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CLIMATE CHANGE, PROTECTED AREAS AND BIOGAS

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LOCAL IS GLOBAL

Climate change is global and protected areas (PA) and biogas management are local. But, they are well connected. This paper explores on how PA buffer zones and biogas plants may help nature conservation, and assist current efforts to address climate change. My study was sponsored as a part of the on-going University Graduate Mentorship Program of Resources Himalaya Foundation (Yonzon, 2006).

Reducing emissions of green house gases (GHGs) is one big explanation to stabilize climate change, where carbon dioxide is the target. Poorer countries need to protect their environment because they depend on limited arable land, water, forest and rangeland. Thus, the Clean Development Mechanism (CDM) of the Kyoto Protocol plans to assist non-industrialized countries in achieving their sustainable development; and limit and/or reduce carbon emission in industrialized countries (UN, 1997). All non-industrialized countries like Nepal can participate in CDM only through energy such as biogas, and land use change including forest cover.

Biogas is energy that can be generated from both cattle and human waste. When a family switches to biogas plant from fuelwood, accrued local and global benefits are saving fuelwood, reducing indoor pollution, protection of forest and reduction of emissions of carbon dioxide. In the last 15 years, over 162,000 households have used biogas plants for cooking and farm manure (GON/AEPC/MOEST, 2006). Considering Nepal's varied topography, biogas has potential to maintain 1.9 million plants in Nepal with 57% in the Terai, 37% in hills and 6% in high mountains (BSP, 2007). However, poverty incidence is just opposite: higher in High mountain (40.1%) and Hills (50%) and low in the Terai (34.5%).

KNOWING THE BUFFER GROUND

Chitwan National Park (932 km^2), a World Heritage Site, harbors elephants, tigers, rhinos and freshwater dolphins. Its buffer zone (750 km^2) has 35 village development committees (VDC) and 2 municipalities with 223,260 people in 36,193 households where the Park spends 30-50% of its annual revenue. Sukranagar buffer zone VDC was chosen as a site to study resource management and conservation (Neupane, 2007).

Sukranagar (1418.2 ha) has nine wards with 1,436 households and 7,637 people (CBS, 2002). The park buffer zone includes its six wards (658 ha) only because of their proximity to the park boundary (fig. 1) where natural resources for subsistence living, are little (agriculture 94.1%, forest 0.9%, and grassland 5%). The study area (6 wards) has a population of 2,873 people in 461 households (average family size: 6.2). Most households (48.4%) are poor with less than 0.5ha of land and only 11.3% of the households own more than 2 ha land - a minimal requirement for subsistence. Existing forest patches are small (forest: 1.1 ha and shrub: 4.4 ha) compared to its grassland (32.7 ha). Over 40% of the households are directly dependent on the Park for fodder and fuelwood. The annual fuelwood deficit was estimated to be 10,487 tons or more and annual fodder (TDN - total digestive nutrient) deficit was estimated at 5,633 tons (Neupane, 2007) (table 1). These deficits are entirely met through the Park one way or the other.

The Rapti River floods Sukranagar every monsoon. Sukranagar has two problems: 1) forest and grassland, on the flood plain, continually change (573 – 658 ha) (DNPWC/PPP, 2001; Neupane, 2007) and 2) community forest does not exist. The park management has informally allowed the 22 buffer zone user groups of Sukranagar to collect fodder and fuelwood from the prime rhino habitat (68 ha) of the Park (core area). In principle, this is a violation of core zone protection and buffer zone management. Therefore, options must be found in the buffer zone and not inside the Park because the demand for forest resources would not slow down in future.

LARGE FARMS, MORE CATTLE

Biogas users in Sukranagar, utilize cattle dung only. The gas produced, is used for cooking and digested slurry is utilized as manure. This technology benefits from stall feeding and tree plantation near by so that

