

## Smoke health and household energy



Issues paper  
compiled for  
DFID – EngKaR project no. R8021  
Liz Bates – September 2002

*photo: Family in Gatlang village seated around fire (ITDG-Nepal)*

***This document is an output from a project funded by the UK Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of the DFID***

## Smoke health and household energy

### Smoke and health – the need for smoke alleviation

Almost half the world's population, around 3000 million people, still rely on biomass fuel – i.e. wood, animal dung or crop wastes – and coal, for their everyday household energy needs (World Resources Institute 1999). Although accurate data are scarce, estimates suggest that in more than 30 countries, wood provides more than 70% of the energy needs, and in 13 countries it is over 90% (World Energy Council 1999). Over the last 25 years, the trend in global biofuel use has changed little, and in some parts of the world where poverty and the prices of alternative fuels such as kerosene and bottled gas have increased, the use of biomass has increased (WHO 1997).

With development, there is generally a transition up the so-called 'energy-ladder' from polluting fuels to those that burn cleaner and hotter. Households typically use a combination of fuels – for example, wood for cooking and heating, kerosene for lighting, and perhaps charcoal for making hot drinks. However, the problem remains that almost half of the world's population relies predominantly on fuels at the lower end of this energy ladder, and, for many, the prospects of moving up the ladder in the short term appear limited.

In these poor rural and urban homes, biomass fuels and coal are typically burnt in open fires or poorly functioning stoves, often indoors, with inadequate ventilation for the smoke. This leads to very high levels of pollution in the homes where especially women and young children are exposed on a daily basis. Smoke from these fuels contains many health-damaging pollutants, including particulates, carbon monoxide, nitrogen oxides, benzo[a]pyrene, benzene, and many others. Together, these pollutants are known to be capable of irritating the airways and lungs, reducing the resistance to infection, and increasing the risk of cancer. Studies from a number of countries in Asia, Africa and the Americas have measured particles (complex mixtures of chemicals in solid form and droplets) which are thought to be the most health-damaging component of smoke pollution. The smaller ones are more dangerous, and are able to penetrate deep into the lungs. Particles are therefore usually described by size or their effective (aerodynamic) diameter, which is measured in microns (millionths of a metre).

Particles of up to 10 microns in diameter ( $PM_{10}$ ) have been most commonly measured, and concentrations of particles are expressed as the weight of particles (in micrograms,  $\mu\text{g}$ ) per cubic metre ( $\text{m}^3$ ) of air, thus  $\mu\text{g}/\text{m}^3$ . Typical 24-hour mean levels of  $PM_{10}$  in homes using biofuels range from 300 to  $>3000 \mu\text{g}/\text{m}^3$ , and during use of an open fire, the  $PM_{10}$  level can reach  $20\,000 \mu\text{g}/\text{m}^3$  or more. By comparison, the US-EPA standard for daily (24-hour) average  $PM_{10}$  is  $150 \mu\text{g}/\text{m}^3$  (this concentration should be exceeded only in one day per 100 days), while the annual average should not exceed  $50 \mu\text{g}/\text{m}^3$  (US-EPA 1997). Most 'western' cities rarely exceed these standards, whereas in rural homes in developing countries, they are exceeded on a daily basis by a factor of 10, 20, and sometimes more. Levels of carbon monoxide and other pollutants also often exceed the standard guidelines.

### Health impacts

Health is influenced by a wide range of physical, social and environmental factors. In addition to the production of toxic pollution, the supply and use of household energy in conditions of poverty and scarcity affects health – particularly of women and young children – in a variety of ways that encompass physical injury, lost opportunity for income generation, environmental stress, and many other issues.

### ***Indoor air pollution***

Indoor air pollution is the clearest and most direct physical health risk, and there is now fairly consistent evidence that biomass smoke exposure increases the risk of a range of common and serious diseases of both children and adults (Bruce et al, 2000). Chief among these is childhood acute lower respiratory infections (ALRI), particularly pneumonia (Smith et al, 2000).

