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Common pool resource dependency of fisheries based rural households: An evidence from North-east India

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ABSTRACT

The study was conducted in the state of Tripura to investigate common pool resource dependency and found that households involved in collecting common pool resources showed 'U' shaped relation with households' current income in a given year. This indicates poorest and richest were depending more on common pool resources than intermediate income quartile. These results suggest that common pool resources play significant role in generating income for poor as well as rich households. Probit model was used to understand the resource dependency of the sample households which showed that timber wood collection, fodder collection, fuel wood collection, collection of tuber crops and capture fishery had significant impact on improving the household income. The study suggests feasibility of natural resource-based development strategies for alleviating poverty and accumulation of productive assets of rural households.

Keywords: Common pool resources, North-east India, Poverty trap, Resource dependence, Resource led development

Introduction

It is a well known fact that income of poor rural households in developing countries mainly depend on common pool resources such as forest, capture fishery and land grazing for their livelihood. Several studies in the past have attempted to quantify this dependence (Jodha, 1986; Hecht *et al.,* 1988; Fisher, 2004; Adhikari *et al.,* 2004; Vedeld *et al.,* 2007). Beck and Nesmith (2001) examined the poor peoples' dependence on common property resources with focus on developing sustainable livelihood and identified common pool resources as the crucial element in reducing poverty, income equity, gender and management issues for the poor of India and West Africa. Several other studies focused on how the income derived from common pool resources varies with households' total income and what this implies for income distribution and its' equity among households. Jodha (1986), Cavendish (1999a, b), Reddy and Chakravarty (1999), Fisher (2004) and Adhikari (2005), found how the common pool resource income reduces income inequality among the households. With this background and considering worldwide dependency of poor rural household's income on common pool resources such as forest, capture fishery and land grazing for their daily livelihood, the present study was taken up in the state of Tripura to understand the dependency of the poor households on common pool resources and how the dependency varies with the household's total income.

Data

Data related to resource dependency for this study was collected from 230 households from 32 villages of Dhalai Tripura, West Tripura, North Tripura and South Tripura Districts of Tripura State covering the period from April 2016 to March 2017. Whenever possible, information about household's total income and asset owned by the households were collected directly from the households' head. The households' head is defined as the member of the household who is responsible for each economic and financial dealings of the household and thus the head was often male and only a few (15 household heads) were females.

Study site

The study was conducted in 4 districts of Tripura which shares international border with Bangladesh from three sides (south, east and west). The state has an area of 10,491 km^2 and lies between 22°56'N to 24°32'N and 90°09'E to 92°10'E. The length of international border shared with Bangladesh is 856 km (84% of the total length of border). The rest of its border length is shared between North-eastern states of Assam (53 km) and Mizoram (109 km). As per 2011 census, the state of Tripura has a total population of 36,71,032 with a density of 350 individual per sq km and about 83% of state's population live in rural areas. Due to its geographical isolation, economic progress in the state is hindered. In spite of poverty and unemployment in the state, the literacy rate of Tripura is 87.75% (GoI, 2011).

Sampling procedure

The study used primary data collected through multi-stage stratified random sampling of rural households related to fisheries. Four among the eight districts of the state *viz*. Dhalai, South, North and West Tripura districts were selected randomly. Two sub-divisions from each selected district and one rural development block from each selected sub-division were selected randomly. Thus, a total of 8 rural development blocks were selected. From each of the selected rural development blocks, 4 villages were selected randomly. A list of households involved in common pool resource collection and are directly or indirectly involved in fisheries activities like production, fishing, fish retailing, wholesaling and other facilitative activities like ice production and packaging, were prepared for each of the selected villages. From the selected villages, 230 sample households that were collecting resources were selected consisting of 90 households involved in capture fisheries and 140 households not involved in capture fisheries. The data from sample households were collected by personal interview method with the help of pre-tested schedules specifically designed for the study.

The data collected from respondents were first used to calculate current income of households obtained during the survey year *i. e.* April 2016 to March 2017, from common pool resources based on study of Narain *et al*. (2008) namely, (a) Fuel wood collection; (b) Dung for fuel; (c) Fodder collection, (d) Construction wood collection, (e) Fruits collection, (f) Tuber crops collection and (g) Capture fishery resource collection. Income from each of these sources was calculated based on monetary value of their collection.

