Morocco, South Africa, Libya, Tunisia
Chromites	12	37	South Africa, Zimbabwe, Madagascar, Sudan
Coal	4	3	South Africa, Zimbabwe
Cobalt	41	60	Democratic Republic of the Congo, South Africa, Zambia
Copper	4	7	Zambia, South Africa, Democratic Republic of the Congo
Iron ore	1	3	South Africa, Algeria, Mauritania
Diamond	56	49	South Africa, Botswana, Democratic Republic of the Congo
Gold	34	18	South Africa, Ghana, Mali
Graphite	0.4	1	Zimbabwe, Madagascar
Lead	1	3	Namibia, South Africa
Natural gas	8	6	Algeria, Egypt, Libya
Manganese	-	23	South Africa, Ghana, Gabon
Oil	10	12	Nigeria, Angola, Algeria, Libya
Phosphate rock	53	25	Morocco, Tunisia, Egypt
Raw steel	-	1	South Africa, Egypt, Libya
Uranium	15	17	South Africa, Niger, Namibia

Source: Computed on the basis of data from U.S. Geological Survey, British Petroleum, and OECD.

Although domestic material consumption in Africa is increasing, the region accounts for only 7.2 per cent of global material consumption.

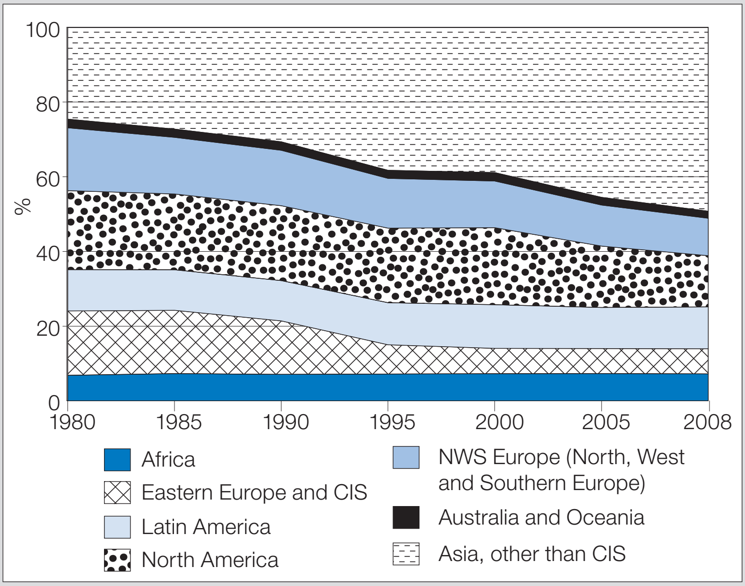
The absolute amount of DMC in Africa — defined as domestic material extraction plus imports minus exports — increased from 2.5 billion tons in 1980 to 4.9 billion tons in 2008, representing an approximately 90 per cent increase in material consumption over the period under consideration (figure 10). DMC is an indicator of potential environmental pressures associated with the disposal of residual materials

Figure 9. Domestic material consumption in selected African countries, 2008



Source: UNCTAD (2012b).
DMC is in tons and GDP is in constant 2005 dollars.

Figure 10. Material consumption by region, 1980–2008 (%)



Source: UNCTAD (2012b).

in the domestic environment. At the global level, absolute material consumption increased in all regions of the world, except in Eastern European countries and the Commonwealth of Independent States (CIS). In 2008 Africa accounted for about 7.2 per cent of global material consumption, compared to 6.8 per cent in 1980. Asian countries (excluding the CIS) have the highest share in global resource consumption, accounting for about 49 per cent in 2008. North America had a share of 14 per cent, Latin America 11 per cent, and Europe (Northern, Western and Southern) 10 per cent.

Within Africa, the absolute amount of domestic materials consumed varies significantly across countries (table 7). In 2008, the highest DMC was in the populous countries of Egypt, Ethiopia, Nigeria, South Africa and Sudan. The five countries as a group consumed around 2.3 billion tons in 2008, or 47 per cent of Africa's total consumption, and accounted for about 44 per cent of the region's

Table 7. Absolute amounts of domestic material consumption, 1980–2008 (millions of tons)

