

Chapter 7

Environment

Key findings

- More than half of rural households and about a quarter of urban households in sub-Saharan Africa lack easy access to sources of drinking water, and most of the burden of water collection falls on women.
- The majority of households in sub-Saharan Africa and in Southern and South-Eastern Asia use solid fuels for cooking on open fires or traditional stoves with no chimney or hood, disproportionately affecting the health of women.
- Fewer women than men participate in high-level decision-making related to the environment.

Introduction

Women and the environment is one of the 12 critical areas of concern for achieving gender equality identified by the Beijing Platform for Action in 1995.¹ The Platform for Action recognizes that environmental conditions have a different impact on the lives of women and men due to existing gender inequality. In particular, lack of access to clean water and energy, environmental degradation and natural disasters disproportionately affect women in terms of health, unremunerated work and well-being. Furthermore, the Platform for Action stresses that women's role in sustainable development is hampered by unequal access to land, financial resources and agricultural information and technologies; unequal access to formal training in professional natural resources management; and limited involvement in policy formulation and decision-making in natural resources and environment management. All these barriers continue to exist 15 years after the Platform for Action was endorsed by governments.

There are also concerns that climate change may deepen environment-related gender inequality, particularly in the less developed regions.² The rise in temperature, the increasing risk of heat waves, droughts and floods, and the more frequent and

more intense storms and tropical cyclones that are all part of climate change are expected to have an overall negative impact on agricultural livelihoods, availability of food and human health and survival.³ Women are considered among the most vulnerable groups, as they tend to be more dependent on the natural resources threatened by climate change and have fewer assets to cope with the change.⁴

This chapter examines several environmental aspects with gender-differentiated impacts. The first part of the chapter looks at access to water and firewood, while the second part discusses the effects on health of environmental factors such as indoor smoke from solid fuels, unsafe water and sanitation, and natural disasters. Awareness of environmental problems and the participation of women and men in preserving the environment, particularly in high-level decision-making, are addressed in the last part of the chapter.

The choice of issues examined in this chapter was constrained by availability of data. More statistical information on links between gender and the environment is needed in several areas. Time use data are largely missing in countries from the less developed regions, where poor infrastructure and housing conditions, as well as natural hazards, result in increased work burdens. Data

¹ United Nations, 1995.

² See, for example, UNDP, 2009; Commission on the Status of Women, 2008; Masika, 2002.

³ IPCC, 2007.

⁴ UN Women Watch, 2009.

on trends and on smaller areas than the national level, needed to assess changes in women's and men's work burdens as a consequence of droughts, floods, deforestation or desertification, for example, are rarely available. Sex-disaggregated data on the effects of natural hazards on other human dimensions, such as education, health, food and economic security are also difficult to obtain.

Monitoring the impacts of climate change on the lives of women and men is particularly challenging. On the one hand, the gendered effects may not be easily detectable at the level of larger geographical units – region, country or even urban/rural area – where the traditional systems of social statistics have been focused; hence, monitoring may need to take into account smaller areas that are particularly prone to climate change manifestations. On the other hand, separating the effect of climate change on women and men's lives from other environmental and socio-economic factors is difficult. Non-climate factors such as demographic pressure or over-exploitation of resources also increase the risk of environmental degradation and have an effect on access to natural resources and on human health and survival.

Finally, data to assess the capability of women and men to protect local natural resources are not available. There is little information on access to environment-related practical knowledge, including access to modern agricultural information and techniques in the less developed regions. Sex-disaggregated data on participation in the management of local natural resources such as water, forests or biodiversity are also lacking.

A. Access to water and firewood

Investment in infrastructure to reduce women's and girls' time burdens in water and firewood collection has been identified by the Millennium Development Goal (MDG) Task Force on Education and Gender Equality as one of seven strategic priorities to achieve gender equality, "empower women and alter the historical legacy of female disadvantage".⁵ This is particularly important in the context of declining supplies of water and firewood linked to desertification, deforestation and climate change, especially in some parts of Africa and Asia.⁶ For example, between 1990 and 2005 the total forest area in the world declined at an

estimated rate of 8.4 million hectares annually.⁷ More than half of this loss, 4.3 million hectares annually, was in sub-Saharan Africa, the region with the highest household dependency on firewood for cooking. Also, increasing frequency and intensity of droughts was noted in some parts of Africa and in many parts of Asia.⁸ By 2020, between 75 and 250 million people in Africa are projected to be exposed to increased water stress due to climate change, and by 2050, freshwater availability is projected to decrease in Central, Southern, Eastern and South-Eastern Asia.⁹

1. Access to sources of drinking water

Lack of access to drinking water on the premises or within a short distance continues to affect the lives of women and men in the less developed regions. In sub-Saharan Africa, only 54 per cent of households are within 15 minutes from a source of drinking water (table 7.1). The proportion of such households is considerably higher in Asia (84 per cent), Latin America and the Caribbean (90 per cent) and Eastern Europe (97 per cent). Within sub-Saharan Africa, easy access to drinking water is particularly low in Eastern Africa (46 per cent of households on average). Less than a quarter of households in Burundi and Uganda and less than a third in Eritrea, Malawi, Rwanda and Somalia have access to water within 15 minutes.

More than half of rural households and about a quarter of urban households in sub-Saharan Africa lack access to drinking water on the premises or within a short distance

The proportion of households within a short distance from a water source is lower in rural areas than in urban areas in all regions (table 7.1). The urban-rural gap is the largest in sub-Saharan Africa where 42 per cent of rural households have easy access to sources of drinking water, compared to 74 per cent of urban households. In rural areas of some sub-Saharan African countries only a minority of households can benefit from easy access to drinking water. The proportion of rural households within 15 minutes from a source of drinking water is as low as 8 per cent in Eritrea, 15 per cent in Somalia and in Uganda and 25 per cent or less in Burkina Faso, Burundi, Democratic Republic of the Congo and Mozambique.

⁷ FAO, 2005.

⁸ IPCC, 2007.

⁹ Ibid.

⁵ UN Millennium Project, 2005, p. 3.

⁶ UNEP, 2005; IPCC, 2007.

Women are more often responsible for water collection than men are

When water is not available on the premises, women are more often responsible for water collection than men are. In 38 of the 48 countries with available data, the percentage of households where an adult woman (15 years or over) is the person responsible for water collection is much larger than the percentage of households where an adult man is the person responsible. This is the case in both rural and urban areas in the majority of sub-Saharan African countries and in rural areas of some Asian countries. On average, an adult woman is the person usually carrying home the water in 63 per cent of rural households and 29 per cent of urban households in sub-Saharan Africa (figure 7.1). In comparison, an adult man has this responsibility in 11 per cent of rural households and 10 per cent of urban households. In rural areas in Asia, women are the ones fetching the water in 30 per cent of households and men in 13 per cent. In contrast, in rural and urban areas in Latin America and the Caribbean the burden falls more often on men.