Association of exposure with chronic bronchitis (long-term cough and phlegm) and chronic obstructive lung disease (narrowing of airways in the lung, which is progressive and can be only partially reversed) is quite well established, particularly among women. There is also evidence, mainly from China, that exposure to coal smoke in the home markedly increases the risk of lung cancer, particularly in women.

In recent years, new evidence has emerged which suggests that indoor air pollution (IAP) in developing countries may also increase the risk of other important child and adult health problems, such as low birth weight, perinatal mortality (stillbirths and deaths in the first week of life), asthma, and middle ear infection in children, tuberculosis, nasopharyngeal and laryngeal cancer, and cataract in adults (Bruce et al, 2000).

The health and well-being of the mother and child are inextricably linked. Women normally continue their usual work during pregnancy, so the unborn child is exposed as the mother continues her activities in the polluted kitchen. After birth, the young child typically stays very close to its mother until s/he is able to walk, so being exposed directly and increasing the risk of a range of serious health problems.

### ***Physical dangers***

Once the child is mobile, open fires, stoves and lamps all pose a significant risk of burns for children who are at serious risk of falling into the hearth (Courtright et al. 1993). Kerosene, although a cleaner fuel, carries the risk of fire if the stove or lamp is knocked over. Another risk from kerosene is poisoning if it is stored in soft drink and similar bottles and a child accidentally drinks it (Yach 1994, Gupta et al. 1998).

Carrying heavy loads of wood exposes women to injury from falls (bruises and fractures) and the risk of miscarriage; in areas of war and civil unrest the women may be exposed to violence as well as injury from land mines (WHO 1992).

### ***Social and economic impacts***

Lack of access to more modern fuels and appliances limits the quality of life and opportunities for income generation in a variety of ways. Lighting may be provided only by the fire, candles, or simple kerosene wick lamps which can be a significant source of pollution. The lack of light restricts activities in the home, including children's homework, reading and opportunities for income-generating activities. Lack of access to electricity further restricts the use of a wide range of appliances that can contribute to food safety (refrigerators), communication/education, leisure (radio, TV), and economic activity.

Dependence on biomass fuels can affect the wellbeing of children in other ways. For example, it is not uncommon for older children to help their mothers in collecting fuel, thus missing school attendance and also being exposed to the risk of physical injury.

## Project locations

Three countries are involved in the project, overall details of which are listed below.

x	Kenya	Nepal	Sudan	UK <sup>1</sup>
Surface area (km <sup>2</sup> x 1000)	580	147	2506 ('97)	245
Population (million)	30.7	23.0	31.1	59
Population aged under 5 (million)	4.7	3.5	4.7	
Population aged under 18 (million)	15.7	10.9	14.5	
Population growth rate p.a. - 1990-99	2.7 <sup>2</sup>	2.4	2.3	0.3
GDP (US\$ x 10 <sup>6</sup> ) - 2000	10.4	5.5	11.2	
GNP per capita US\$	360	220	330	22 640
Infant mortality	77	72	66	
Under – 5 mortality (per 1000)	120	100	108	7
Life expectancy	50-52	58-58	55	75-80
Fully immunized (% - BCG, DPT3, Polio, Measles) – aged 1 year	96, 79, 81, 79	86,76,70, 73	65,50,50, 53	
Routine EPI vaccines supplied by government (%)	36	60	25	
Infants with low birthweight (%)	9	21	-	
Access to clean water (%)	57	88	75	
Access to adequate sanitation (%)	87%	28	62	
CO <sub>2</sub> emissions per capita (tonnes) - 1996	0.2	0.1	-	9.5
Adult literacy(male/female)	89/76	59/24	68 / 46	

1. UK figures put in for comparative purposes

2. Projected population growth rate for Kenya - 2001 is 1.27% due to AIDS; life expectancy 47-48 (World Development Report, World Bank 2000 – updated UNICEF 2002)

# The project in Kenya

## Country overview

### ***Politics***

President Jomo Kenyatta led Kenya from independence until his death in 1978, when current President Moi took power in a constitutional succession. The country was a one-party state, the Kenya African National Union (KANU) from 1969 until 1982. Despite some unrest, elections in 1992 and 1997 are viewed as having generally reflected the will of the Kenyan people, as the opposition was fractured and not well structured. The country faces a period of political uncertainty because President Moi is constitutionally required to step down at the next elections that have to be held by early 2003.