	1980	1985	1990	1995	2000	2005	2008
Algeria	96.3	161.6	140.0	163.4	160.2	210.0	269.8
Cameroon	42.2	49.8	53.1	55.6	70.1	76.8	76.5
Côte d'Ivoire	26.4	29.6	33.7	41.5	46.1	46.1	51.6
Egypt	157.5	268.7	294.1	347.3	433.9	461.2	563.9
Ethiopia	245.0	264.6	286.8	261.3	288.2	362.7	389.7
Kenya	89.5	101.0	124.6	118.7	114.1	138.3	136.3
Madagascar	62.3	64.8	67.9	70.7	71.9	72.7	73.8
Malawi	14.0	16.0	16.8	18.1	24.3	24.1	29.8
Mali	47.6	38.2	46.4	55.3	69.9	86.3	92.7
Morocco	104.1	119.2	125.0	128.6	154.9	229.5	234.0
Nigeria	210.5	218.0	276.9	332.9	342.4	432.3	449.7
Senegal	24.1	27.7	33.6	40.9	48.1	60.0	63.4
Seychelles	0.4	0.4	0.5	0.6	0.6	0.8	1.1
South Africa	422.4	494.7	527.9	541.8	516.6	552.5	607.0
Sudan	143.8	168.0	170.3	201.3	257.8	288.9	294.5
Togo	7.8	9.0	12.6	12.0	13.9	15.6	17.9
16 African countries	**1,693.7**	**2,032.2**	**2,209.9**	**2,390.0**	**2,613.1**	**3,057.8**	**3,351.7**
Africa	**2,547.0**	**2,938.5**	**3,115.9**	**3,432.1**	**3,813.4**	**4,478.0**	**4,879.8**

Source: UNCTAD (2012b).

population. Ranking all countries in the world according to their absolute material consumption in 2008, South Africa was 22nd, Egypt 26th and Nigeria 28th. In terms of growth of material consumption, Algeria, Senegal and Seychelles are some of the countries with the highest growth rates of absolute material consumption in the region.

Non-renewable resources account for a large share of domestic material consumption in African countries that are at a relatively higher level of industrial development.

Among the 16 African countries for which we have good-quality data by material category, the countries that have higher DMC per capita than the African average of 5.3 tons also have a relatively higher level of industrial development (table 8). For example, Algeria, Egypt, Morocco, Seychelles and South Africa have high per

Table 8. Industrial development and per capita resource use in Africa, 2008

	Domestic material consumption	Biomass	Fossil fuels	Metal ores	Minerals	Level of industrial development (MVA per capita)
	Tons per capita					
South Africa	12.4	3.6	4.4	1.9	2.6	948.5
Seychelles	12.1	3.9	0.8	0.7	6.6	880.3
Algeria	7.9	2.0	1.0	0.2	4.5	142.9
Morocco	7.4	2.4	0.5	0.2	4.3	311.0
Sudan	7.1	6.3	0.2	0.0	0.5	77.6
Egypt	6.9	2.1	0.8	0.1	4.0	239.9
Mali	6.4	5.1	0.1	0.7	0.6	26.2
Senegal	5.2	3.3	0.1	0.0	1.8	98.3
Ethiopia	4.8	4.5	0.0	0.0	0.3	8.7
Cameroon	4.0	3.1	0.1	0.0	0.8	156.4
Madagascar	3.9	3.5	0.0	0.0	0.3	40.4
Kenya	3.5	2.9	0.1	0.0	0.5	60.0
Nigeria	3.0	2.3	0.1	0.0	0.5	27.2
Togo	2.8	2.0	0.1	0.5	0.2	37.7
Côte d'Ivoire	2.5	1.8	0.1	0.1	0.6	142.8
Malawi	2.1	1.7	0.0	0.0	0.4	27.2

Source: UNCTAD (2012b).

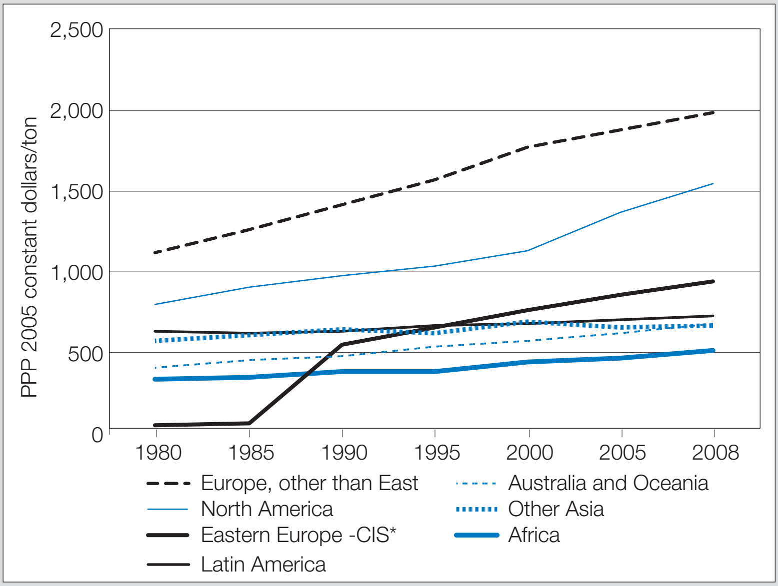
capita DMC and also have manufacturing value added (MVA) per capita above the regional average of $125. Mali and Sudan are exceptions in the sense that their per capita DMC is higher than the regional average but they have an MVA per capita level that is well below the regional average. It should be noted that the bulk of the per capita DMC in Mali and Sudan, as well as in other African countries at very low levels of industrial development, comes from biomass as opposed to non-renewable resources. In contrast, a large part of the per capita DMC in the African countries at a relatively high level of industrial development is accounted for by non-renewable resources. In the case of Algeria, Egypt, Morocco and Seychelles, non-metallic minerals are the most important non-renewable resources, whereas in South Africa, fossil fuels are the most dominant. Among the African countries at a relatively high level of industrial development, South Africa is the only country where consumption of fossil fuels per capita is quite high. This is not surprising, given that South Africa has the most advanced manufacturing sector in the region. These findings suggest that the industrial development process in African countries seems to be following the same pattern that was observed in currently developed countries, where fossil fuels and minerals played a critical role. In addition, these findings are in line with existing evidence indicating that the transition from an agrarian to an industrialized economy has historically involved greater use of non-renewable resources, particularly fossil fuels (Haberl and Weisz, 2007).