Income quartiles and tools

After calculation of current household income from all the sources, households were divided in to four income quartiles from lowest income quartile to highest income quartile to see the variation of their dependency on common pool resources by different income quartiles (Narain *et al*., 2008). Lowest income quartile comprised of 27 sample households, 25-50% income quartile comprised of 154 sample households, 50-75% income quartile comprised of 37 sample households and top income quartile (75-100%) comprised of 12 sample households. Thus, income quartile-wise resource dependency of a total of 230 sample households was calculated and are presented in the subsequent section of this paper.

Resource dependence of the sample households

Table 1 presents the composition of current income from common pool resource collection and demographic characteristics of the households by current income quartile. Income quartile-wise, household's income from several common pool resources and demographic characteristics were estimated as per Narain *et al*. (2008). Large disparity between the poor income quartile and rich income quartile was noted. Lowest income quartile had household income of ₹13,946/- per annum from common pool resources and top income quartile had household income of ₹11,708/- per annum from common pool resource collection. The dependence of household's income on common pool resource collection was found not to decline gradually with increase in income but dependency showed 'U' shaped relationship in which dependence declined first in lower income quartile which then increased in top income quartile. This result contrast the findings of Jodha (1986); Reddy and Chakravarty (1999); Bahuguna (2000); Cavendish (2000); Beck and Nesmith (2001); Adhikar *et al*. (2004); Fisher (2004); Adhikari (2005) and Narain *et al*. (2008). It may be due to the fact that freely available resources were more consumed by households of lower income quartile.

Table 1. Composition of current income and demographic characteristics of the sample households (₹ per annum per households)

Source of income for the sampled households	Current income quartile				Overall
	Lowest 25%	25-50%	50-75%	Top 25%	
Sample size (Nos.)	27	154	37	12	230
Total income	29716.66	52330.19	80879.72	124708.33	58044.56
Income from common pool resources	13946.29	10240.58	10855.40	11708.33	10851.08
Fuel wood collection	559.25	409.41	440.54	466.66	435.00
Dung collection	283.33	358.76	366.21	266.66	346.30
Fodder collection	651.85	714.28	108.10	500.00	598.26
Timber wood collection	3777.77	2198.05	3675.67	2000.00	2610.86
Fruits collection	400.00	249.02	278.37	100.00	319.78
Tuber crops from forest	777.77	866.88	545.94	441.66	794.34
Capture fisheries	5598.69	7496.29	5424.67	4572.97	6725.00
Age of households head (years)	44.62	44.08	42.73	43.21	43.88
Education level (years)	3.15	4.91	6.32	6.52	5.01
Pond owned by households (ha)	0.14	0.25	0.28	0.55	0.25
Household size (nos.)	7.00	5.3	5.01	4.40	5.40
Agricultural market distance (km)	12.21	10.12	13.24	13.20	11.02

Income from capture fisheries was also higher in case of lower income quartile which indicates that the poor were generating more income from the resource since low investment or almost no investment was needed in this sector. It was also observed that households of top income quartile were also exploring capture fishery resources. Table 1 clearly indicates, lower level of education in terms of the year of schooling in the lower income quartile households (3.15 years) and higher level of education in case of higher income quartile (6.52 years of schooling). This indicates positive correlation among income quartile and year of schooling. Pond owned by the household was also found to be monotonically increasing with the income quartile indicating that poverty is attributed to the less pond area owned by the poor. The average age of head of household was 44 years. The household size gradually decreased with the income quartile indicating negative correlation between income quartile and size of the households. The average distance to the market was 11.02 km which imply the need of development of market infrastructure in the study area to boost transactions and higher income generation across all income quartiles.

Income quartile-wise share

The current income quartile-wise percentage share of the common pool resources to the total current income is presented in Table 2. Perusal of the table shows that among the sample households those were involved in collection of any kind of common pool resources, the poorest derived 46% of the total current income from the common pool resources. This share decreases in the second, third and fourth quartile to 19, 13 and 9% to the total current income from the common pool resources, respectively, that indicates inverse relationship of dependency on common pool resources with the household's total income. This result corroborates the findings of Jodha (1986), Reddy and Chakravarty (1999) and Narain *et. al.* (2008). It was also found that dependence on capture fisheries by first income quartile group was highest (18.84%) and lowest in fourth income quartile (3.66%). The share of capture fishery across all current income quartile decreases monotonically which indicates poor are more dependent on capture fisheries resources, that declined with increase in total income of households.