Girls under 15 years are also more likely than boys of the same age to be in charge of water collection (figure 7.1). In sub-Saharan Africa, the usual person collecting water in rural areas is a girl in 7 per cent of households and a boy in 3 per cent of households. In Cameroon, Ghana, Sierra Leone and Uganda, a girl is the main person to collect water in more than 10 per cent of rural households. In urban areas of sub-Saharan Africa, girls and boys are the predominant water collectors in

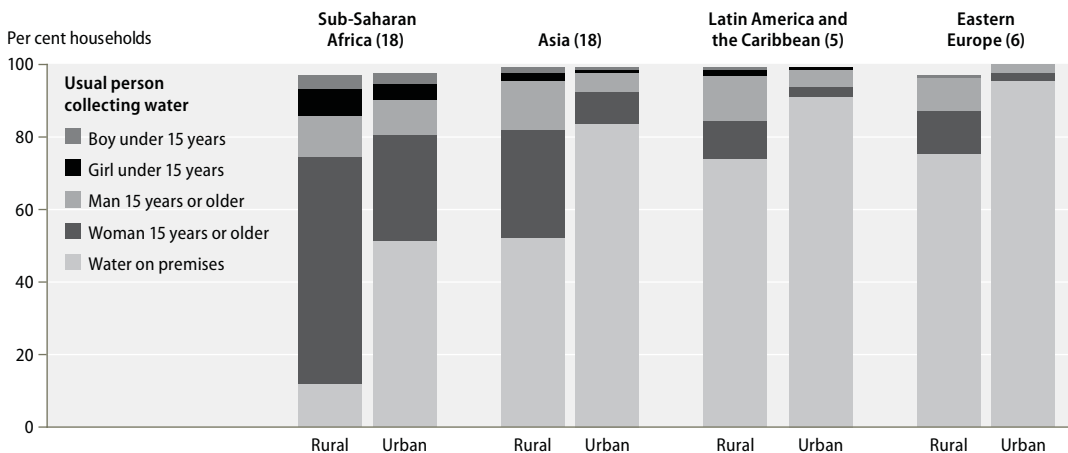
Table 7.1
Households within 15 minutes from a source of drinking water by region and urban/rural areas, 2000–2008 (latest available)

	Households within 15 minutes from a source of drinking water (%)		
	Total	Urban	Rural
Sub-Saharan Africa (40)	54	74	42
Eastern Africa (15)	46	71	33
Middle Africa (6)	51	69	37
Southern Africa (4)	66	89	49
Western Africa (15)	60	75	50
Asia (24)	84	93	78
Central Asia (5)	82	93	72
South-Eastern Asia (6)	89	95	86
Southern Asia (4)	83	90	80
Western Asia (8)	88	97	79
Latin America and the Caribbean (13)	90	94	83
Caribbean (5)	85	90	74
Central America (4)	91	95	87
South America (4)	94	97	88
Eastern Europe (7)	97	98	95

Source: Computed by the United Nations Statistics Division based on data from Macro International, Demographic and Health Survey (DHS) reports (2009a); Macro International, Demographic and Health Survey (DHS) STATcompiler (2009b); UNICEF, Multiple Indicator Cluster Survey (MICS) reports (2009).
Note: Unweighted averages; the numbers in brackets indicate the number of countries averaged. The averages calculated for Asia cover countries from the four sub-regions presented in the table and Mongolia (Eastern Asia).

4 and 3 per cent of households, respectively. In rural areas in Asia, girls and boys from 2 per cent of households are the usual persons collecting the water. It must be noted that the percentages shown refer to the situation where a child is the main person collecting water; the proportion of households where children are involved to some degree in water collection is undoubtedly much higher.

Figure 7.1
Distribution of households by person responsible for water collection, by region and urban/rural areas, 2005–2007 (latest available)



Source: Computed by the United Nations Statistics Division based on data from Macro International, Demographic and Health Survey (DHS) reports (2009a) and UNICEF, Multiple Indicator Cluster Survey (MICS) reports (2009).
Note: Unweighted averages; the numbers in brackets indicate the number of countries averaged. The difference up to 100 per cent is made up by the share of households where a person from outside the household would collect the water or missing information.

Women in rural sub-Saharan Africa expend the most time to bring water home

Women in rural sub-Saharan Africa are the most burdened not only because they are usually the ones in charge of water collection but also because more time is needed in that region to bring the water home (table 7.2). The time needed to go to

Table 7.2

Average time (in minutes) needed to collect water per trip to the source of drinking water by region and rural/urban areas, 2005–2007 (latest available)

	Sub-Saharan Africa (13)	Asia (13)	Latin America and the Caribbean (4)	Eastern Europe (7)
National level	34	21	17	15
Urban areas	25	17	19	20
Rural areas	36	23	17	13

Source: Computed by the United Nations Statistics Division based on data from Macro International, Demographic and Health Survey (DHS) reports (2009a) and UNICEF, Multiple Indicator Cluster Survey (MICS) reports (2009).

Note: Unweighted averages; the numbers in brackets indicate the number of countries averaged. Time needed to collect water is measured as the time spent in one trip to go to the source of drinking water, get water and return home.

the source of drinking water, get water and return home is on average 36 minutes in rural areas, compared to 25 minutes in urban areas. However, in rural areas of some countries in the region, the time burden is much greater. For example, one

Table 7.3

Women and men engaged in water collection and average time burden

	Year	Percentage collecting water		Average time burden in population (minutes per day)		Gender gap
		Women	Men	Women	Men	
Sub-Saharan Africa						
Benin	1998	73	19	45	12	33
Ghana	1998/99	60	38	41	33	8
Madagascar	2001	44	16	27	9	18
Malawi	2004/05	..	..	54	6	48
South Africa	2000	13	7	8	3	5
Asia						
Lao People's Dem. Rep.	2002/03	..	..	12	6	6
Pakistan	2007	3	1	3	0	3
Central America						
Nicaragua	1998	30	29	38	23	15

Sources: Compiled by the United Nations Statistics Division from World Bank, *Gender, Time Use, and Poverty in Sub-Saharan Africa* (2006) and time use survey reports from national statistical offices of Lao People's Democratic Republic, Nicaragua, Pakistan and South Africa.

Note: Average time burden in population is calculated taking into account those involved in water collection as well as those not involved. Data may not be strictly comparable across countries as the methods involved for data collection may differ.

trip back and forth to the water source takes on average one hour and 22 minutes in rural areas in Somalia and one hour and 11 minutes in rural areas in Mauritania. More than one trip per day may be needed to cover all the household needs and this limits the amount of time that women can spend on other activities, whether income-earning, educational or leisure.

The data presented above, only recently made available through DHS and MICS surveys for a large number of countries from the less developed regions, provide an overview of the role of women in water collection. Still, they offer only a crude measure of women's burden in this area. When available, further information from time use surveys can show the proportion of women and men actually involved in water collection, how much time they spend doing this activity, as well as how the gender-specific time burden is associated with other factors such as age, employment or economic status. However, limited data on time use are available. So far only a small number of countries from the less developed regions – where drinking water on premises is most lacking – have implemented time use surveys and, although disseminated results have been disaggregated by sex, other demographic or socio-economic factors have not been systematically considered.

Nevertheless, time use data for eight countries from the less developed regions confirm that larger proportions of women are involved in water collection and that the average time burden is greater for women than for men (table 7.3). In Benin, for example, 73 per cent of women collect water, compared to only 19 per cent of men. The average woman spends 45 minutes every day on this task, 33 minutes more than a man does. In Madagascar, 44 per cent of women collect water, compared to 16 per cent of men, and spend 18 minutes longer. The average woman in Malawi takes almost an hour a day to collect water, more than three quarters of an hour longer than a man does. The gender gap is lower in countries where low proportions of women and men need to collect water, such as in Pakistan and South Africa.

In rural areas the work burden of water collection is greater than in urban areas and so is the gender gap. For example, to collect water, an average woman from Benin spends about one hour a day if she lives in a village and about a quarter of an hour a day if she lives in a city or town.¹⁰ This is

¹⁰ World Bank, 2006.