### ***Economy***

Kenya is well placed to serve as an engine of growth in East Africa, having borders with Ethiopia, Somalia, Sudan, Tanzania, Uganda, but its economy has been stagnating. In 1993, the government of Kenya implemented a programme of economic liberalization and reform that included the removal of import licensing, price controls, and foreign exchange controls. With the support of the World Bank, IMF, and other donors, the reforms led to a brief turnaround in economic performance following a period of negative growth in the early 1990s. Growth slowed after 1997, averaging only 1.5% in 1997-2000. In 1997, political violence damaged the tourist industry, and Kenya's Enhanced Structural Adjustment Program lapsed. Severe drought in 1999 and 2000 caused water and energy rationing and reduced agricultural sector productivity. A new economic team was put in place in 1999 to revitalize the reform effort, strengthen the civil service, and curb corruption. The IMF and World Bank renewed their support to Kenya in mid-2000, but there were a number of setbacks to the economic reform programme in late 2000 leading to renewed donor and private sector concern. Long-term barriers to development include electricity shortages, inefficient government dominance of key sectors, endemic corruption, and high population growth.

### ***Topography***

Kenya's land use reflects the wide extremes of elevation, from Mount Kenya (5199m) to the shores of the Indian Ocean (0m). Permanent pastures (37%) and forests/woodlands (30%) account for the major part of its land use.

### ***Natural resources***

Kenya is rich in natural resources: agricultural products such as coffee and tea, wildlife, horticultural products, hydropower and gemstones. The Kenyan Highlands comprise one of the most successful agricultural production regions in Africa.

### ***Biomass resources***

Kenya is lightly forested with around 2 percent of forest cover, but an additional 27 percent of other wooded land cover. The majority of closed forests are upland broadleaved forests of either semi-deciduous or evergreen type. The largest areas of upland forests occur on the main mountains, Mt. Kenya, Mt. Elgon, and the Aberdare range. Kenya has established significant areas of plantation forest. Wood is an important fuel source in Kenya. More than 75 percent of the country's domestic energy comes from fuelwood and charcoal.

	Land area '000 ha	Forest Cover 2000 '000 ha	Forest Cover Change 1990-2000		Distribution of land cover/use % (1993)		
			'000 ha/year	%/year	Forest	Other Wooded Land	Other land
<b>Kenya</b>	56,914	17,096	-93	-0.53	30.0	36.2	31.7
<b>Africa</b>	3,090,228	649,866	-5,264	-0.78	21.0	15.5	61.6
<b>World</b>	13,139,618	3,869,453	-9,319	-0.24	29.4	11.2	58.6

Source: FAO

### **Vulnerability**

- **AIDS**

This is resulting in lower life expectancy, higher infant mortality and death rates, lower population and growth rates, and changes in the distribution of population by age and sex than would otherwise be expected. A 1999 estimate suggests that the adult prevalence rate is 13.95% of the adult population affected by HIV/AIDS.

- **Environmental hazards**

Kenya is subject to recurring drought in northern and eastern regions; flooding during rainy seasons. Water is affected by pollution from urban and industrial wastes; degradation of water quality from increased use of pesticides and fertilizers; water hyacinth infestation in Lake Victoria, and land use by deforestation and soil erosion

- **Refugees**

According to UNHCR, by the end of 1999 Kenya was host to 223,700 refugees from neighbouring countries, including: Somalia 141,000 and Sudan 64,250

### **Project community in Kisumu**

#### **Community selection criteria**

Kisumu town comprises many communities and it was important to identify which groups would be most appropriate to work with on the project. The Kenya team identified the following criteria:

- Not in the centre of Kisumu, where most people use some form of 'clean' fuel, so the indoor air pollution is not so great a problem as further out
- Not in the houses which are rented to the very poor – it was felt that any improvement in these houses would make the homes more desirable, and therefore the owners would increase the rental, and they would be evicted – the risk of an adverse effect on this group needed to be avoided
- The households selected should use mainly biomass but live within the money economy of the town, rather than being dependent on agriculture for their livelihoods.