Material productivity in Africa is the lowest for any region in the world. Nevertheless, material productivity in Africa has improved over the past three decades.

Over the past three decades, the level of material productivity in Africa — defined as the ratio of real output to domestic material consumption (GDP/DMC) — has been very low compared to other regions (figure 11). For example, in 2008, the average level of material productivity in Africa was about $520 per ton of material, which is quite low relative to the global average of $950 per ton of material. Although the level of material productivity in Africa is low, it has increased significantly over the last three decades, from $338 per ton of material in 1980 to $520 per ton of material in 2008. To understand this change in material productivity in Africa, it is important to note that between 1980 and 2008, DMC almost doubled in Africa and exhibited similar trends to population over this period. Furthermore, the trend in GDP (at constant 2005 prices) was similar to the trends in population and DMC until 1995. After 1995, income increased significantly faster than material consumption and population in Africa, resulting in a 33 per cent rise in material productivity between 1995 and 2008.

The average figures for material productivity in Africa conceal important variations across African countries. Generally, industry- and service-oriented economies have higher material productivities than resource-based economies (Dittrich et al., 2011; Giljum et al., 2010). For example, Seychelles, which is a service-based economy, has the highest level of material productivity (above the global average), although there has been a decrease in its material productivity since 2000. It is important to note that most islands with a significant financial or tourism sector are net importers of resources, and the upstream flows of their imports outweigh those associated with exports.[5] It can be assumed that consideration of upstream flows would result in significantly lower material productivity values, as can be observed for other net importing countries (Dittrich, 2009).

Figure 11. Material productivity, by region, 1980–2008 (PPP 2005 constant dollars per ton)



Source: UNCTAD (2012b).

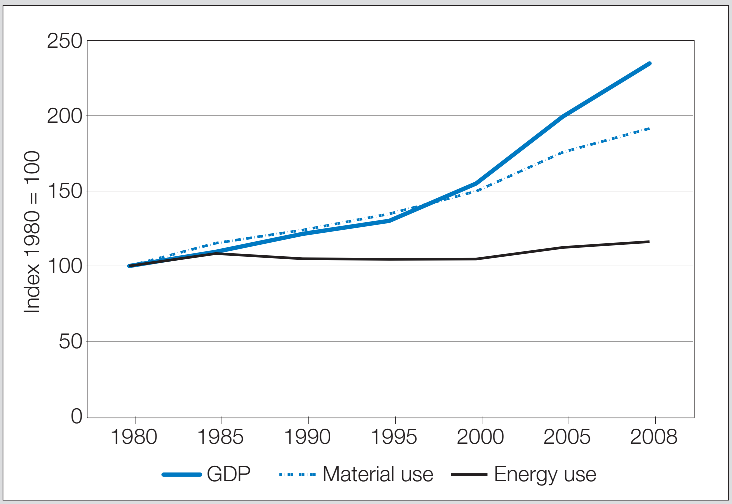
* Before 1990 no data were available for GDP of Soviet Union.

The second-highest level of material productivity can be found in Algeria, followed mainly by other oil- and metal-exporting countries such as Nigeria and South Africa, while countries with a high share of agriculture (which goes along with high extraction of biomass) have a comparably lower level of material productivity. This feature has also been observed in Asian countries (Giljum et al., 2010). Among the countries with high levels of biomass extraction, those with high shares of extraction for livestock-breeding generally have lower material productivities than countries with higher shares of intensive land use or crop-growing: typical examples are Ethiopia and Sudan, with material productivities of $166 and $276/ton, respectively, compared to Côte d'Ivoire and Malawi, which had $610 and $343/ton respectively, in 2008.

Energy use in Africa is low and has been increasing much less rapidly than material use.

