

ENERGY USE PATTERNS IN RURAL AREAS AND ENVIRONMENTAL DEGRADATION IN DEVELOPING COUNTRIES

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ABSTRACT

The major environmental problems (1,2) facing the developing world are

- i) Depletion (3) and degradation of tropical forests(4,5)
- ii) Soil erosion, sedimentation (6,7) and degradation of soil systems (8)
- iii) Fuelwood shortage (9)
- iv) Air and water pollution (1,2,10,11)
- v) Extinction of species (12,13) and reduction in biological diversity (14) or genetic erosion

Except water pollution all the other problems are linked to energy use in rural areas. This paper highlights the linkage between energy use and environmental degradation using the available data.

FUELWOOD USE AND DEFORESTATION

Fuelwood is the major energy source of the rural poor in a number of developing countries. In the normal course extraction of small quantities of fuelwood does not do any harm to the ecosystem since it is a renewable source of energy. When the annual extraction exceeds the annual incremental yield or sustainable yield, there is depletion of capital stock. Tropical forests can be considered as common pool resources and any common pool resource can be sustained only at low population density or when there are only limited number of users. In a number of developing countries already the fuelwood use have exceeded the sustainable forest yield. They are, Burundi, Ethiopia, Guinea, Kenya, Rwanda, Sierraleone, Uganda, Ghana, Swaziland, Tunisia, Lebanon, Pakistan, Haiti and Egypt.(3) Out of this in Ghana, Kenya and Pakistan the growth rate of population as well as that of wood extraction exceeds three percent per annum.

In a large number of developing countries wood is the main

fuel for the rural population. This is corroborated by the fact that in the following countries (3) more than 90 percent of the wood extracted is used as fuelwood, namely S.Korea, Nepal, Pakistan, Vietnam, Srilanka, Guatemala, Haiti, El Salvador, Panama, Bhutan, Zambia, Zimbabwe, Colombia, Venezuela, India, Bangladesh, Laos, Benin, Chad, Egypt, Ethiopia, Kenya, Mali, Malawi, Mozambique, Niger, Nigeria, Rwanda, Sierraleone, Sudan, Somalia, Tanzania, Tunisia, and upper Volta. Not only that the wood that is used as fuelwood is high, in actual units the per capita fuelwood use is also very high. The countries where fuelwood use percapita exceeds one cubic meter per annum, are Angola, Benin, Cameroon, Central African Republic, Chad, Kenya, Liberia, Malawi, Mali, Nigeria, Sierraleone, Sudan, Tanzania, Zimbabwe, Guatemala, Honduras, Brazil, Colombia, Paraguay, Bhutan, S.Korea, Laos, Vietnam and Papua, New Guinea. If you list these with countries where per capita area is less than 0.5 hectare it can be seen that Benin, Kenya, Malawi, Nigeria, Sierraleone, S.Korea, and Vietnam come under both these categories.

³ These factors along with the actual wood extraction rates (m³ per hectare of forest area) from forests (Table 1) indicate that most of the countries where fuelwood extraction is high are low income countries (except Libya). These countries cannot switch over to fossil fuels since they are mainly oil import in developing countries (except Libya) and mostly have percapita less than US \$ 500 (15). In otherwords, environmental degradation of forest quality and deforestation (16,17) are the result of poverty, low incomes and under development. Unless fuelwood availability is increased or alternative fuels are provided the current trend of deforestation will continue. One of the major environmental consequences of deforestation of the tropical forest ecosystems (12,14,18-20) has been disappearance of extinction of species. Tropical forests of Africa, India, Malaysia, and Amazonia are species rich and indiscriminate extermination of species is an irreversible loss. Because of population pressure the tropical forest ecosystems are cleared a very fast rate. Rate of deforestation in 76 developing countries comes to be 11.3 million hectares per annum whereas the afforestation is very meagre compared to this i.e. 0.52 million hectares (21). Tropical forest ecosystem are nutrient poor, very fragile, poorly studied and once disturbed gets irreversibly damaged (16,17).

FAO in a recent study has identified that in many developing countries there is fuelwood shortage and this shortage is likely to increase the illegal extraction. In India illegal fuelwood extraction exceeds 80 percent of the total use. In Srilanka (3) illegal extraction was only 20 percent of the total consumption (in 1960) but this has become 72 percent by 1975. It is illegal extraction that causes severe environmental degradation since

- i) areas where illegal extraction occurs are areas of low biomass productivity
- ii) no efforts are made for regeneration in illegally