46 minutes more per day than a man in a village and 10 minutes more per day than a man in a city. In Guinea, women spend on average almost half an hour a day to bring water home in rural areas and 10 minutes a day in urban areas.¹¹ The daily time burden is greater for women than for men by 22 minutes in rural areas and by 7 minutes in urban areas.

2. Access to firewood

In the less developed regions, a large proportion of households still use firewood for cooking and heating. On average, 66 per cent of households in sub-Saharan Africa, 55 per cent of households in Southern and South-Eastern Asia and 31 per cent of households in Latin America rely on firewood for cooking.¹² The dependency on firewood is particularly high in some African and Asian countries. In sub-Saharan Africa, over 90 per cent of households in Central African Republic, Malawi, Rwanda and Sierra Leone are dependent on firewood. In Asia, more than 75 per cent of households in Cambodia, the Lao People's Democratic Republic and Nepal depend on firewood.

In communities from poor areas affected by deforestation or where nearby forests are protected, women and men may need to take longer and longer trips to collect firewood. For example, in Uganda, as a result of deforestation, the average distance to collect firewood – travelled usually by women and children – increased between 1992 and 2000 from 0.06 km to 0.9 km at the country level.¹³ In some villages in India, women used to spend one to two hours per trip to gather firewood in the early 1990s prior to forest protection policies being put in place, but about three to five hours afterwards.¹⁴

Very few countries have available statistics on how many women and men collect firewood for their household needs and how much time they spend on this work. In addition, even when time use data on firewood collection are available, information is lacking on the purposes for which women and men collect wood – for example, for household needs (cooking and heating), to sell (and gain

income) or as an input for income-earning activities (for example, a bakery or brick kiln). Men, for example, may be more likely than women to collect wood for selling purposes.¹⁵

Available time use data (table 7.4) show that in some countries women spend more time than men collecting firewood, while in others men spend more time. In Benin, Ghana, Malawi and the Lao People's Democratic Republic, for example, women are more burdened. In Benin, 22 per cent of women collect firewood compared to only 5 per cent of men, and the average time burden is 16 minutes per day for women and 4 minutes for men. By contrast, in Madagascar and Nicaragua, men are more burdened. In Nicaragua, for instance, 34 per cent of men take care of firewood collection compared to 9 per cent of women, and the average time burden is 39 minutes per day for men and 8 minutes for women.

B. Environmental factors with an impact on women's health

Lack of access to clean water and energy has a major impact on women's and men's health. In 2004 almost 2 million deaths were attributable to unsafe water, sanitation and hygiene, and 2 mil-

Table 7.4
Women and men engaged in firewood collection and average time burden

Year	Percentage collecting firewood		Average time burden in population (<i>minutes per day</i>)		
	Women	Men	Women	Men	
Africa					
Benin	1998	22	5	16	4
Ghana	1998/99	35	16	37	30
Madagascar	2001	10	15	7	13
Malawi	2004/05	..	..	19	3
Morocco	1997/98	3	..	3	..
South Africa	2000	5	2	5	3
Asia					
Lao People's Dem. Rep.	2002/03	..	..	18	6
Pakistan	2007	4	2	3	2
Central America					
Nicaragua	1998	9	34	8	39

Sources: Compiled by the United Nations Statistics Division from World Bank, *Gender, Time Use, and Poverty in Sub-Saharan Africa* (2006) and time use survey reports from national statistical offices of Lao People's Democratic Republic, Nicaragua, Pakistan and South Africa.

Note: Average time burden in population is calculated taking into account those involved in firewood collection as well as those not involved. Data may not be strictly comparable across countries as the methods involved for data collection may differ.

11 Ibid.

12 Unweighted averages computed by the United Nations Statistics Division based on data from Macro International, 2009a and 2009b; UNICEF, 2009.

13 Uganda Ministry of Finance, Planning and Economic Development, 2003.

14 Agarwal, 2001.

15 Jackson, 1993.

Box 7.1

Estimating the mortality attributable to environmental risk factors

The World Health Organization (WHO) estimates mortality and burden of disease caused by health risk factors. Although the number of such factors is countless, WHO focuses on selected risk factors “which have global spread, for which data are available to estimate population exposures and health outcomes, and for which the means to reduce them are known” (WHO, 2009, p. v). Among the risk factors assessed, six were environment-related: indoor smoke from solid fuels; unsafe water, sanitation and hygiene; urban air pollution; occupational risks; lead exposure; and climate change. Altogether, the six environmental factors accounted for 6.3 million deaths in 2004, about 11 per cent of total number of deaths in that year.

Mortality attributable to a risk factor is estimated by WHO based on three types of information: (a) the proportion of population exposed to the risk factor by level of exposure; (b) the relative risk of specific disease for each exposure level; and (c) the total number of deaths. For example, the number of deaths attributable to indoor smoke is estimated based on (a) data on proportion of population using solid fuels (biomass and coal) for cooking, adjusted by a ventilation factor; (b) information on relative risks of lower respiratory infections, chronic obstructive pulmonary disease and lung cancer, obtained from epidemiological studies; and (c) data on total number of deaths.

Methodologically, the idea is to estimate the proportional reduction in death that would occur if exposure to a selected risk factor were reduced to zero. The fraction of deaths attributed to a selected risk factor is estimated by WHO based on an analysis where the observed level of death under the current distribution of exposure by age, sex and region is compared to the expected level of death if an alternative exposure distribution that would lead to the lowest level of death had applied. In the case of indoor smoke from solid fuels, for example, the alternative exposure distribution is zero.

Sources: WHO, *Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks* (2009) and Ezzati and others, *Comparative Quantification of Health Risks: Global and Regional Burden of Diseases Attributable to Selected Major Risk Factors* (2004).

lion more were attributable to indoor smoke from solid fuels.¹⁶ The two factors combined accounted for almost two thirds of all deaths attributable to environmental risks (see box 7.1).

1. Access to improved water and sanitation

Of the almost 2 million deaths in 2004 attributed to unsafe water, sanitation and hygiene¹⁷, 48 per cent were female deaths and 52 per cent were male deaths. Women and men living in the less developed regions were most vulnerable. Almost 8 per cent of the total number of deaths in sub-Saharan Africa and almost 5 per cent in Southern Asia and in Oceania (excluding Australia and New Zealand) were due to unsafe water, sanitation and hygiene, compared to less than 0.1 per cent in the more developed regions.¹⁸

¹⁶ WHO, 2009.

¹⁷ The estimated number of deaths reflects mainly the disease burden of infectious diarrhoea and a small additional contribution related to schistosomiasis, trachoma, ascariasis, trichuriasis and hookworm disease. Although it is recognized that unsafe water, sanitation and hygiene are important determinants in a number of additional diseases such as malaria, yellow fever, dengue, hepatitis A, hepatitis E, typhoid fever or others, they were not included in the above estimate (Prüss-Üstün and others, 2004).

¹⁸ WHO, 2009.

There have been improvements in access to safe water and sanitation, but some regions are still lagging behind

Although access to improved drinking water and sanitation is increasing at the world level, some regions are still lagging behind. It is estimated that in 2008, 87 per cent of the world's population used an improved drinking water source, an increase of 10 percentage points from 1990.¹⁹ All regions of the world gained in access to improved drinking water over the period except for Oceania (excluding Australia and New Zealand), which remained at about the same level of 50 per cent of the population. In sub-Saharan Africa, 60 per cent of the population in 2008 had access to improved drinking water, an increase of 11 percentage points since 1990.