Energy use in Africa is quite low relative to other regions of the world. For example, in 2009, per capita electricity consumption in Africa was only 561 kilowatt-hours (KWh), compared to 741 KWh for Asia, 1,884 KWh for Latin America, and 2,730 KWh for the world (IEA 2011). Although the level of energy use in Africa is low, it increased by about 16.3 per cent in the period from 1980 to 2008. Interestingly, the increase in energy use observed in Africa in 1980–2008 is far below the 92 per cent increase in material use over the same period (figure 12). It should be noted, however, that the low energy use observed in Africa reflects the fact that the region has a very low level of industrial development. The experience of industrialized economies suggests that industrialization is typically associated with high use of modern energy. This implies that if African countries want to successfully promote industrial development, they will have to improve access to modern energy and increase its use. This issue will be discussed in more detail in chapter 4.

Figure 12. Trends in GDP, material use and energy use, in Africa, 1980–2008 (Index 1980 = 100)



Source: UNCTAD (2012), U.S Energy Information Administration (2011) and United Nations Statistics (2011).

Africa has contributed the least to global greenhouse gas emissions but is the region most affected by climate change.

Africa's contribution to GHG in the atmosphere has been relatively small. In 2009, the total of CO_2 emissions in the region was 928 million tons compared to 10,030 million tons and 12,045 million tons for Asia and the OECD countries respectively (table 9). In fact, Africa accounted for only 3.2 per cent of global CO_2 emissions in 2009, reflecting the fact that it is at a much lower level of industrial development, and so has lower levels of income and of energy consumption. In per capita terms, the region emitted 0.9 tons of CO_2 per capita in 2009. This compares with 4.3, 9.8, 2.8 and 2.2 for the world, the OECD countries, Asia, and Latin America, respectively (IEA 2011). That said, the carbon intensity of output in Africa is higher than the average for the OECD countries and the world, but less than for Asia and the Middle East. Within Africa, Libya and South Africa have the highest per capita emissions of CO_2. In 2009, they had 7.9 and 7.5 tons per capita respectively, which is higher than the global average of 4.3 but less than the OECD countries' average of 9.8. Other African countries that have per capita emissions that are higher than the African average of 0.9 include Algeria, Botswana, Egypt, Gabon, Morocco, Namibia and Tunisia.

With regard to the impact of climate change, recent research indicates that this has and may continue to have a more severe impact in the region because of Africa's geography, its high level of dependence on agriculture, and the fact that it has less capacity to adapt. Boko et al. (2007) suggest that the projected reduction

Table 9. Population, output and carbon emissions, across regions, in 2009

	Population (millions)	GDP (billions of 2000 dollars)	CO_2 emissions (Mt of CO_2)	CO_2 per capita (t CO_2/capita)	CO_2/GDP (kg CO_2/ 2000 dollars)
World	6,761	39,674	28,999	4.3	0.7
OECD countries	1,225	29,633	12,045	9.8	0.4
Middle East	195	782	1,509	7.8	1.9
Asia	3,546	5,655	10,030	2.8	1.8
Latin America	451	1,957	975	2.2	0.5
Africa	**1,009**	**896**	**928**	**0.9**	**1.0**
Africa (share of global)	15 %	2.3 %	3.2 %		

Source: International Energy Agency (2011), *Key World Energy Statistics*.
Notes: Mt = million tons; t = metric ton; kg = kilogram

in agricultural yields in some African countries is likely to be as high as 50 per cent by 2020, and that net crop revenue could decline by as much as 90 per cent by 2100. It is also estimated that the proportion of arid and semi-arid lands in the region may increase by 5–8 per cent by 2080. Furthermore, the study suggests that between 75 and 250 million people in Africa are expected to be at risk of increased water stress by 2020. Other studies have estimated the impact of climate change in Africa too, and have arrived at qualitatively similar results (Boyd and Tompkins, 2009). For example, Wheeler (2011) provides an estimate of the vulnerability of countries to climate change resulting from increasing weather-related disasters, sea-level rise, and loss of agricultural productivity. The results show that the loss of agricultural productivity will be higher in Africa compared to other regions. In particular, the loss is expected to be higher in Central Africa, with a loss in agricultural productivity over the period 2008–2050 of as much as 20 per cent. Collier, Conway and Venables (2008) have also argued that Africa is likely to be affected more severely by climate change than other regions.

The human impact on natural ecosystems in Africa is generally low but increasing at a rapid rate.

The Human Appropriation of Net Primary Production (HANPP) is an indicator that measures the human impact on the yearly availability of energy (biomass) in ecosystems (see box 2). By appropriating a certain percentage of accumulated net primary production (biomass), humans cause transformations in the productivity of natural ecosystems by reducing the amount of biomass that is left in the system. There are two ways in which human beings appropriate biomass in an ecosystem — directly, through harvest; and indirectly, through changes in productivity associated with processes of land conversion, such as land cover change and human-induced land degradation. The harvest component of HANPP is made up of used extraction and unused extraction (harvest losses).