Table 1. Forests and Economic Development

Country	Fuelwood use per capita	Percent of wood extracted used as fuel wood	Wood extraction per unit forest area	Growth rate of wood extraction	Percapita income	Commercial energy use per capita
	(m ³)	(%)	(m ³ /ha)	(%)	US \$	(Kilogramme Equivalent)
Ethiopia	0.72	94	2.68	2.48	130	20
Guinea	0.55	85	3.14	2.31	280	55
Kenya	1.64	96	14.0	3.81	380	180
Rwanda	0.96	99	17.11	2.89	200	30
Sierraleone	2.10	97	25.34	2.53	250	89
Uganda	0.33	75	2.03	2.92	290	39
Ghana	0.60	73	-	3.10	400	265
Tunisia	0.40	96	5.17	2.16	1120	618
Pakistan	0.22	97	6.40	3.10	260	218
Egypt	0.04	95	-	2.36	480	565
Haiti	0.95	95	24.57	2.10	260	66
Central African Republic	1.21	83	0.39	3.01	290	55
Malawi	1.62	97	6.42	3.12	200	70
Senegal	0.41	83	0.52	3.06	430	266
Zimbabwe	1.01	92	0.33	3.36	470	791
Nicaragua	0.85	72	0.49	4.37	660	455
Malaysia	0.80	24	1.99	5.28	1370	767
Bhutan	2.16	100	0.94	2.17	80	--
India	0.30	93	3.23	2.66	190	242
Burma	0.70	91	0.79	2.05	160	72
Guatemala	1.60	98	1.91	2.53	1020	251
Vietnam	1.14	96	5.03	2.26	--	140
Sri Lanka	0.48	92	3.18	1.80	230	140
Libya	0.18	86	14.52	3.40	8170	2360
Madagascan	0.60	86	0.48	2.05	290	94
Zambia	0.86	91	0.14	2.97	260	130
Paraguay	1.13	76	0.21	1.84	1070	251
S. Korea	1.71	96	10.25	1.91	1480	1642
Mali	4.17	99	6.42	2.53	140	30

extracted areas

- iii) illegal extractors have no incentive to burn fuelwood efficiently and hence its inefficient and over use.

Deforestation and the consequent environmental degradation will continue unless efforts are made to stimulate productivity of forests and generation of forests. Under increasing population density regulations alone cannot arrest deforestation. In spite of severe restrictions forest cover (3) came down in Haiti from 55 percent of the total area to 9% between 1950 and 1979. Forest regeneration efforts has to be supplemented by introduction of renewable sources of energy such a solar energy, biogas, wind energy, etc.

BURNING AGRICULTURAL RESIDUES AND ANIMAL WASTES

Another major energy source of widespread use in developing countries is agricultural residues and animal wastes. Agricultural residues and animal wastes are burnt directly as fuel in rural areas. Burning of residues and wastes results in loss of nitrogen. Increased trend of burning these fuels have caused the carbon to Nitrogen ratio to fall considerably in the soils. Use of agricultural residues (in the form of Compost or directly) and use of animal wastes reduces the organic carbon into the soil. This, with the trend of increased use of chemical nitrogen directly results in drastic reduction in carbon and increase in nitrogen. Lowering of the carbon to nitrogen ratio affects long term productivity and agronomic stability (22).

Soil is one most critical resources and degradation of soil quality under increasing population density is likely to be an irreversible change (23). Increased deforestation, shifting cultivation, improper water management along with degradation of soil quality are a severe environmental problems of the developing world. Very little attention has been given to soil management in developing countries and loss of top soil is an irreversible process.

FUELWOOD USE AND AIR POLLUTION

Though it is generally considerable that air pollution from industries is a severe problem the risk of air pollution from fuelwood use has some serious dimensions. It has been reported that the total suspended particle concentration a rural women is exposed to in cooking is much higher than the concentration to which industrial workers are exposed to. Rural women cook mainly in ill-ventilated houses and are exposed to the smoke for many number of hours even after the cooking process is over because of poor ventilation in rural households. Actual field studies conducted indicate that the Benzoalpha pyrene concentration to which

rural women are exposed (close to fuelwood stoves) in certain areas of India is 3850 nano grams per cubic meter (24,25). Compared to this the average Benzo alpha pyrene concentration in a US house (indoor) with wood stove heating is as low as 1.2 nano grams per cubic meter (24,25).

Continuous exposure to very high levels (many times higher compared to industrial standards or ambient standards) has many health risks. Rural women has high incidence of anaemia (22,23) and it can be a consequence of exposure to high levels of carbon monoxide.

ENVIRONMENTAL RISK

These three examples can be considered as examples of environmental risk (26-32) indicating that environmental problems in developing countries are very closely linked to illiteracy, underdevelopment, poor awareness, lack of information, poor environmental planning, lack of concern by the government administrators, and poor efforts by mass media. The hazards in all the three cases arises out of the fact that people are exposed to various environmental risks while the subjects are trying to undertake activities for satisfying the basic human needs. It is very difficult to avert these risks. Developmental and environmental problems are two sides of the same coin (33). Unless environmental issues are taken into consideration the environmental risks are going to become serious, since environmental problems are intricate and highly interactive.

CONCLUSIONS

Many of the environmental problems faced by developing countries are closely linked to the energy use patterns, more so in the rural areas. Most of these problems occur in the low income developing countries and are closely linked to the use of traditional fuels such as fuelwood, agricultural residues and animal wastes. Reversing the trend of usage of traditional fuels will be a long drawn out procedure, but then the problems would have very severe. Unless deliberate efforts are initiated to institutionalize environmental concerns in economic planning through a series of policy interventions many of the unique and fragile ecosystems would be irreversibly lost. This institutionalization will need the commitment of political bosses and government administrators. These groups have to be sensitized and stimulated to achieve improvements in environmental quality in developing countries.

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