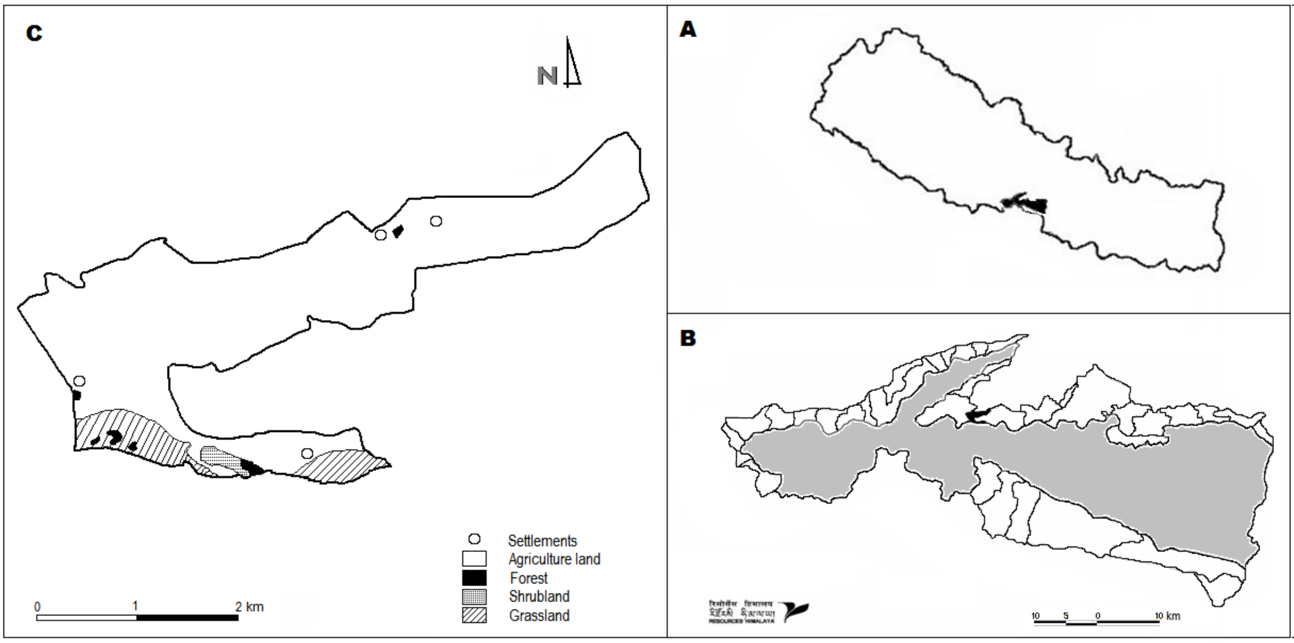

Figure 1. A: Nepal and Chitwan National Park (dark shade); B: Chitwan National Park (light shade), Sukranagar Buffer Zone (dark shade) with 35 Buffer Zone VDCs and 2 municipalities; C: Landuse of Sukranagar.

raw material is adequate and easier to collect to keep the biogas plants going every day. BSP (2007) states a decrease of 3.4 kg fuelwood per biogas household per day in summer and 7.5 kg fuelwood in winter. Grazing practices of the livestock has been changing more towards stall feeding, reducing the pressures on nearby forest.

Considering these, two assumptions warrant validation: 1) There is a significant difference in fuelwood consumption between biogas households and no-biogas households in Sukranagar, and 2) There is significant difference in green fodder collection between biogas households and no-biogas households. Are they true?

Sources of fodder and fuelwood were agricultural residue, grassland, private land and the Park. About 69 (15%) households were reported to have biogas plants (BSP Database, 2007). All biogas households owned more cattle than the households without biogas. As cattle herd size is tied up with forage and fodder production, average livestock value in the biogas households was 8.08 LU (livestock unit) and 4.14 in the no-biogas households. Biogas households not only owned more livestock but land holding as well (table 2). Average farm size of biogas households was 2 ha and others had 0.6 ha.

All biogas households practiced stall feeding with intent to optimize dung collection. Therefore, fodder collection is significant between biogas households and no-biogas households ($\chi^2 = 5.304$, df = 1 and $p < 0.021$). For all households, over 74% of the livestock feed requirement was met from the Park and only 0.5% from buffer zone forest. Farm residue constituted over 25.4% of the feed. Farmers reported that straw from rice, finger millet and maize, make the bulk of farm residue.

UNTIE BIOGAS WITH FUELWOOD

Several studies have suggested that biogas household can save 15 - 20 kg of fuelwood everyday. This is logical and proven. But Sukranagar has a different story. The annual fuelwood consumption of biogas households was higher (8,160 kg/household) than those of the no-biogas household (7,414 kg). There was no significant difference in fuelwood consumption between biogas households and no-biogas households. Apparently, this element of surprise was found to be connected with the poorer households with no-biogas. These households collect fuelwood illegally from the Park, and sell them at cheapest to the food-surplus households with biogas plants (Neupane, 2007).

WHO OWNS BIOGAS?

Adoption of biogas technology, can be hierarchal. Therefore, biogas ownership need to be addressed on two fronts: social hierarchy and economic well-being. Social status included ethnicity, and buffer zone membership: 1) Over 90% of the biogas users were from the Brahmin and Chhetri castes; and 2) Buffer zone executive members (20%) and user group members (80%) made biogas an exclusive scheme.

On the economic front, farm and food had a significant bearing. Households with surplus food (90%) dominated biogas. Average farm size, cattle herds and family size were different between biogas households and those without biogas (χ^2=49.69, df; 2, α=0.05).

