Environmental Awareness and Sustainable Development

Awareness of the Deforesting Effect of Firewood Use in Rural Firewood Users.

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Sustainable development is not possible without participation by the people. Popular participation requires that people should be aware of the environmental effects of their day-to-day activities. Deforestation is one environmental aspect of development that needs attention for sustainable development. There is some evidence to show that deforestation is encouraged by the use of firewood as domestic fuel. This paper tries to examines the patterns in awareness of the deforesting effect of firewood use in rural firewood users in Andhra Pradesh.

Deforestation and Firewood Use

India with 16 percent of the world's human population and 15 percent of global livestock, has only 1.7 percent of the world's forest stock. At least in some perceptions, despite large-scale tree planting programs, forestry is one arena in which India has actually regressed since independence (http://countrystudies.us/india). A substantial part of land ostensibly under forest cover, is degraded into brush land. [1]

The problem of deforestation is common to the developing world. The relative contribution of fuel wood collection to this process varies across the developing world, and can be difficult to assess. In China, it appears to account for 30% of land clearing.[2] FAO estimates that fuel wood accounts for 80% of wood products in developing countries.[3] In India, a UNFPA study says the present annual firewood use of some 235 million cubic metres is a grave threat to forests as it is not possible for the green cover

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[1] "In FY 1987, however, actual forest cover was 64 million hectares. However, because more than 50 percent of this land was barren or brush land, the area under productive forest was actually less than 35 million hectares, or approximately 10 percent of the country's land area." ibid

[2] "Desertification and Rehabilitation in China," Lanzhou, 1988, quoted in Donna M. Staton & Marcus H. Harding (2004).

[3] FAO, World Bank, Wood Production and Trade, World Resources 2000-2001.

Table 1. Fuelwood Consumption in India

1980	201,921
1981	206,330
1982	210,986
1983	215,617
1984	220,391
1985	225,141
1986	229,907
1987	234,772
1988	239,532
1989	244,406
1990	249,274
1991	254,262
1992	259,229
1993	264,209
1994	269,157

Source: Total fuelwood consumption from FAO forest products yearbook; (1000 m3)[1]

to replenish itself so fast. Calculations show that India's forests can support a withdrawal of no more than 48 million cubic metres of fuel wood every year. [4]

Since firewood collection is mostly in the commons, it easily leads to overexploitation. In most cases, it contributes to a degradation of forest cover paving the way for diversion of land to other uses.[5] It is estimated by the FAO that total fuel wood consumption in India amounted to 269 million cubic metres in 1994 alone. The estimates indicate an annual rate of growth of nearly 2.1%, which is close to the rate of growth of the population. This means a continual aggravation of an already serious problem.

The use of firewood as domestic fuel is widespread in rural India. Data from the Centre for Science and Environment (1991) put the incidence of rural firewood users at 71.7%, while Ravindranath and Hall (1995) put it at 88%. Others estimate this to be about 75% (Shubhashis Gangopadhyay et al, 2004).[6] The data collected by the National Akademi of Development (2004) from 48 villages spread over 3 districts of AP (East Godavari, Warangal & Anantapur), reveal that rural households that use firewood only, or firewood mainly as domestic fuel constitute about 72% of the total (=1021÷1418). This study analyses the spread of awareness of the deforesting effect (DFE) of firewood use in these 1021 households.

Awareness of Deforesting Effect of Firewood Use (DFE)

The data reveals that a surprisingly high proportion of the firewood using households are aware of the DFE. Of the 1021 household heads, 581 (57.4%) report awareness of DFE, and 42.6% expressed ignorance. It is to be expected that popular participation in reforestation programmes would depend upon the spread of awareness. Hence, we now

[4] 'Population and Forests. A report on India' released by the India office of the U.N. Population Fund (UNFPA)

[5] Deforestation: Tropical Forests in Decline: http://www.rcfa-cfan.org/english/issues.12-1.html,12-9.html

[6]

examine whether the awareness of DFE is fractured along social, economic or regional lines.

Deforestation imposes physical and monetary costs on firewood users. They have to either to travel longer distances to collect free firewood, or have to purchase firewood from the market. Our data reveals that 169 households bought all the firewood they used, and the distances travelled to collect free firewood varied widely from 0 to 8 kilometres. It is plausible to suppose that the costs imposed by deforestation would heighten the awareness of DFE. It is also possible that the educational level of the household, its community affiliation, its income level, occupation of the head, type of dwelling and the district to which it belongs could all affect the awareness of DFE.

Bivariate analysis would be misleading in such a situation, since the influence of excluded variables could be captured by the included variable, which would then show a spurious relation or pattern in the incidence of awareness. To avoid this, a binary logistic regression is used to estimate the partial 'effects' of the different factors on DFE awareness. Factors that have a very low level of significance according to the likelihood estimates, are dropped in successive regressions, and the final form is reported in the Table 1.

