Why will investment in clean energy technology at the household level in Nepal offer co-benefits for global climate and local people's health?

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In its fourth assessment report (most recent), the world's most authoritative voice on climate change, the United Nations Intergovernmental Panel and Climate Change (IPPC), has loudly and clearly said that warming of the earth's climate is "unequivocal," and human activity, particularly the burning of fossil fuels, is a major cause.[‡] IPCC scientists now accept that if the trend of anthropogenic emission continues, earth's average temperature could rise 1.5 to 6 degrees Celsius or higher by 2100. There is already evidence of increases in average temperatures of air and oceans around the world. For example, years 1995-2006 have had 11 of 12 warmest years on record since 1850.

Carbon dioxide (CO_2), methane, nitrous oxide, ozone and water vapor are all greenhouse gasses (GHGs) that can lead to global warming. Just before the industrial revolution (1850), atmospheric CO_2 levels were about 280 parts per million (ppm) by volume, but since then the concentration of CO_2 has increased by a bit over 100 ppm (383 ppm in 2008). Of that 100 ppm concentration, the first 50 ppm increase happened in over 100 years, but the next 50 ppm increase happened within 35 years (1973-2008)[§]. In his recent interview to New York Times (May 29 2008), Professor F. Sherwood Rowland, who shared the Nobel prize for his groundbreaking work on threats to the ozone layer from chloroflourocarbons (CFC's), has predicted that concentrations of CO_2 could rise to 1,000 ppm if multi-trillion-dollar energy systems are not introduced immediately. IPCC scientists have predicted higher risk to life, ecosystems and the global economy when CO_2 concentrations surpass 450 ppm. Thus, according to the IPCC, to avoid any climate related disasters, global efforts should be made to turn the atmospheric concentration of CO_2 to 350 ppm, the mean CO_2 level of 1988. And for this, global collective efforts and cooperation are essential.

Nepal's situation: Nepal's climate records show that temperature has increased dramatically in upland regions. From 1977 to 1994, mean annual maximum temperatures in the northern part of the country have increased by more than 0.06 C^o per year above the long-term mean, with

[‡] http://www.ipcc.ch/

[§] Barnola, JM, D Raynaud, S Korotkevich & C Lorius, 1987. Vostok Ice Core provides 160,000-year record of atmospheric CO_2, Nature, 329, 408-414

some regions recording increases of up to 0.12 C ^{o} per year. This contrasts with the Siwalik and Terai regions in the lowlands that warmed less than 0.03 C ^{o} per year[**]. Rising average temperatures in the higher elevations have already caused a massive retreat of glaciers, which are sources of headwaters of many large rivers in South Asia[††]. And there are possibilities of shifting disease vectors and epidemics such as malaria upwards in elevation, along with shifting of agriculture patterns leading to over or under production depending on the region. Compared to developed countries, climate change will have different repercussions in Nepal, although its average per capita CO_2 emission is only about 0.2 metric ton/year compared with USA at 6 metric ton/year, with Canada and Australia not far behind[‡‡]. Since the average Nepali's per capita contribution of CO_2 is 30 times less than that of the average American, Canadian or Australian, Nepal does not currently have any obligations under the climate change convention to reduce its CO_2 or GHGs. However, Nepal's effort to reduce these gases is tremendous and working further on this will not only help combat global warming but will also offer clear co-benefits for other aspects of its development, particularly in improvement of the health of millions of its people.

Nepal's major sources of CO_2 and GHGs: The national green house gas inventory conducted in 1994-95 by the Government of Nepal shows that the net emission of CO_2 is about 9747 Gigagrams (Gg) of carbon. Emission of two other global GHGs, methane (CH4) and nitrous oxide (N2O), are 948 Gg and 31 Gg respectively. Of total CO_2 emission, the share contributed by fossil fuels is 1465 Gg, and the transport, industrial and residential sectors account for 31%, 22% and 22% of emissions respectively[§§]. The remaining emissions come from residential and commercial uses of traditional energy, mainly biomass. Similarly in the case of methane emissions, the bulk (91%) comes from traditional activities such as rice cultivation and enteric fermentation (livestock). Thus, measures to reduce methane will not be viable as they will

[**] Shrestha Arun B, 1999. Maximum Temperature Trends in the Himalaya and Its Vicinity: An Analysis Based on Temperature Records from Nepal for the Period 1971–94. American Meteorological Society

[††] Mool PK, Bajracharya Samjwal BR & Joshi SP, 2001. Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburs Floods: Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region. ICIMOD and UNEP.

[‡‡] Patz JA, Gibbs HK, Foley JA, Rogers JV & Smith KR, 2007. Climate Change and Global Health: Quantifying a Growing Ethical Crisis. EcoHealth 4, 397-405.

[§§] Initial National Communication to the Conference of the Parties of United Nations Framework Convention on Climate Change. Ministry of Population and Environment, July 2004.

jeopardize the socio-economic conditions of millions of people. But reduction of CO_2 in the energy sector by promoting clean energy technology at the household level and within the transportation sector will clearly offer benefits.