In 2008, 61 per cent of the world's population used improved sanitation facilities, an increase of 7 percentage points since 1990.²⁰ The regions with lowest access to improved sanitation facilities remained sub-Saharan Africa (31 per cent) and Southern Asia (36 per cent), although improvements were seen in both regions (3 and 11 percent-

¹⁹ WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation, 2010.

²⁰ Ibid.

age points respectively). Although declining, open defecation is still substantial in the two regions, resulting in considerable health risks for women and men. In 2008, 44 per cent of the population in Southern Asia was still practicing open defecation (a decline of 22 percentage points since 1990) and 27 per cent in sub-Saharan Africa (a decline of 9 percentage points from 1990). At the world level, 17 per cent of the population was estimated as practicing open defecation in 2008, a decline of 8 percentage points since 1990.

2. Use of solid fuels for cooking and indoor smoke pollution

There are increased health risks for people exposed to smoke from solid fuels, especially women

Almost 2 million deaths a year were attributable to indoor smoke from solid fuel in 2004. More than 1 million (55 per cent) were female deaths and less than 900,000 (45 per cent) were male deaths.²¹ Women and men living in the less developed regions were most vulnerable. Almost 6 per cent of the total number of deaths in Eastern Asia and almost 5 per cent in Southern Asia and sub-Saharan Africa were due to indoor smoke from solid fuels, compared to less than 0.2 per cent in the more developed regions.²²

Strong evidence suggests that women and men exposed to smoke from solid fuels have an increased risk of developing acute lower respiratory infections, chronic obstructive pulmonary disease and lung cancer (table 7.5). A WHO meta-analysis of epidemiological studies reviewing the impact of exposure to indoor air pollution on health²³ concluded that women over 30 years who were exposed to solid fuel smoke are on average about three times more likely to develop chronic obstructive pulmonary disease than women who had not been exposed. In comparison, the risk for men exposed to solid fuel smoke increases less than twice. Also, women exposed to coal smoke are 1.9 times more likely to develop lung cancer than women not exposed, and exposed men are 1.5 times more likely to develop lung cancer than men not exposed. Small children, often carried on their mothers' backs during cooking or when being taken care of indoors, are 2.3 times more likely to develop acute lower respiratory

Table 7.5
Relative risks for health outcomes from exposure to solid fuel smoke

Strength of evidence	Health outcome	Sex and age group	Relative risk
Strong evidence			
	Acute lower respiratory infection	Children < 5	2.3
	Chronic obstructive pulmonary disease	Women ≥ 30	3.2
	Lung cancer (from exposure to coal smoke)	Women ≥ 30	1.9
Strong evidence for specific groups only			
	Chronic obstructive pulmonary disease	Men ≥ 30	1.8
	Lung cancer (from exposure to coal smoke)	Men ≥ 30	1.5
Limited evidence			
	Lung cancer (from exposure to biomass smoke)	Women ≥ 30	1.5
	Asthma	Children 5–14	1.6
	Asthma	All ≥ 15	1.2
	Cataracts	All ≥ 15	1.3
	Tuberculosis	All ≥ 15	1.5

Source: Desai and others, Indoor smoke from solid fuels: assessing the environmental burden of disease at national and local levels (2004).

Note: Relative risk is defined as the probability of the health outcome in the population exposed to smoke from solid fuels relative to the probability of the health outcome in the population not exposed to smoke from solid fuels. For confidence interval values of the relative risk of health outcomes shown, see Desai and others (2004).

infection (a disease with a high risk of mortality in developing countries) when exposed to solid fuel smoke compared to children not exposed.

Three factors are mainly responsible for varying levels of exposure to indoor smoke for women and men across countries²⁴ and, consequently, for varying levels of relative health risks. The first is the type of fuel used for cooking. The level of indoor smoke pollution varies from practically none when electricity is used, to medium for gas and liquid fuels such as kerosene and liquid petroleum gas, to a high level when solid fuels are used. Among the solid fuels, biomass fuels – such as animal dung, crop residues and wood – produce the highest levels of pollutants, followed by coal and charcoal. When burnt, solid fuels emit substantial amounts of pollutants with health-damaging potential, including particulate matter, carbon monoxide, nitrogen oxide, sulphur oxide and benzene.

The second factor is related to ventilation. The concentration of pollutants is lower when the cooking takes place outdoors and/or when improved stoves with a chimney or hood are utilized instead of an open fire or a stove with no chimney or hood. The third factor is the different amount of time spent indoors and near the fire by women and men. Compared to men, women spend more time indoors and more time near the fire while cook-

²¹ WHO, 2009.

²² Ibid.

²³ Desai and others, 2004.

²⁴ WHO, 2006.

ing, and are therefore more exposed to high-intensity pollution episodes. Statistics for these three main determinants of exposure to indoor smoke are presented in the following sections.

Use of solid fuels for cooking

Several regions of the world still rely heavily on solid fuels for cooking

Sub-Saharan Africa, Southern Asia and South-Eastern Asia are the regions that still rely heavily on solid fuels for cooking. This is the case for, on average, more than 80 per cent of households in sub-Saharan Africa (table 7.6). In 21 of the 38 countries with available data in that region, over 90 per cent of households cook with solid fuels. A similar situation is seen for some countries in Southern and South-Eastern Asia. Solid fuels are used by more than two thirds of households in India, Mongolia, Pakistan and Viet Nam; more than 80 per cent in Nepal; and more than 90 per cent in Bangladesh, Cambodia and the Lao People's Democratic Republic. The lowest use of solid fuels for cooking is found in Northern Africa and in the more developed regions other than Eastern Europe, with the percentage of households relying on solid fuels for cooking close to zero.²⁵

Table 7.6
Households using solid fuels for cooking by region and urban/rural areas, 2005–2007 (latest available)

	Households using solid fuels for cooking (%)		
	Total	Urban	Rural
Sub-Saharan Africa (38)	82	66	95
Eastern Africa (14)	85	68	97
Middle Africa (6)	73	57	94
Southern Africa (3)	58	12	83
Western Africa (15)	89	78	96
Asia (22)	43	22	56
Central Asia (5)	21	5	34
South-Eastern Asia (5)	69	44	80
Southern Asia (4)	78	38	93
Western Asia (7)	16	3	27
Latin America and the Caribbean (10)	33	17	56
Eastern Europe (8)	29	13	47

Source: Computed by the United Nations Statistics Division based on data from Macro International, Demographic and Health Survey (DHS) reports (2009a) and UNICEF, Multiple Indicator Cluster Survey (MICS) reports (2009).
Note: Unweighted averages; the numbers in brackets indicate the number of countries averaged. The averages calculated for Asia cover countries from the four sub-regions presented in the table and Mongolia (Eastern Asia).

²⁵ Desai and others, 2004.

Overall, households in rural areas are more likely to use solid fuels than those in urban areas (table 7.6), although urban-rural disparities are larger in some countries than in others. In sub-Saharan Africa, Southern Asia and South-Eastern Asia, the overwhelming majority of rural households use solid fuels for cooking. The urban areas in some countries from those regions also have high proportions of households that do so. For example, in the United Republic of Tanzania, 99 per cent of rural households and 87 per cent of urban households use solid fuels. In the Gambia, the corresponding proportions are 97 per cent and 84 per cent, respectively. In the Lao People's Democratic Republic, all rural households and 91 per cent of urban households use solid fuels for cooking. In some other countries, however, urban-rural disparities are large. In Namibia, for example, 90 per cent of rural households use solid fuels for cooking, but only 16 per cent of urban households do. In Nepal, 92 per cent of rural households and 39 per cent of urban households use solid fuels.