In Africa, the level of HANPP at the national scale ranges from close to zero to 10 tons of carbon per hectare per year (tC/ha/yr), with an average of 0.7 tC/ha/yr which is quite low compared to other regions of the world.[6] Nevertheless, there are a few countries in the region with very high HANPP levels. For example, countries in East Africa (Burundi, Rwanda and Uganda) have levels of between 4 and 10 tC/ha/yr. Also, some West African countries, particularly Côte d'Ivoire, Nigeria and Togo, have moderate levels of HANPP — between 2 and 4 tC/ha/yr. High levels of HANPP can be observed in African countries with high population densities. Although HANPP levels in Africa are generally low, they are increasing

Box 2. Land degradation, deforestation, and loss of biodiversity in Africa

Land degradation — defined as a reduction in the capacity of the land to provide ecosystem goods and services over a period of time — is one of the key environmental sustainability challenges facing the Africa region. UNEP (2008) argues that 65 per cent of Africa's agricultural land, 31 per cent of its pasture lands, and 19 per cent of its forests and woodlands are degraded. Furthermore, Requier-Desjardins (2006) shows that the economic cost of land degradation in Africa ranges from 1 to 18 per cent of GDP. Land degradation has very serious consequences for Africa, given its heavy dependence on its natural resource base. Although natural events (such as droughts) can exacerbate land degradation, it is generally assumed that the main causes are deforestation, desertification, erosion (water and wind), and poor agricultural practices such as the unbridled use of irrigation and fertilizers. However, it should be noted that high population growth (and hence density) are important drivers of these human activities associated with land degradation.

Although Africa has a significant amount of forest resources, it also has a very high rate of *deforestation*. In 2010, Africa's forest area was 674 million hectares, representing 16.7 per cent of the world's total forest area of about 4 billion hectares. However, the region lost about 10 per cent of its forest area between 1990 and 2010. A large part of this loss occurred in the period 1990–2000 when the total forest area declined by 4.1 million hectares per year, compared with a decline of 3.4 million hectares per year in the period 2000–2010. In fact, Africa and South America are the only regions in the world where forests are disappearing at a rapid rate. South America lost about 4 million hectares of forest area per year between 2000 and 2010 (United Nations, 2011). Within Africa, Burundi, Comoros, Ghana, Mauritania, Niger, Nigeria, Togo and Uganda are the countries with the highest net loss of forest area in percentage terms (box table 1). However, in absolute terms, the most significant losses were observed in Cameroon, the Democratic Republic of the Congo, Mozambique, Nigeria, Sudan, the United Republic of Tanzania, and Zimbabwe. The main causes of deforestation in Africa are logging, land conversion for agriculture and settlements, wildfires, cutting for firewood and charcoal, and civil unrest (UNEP, 2008).

The rapid depletion of Africa's forest resources is a source of concern because forests play an important role in the ecosystem. They are useful for the provision of food, fuel, and medicines. They also protect the soil, reduce the amount of CO_2 in the atmosphere, and are needed for the regeneration and survival of plant and animal species. Five countries — Angola, the Democratic Republic of the Congo, Mozambique, Sudan and Zambia — account for about 55 per cent of the region's forest area. Furthermore, Congo, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, Guinea-Bissau, Seychelles and Zambia are the African countries with a very high percentage of total land area covered by forests (more than 50 per cent).

Desertification is another form of land degradation and a major environmental challenge facing Africa. It is associated with loss of vegetation cover, reduction of the soil's organic matter, and diminished water-holding capacity of the soil. It is common in the arid and semi-arid areas of Africa with low and unpredictable rainfall. Africa is the region of the world most vulnerable to desertification, because two thirds of its land is either desert

Box 2 (contd.)

Box table 1. Forest area and depletion in Africa

	Forest area in 2010 (Km²)	Percentage change between 1990 and 2010	Percentage of land area covered by forests in 2010
Algeria	14 920	-10.5	1.0
Angola	584 800	-4.1	47.0
Benin	45 610	-20.8	41.0
Botswana	113 510	-17.3	20.0
Burkina Faso	56 490	-17.5	21.0
Burundi	1 720	-40.5	7.0
Cameroon	199 160	-18.1	42.0
Cape Verde	850	46.6	21.0
Central African Republic	226 050	-2.6	36.0
Chad	115 250	-12.1	9.0
Comoros	30	-75.0	2.0
Congo	224 110	-1.4	66.0
Côte d'Ivoire	104 030	1.8	33.0
Dem. Rep. of the Congo	1 541 350	-3.9	68.0
Djibouti	60	0.0	0.0
Egypt	700	59.1	0.0
Equatorial Guinea	16 260	-12.6	58.0
Eritrea	15 320	-5.5	15.0
Ethiopia	122 960	-18.6	11.0
Gabon	220 000	0.0	85.0
Gambia	4 800	8.6	48.0
Ghana	49 400	-33.7	22.0
Guinea	65 440	-9.9	27.0
Guinea-Bissau	20 220	-8.8	72.0
Kenya	34 670	-6.5	6.0
Lesotho	440	10.0	1.0
Liberia	43 290	-12.2	45.0
Libya	2 170	0.0	0.0
Madagascar	125 530	-8.3	22.0
Malawi	32 370	-16.9	34.0
Mali	124 900	-11.2	10.0
Mauritania	2 420	-41.7	0.0
Mauritius	350	-10.3	17.0
Morocco	51 310	1.6	11.0
Mozambique	390 220	-10.0	50.0
Namibia	72 900	-16.8	9.0
Niger	12 040	-38.1	1.0
Nigeria	90 410	-47.5	10.0
Rwanda	4 350	36.8	18.0
Sao Tome and Principe	270	0.0	28.0
Senegal	84 730	-9.4	44.0
Seychelles	410	0.0	88.0
Sierra Leone	27 260	-12.6	38.0
Somalia	67 470	-18.5	11.0
South Africa	92 410	0.0	8.0
Sudan	699 490	-8.4	29.0
Swaziland	5 630	19.3	33.0
Togo	2 870	-58.1	5.0
Tunisia	10 060	56.5	6.0
Uganda	29 880	-37.1	15.0
United Republic of Tanzania	334 280	-19.4	38.0
Zambia	494 680	-6.3	67.0
Zimbabwe	156 240	-29.5	40.0