#### **Characteristics of selected communities**

The two communities selected were: Kajulu in North-eastern Kisumu, and Otonglo, in West Kisumu. In these two areas, the majority of the householders are small entrepreneurs; in Otoglo, many women sell fish for their income, whilst in Kajulu, they mainly sell agricultural produce, including vegetables, fruit crops, cassava and maize for their income. Some of this produce may be cooked before sale, e.g. maize, so this aspect of energy use must be taken into account. Other aspects of the lifestyle include:

- Woodfuel in this area is usually purchased, and some charcoal is also used.
- The families in these areas tend to be large
- There is a mix of styles; most houses have metal roofs, but some still have thatch. Some of the kitchens are integral with the main house, some are separate.

- By selecting two separate areas of the town, scaling up and wider dissemination would be more effective.

<i>Weather in Kisumu town</i>	
Wet months	March → June
Variable	July → September
Dry months	November → February

## The project in Nepal

### Country overview

#### **Politics**

In 1951, the Nepalese monarch ended the century-old system of rule by hereditary premiers and instituted a cabinet system of government. Reforms in 1990 established a multiparty democracy within the framework of a constitutional monarchy. More recently, however, political instability - five different governments over the past few years - has hampered Kathmandu's ability to forge consensus to implement key economic reforms.

King Birendra Bir Bikram Shah Dev died in a bloody shooting at the royal palace on 1 June 2001 that also claimed the lives of most of the royal family. The king's son, Crown Prince Dipendra was implicated in the shootings before fatally wounding himself; immediately following the shootings and while still clinging to life, he was crowned king, but died three days later and was succeeded by his uncle. Nepal borders China 1,236 km, India 1,690 km

#### **Economy**

Nepal is among the poorest countries in the world with nearly half of its population living below the poverty line. Agriculture is the mainstay of the economy, providing a livelihood for over 80% of the population and accounting for 41% of GDP. Industrial activity mainly involves the processing of agricultural produce including jute, sugarcane, tobacco, and grain. Production of textiles and carpets has expanded recently and accounted for about 80% of foreign exchange earnings in the past three years. Agricultural production is growing by about 5% on average as compared with annual population growth of 2.3%. Since May 1991, the government has been moving forward with economic reforms, particularly those that encourage trade and foreign investment. The government has also been cutting expenditures by reducing subsidies, privatizing state industries, and laying off civil servants. Prospects for foreign trade or investment in sectors other than tourism remain poor, because of the small size of the economy, the absence of new technologies, its remoteness, its landlocked geographic location, and its susceptibility to natural disaster.

#### **Topography**

The climate of Nepal varies from cool summers and severe winters in north to subtropical summers and mild winters in south. There are three main regions: the Terai or flat river plain of the Ganges in south, a central hill region, and the rugged Himalayas in north. The elevation ranges from Mount Everest 8,850 m (1999 est.) to the lowest point of Kanchan Kalan (70 m). Forests and woodland account for most land use (42%) with arable land (17%) and permanent pasture (15%) accounting for other large areas.

### **Natural resources**

Quartz, water, timber, hydropower, scenic beauty, small deposits of lignite, copper, cobalt, iron ore

### **Biomass resources**

The entire country lies within the latitude of the subtropical region but variation in elevation, slope rainfall, temperature and, to a large extent, soil and drainage determines the location of major forest types. The vegetation varies from tropical moist forests to alpine scrub.