Ventilation factors: outdoor cooking and type of stoves

In countries where households rely on solid fuels for cooking, cooking usually takes place indoors rather than outdoors.²⁶ For example, in Ethiopia, 95 per cent of households use solid fuels for cooking, but only 6 per cent have the cooking area outdoors. In Nepal, 83 per cent of households use solid fuels for cooking, but only 5 per cent cook outdoors. On the other hand, Liberia, where 99 per cent of households use solid fuels for cooking, has one of the highest percentages of households cooking outdoors (57 per cent).

Only a small proportion of households using solid fuels in sub-Saharan Africa and Southern and South-Eastern Asia have improved stoves that would reduce the exposure to indoor smoke

The use of improved stoves as opposed to an open fire/stove with no chimney or hood varies among regions (figure 7.2) In countries in sub-Saharan Africa and Southern and South-Eastern Asia, only a small proportion of households using solid fuels have improved stoves that would reduce the exposure to indoor smoke. For

²⁶ Data compiled by the United Nations Statistics Division from Macro International, 2009a and UNICEF, 2009.

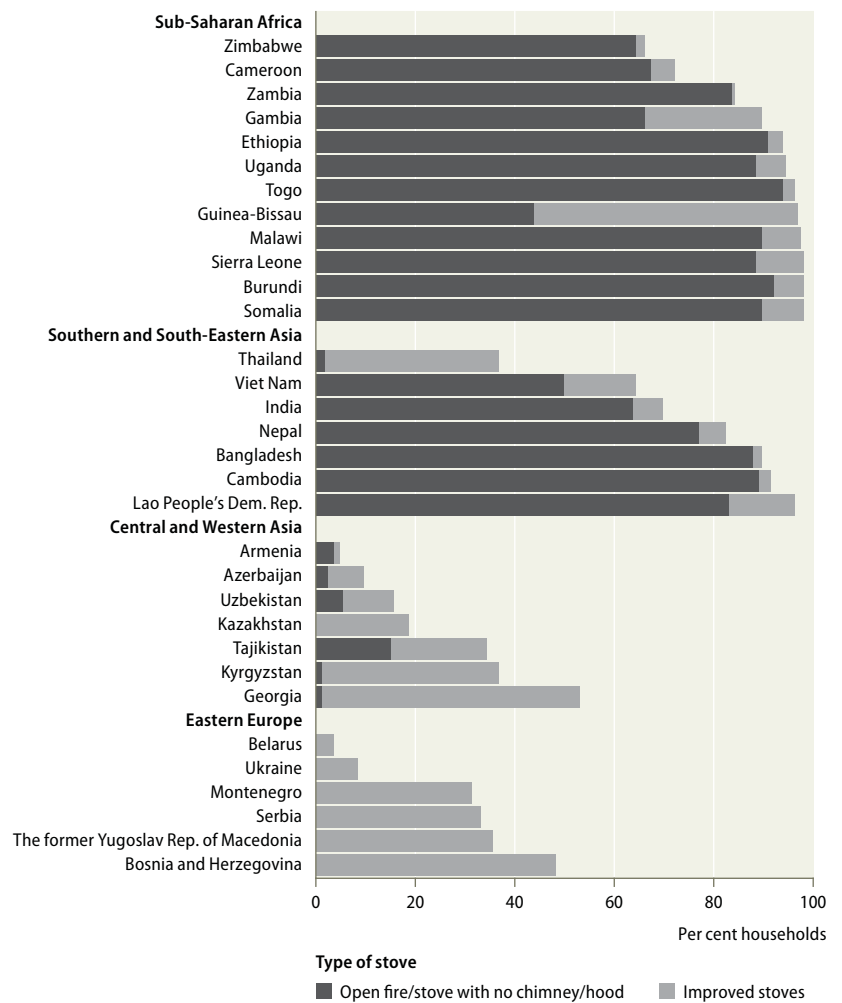
example, in Ethiopia, out of the 95 per cent of households using solid fuels for cooking, only 3 per cent have improved stoves. Similarly, in Nepal, out of the 83 per cent of households using solid fuels, only 5 per cent have improved stoves. On the other hand, in Guinea-Bissau, more than half of the 98 per cent of households using solid fuels for cooking have improved stoves. In countries in Eastern Europe and Central and Western Asia, although significant proportions of households use solid fuels for cooking, the exposure to indoor smoke is reduced through the utilization of improved stoves.

More people living in rural than in urban areas are exposed to indoor smoke from solid fuels

Women and men living in rural areas are more exposed to indoor smoke than people living in urban areas, not only because they are more likely to use solid fuels for cooking but also because they are more likely to use open fires or traditional stoves with no chimney or hood (figure 7.3). In countries such as Burundi, India, Nepal, Viet Nam and Zimbabwe, people living in cities have considerably better access to cleaner fuels and improved stoves compared to people living in rural areas. However, in some other countries the percentage of households with high potential exposure to indoor smoke from solid fuels is almost as high in urban as it is in rural areas. In Lao People's Democratic Republic, Malawi, Sierra Leone, Somalia and Togo over 80 per cent of households from urban areas and over 85 per cent of households from rural areas use solid fuels for cooking on open fires or traditional stoves with no chimney.

The type of stove used for cooking and the place of cooking (indoors or outdoors) have a considerable impact on health outcomes. A study in central Kenya showed a big reduction in acute respiratory infection (ARI) and acute lower respiratory infection (ALRI) rates when a switch was made from an open fire indoors to certain types of stoves inside and when the place of cooking was moved from indoors to outdoors²⁷ (table 7.7). Women benefited more than men from changing the type of stove than by changing the cooking place from indoors to outdoors, due to the fact that they spend more time close to the fire while cooking and are therefore more

Figure 7.2
Households using solid fuels for cooking by type of stove, 2005–2007 (latest available)

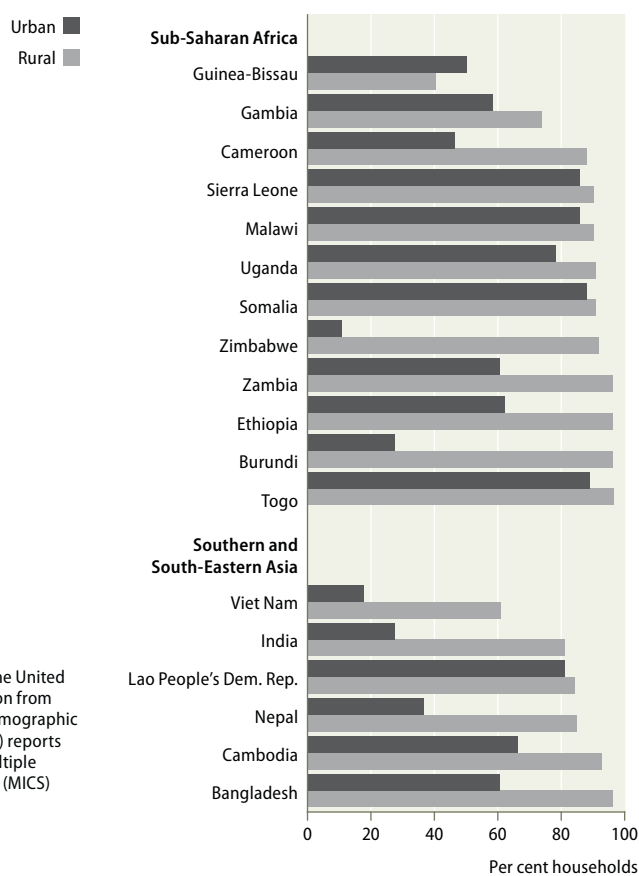


Source: Compiled by the United Nations Statistics Division from Macro International, Demographic and Health Survey (DHS) reports (2009a) and UNICEF, Multiple Indicator Cluster Survey (MICS) reports (2009).