How? Traditional sources of energy such as biomass fuel dominate the energy supply in Nepal. The share of traditional, commercial and renewable energy was 87.7 percent, 11.75 percent 0.53 percent respectively during FY 2004/05. Of the total traditional energy consumed, 89.0 % was fuel wood, 4.34% was agriculture residue and 6.57 % was cattle residue (i.e. dried dung used for cooking and heating).[***] This clearly shows that energy consumption is dominated by household uses and almost all are supplied by traditional sources, mainly fuel wood and other biomass. Similarly, energy consumption growth over the last 15 years (until 2005) is almost linear, with an annual average increase of 2.7 percent. The annual average growth rate of traditional energy consumption is 2.2 percent. The contribution of alternative energy technologies including hydropower is increasing rapidly but, as it started from a small base, alternative energy still contributes only about 0.6 percent of the current total energy demand for the country. Although the share of traditional sources of energy is gradually decreasing in total energy consumption, its utilization is still increasing at a steady pace.

Burning of traditional biomass fuels indoors generates indoor air pollution (IAP) and exposes millions of people, especially women and small children, to harmful pollutants. Studies conducted in developing countries have provided evidence of associations between IAP and acute lower respiratory infections (ALRI), low birth weights in children, chronic obstructive pulmonary diseases (COPD), asthma, cataracts and tuberculosis in adult women.[†††] ALRI, COPD, cataracts and tuberculosis are the four most common diseases associated with IAP in Nepal. These diseases account for more than 6% of all OPD visits to health institutions.[‡‡‡] Similarly, Nepal has a childhood mortality rate (under 5 years old) of 91/1,000 live births. It has been estimated that, on average, of 1,000 children below 5 years of age who visit health facilities, 90 have

[***] Ministry of Finance. 2006. Economic Survey.

[†††] Smith KR, Desai MA, Mehta S. Indoor Smoke from solid fuels: Assessing the environmental burden of disease at national and local levels. WHO, 2004; 1-15.

[‡‡‡] Annual Report 2004/05, Department of Health Services 2006, Ministry of Health and Population, Government of Nepal, Kathmandu.

pneumonia and four of those cases are severe.[§§§] According to a recent report of the World Health Organization (WHO) concerning the global burden of diseases from traditional fuel sources, 5,000 deaths per year from ALRI and 3,000 death per year from COPD are attributable to traditional fuel use in Nepal.[****] The national burden of diseases attributable to the use of traditional fuels is about 3 percent using the Disability Adjusted Life Years (DALYs) measure, which is a combined metric of lifetimes lost due to premature mortality and morbidity from particular diseases.

Along with indoor air pollution, combustion of one gram of wood fuel in traditional stoves produces approximately 1.7 grams of CO_2 as emissions.[††††] A six member family's house burns about 10 Kg of wood every day, which means in one year one traditional wood stove generates about 7 tons of CO_2. Even with conservative estimates of fifty percent efficiency of improved stove (wood stoves with a grate and chimney), replacement of one traditional woodstove by an improved stove in rural areas will emit 3.5 tons less CO_2/year per stove. A robust improved stove cost ~$ 20 and they last for at least 4 years. Thus, 100,000 improved stoves disseminated in rural areas would reduce CO2 emission by about 350,000 tons. Assuming improved stoves will avert half of the total DALY, the crude cost-effectiveness of such a program will be about $ 20/DALY and about $6/ ton equivalent of CO_2, respectively. Currently the market value of one ton of CO_2 equivalent in Europe is about $26;[‡‡‡‡] market threshold for health intervention is $1,500/DALY.[§§§§] Similarly, compared to traditional stoves, one small biogas plant emits 7 tons less CO_2. If 100,000 such plants are used, then 700,000 tons less CO_2 will be emitted, with additional health benefits. Unfortunately, currently improved cooking stoves are omitted from the Clean Development Mechanism (CDM) approved projects, and hence our efforts should be to lobby CDM because Nepal has already introduced more than 100,000 improved stoves. However, biogas plants are approved as CDM projects and currently 19,396 biogas plants have been included in the first two Biogas CDM

[§§§] ibid

[****] Indoor Air Pollution: National Burden of Disease Estimate. WHO/SDE/PHE/07.01, 2007.

[††††] MacCarty N, Ogle D, Still D, Bond T, Roden C & Willson B, 2007. Laboratory Comparison of the Global-Warming Potential of Six Categories of Biomass Cooking Stoves. Aprovecho Research Center, OR, USA.

[‡‡‡‡] http://www.carbonpositive.net/

[§§§§] Smith KR & Haigler Evan, 2007. Cobenefits of climate mitigation and health protection in energy systems: scoping methods. Annu.Rev.Public Health 2008. 29:18.1-18.5

projects by the World Bank. This will translate into more than $6.5 million within the first 10-year crediting period at US$ 7 per ton CO_2. This revenue will then be used to develop more biogas plants, which in turn will generate more revenue. In the end, although the calculations made above are rather crude, the assumptions are fair estimates and call attention to this type of intervention for co-benefits investment in Nepal.