The table below shows the FAO estimates of forest cover in year 2000 and the annual change rate between 1990 and 2000

<b>Forest cover (ha)</b> [ha]	<b>Forest cover change 1990-2000</b>	
	<b>[ha/year]</b>	<b>[%/year]</b>
3,900,203	-78,236	-1.8

### **Vulnerability**

#### ***Environmental hazards***

Nepal is vulnerable to severe thunderstorms, flooding, landslides, drought, and famine depending on the timing, intensity, and duration of the summer monsoons. Deforestation in mountainous areas has occurred through overuse of wood for construction and for fuel (through lack of alternatives); contaminated water has become a problem caused by human and animal wastes, agricultural runoff, and industrial effluents. Vehicular emissions are a major source of pollution in the urban centres.

#### ***Tourist fears***

Currently, political unrest has damaged the tourist industry which is an important element in the country's economy.

#### ***Refugees***

The refugee issue over the presence in Nepal of approximately 98,700 Bhutanese refugees, 90% of whom are in seven United Nations Office of the High Commissioner for Refugees (UNHCR); this issue remains unresolved.

#### ***Illicit drugs***

Illicit producer of cannabis for the domestic and international drug markets gives international cause for concern; transit point for opiates from Southeast Asia to the West

### **Project community in Gatlang**

#### ***Location***

Gatlang village is part of the Gatlang Village Development Committee (VDC) in Rasuwa district. The village has a cluster settlement and covers ward no. 1, 2, 3, 4, 5 and 6 of *Gatlang* VDC. Each VDC has nine geographical division called wards. An all weather earthen road connects the village. Gatlang lies 148 Km from Kathmandu, at the altitude of 2200 meters from the sea level.

#### ***Baseline information***

- The majority group in this region belong to the Tamang community, but there are also members of the Bishwokarma community (an occupational caste).
- There are about 250 households in the village, with other Tamang villages nearby



- Although the village houses are well-built, of stone and wood, there is very little provision for water and sanitation, and food security is a major problem.
- The area is largely rural, with the main crops of potatoes, beans, millet, apples.
- Currently there is no actual shortage of biomass, although the forest is protected, so only 'dead' wood can be gathered. As a result, women find it increasingly difficult to gather wood locally, and men find it takes more hours to gather larger pieces of wood from the high hills.
- Food is predominantly cooked using a three-stone fire and a tripod on which the cooking pot is placed. Some of the households have the tripod surrounded by mud to make a stove.
- Although electricity has reached the village, only 13 households are connected and lighting is mainly by kerosene wick-lamp.
- Respiratory infections are the major source of ill-health in the village – of the 773 patients reporting to the health centre last year, 226 were for ARI. Cases of active tuberculosis are also reported in the village.

<b><i>Weather in Gatlang</i></b>	
Wet	July – September
Dry	March – May
Cold, snow - mainly dry	December – February

## **The project in Sudan**

### **Country overview**

#### ***Politics***

Sudan gained its independence from Britain in 1956. The first episode in what has become an intractable civil war in southern Sudan occurred in 1955. Since then, civil strife has escalated as the southern part of the country has sought political expression and economic development. Sudan, consequently, has endured a civil war that has spanned more than three decades. Since 1997, the Sudan People's Liberation Army (SPLA) has controlled much of the south. More recently, the southern-based rebels and the government have conducted direct negotiations under the auspices of the Inter-Governmental Authority on Development (IGAD).

A new Constitution came into effect on June 30, 1999, allowing for some political pluralism. Presidential and parliamentary elections held in mid-December 2000 were boycotted by the opposition. Only the ruling Congress Party and Government-approved parties participated. Relations with the EU have been improving as have been relations with Sudan's neighbours, including Uganda, Eritrea, Ethiopia and Egypt. The IMF reinstated Sudan's voting rights in August 2000.

Sudan borders: Central African Republic, Chad, Democratic Republic of the Congo, Egypt, Eritrea, Ethiopia, Kenya, Libya, Uganda.