exposed to high-intensity pollution episodes both indoors and outdoors. Men benefited from changes in the stove and cooking area, since they are more likely to be affected by the smoke trapped indoors during the hours of sleep than by the pollution emissions during cooking time. For example, switching indoors from an open fire to a ceramic woodstove reduced the ARI and ALRI rates for women by 14 per cent and 15 per cent respectively, while for men it was by 2 and 10 per cent respectively. On the other hand, having the cooking area outdoors as opposed to inside reduced the ARI and ALRI rates for women by 15 and 17 per cent respectively, and for men by 50 and 38 per cent respectively.

²⁷ Ezzati and Kammen, 2002.

Figure 7.3
Households using solid fuels on open fire or stove with no chimney or hood, by urban/rural areas – selected countries with the highest values, 2005–2007 (latest available)



Source: Compiled by the United Nations Statistics Division from Macro International, Demographic and Health Survey (DHS) reports (2009a) and UNICEF, Multiple Indicator Cluster Survey (MICS) reports (2009).

Table 7.7
Reduction in acute respiratory infections and acute lower respiratory infections for women and men aged 15–49 by switching the cooking from indoor open fires to different indoor and outdoor stoves, Central Kenya, Laikipia District, Mpala Ranch, 1999

	Disease rate (%)	Disease reduction (%) by switching to...			
		Open fire inside	Ceramic woodstove inside	Charcoal stove inside	Open fire outside	Ceramic woodstove outside
Acute respiratory infection					
Female	7	14	68	15	37
Male	4	2	62	50	58
Acute lower respiratory infection					
Female	2	15	65	17	43
Male	1	10	45	38	42

Source: Ezzati and Kammen, Evaluating the health benefits of transitions in household energy technologies in Kenya (2002).

Note: Disease rate was calculated as the percentage of weekly examinations (in a two-year period) during which a person was diagnosed with acute respiratory infection or acute lower respiratory infection.

Time spent cooking and near a fire

Women are more exposed than men to smoke from cooking with solid fuels

Because they spend more time than men cooking (as shown in Chapter 4 – Work), women are more exposed to smoke from cooking with solid fuels, especially when using open fires or a stove without a chimney or hood. For example, in the Lao People's Democratic Republic, where 84 per cent of households use solid fuels in an open fire or stove with no chimney or hood, a woman on average spends 54 minutes a day cooking, while a man spends only 6 minutes. In Benin, 93 per cent of households use solid fuels for cooking, and women spend on average one hour and 15 minutes a day cooking compared to men's 6 minutes.

In central Kenya, adult women, girls aged 5–14 and children less than 5 years spend more time indoors and more time near a fire compared to adult men and 5–14-year-old boys²⁸ (figure 7.4). For example, a woman aged 15–49 spends more than five hours a day near a fire, compared to less than an hour for a man in the same age group. A girl (5–14 years old) spends more than three hours a day close to a fire, while a boy spends less than two hours. Similarly, in Bangladesh (in 2004), an adult woman (20–60 years old) spends almost four hours a day in the cooking area while an adult man spends less than a quarter of an hour.²⁹ A teenage girl (13–19 years old) spends almost two and a half hours per day in the cooking area, while a teenage boy spends less than 20 minutes. Children under 5 years old of both sexes spend about an hour a day in the cooking area.

3. Natural disasters and their impact on number of female and male deaths

The lives of thousands of women and men are lost worldwide every year as a result of natural disasters. Between 2000 and 2008, an average of 5,600 deaths per year occurred due to floods, 3,500 due to storms/tropical cyclones and 1,700 due to extreme temperature.³⁰ These averages do not include the number of deaths caused by extreme temperature in 2003, when the Euro-

²⁸ Ibid.

²⁹ Dasgupta and others, 2006.

³⁰ Computed by the United Nations Statistics Division based on data from the Centre for Research on the Epidemiology of Disasters (CRED) and Universite Catholique de Louvain, Emergency Events Database EM-DAT, 2009.

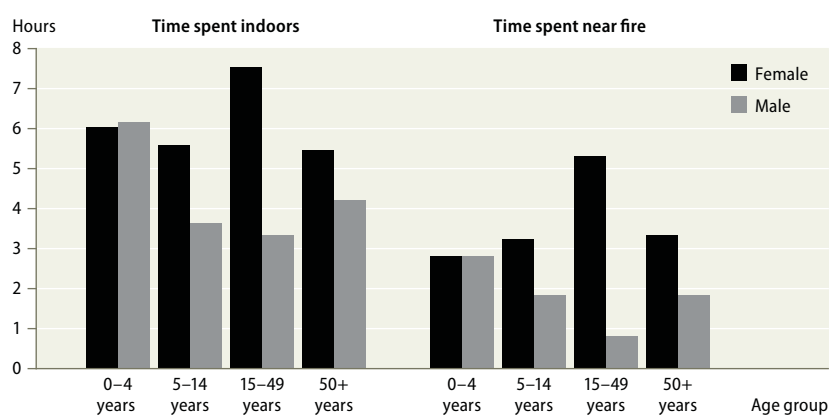
pean heat wave struck, or the number of deaths caused by storms in 2008, when Cyclone Nargis hit Myanmar. Those extreme weather events drove the number of casualties exceptionally high. The number of deaths due to extreme temperature in 2003 climbed to about 75,000, and the number due to storms in 2008 escalated to over 142,000. It is predicted that climate change will further increase the number of human deaths from heat waves, floods, storms and droughts, as these extreme weather events will increase in frequency and intensity.³¹

In this context, as one of the agreed conclusions on the mitigation of natural disasters during its forty-sixth session, in 2002, the Commission on the Status of Women urged governments and relevant international agencies to develop national gender-sensitive indicators and analyse gender differences with regard to disaster occurrence and associated losses and risks as well as vulnerability reduction.³² Yet, systematic collection and compilation of statistics on gender and natural disasters are lacking at the international level. In general, the availability and reliability of data on disaster occurrence and its effect on people is affected by constraints of time, funding and complexity of situation, as well as by the lack of standardized definitions and methodological tools of data collection.³³ However, some data on victims of natural disasters disaggregated by sex are available for a small number of countries and for certain weather events. Such cases, presented in the following paragraphs, suggest that mortality differences by sex may vary from one country to another and by type of hazard.

Recent information on the impact of the tsunami in December 2004 suggests that women and girls may be more vulnerable to some natural disasters as a result of less access to information and life skills development and culturally constrained mobility of women outside of their homes.³⁴ Many more women than men died in several locations particularly hit by the tsunami.³⁵ In Indonesia, in four villages from North Aceh district, female deaths accounted for 77 per cent of total deaths. In India, female deaths represented 73 per cent of the total deaths in Cuddalore and 56 per cent in Nagapattinam district of Tamil Nadu.