Table 1: Results of Logistic Regression of Awareness of DFE

Model Summary	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
	1080.741	.256	.344

Row		B	S.E.	Wald	df	Sig.	Exp(B)
		1	2	3	4	5	6
1	BUYDUM	1.125	.280	16.112	1	.000	3.081
2	DIST0	.665	.092	51.841	1	.000	1.944
3	KCHADUM	.580	.208	7.747	1	.005	1.786
4	SPCADUM	.353	.191	3.407	1	.065	1.423
5	LABDUM	-.845	.164	26.486	1	.000	.430
6	LARGCDUM	.631	.384	2.706	1	.100	1.880
7	Warangal	.802	.214	13.983	1	.000	2.230
8	Anantapur	1.344	.186	52.322	1	.000	3.834
	Constant	-1.786	.266	45.178	1	.000	.168

Classification Table		Predicted		
		DFAWARE		Percentage Correct
Observed		0	1	
DFAWARE	0	284	147	65.9
	1	116	465	80.0
Overall Percentage				74.0

Hosmer and Lemeshow Test	Chi-square	df	Sig.
1	15.149	8	.056

The measurement of variables is as follows: Distance is measured in kilometers, education of the household head is categorised into 5 levels: illiterate, primary, secondary, intermediate and degree. Three types of dwellings are considered: kutcha, semi-pucca and pucca, and four types of community affiliation: ST, SC, BC OC. Occupations are grouped under ag. Labour, labour cultivators, village professions, small cultivators, large cultivators, businessmen and employees.

Table 1 shows that the joint influence is highly significant (-2 Log likelihood: 1080) and the strength of association is 0.344 (Nagelkerke). The success rate of prediction of the model is 80% (classification table), and the Hosmer & Lemeshow Test is unable to reject

a good fit at 5%. The parameter estimates may be interpreted on the basis of col. 6 of the Table as follows.

The costs imposed by deforestation appear to heighten the awareness of DFE. Cet. Par., Households that buy all their firewood are 3 times as likely as households that collect at least part of their supply, to be aware of DFE (row 1). Likewise, awareness of DFE appears to rise with the distance travelled to collect free firewood. Thus, every extra kilometre travelled increase the odds of awareness by 94%, ceteris paribus. That is, a household that has to travel an extra kilometre is 94% more likely (or 1.9 times as likely as) than others to be aware of DFE.

It is interesting that neither income, nor education of the head test significant even at 20%. However, the type of dwelling appears to be significantly related to awareness. Row 3 shows that dwellers of kucha houses are 1.78 times as likely as (or 78% more likely than) those in pucca houses to be aware of DFE, ceteris paribus. Likewise, dwellers of semi-pucca houses are 1.4 times as likely as (or 40% more likely than) pucca house dwellers to be aware of DFE, ceteris paribus[7] (row 4). Thus, the poorer the house type, the higher the consciousness, cet. Par.

There appears to be no significant relation between community affiliation of the household and awareness. However, two occupational groups appear to differ significantly from others. Row 5 shows that agricultural labour tend to be less aware than other occupations (B=-0.845), ceteris paribus. Interpreting it in terms of the inverse, this estimate means that other occupations (other than labour and large cultivators) are 2.3 times as likely (=1÷.43) as ag. Labour to be aware of DFE. Row 6 shows (at 10%) that large farmers are 1.9 times as likely as other occupations to be aware of DFE, ceteris paribus.

Row 7 and 8 indicate a regional pattern in awareness, controlling for other variables. Thus, households in Warangal are 2.2 times as likely as, and households in Anantapur are 3.8 times as likely as a household in East Godavari, to be aware of DFE. This regional difference may be correlated with the pressure exerted on forest by firewood use, since in the order of fertility and water availability, East Godavari comes first, Warangal comes next and Anantapur is last.

The positive relation between distance and awareness in fw-users detected by the

Table 2: Awareness by Distance Travelled to get free firewood (5 classes)

		0 k.m	≤ 1k.m.	1.5 k.m.	2-3 k.m.	3.5-4 k.m	≥ 4.5 km.	Total
Aware	Count	169	47	111	171	58	107	494
	%	16.5%	32.9%	46.4%	59.0%	85.3%	99.1%	58.3%

[7] Although this estimate is significant only at 10%.

logistic regression is revealed by Table 2. The table unveils the sharp rise in awareness as the distance of free firewood increases. In fact at 4.5 k.m. and above it is nearly hundred percent. Thus, cross-tabulation provides a useful description of the distribution of data. Could it have also have been used as an analytical tool instead of logistic regression? The next section argues that bivariate methods can be a dangerous tool of analysis in multivariate situations.

Methodological Implications

Bivariate tools are not very suitable for analysis of survey data. Economists usually rely on survey data, rather than experimental designs. One limitation of survey data is that the control group differs from others in a large number of variables. Hence, the dependant variables is usually affected by a large number of variables that act simultaneously, that is the problem is multivariate rather than bivariate.