Statistical significance of these observed trends is presented in Table 2, which shows the F statistics from ANOVA for each current income quartile. While calculating the same, income was taken as categorical variable, nE {1,2,3,4} if the households fall in n^{th} income quartile and then testing the significance of the slope coefficient. F statistics clearly indicates fuel wood collection and income from capture fisheries are significantly different among all the income quartiles at 5% level of significance and collection of construction wood is significantly different among all the income quartiles at 1% level of significance.

Resource dependency as a function of total income

To understand the resource dependency of the sample households, Probit model was used (Leung and Yu, 1996; Puhani, 2000; Narain *et al.,* 2008). While estimating the Probit function, only those households collecting resources were taken into consideration. The income share (%) was calculated by dividing total income from resource collection by total income from all the sources and multiplying with hundred. Then the mean of the income shares in per cent of the resource collecting households was calculated. After calculating mean, the households whose income share was higher than the mean value was coded as '1' and households whose income share of resource collection was less than mean value was coded as '0'. Thus, the dependent variable was dummy variable and all the parameters of common pool resources were taken as independent variables. After selection of dependent and independent variables, Probit model was estimated using software GRETL (Gnu Regression, Econometrics and Time series Library) software developed by Baiocchi and Distaso (2003). The result of the Probit model is presented in the Table 3.

The McFadden pseudo R-squared value was 0.33, that is smaller than R-square and falls in between 0.2 to 0.4,

Table 2. Income quarter-wise resource dependency of sample households (%)

Resource	Income quartile				Overall	F statistic
	Lowest 25%	25-50%	50-75%	Top 25%		
Fuel wood	1.88	0.78	0.54	0.37	0.74	3.86*
Dung for fuel	0.95	0.68	0.45	0.21	0.59	0.82
Fodder	2.19	1.36	0.13	0.40	1.03	1.49
Wood for construction	12.71	4.20	4.54	1.60	4.49	2.76*
Fruits	1.34	0.47	0.34	0.08	0.55	1.26
Capture fisheries	18.84	14.32	6.70	3.66	11.58	4.72**
Tuber crops	2.61	1.65	0.67	0.35	1.36	2.12
All resources combined	46.93	19.56	13.42	9.38	18.69	2.48*

*Indicates significant at 1% level of significance and **indicates significant at 5% level of significance.

Table 3. Common pool resource dependence as a function of current income

Particulars	Coefficient	Std. Error	Z	p value	Slope
Constant	-0.703449	0.17493	-4.0213	0.0001**	-4.0213
Capture fisheries	0.107217	0.0348585	3.0758	0.0021**	0.0422
Fuel wood	0.159089	0.074364	2.1393	0.0324*	0.0627
Dung for fuel	0.0348225	0.168004	0.2073	0.8358	0.0137
Fodder	0.210639	0.107121	1.9664	0.0493*	0.0830
Timber wood	0.144424	0.0440685	3.2773	0.0010**	0.0566
Fruits	0.175171	0.107287	1.6327	0.1025	0.0690
Tuber crops	0.224667	0.0766722	2.9302	0.034*	0.0885
McFadden R-Squared		0.33			
Adjusted R-Squared		0.21			
Log-likelihood		-136.57			
Schwarz criterion		316.58			
Akaike criterion		289.15			
Hannan-Quinn		300.22			
N		228			
% Correctly predicted		73.7% (168)			
Probability >Chi-square		13.68 (0.00106*)			

*Indicates significant at 5% level of significance; **Indicates significant at 1% level of significance

which is considered highly satisfactory. The model predicted 73.7% variables correctly. The co-efficient of income, from fuel wood collection, from fodder collection, from timber wood collection, from tuber crops collection; from forest and income from capture fishery resources were positive and significant (based on p-values). The effect of income from timber wood collection and income from tuber crops collection on the households was found significant at 1% level and the effect of income from fuel wood collection, income from fodder collection and income from capture fishery resources were found significant at 5% level. It implies that when income received from common pool resources *viz*, fuel wood, fodder, timber wood collection, tuber crops and capture fishery increases, the likelihood of positive impact on poor household's total income increases. The Chi-square value for test of normality of residuals was found 13.68 (p-value=0.0010) and significant. It implies the acceptance of assumption on Probit regression regarding the normal distribution of errors.