31 IPCC, 2007; Confalonieri and others, 2007.
 32 Commission on the Status of Women, 2002.
 33 Tschogl and others, 2006; Guha-Sapir and Below, 2002.
 34 Oxfam International, 2005.
 35 Ibid.

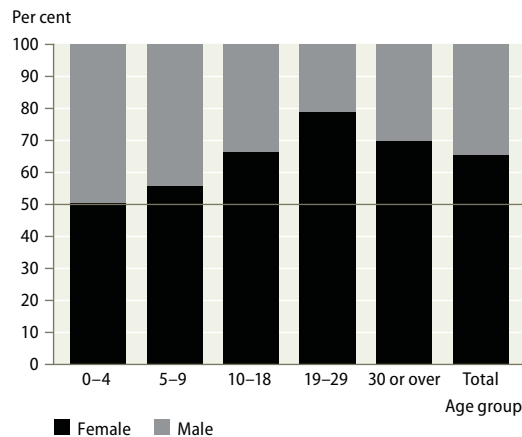
Figure 7.4
 Time spent indoors and near fire by age group and sex in central Kenya, Laikipia District, Mpala Ranch, 1999



Source: Ezzati and Kammen, Evaluating the health benefits of transitions in household energy technologies in Kenya (2002).
 Note: The results are averages among different days, and the time calculated refers to the interval between 6:30 a.m. and 8:30 p.m.

The census conducted in Sri Lanka in the areas affected by the tsunami revealed that women were the majority of casualties.³⁶ Out of the more than 13,000 dead and missing persons, 65 per cent were women. The share of females in the total number of deaths was highest in the age group 19–29 years (figure 7.5), 79 per cent, suggesting a combination of increased vulnerability of women staying home with children at the time of the sea-level rise and the more fortunate situation of some of the young men who were far away from the coastline, fishing at sea or out in the agricultural fields.³⁷

Figure 7.5
 Distribution of deaths due to the 2004 tsunami in Sri Lanka by sex within age category



Source: Computed by the United Nations Statistics Division based on data from Sri Lanka Department of Census and Statistics, Sri Lanka Census on the Persons and Buildings affected by the Tsunami 2004 (2005).

36 Sri Lanka Department of Census and Statistics, 2005.
 37 Oxfam International, 2005.

Similarly, the Post-Nargis Joint Assessment in Myanmar concluded that women were overrepresented among the people who died or went missing during the May 2008 cyclone. Out of the over 85,000 people dead and 53,000 people still missing in June 2008, 61 per cent were women.³⁸ In the villages most affected, the share of females dead or missing in the age category 18–60 years was even higher at 68 per cent.

Some studies indicate that the excess mortality due to the 2003 summer heat wave in Europe was higher for women and older persons. For example, the number of excess deaths estimated for women in Portugal was more than twice the number estimated for men,³⁹ while mortality in France was 70 per cent higher than expected for women and 40 per cent higher than expected for men.⁴⁰ Higher excess mortality for older persons and women was also reported in three cities in Italy (table 7.8).⁴¹ For example, compared to values recorded in previous years, the number of deaths during the heat wave in Rome was higher than expected by 26 per cent for persons aged 75–84, and by 38 per cent for persons over 85 years. The number of female deaths was higher than expected by 27 per cent and the number of male deaths by 10 per cent. It is not yet clear how much of the sex difference is due to the fact that women are overrepresented among

older persons and how much is due to other factors (see Chapter 1 – Population and families for more information on sex distribution at older ages).

While the extreme cases of the 2004 tsunami, the 2008 cyclone in Myanmar and the 2003 summer heat wave in Europe underline the vulnerability of women, natural hazards in other regions of the world caused larger shares of male deaths, thus suggesting that gender differences may vary by type of hazard and across regions. For example, in Nicaragua and El Salvador, men represented 54 per cent and 57 per cent respectively of those killed by the 1998 hurricane Mitch.⁴² Also, a study on male-female flood death ratios in Australia showed that out of the 1,513 fatalities reported by sex between 1930 and 1996, 81 per cent were male.⁴³ Over the period studied, the male-female death rate ratio fluctuated between 10:1 and 1:1, and although it declined overall, it continued to disfavour men, suggesting that men were more inclined to risk-taking or more involved in activities that would put them at risk.

Similar findings to those from Australia are found in statistics from the United States of America on natural hazards. More than 60 per cent of the total deaths due to natural hazards in 2000–2008 were male (figure 7.6). Among different types of

Table 7.8
Excess mortality by age group and by sex in Rome, Milan and Turin during 2003 summer heat wave

	Rome		Milan		Turin	
	Number of deaths	%	Number of deaths	%	Number of deaths	%
Age category						
0–64	-58	-6	-35	-9	21	7
65–74	51	5	-23	-5	58	16
75–84	397	26	305	43	213	40
85+	554	38	312	40	285	50
Sex						
Male	246	10	141	12	215	25
Female	698	27	418	33	362	40
Total	944	19	559	23	577	33

Source: Michelozzi and others, Heat waves in Italy (2005).

Note: Expected daily mortality was computed as the mean daily value from a specific reference period: 1995–2002 for Rome and Milan and 1998–2002 for Turin. Daily excess mortality was calculated as the difference between the number of deaths observed on a given day and the smoothed daily average for the previous years. Negative figures are shown when daily mortality observed was lower than expected.

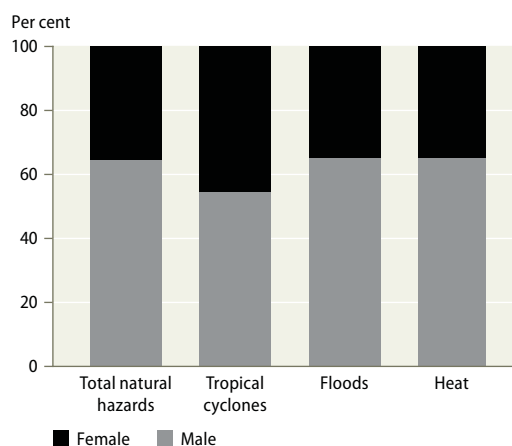
38 Myanmar Government, Association of Southeast Asian Nations and the United Nations, 2008.

39 Nogueira and others, 2005.

40 Pirard and others, 2005.

41 Michelozzi and others, 2005.

Figure 7.6
Average share of female and male deaths in total deaths due to natural hazards for selected types of hazard, United States of America, 2000–2008



Source: Computed by the United Nations Statistics Division based on data from United States National Weather Service, Natural hazard statistics (2009).

Note: Natural hazards included for the total are cold, heat, flood, lightning, tornado, tropical cyclone, wind and winter storms.

42 Delaney and Shrader, 2000.

43 Coates, 1999.

natural hazards, floods and heat were associated with a larger share of males in total deaths (65 per cent for each type), compared to tropical cyclones/hurricanes (54 per cent).