Source: UNCTAD computation on the basis of data from United Nations Statistics Division.

Box 2 (contd.)

or drylands. The African countries facing very high risk of desertification include: Algeria, Botswana, Burkina Faso, Chad, Eritrea, Gambia, Guinea-Bissau, Kenya, Malawi, Mali, Mauritania, Morocco, Namibia, Niger, Senegal, Somalia, Sudan, Zambia and Zimbabwe. The primary causes of desertification are overgrazing, deforestation, intensive cropping, and climatic variability. Deblij, Murphy and Fouberg (2007) suggest that over 270,000 miles of farming and grazing lands in sub-Saharan Africa have been turned into desert over the past fifty years. Desertification has a significant negative impact on land productivity, with severe consequences for agricultural production and food security.

The loss of biological diversity — encompassing the total variety of plant and animal species — is increasingly a major concern for African governments and the international community. Africa's social and economic systems depend heavily on the continent's rich and varied biological resources. These resources are important sources of food, energy, medicines, and clean air and water. They also contribute to industrial production, construction, tourism and psychological well-being. Africa accounts for one third of global biodiversity. In particular, one quarter of the world's mammal species and one fifth of the existing species of birds are in Africa. Furthermore, the region is home to between 40,000 and 60,000 plant species. Despite its rich biological resources, there are indications that human activities have led to significant declines in biodiversity in Africa. It is estimated that over 120 plant species in the region are extinct, and that about 1,771 are under threat. African forests are also disappearing at an alarming rate, and several birds and animal species are either under threat or have been driven to extinction (UNEP, 2008 and 2010c). For example, in Egypt, the expansion of economic activities is creating significant hazards to birds. In Comoros and Seychelles, large numbers of bird species are now classified as endangered. In Somalia, overhunting, drought and loss of habitat have resulted in a significant reduction in the species of long-necked antelopes (gerenuks). Africa is also experiencing a decline in its fish stocks, because of illegal fishing by foreign vessels coupled with excessive fishing by local fishermen and legal commercial fleets. It is estimated that illegal fishing costs Africa about $1 billion every year (United Nations, 2009). In recent years, efforts have been made at different levels to protect Africa's biodiversity through an increase in the number of protected areas. However, the percentage of protected areas remains low in a large number of countries. In 2009, the proportion of terrestrial and marine areas protected to total territorial area was less than 10 per cent in 31 of the 54 African countries. In particular, the ratio of protected to total area was less than 1 per cent in Djibouti, Lesotho, Libya, Mauritius, Seychelles and Somalia.

at a rapid rate. Between 1980 and 2005, HANPP grew by about 53 per cent in Africa. The highest growth rate was in West Africa (84 per cent), and the lowest was in Southern Africa (10 per cent). Increasing HANPP in Africa is due in part to the expansion of agricultural land area through land conversion (for example, the replacement of forests by pasture or cropland) and through land degradation.

Land use processes are found to be largely inefficient over large parts of Africa.

Land use efficiency — analysed in terms of the ratio between (a) used extraction (i.e. the used fraction of harvest) and total HANPP and (b) used extraction per harvest — is very low in sub-Saharan Africa. Table 10 shows that the ratio of used extraction to total HANPP is below 20 per cent in Angola, Congo, Côte d'Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, Liberia and Madagascar. Furthermore, the share of unused extraction (i.e. unused crop residues, felling losses and livestock feces) in total harvest is above 30 per cent in 15 African countries. Low land use efficiency in sub-Saharan Africa is due largely to large-scale land cover changes (deforestation) and degradation (see box 2). In these countries, the productivity losses associated with human land use are much higher than the harvested biomass. In contrast to many European and Asian countries, many African countries were not able to improve land use efficiency (e.g. increase crop yields per land area) over time. In several countries, such as the Democratic Republic of the Congo, Senegal, and Uganda, land use efficiency has even declined in the past decades. Egypt and South Africa, which both have relatively advanced agricultural production systems, are the few countries in the region that do not follow this trend. A crucial factor is human-induced soil degradation in dry lands, a phenomenon that is responsible for a large share of the low land use efficiency. The countries heavily prone to dry land degradation include Botswana, Burkina Faso, Cameroon, Eritrea, Madagascar, Senegal, Swaziland, Togo and Uganda. In these countries, which are characterized by high fractions of dry land areas, livestock overstocking, forest depletion for fuel wood consumption or overexploitation of soils due to short fallow periods are the main causes of soil degradation. Combating and mitigating degradation is therefore a prerequisite for increasing land use efficiency in the above-mentioned countries.