The coefficients of all the common pool resources presented in Table 3 did not directly show the magnitude of effect of income from each resource towards positive impact on household's total income which will lead to better livelihood status. The 'marginal probability effect' of each explanatory variable is required to be estimated to find out the magnitude of effect on dependent variable. For this, 'marginal probability effect' in terms of 'slope at mean' for each explanatory variable was estimated using Gretl. As Gretl did not provide the p-values and slope at the same time, the analysis was repeated using Gretl for estimating the 'slope' (marginal probability effect) of the independent variables. The estimated values of marginal probability effect of each independent variable have been mentioned in last column of Table 3. The values showed the probability of having positive impact on households' total income from resources due to one-unit increase in the effectiveness of the explanatory variables. For example, 'marginal probability effect' for the explanatory variable income from capture fishery resources is 0.0422, implies that every unit increase in income from capture fishery is having 4.22% probability for improvement in household's total income. Similarly, the likelihood of positive impact on household's total income from common pool resource collection increases by 6.27, 8.30, 5.66 and 8.85% for one-unit increase in income from fuel wood collection by the households, income from fodder, income from timber wood collection and income from tuber crops collection, respectively.

The study revealed that those households collecting common pool resources for generating their livelihood are mainly dependent on timber wood collection, fodder collection, fuel wood collection, collection of tuber crops and importantly capture fishery which corroborates the study of Singh *et al.* (1996). Proper management of common pool resources like capture fishery may be one of the vital factors to improve the livelihood of the rural fisheries households of the study area. Pearce (2005) and Narain *et al.* (2008) suggested the feasibility of natural resource led development strategies. These strategies will do more than merely alleviation of poverty, rather will lead to escaping from poverty trap by lifting the income above the subsistence level of respective households and also lead to accumulation of their productive assets (Angelsen and Wunder, 2003).

Resource dependency as a function of households' demography

After calculating mean of income share of resource income in total households income, the households whose income share was higher than the mean value was coded as '1' and households income share of resource collection having lesser than mean value were coded as '0' and taken as dependent variable. Other households characteristics *viz,* age (continuous variable), sex (dummy), year of schooling, caste (categorical), family type (dummy), number of members in family and land holding by the households were taken as independent variable. Logit model was then estimated using SPSS verion 16 and presented in Table 4.

The logistic regression coefficient was interpreted based on odds ratio. For variables those are significant in the model, an odds ratio greater than one indicates that the relevant factors tend to increase resource dependency and the factors for which odds ratio is lesser than one indicates that the relevant factors tend to decrease resource dependency.

The major factors contributing to resource dependency were social group, family size and households land holdings. The odds of resource dependency were highest for social group followed by family size and households land holdings. The odds of social group in resource dependency by the family 5.27 indicates chance of collecting resource is 5.27 times greater for any scheduled tribe (ST) households than any general category households as the people of this category are generally poor. The odds of 2.5 for family size indicates chance of collecting resource is 2.5 times greater in large family than small family. But the odds of household's land holding (4.34) indicates that there is 4.34 times fall in resource dependency of households with large land holding than households with no land holdings at all.

Table 4. Resource dependence as a function of profile of the households

Variables	Coefficient	Odd ratio	Std. Error.
Constant	-3.603	0.02	1.39
Age	0.014	1.01	0.01
Sex	-0.052	0.94	0.46
Level of education	0.56	1.75	1.12
Caste	0.927*	2.52	0.69
Family type	0.182	1.19	0.08
Family members	0.918*	2.50	0.61
Households land holdings	-0.57**	0.56	0.23
Prob> Chi square	0.002		
Cox and Snell R square	0.57		
-2 log likelihood	288		
N	228		
Correctly predicted	76.1%		

*Indicates significant at 5% level of significance; **Indicates significant at 1% level of significance

Previous studies on common pool resource dependency in several developing countries showed decline in common pool resource dependency with the increase in household's total income. However, this study examines the common pool resource dependency of households of Tripura by using different measures of resource dependency. The share of common pool resource income in total current income of sample households indicate high levels of dependency for households that happen to have low current income in a given year but dependency increased in top income quartile. It may be due to the fact that owing to free availability, the resources were more consumed by the lower income quartile. Income from capture fisheries was higher in case of lower income quartile which indicates the poor were generating more income from these sources since low investment or almost no investment was needed in this sector. On the other hand, the findings that dependence on some common pool resources like tuber crop collection and fruits collection gradually declines with increase in income due to the ownership of more productive resources. Later on, study also found that social group, family size and households land holdings as the major factors contributing to resource dependency. The study suggests the feasibility of natural resource led development strategies for alleviating poverty and accumulation of productive assets of rural households.

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