C. Involvement of women and men in preserving the environment

1. Awareness of environmental problems

As reflected in the fourth assessment of the Intergovernmental Panel on Climate Change (IPCC), the vast majority of scientists agree that emissions of greenhouse gases due to human activity, of which carbon dioxide and methane are the most significant, are already causing climate change.⁴⁴ In addition, carbon dioxide emissions are continuing to rise, highlighting the urgent need to address the issue.⁴⁵ The level of global carbon dioxide emissions reached 29 billion metric tons in 2006, 31 per cent above the 1990 level. Countries from the more developed regions still have the highest emissions per capita, about 12 metric tons of carbon dioxide per person per year, compared to about three metric tons per person per year in the less developed regions. Loss of environmental resources are also an increasing concern. According to the 2009 MDG report, only 12 per cent of terrestrial and marine areas were under some form of protection in 2008, the number of species threatened with extinction continued to grow and the stress on water resources was severe.⁴⁶

Large proportions of women and men around the world recognize that the global environmental problems are very serious

Across the world, environmental problems are now recognized to be very serious by large proportions of women and men. In most of the countries with available internationally comparable data⁴⁷ more than half of the people are concerned with regard to three global environmental issues: global warming or the greenhouse effect; loss of plant or animal species; and water pollution (table 7.9). Among these issues, the pollution of rivers, lakes and oceans was considered as very serious by the largest proportions of women and men, reaching

Table 7.9
Proportion of persons considering as very serious three major environmental issues at the global level, by region and sex, 2005–2007 (latest available)

	Global warming or the greenhouse effect		Loss of plant or animal species or biodiversity		Pollution of rivers, lakes and oceans	
	Women (%)	Men (%)	Women (%)	Men (%)	Women (%)	Men (%)
Africa (9)	57	57	55	56	67	67
Asia (12)	52	55	46	50	54	56
Latin America and the Caribbean (6)	71	73	74	74	83	83
Eastern Europe (7)	60	59	56	55	72	71
Western Europe and other developed countries (10)	65	57	56	50	72	65

Source: Computed by the United Nations Statistics Division based on data from World Values Survey, Fifth wave of the World Values Survey. Online data analysis (2009).

Note: Unweighted averages; the numbers in brackets indicate the number of countries averaged. Women and men surveyed were asked how serious ("very serious", "somewhat serious", "not very serious" or "not serious at all") they considered the environmental problems listed in the table to be in the world as a whole. Only percentages for those who answered "very serious" are shown in the table.

about 90 per cent in countries such as Argentina, Egypt and Trinidad and Tobago. In only a few countries – Malaysia, Thailand and Zambia – was the proportion of women and men who defined the three environmental issues as very serious only about a third or less.⁴⁸

In most of the countries from the less developed regions, there are no significant differences by sex in the perception of the environmental problems as being very serious. By contrast, higher proportions of women than men define the environmental problems as very serious in most of the countries with available data from the more developed regions except Eastern Europe. These are Australia, Finland, Germany, Japan, Sweden, Switzerland and the United States of America. For example, in Sweden, 83 per cent of women and 66 per cent of men thought that the pollution of rivers, lakes and oceans was very serious. In Finland the corresponding proportions of concerned women and men were 68 per cent and 55 per cent, respectively. In the United States of America, 51 per cent of women and 40 per cent of men considered the loss of plant or animal species or biodiversity to be very serious. In Australia, 69 per cent of women and 58 per cent of men considered as very serious global warming or the greenhouse effect.⁴⁹

⁴⁴ IPCC, 2007.

⁴⁵ United Nations, 2009.

⁴⁶ Ibid.

⁴⁷ Forty-four countries covered by national representative sample surveys conducted within the fifth round of the World Values Survey (2009).

⁴⁸ World Values Survey, 2009.

⁴⁹ Ibid.

Table 7.10
Share of women in national coordinating bodies for the implementation of the United Nations Convention to Combat Desertification, 2002–2006 (latest available)

0–9%	10–19%	20–29%	30–39%	40–49%	50–59%
Africa					
Angola Benin Chad Mali	Côte d'Ivoire Djibouti Eritrea Guinea Guinea-Bissau Kenya	Algeria Burkina Faso Congo Mauritania Namibia Niger	Botswana Cape Verde Central African Rep. Comoros Gabon Madagascar South Africa Uganda Zambia Zimbabwe	Swaziland	Lesotho
Asia					
Sri Lanka Thailand	Indonesia Lebanon Turkmenistan Viet Nam	China Iran (Islamic Republic of)			
Latin America and the Caribbean					
	Costa Rica Saint Vincent and the Grenadines	Paraguay Peru	Panama	Brazil	Argentina Cuba
Oceania					
		Fiji		Samoa	

Source: Compiled by the United Nations Statistics Division from UNCCD, National reports on the implementation of the United Nations Convention to Combat Desertification (2009).

Although large proportions of women and men recognize that environmental problems in the world are very serious, public awareness of environmental issues at national or more local levels is still lacking, as indicated by some countries during the review conducted for the forty-ninth session of the Commission on the Status of Women.⁵⁰ As emphasized by other countries, there is also a lack of awareness about the harmful effects of environmental change and degradation on women.⁵¹

2. Participation in environmental decision-making

Women are underrepresented in environmental decision-making

Involvement of women in environmental decision-making at all levels is a key step in ensuring that women's issues and gender perspectives on the environment are included in policy-making

⁵⁰ United Nations, 2004.

⁵¹ Ibid.

from local to national and global level.⁵² However, as presented in Chapter 5 – Power and decision-making, women still hold a minority of decision-making positions in most public and private institutions. Consistent with these findings, women participate less than men in high-level decision-making related to environmental issues in many countries. For example, a survey on gender mainstreaming among 17 environment ministries conducted in 2006 showed that women made up 41 per cent of the entire staff of the ministries but only 27 per cent of managerial positions.⁵³

The underrepresentation of women in environmental decision-making is also illustrated by the low share of women in national coordinating bodies for the implementation of the United Nations Convention to Combat Desertification⁵⁴. The share of women in the Convention coordinating bodies varied greatly among the countries with available data, ranging from 0 per cent in Chad to over 50 per cent in Argentina, Cuba and Lesotho (table 7.10). Women were less than 30 per cent of the members in more than half of the African countries and in all the Asian countries with available data.

Women's involvement in high-level decision-making related to the environment continues to be hampered by limited access to formal training. As shown in Chapter 3 – Education, science and agriculture are two of the tertiary fields of education where women are underrepresented in most countries. Further disaggregated data within the field of study, available for a few countries, also illustrate the point. For example, women represented only 18 per cent of college graduates in environmental protection in Croatia in 2006;⁵⁵ 27 per cent of college graduates in environmental science in Nigeria in 2005;⁵⁶ and 25 per cent of students enrolled for the higher diploma and certificate in water at the Kenya Water Institute between 2000 and 2004.⁵⁷

Analysis of the role of women and men in protecting the environment at more local levels of decision-making – at community level, in local

⁵² United Nations, 1995.

⁵³ UNEP, 2007.

⁵⁴ This is one of the few major conventions on natural resource issues that explicitly addresses the participation of women in environmental decision-making.

⁵⁵ Croatia Central Bureau of Statistics, 2008.

⁵⁶ Nigeria National Bureau of Statistics, 2005.

⁵⁷ UNESCO World Water Assessment Programme, 2005.

non-governmental or grass-roots organizations – and through day-to-day activities is hampered by a lack of sex-disaggregated data, particularly in the less developed regions. In some instances, such data are available only for women, thus limiting the gender analysis. Some information on women's and men's behaviour in the area of environmental protection is available, but mainly for countries from the more developed regions. For example, a review covering Western Euro-

pean countries, Australia and the United States of America showed that women tend to be more environmentally friendly with regard to recycling; choice of public transport for commuting; choice of smaller, less polluting and more efficient cars; and choice of organic food.⁵⁸ These gender-specific choices are connected to some extent with the specific household and social roles of women and men. Nevertheless, such information can be used in maximizing policy effectiveness.⁵⁹

⁵⁸ OECD, 2008

⁵⁹ UNEP, 2005.