Table 1. Annual demand and supply of green fodder and fuelwood in Sukranagar VDC

Resources	Variables (measured**, estimated*)	Weight (ton)
Fuelwood	Yield** (forest)	11.7
	Demand*	10,499.5
	Deficit	-10,487.8
Fodder	Yield**(grassland+shrub+forest+farm residue)	1,970.2 (32.1+4.6+2.5+1931)
	Demand*	7,603.2
	Deficit	-5,632.9

Table 2. Households size (HH), livestock units (LU) and biogas.

Households Size (ha)	HH Surveyed	Percent HH	LU/HH	Biogas HH	Percent Biogas HH
Landless	1	1.6	1.2	0	0
<0.34	24	38.7	2.53	1	4.2
0.35 – 0.68	7	11.3	6.34	0	0
0.69 – 2.72	27	43.6	5.9	6	22.2
>2.72	3	4.8	10.5	3	100

Table 3. Gini Coefficient.

Households (ha)	Total HH% (X_i)	Biogas HH% (Y_i)	Cumulative X_i	Cumulative Y_i	$X_i(Y_{i+1})$	$(X_{i+1})Y_i$
<0.34	40.3	10	40.3	10	403	516
0.35 – 0.68	11.3	0	51.6	10	3612	952
0.69 – 2.72	43.6	60	95.2	70	9,520	7,000
>2.72	4.8	30	100	100	0	0
					13,535	8,468

CAN CONSERVATION ADDRESS INEQUALITY?

Gini Coefficient is an aggregate numerical measure of inequality that ranges from perfect equality (0) to high inequality (1). Its value [$\Sigma X_i\ (Y_{i+1}) - \Sigma(X_{i+1})Yi$] assists in determining whether the distribution of biogas plants to the beneficiaries households has remained equitable (Sharma, 2007; Kanel, 1993). For Sukranagar, Gini Coefficient was 0.5 suggesting inequality in the distribution of biogas plants between the poor and rich households (table 3).

Biogas requirement has been estimated as 0.33 m^3 per person per day in Nepal and a household of 6 family members must produce 2 m^3 of gas each day to meet all cooking requirements (Karki and Dixit, 1984). To install biogas plants in the buffer zone, two things are important but difficult for the landless and poor: 1) sizeable cattle herd and their maintenance and; 2) shortage of cash — they need capital investment of NPR 6,000 (US $ 93) which is already a subsidized cost.

ROAD TO CARBON SEQUESTRATION

Nepal earns over $ 600,000 per year through the World Bank from two biogas CDM projects which include 19,396 biogas plants (BSP, 2007; Winrock, 2007). It is voluntary carbon emission reduction. In addition, several studies suggest that Nepal may trade over 96,000 tons of carbon dioxide by 2012 and earn more credit.

Existing 69 biogas plants in Sukranagar may generate 184.7 KW of equivalent power each year. Considering Sukranagar cattle population and their estimated production of 2,959 m^3 of gas each day, annual generation of 738.8 KW is considered feasible. Today, only 25% of the estimation, is produced suggesting a huge untapped potential.

As carbon emissions is estimated to be 1.8 kg from one kg of fuelwood, biogas helps in reducing GHG emissions (Bajgain and Shakya, 2005). The GHG saving per biogas plant of size 6 m^3 in the Terai, is 6.8 tons each year (CDM/SSC/PDD, 2005). Thus, accounting for the 69 operational biogas plants in Sukranagar, reduction of approximately 469.2 tons of GHG emission per year, is estimated. Also there is possibility of more reduction of GHGs emission when biogas potential is fully realized. Since the equivalent value for GHG reduction is US $ 4.5/ton of carbon dioxide (Bajgain and Shakya, 2005), Sukranagar may get carbon credit for a minimum of $ 2,111 for keeping existing biogas plant operational.

ADAPT NOW FOR A BETTER TOMORROW

In Sukranagar, all expectations and stumbling blocks lead to resource management. Fodder constitutes more grasses than shrubs and tree parts. During the annual grass-cutting season, farmers are allowed to cut grasses (*Sacchrum spontaneum*) from Chitwan National Park and sell them as raw materials to nearby pulp factory (Lehmkuhl, 1999). Cattle do not eat them but the rhinos and elephants do, suggesting alternatives to fodder scarcity need to be developed in the buffer zone. Prioritizing activities to address fodder deficit has obvious additional advantages:1) maximum biogas plants can remain operational; and 2) more plants can be installed for carbon credit.

As options to secure fodder during the dry season do not exist, the carbon credit money when realized, can be invested as the best choice in restoring grassland, shrub and forest patches (38.2 ha) so that fodder and fuelwood deficits are gradually met.

The strategy on common property resource management is not only for biogas households but also for those who cannot afford but have cattle. In the long run, this carbon money can be the alternative source of financing to reach out poor households who have been discriminatorily ignored on the ground of social hierarchy.

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