Unlike in sub-Saharan Africa, the countries in the Northern African and Western Asian desert and the Gulf States have been able to cultivate parts of the naturally arid areas by means of advanced cultivation techniques in the last decades (e.g. through irrigation and fertilizer application) and have thus achieved productivity gains (i.e. negative productivity losses). Regions where agriculture has been highly industrialized in the last decades and where advanced means of cultivation are applied (mostly agrochemicals and irrigation) tend to show very high levels of harvest compared to low fractions of productivity losses associated with land use. Similar patterns can be found in South Asia, East Asia, Europe and North America. However, these regions often rely heavily on fossil energy carriers in order

Table 10. HANPP levels and composition in African countries

	HANPP (tC/ha/yr)	Used extraction (% of HANPP)	Unused extraction (% harvest)	Productivity loss (% of HANPP)
Algeria	1.1	49	24.6	35
Angola	0.7	10	16.7	88
Benin	1.9	27	34.1	59
Botswana	0.2	50	5.7	47
Burkina Faso	1.9	37	22.9	52
Burundi	6.2	24	27.3	67
Cameroon	1.8	24	27.3	67
Cape Verde	-	58	-	23
Central African Republic	0.4	39	15.2	54
Chad	0.5	52	17.5	37
Comoros	0.0	27	-	63
Congo	0.7	6	45.5	89
Dem.Rep. of Congo	0.5	15	37.5	76
Côte d'Ivoire	2.5	16	33.3	76
Djibouti	0.4	92	9.8	-2
Egypt	-0.5	4,473	37.4	-7,047
Equatorial Guinea	0.9	16	50.0	68
Eritrea	0.7	-	-	-
Ethiopia	1.9	41	18.0	50
Gabon	0.4	14	50.0	72
Ghana	2.4	27	35.7	58
Gambia	1.8	51	25.0	32
Guinea	1.1	27	30.8	61
Guinea-Bissau	1.1	27	22.9	65
Kenya	1.5	39	22.0	50
Lesotho	2.5	30	14.3	65
Liberia	1.1	18	41.9	69
Libya	0.4	114	13.6	-32
Madagascar	2.2	16	15.8	81
Malawi	1.6	38	30.9	45
Mali	0.7	52	17.5	37
Mauritania	0.5	79	3.7	18
Morocco	1.3	64	15.8	24
Mozambique	0.7	20	35.5	69
Niger	0.9	54	18.2	34
Nigeria	3.2	39	27.8	46
Rwanda	7.4	29	25.6	61
Senegal	1.5	50	19.4	38
Sierra Leone	1.4	23	34.3	65
Somalia	0.6	84	5.6	11
South Africa	1.6	57	26.0	23
Sudan	1.1	54	12.9	38
Swaziland	1.5	78	25.7	-5
Togo	3.4	25	35.9	61
Tunisia	2.0	42	20.8	47
Uganda	4.8	27	32.5	60
United Rep. of Tanzania	1.1	36	23.4	53
Zambia	0.6	20	25.9	73
Zimbabwe	1.0	56	21.1	29

Source: UNCTAD (2012a).

to increase harvest outputs and minimize productivity losses. Hence, agricultural production in these parts of the world results in substantial sustainability challenges, in particular regarding their role in the global climate change debate. Furthermore, these regions will have to deal with issues of scarcity of non-renewable resources, such as water and fossil fuels, which are likely to have major impacts on the welfare of entire economies. Constantly rising global oil prices are a stringent indicator for this scenario.

C. CONCLUSION

The analysis of resource use presented in this chapter indicates that African countries have very low levels of material extraction and material consumption, both as a share of the global total and also in per capita terms. Levels of energy use are particularly low, and there is a major gap between GDP growth and the growth in energy use. It also indicates that average material productivity (which measures resource efficiency) is roughly half the global average. There is low land use efficiency in the region, due mainly to large-scale land cover changes (deforestation) and land degradation. Despite major reserves, the region's stock of non-renewable resources is being depleted, particularly through international trade, and the overuse of and lack of investment in non-renewable resources means that the renewable natural capital stock is depreciating.