#### **Economy**

Economic progress has been constrained by the civil war, military expenditures, social dislocation, deterioration of basic infrastructure and lack of access to aid and foreign investments. However, in 1999, Sudan's GDP grew by 5.2 percent, and GDP growth reached 8.3 percent in 2000, led mainly by agriculture which accounts for an estimated 45 percent of GDP. Inflation has slowed dramatically after reaching 133 percent in the mid-1990s, and was measured at 8 percent in 2000.

The general economic improvement has been helped by reforms supported by the IMF. The key structural reforms aim at enhancing efficiency by liberalizing the trade and exchange rate regime, phasing out price controls and privatizing public enterprises. In 1999, Sudan began exporting oil and in 1999-2000 had recorded its first trade surpluses. Current oil production stands at 185,000 barrels per day, of which about 70% is exported and the rest refined for domestic consumption. Despite its many infrastructure problems, Sudan's increased oil production, the return of regular rainfall, and recent investments in irrigation schemes should allow the country to achieve economic growth of 6% in 2001.

While the economy is recovering, decades of conflict, stagnation and displacement of families have eroded living conditions for most Sudanese. Donor support has mainly been limited to humanitarian assistance and disaster relief -- UNDP has been taking the lead in coordinating such efforts; a few donors, have started providing lending for infrastructure projects.

### Topography

The terrain is mainly flat, with mountains in the east and west. The country is at sea level at the Red Sea and its highest point is at Kinyeti (3,187m) . Permanent pasture accounts for 46% of the land use, with forests and woodland accounting for 19%

### Natural resources

Low-sulphur petroleum; small reserves of iron ore, copper, chromium ore, zinc, tungsten, mica, silver, gold, hydropower

### Biomass resources

The Republic of the Sudan is moderately forested with around 17% forest cover and an additional 10% of other wooded land. Most of the northern half of Sudan is desert or semi-desert and vegetation is limited to scattered shrubs such as *Acacia ehrenbergiana*. Closed forests are found in the mountain ranges and in the derived woodland savannahs. Closed tropical rainforest is confined to a few small, scattered localities. Montane vegetation is predominantly in Equatoria province and is mainly coniferous. Open broadleaved forest is the most common forest type, with high rainfall woodland savannah extending into most parts of Equatoria and Bahr el Ghazal provinces. Low rainfall savannah extends through most of central Sudan. Sudan has an extensive network of protected areas, mainly national parks and game reserves. Around 11 percent of Sudan's forests are in protected areas. Fuelwood is used extensively in Sudan.

Land area	Forest cover 2000	Forest cover change 1990-2000		Distribution of land cover/use % (1990)		
		'000 ha/year	%/year	Forest	Other Wooded Land	Other land
'000 ha	'000 ha	'000 ha/year	%/year	Forest	Other Wooded Land	Other land
237,600	61,627	-959	-1.44	25.9	21.9	48.6
3,090,228	649,866	-5,264	-0.78	21.0	15.5	61.6
13,139,618	3,869,453	-9,319	-0.24	29.4	11.2	58.6

### Vulnerability

Official figures reveal that about 93% of the population live under the poverty line in Sudan. Four million of these are displaced people, and it is this group who live in the project area of Wau Nur

### **Environmental shocks**

Sudan is vulnerable to floods and drought which have resulted in and increase in poverty levels despite economic growth.

### **Environment hazards**

These include: dust storms, inadequate supplies of potable water; wildlife populations threatened by excessive hunting; soil erosion; desertification

### **Economic shocks**

Weak world agricultural prices, a drop in remittances from abroad.

### **Project community in Kassala**

#### **Working with displaced people**

Within the Wau Nur neighbourhood, where ITDG will be basing this study, people are mainly from Southern Sudan. The main fuels they use are wood and charcoal, which must be bought. Although gas is relatively cheap, the set-up costs are too great for most people, and people are unfamiliar with gas cooking. The National Forest Corporation has co-operated with a gas supplier 'Sudagas' to provide subsidies to allow people to buy cookers.