Bivariate analysis in a multivariate context can lead to errors. First, because independent variables in survey data tend to be well correlated, since they are frequently hierarchical. For instance, Table 3 shows that the rank correlation of house type with caste, education and income ranges between 0.162 and 0.237, and is highly significant. Since bivariate analysis excludes all but one independent variable, the included variable is likely to capture the influence of excluded variables and exhibit a spurious relation. Second, since bivariate analysis does not adjust the dependent variable for the action of other variables, it is possible that weak influences on the dependant variable will not be picked up.

Table 3. Correlation of Hierarchical Variables

	Housetype	Caste	Education	Income
Spearman's Coeff.	.162	.189	.237	
Sig. (2-tailed)	.000	.000	.000	
N	1021	1021	1004	

Table 4: Rank Correlation between Awareness and Other Variables

	DFE awareness	Income	House type	BUYDUM
Spearman's Corr.		.178	-.032	-.039
Sig. (2-tailed)		.000	.305	.218

The sample data can be used to illustrate the above problems. Table 4 shows the rank correlation between awareness and other variables. It can be seen that the correlation between income and awareness is 0.178, and highly significant. In contrast, the binary regression analysis found the relation to be not significant in the presence of other variables, as a result of which, it was dropped from the final regression. On the other hand, the correlations between house type and DFE awareness, and BUYDUM and DFE awareness are both not significant, even at 20%, even though they show significant association in logistic explanation.

Table 5. Awareness by House type

house type		Pucca	Semi-pucca	Kuccha	Total
Not aware	Count	108	192	131	431
	%	44.4%	43.25	40.35	42.6%
Aware	Count	135	252	194	581
	%	55.6%	56.8%	59.7%	57.4%
Total	Count	243	444	325	1012
	%	100%	100%	100%	100.0%
Chi-square	**1.112**	**Df=2**	**Sig: 0.574**		

Thus bivariate analysis also fails to pick up significant influences. This problem is not limited to correlation analysis alone, but extends to cross tabulations as well. For instance, consider the contingency tables 5 & 6. Table 5 detects no significant difference in awareness between the different house types. Chi-square test of homogeneity is also unable to reject the hypothesis of homogeneity. Likewise, Table 6 detects no significant different of awareness between those who buy all their firewood, and those who collect at least part of it. The corresponding chi-square statisitic is also not significant.

Table 6: Awareness by Type of FW Users

BUYDUM		Not buyers	Buyers only	Total
Not aware	Count	354	77	431
	%	41.7%	47%	42.6%
Aware	Count	494	87	581
	%	58.3%	53%	57.4%
Total	Count	848	164	1012
	%	100%	100%	100.0%
Chi-square	**1.523**	**Df=1**	**Sig.=0.217**	

Clearly if the researcher were to rely upon cross-tabulation and chi-square analysis alone, he would be led to detect no significant association between house type & awareness, and fw-buyers and awareness. In contrast to these findings of bivariate analysis, logistic regression finds that households that buy all their firewood are 3 times as likely as households that collect at least part of their firewood, to be aware of DFE. Likewise, the previous section has shown that those who live in poorer type of houses (kutcha, semikuccha) are more likely to be aware of DFE than those who live in pucca houses.

Thus, the results of the foregoing analysis sound a strong warning against the use of bivariate tools of analysis to detect or estimate associations in multivariate contexts, especially in survey data. However, it is quite feasible to use cross tabulations as descriptive tool to further understand regression results, as has been done in the last paragraph of the preceding section.

Conclusions and Policy Implications

This study reveals the severe limitations of tools of bivariate analysis (correlations, cross-tabulations, chi-squares) in multivariate situations involving survey data. In some cases bivariate tools fail to detect associations revealed to be significant by logistic analysis, and in other cases, they detect a spurious association by attributing the effects of excluded variables to the included independent variable.

This apart the study suggests that the costs imposed by deforestation heighten the awareness of DFE in firewood users. Specifically, households that buy all their firewood are 3 times as likely to be aware as households that collect at least part of their firewood, ceteris paribus. Likewise, every extra kilometre travelled to collect free firewood increases the odds of awareness by 94%, ceteris paribus.

Income, education of the head, and community affiliation show no significant association with awareness. However, those in poorer dwellings are more likely to be aware of the DFE than those in pucca houses, ceteris paribus. Large cultivators are more likely to be

aware of DFE, whereas ag. Labour are less likely to be aware than other occupations, controlling for other factors.

Finally, ceteris paribus, firewood users in less fertile districts appear to be more likely to be aware of the DFE effect than firewood users in more fertile districts.

The results of the study provide pointers for the focus of reforestation/social forestry programmes. Awareness appears to spread with the distance of free firewood, and the monetary costs of firewood. It seems plausible that the greater the awareness, the greater the receptivity to reforestation/social forestry programmes. This suggests that villages that are more distant from sources of free firewood, and/or where a greater proportion of households buy all their firewood, are prime targets for reforestation/social forestry programs.

The results also suggest on what groups/areas, campaigns to increase awareness of DFE should be concentrated. They suggest the need for a greater focus on agricultural labour, dwellers of pucca houses, and more fertile districts, relative to other groups.

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