The low level of resource use in Africa reflects the very low levels of consumption and the fact that the region has not successfully gone through the transition from a predominantly agrarian to an industrial economy, which generally involves more resource use. As the region goes through this structural transformation process, there will be a significant increase in resource use, particularly energy. The stylized facts presented in this chapter indicate that there is already an ongoing shift from renewable to non-renewable resources in Africa, and this is likely to intensify as the structural transformation process gathers momentum. Structural transformation in Africa will also have adverse environmental impacts. For example, it will increase waste generation as well as pollution, and thus will have important implications for environmental sustainability. In this regard, the challenge facing African countries is how to promote structural transformation while mitigating the associated environmental impacts. In this regard, the analysis suggests that there are major opportunities to improve resource use efficiency. The next chapter presents a framework and strategies that African countries can adopt in order to respond to this challenge.

ANNEX

Water use and sustainability in African countries

Water scarcity and stress are major environmental sustainability challenges in Africa. UNEP (2008) suggests that over 300 million people in Africa experience water scarcity and that by 2025, eighteen countries in the region will experience water stress. A country is considered to face water scarcity if it has less than 1,000 cubic meters of water available per person in a given year. In the case of water stress, the threshold is 1,700 cubic meters. In 2007, renewable internal freshwater resources per capita were less than 1,000 cubic metres in the following African countries: Algeria, Burkina Faso, Cape Verde, Djibouti, Egypt, Eritrea, Kenya, Libya, Mauritania, Morocco, Niger, Somalia, South Africa, Sudan, Tunisia and Zimbabwe. In terms of absolute water withdrawals, Egypt, Madagascar, Nigeria and Sudan are the African countries with annual freshwater withdrawals of more than 10 billion cubic metres over the period 2000–2005. Furthermore, in 2008, only 60 per cent of the population of sub-Saharan Africa had sustainable access to an improved water source, compared with 92 per cent in North Africa. An increase in water consumption and withdrawal, due largely to population growth and decreasing water supply, are the main reasons for water scarcity and stress in Africa. In general, water consumption and withdrawal could be for agriculture, industrial or domestic use. However, given Africa's low level of industrial development, a large part of water use is for agriculture (annex table 1). Nevertheless, there are differences across countries in terms of the importance of these sectors in water use. For example, in Lesotho 40 per cent of water use is in industry, and in Seychelles and Togo, domestic use accounts for 65 per cent and 53 per cent of water use respectively.

Annex table 1. Share of sectors in water use in Africa, 1998–2007 (%)

	Agricultural	Industrial	Domestic
Algeria	64.9	13.2	21.9
Angola	60.0	17.1	22.9
Benin	45.4	23.1	31.5
Botswana	41.2	18.0	40.7
Burkina Faso	86.3	0.8	13.0
Burundi	77.1	5.9	17.0
Cameroon	73.7	8.1	18.2
Cape Verde	90.9	1.8	7.3
Central African Republic	4.0	16.0	80.0
Chad	82.6	-	17.4
Comoros	47.0	5.0	48.0
Congo	8.7	21.7	69.6
Dem. Rep. of Congo	30.6	16.7	52.8
Côte d'Ivoire	64.5	11.8	23.7
Egypt	86.4	5.9	7.8
Equatorial Guinea	0.9	15.7	83.3
Eritrea	94.5	0.2	5.3
Ethiopia	93.6	0.4	6.0
Gabon	41.7	8.3	50.0
Gambia	65.4	11.8	22.9
Ghana	66.4	9.7	23.9
Guinea	90.1	2.0	7.9
Guinea-Bissau	82.3	4.6	13.1
Kenya	79.2	3.7	17.2
Lesotho	20.0	40.0	40.0
Liberia	54.5	18.2	27.3
Libya	82.8	3.1	14.1
Madagascar	95.7	1.5	2.8
Malawi	80.2	5.0	14.9
Mali	90.1	0.9	9.0
Mauritania	88.2	2.9	8.8
Mauritius	67.7	2.8	29.5
Morocco	87.4	2.9	9.8
Mozambique	87.3	1.6	11.1
Namibia	71.0	4.7	24.3
Niger	95.4	0.5	4.1
Nigeria	68.8	10.1	21.1
Rwanda	68.0	8.0	24.0
Senegal	93.0	2.6	4.4
Seychelles	7.3	27.6	65.0
Sierra Leone	92.1	2.6	5.3
Somalia	99.5	0.1	0.5
South Africa	62.7	6.0	31.2
Sudan	96.7	0.7	2.7
Swaziland	96.5	1.2	2.3
Togo	45.0	2.4	52.7
Tunisia	76.0	3.9	12.8
Uganda	40.0	16.7	43.3
United Rep. of Tanzania	89.4	0.5	10.2
Zambia	75.9	7.5	16.7
Zimbabwe	78.9	7.1	14.0
World	70.0	20.0	10.0

Source: FAO, *Statistical Yearbook 2010*.