Gas can be used for all types of cooking (cooking meals, tea making etc.). The cost per month for a family of seven ranges between £3.60 and £4.40, depending on whether it is purchased at a central depot or from a local distributor.

Charcoal and wood are normally used in combination: charcoal for making for tea, meat and soup (eaten with bread) and wood for cooking *Kisra* (like bread) and porridge. For the size of family described above, a survey has shown the monthly costs to be between £9.30 (charcoal - £3 and wood £6.30) and £10.60 ( charcoal - £3.50 and wood £7.10).

Already the Red Crescent is providing some support for families in Wau Nur, and there are contacts with the health authority.

#### **Collaborators in each country**

Initial list of those already identified as collaborators in the project

<b>Kenya</b>	<b>Nepal</b>	<b>Sudan</b>
Ministry of Health	SEARCH Nepal (Local NGO)	Ministry of Health
K-REP (financial institution)	Institute of Medicine, Tribhuvan University,	National Forestry Corporation
NCCK ( financial institution)	Local government offices	University of Kassala
WEDCO(financial institution)	DEPROSC (micro-finance)	Ministry of Education
Ministry of Culture and Social Services	Nepal Bureau of Standards.	Women Development Association
	Ramdaresh Pandit – Local community healthworker	Neighbourhood committees
		WHO
		ACCORD
		GOAL
		PLAN

## Bibliography

Biran, A., Budds, J. & Rouse, J., *Indoor Air Pollution ;A review of the health impacts of indoor air pollution and technical interventions for its reduction*, WELL Task 512 March 2001

Bruce, N., Perez-Padilla, R., & Alablak R. Indoor air pollution in developing countries: a major environmental and public health challenge. *WHO Bulletin 2000*, 78: 1078-1092  
Website: [www.who.int/bulletin/tableofcontents/2000/vol.78no.9.html](http://www.who.int/bulletin/tableofcontents/2000/vol.78no.9.html)

Courtright P., Haile D., & Kohls, E. The epidemiology of burns in rural Ethiopia. *Journal of Epidemiology and Community Health*, 1993, 47: 19-22.

Engle P.L., Hurtado E., & Ruel M. Smoke exposure of women and children in Highland Guatemala: prediction and recall accuracy. *Human Organization* 1997; 56(4): 408.

Gupta, S., Govil, Y.C., Misra, P.K., Nath, R. & Srivastava, K.L. Trends in poisoning in children: experience at a large referral teaching hospital. *National Medical Journal of India*, 1998, 11 : 166-168.

Parikh, J. *Rural Energy and Health Impacts*. IGIDR Project Report No. 048, Indira Gandhi Institute of Development Research, Mumbai UNDP, 2000.

Reddy, A.K.N., Williams R. H., & Johansson, T. B., *Energy after Rio: prospects and challenges*. UNDP, with the International Energy Initiative and Energy 21 Stockholm Environment Institute.

Smith K. & Mehta S. Background paper for *US AID/WHO Global Consultation on Indoor Air pollution and household energy in developing countries*, Washington, DC, 3-4 April 2000.

Smith, K.R. *Biofuels, air pollution, and health. A global review*. New York, Plenum Press, 1987

USEPA. Revisions to the National Ambient Air Quality Standards for Particulate Matter. *Federal Register July 18, 1997*, 62(138).

World Bank: World Development Indicators 2000; UNICEF updated 2002

World Bank Indoor Air Pollution journal Vols 1-5

World Development Report 2000-2001 (1998-99 figures)

World Health Organization. *Health and Environment in sustainable development. Five years after the earth summit*. WHO, Geneva, Switzerland, 1997.

World Resources Institute. UNEP, UNDP, World Bank. 1998-99 *World Resources: a guide to the global environment*. Oxford University Press. Chapter 2, pages 65-67.

Yach D. Paraffin poisoning: partnership the key to prevention. *South African Medical Journal*; 1994, 84: 717.