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Jhum cultivation and its consequences on forest and environment in Eastern Himalayan tract of India: a participatory assessment

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Abstract
Shifting or *'jhum'* cultivation, is a predominant form of farming in North East India, practiced since time immemorial. The ever shortened *jhum* cycle in the region has impacted both the forest and environment negatively. The present study was an attempt towards participatory assessment of these impacts vis-à-vis indiscriminate *jhuming*. The sample of the study consisted of 660 *jhumia* families across seven North Eastern states. As high as 80.61 per cent of the *jhumias* perceived negative consequences of *jhum* cultivation on forest in terms of significant reduction in forest area over the years and 44.55 per cent *jhumias* felt that there had been complete loss of forest due to indiscriminate *jhuming.* Similarly 67.73 per cent *jhumias* perceived that *jhum* cultivation has resulted in soil erosion, enormous loss of top soil and soil nutrients. Education, family size and cosmopoliteness largely determined their awareness. About three fourth (73.03%) of the *jhumia* families had a per capita income of less than US$1 a day, only 11.97 per cent of them had a per capita income of more than US$ 2 a day. The study suggested that there is urgent need for initial investment by the Government, exploration and promotion by the grassroots level organizations for creating alternate farm based and nonfarm employment opportunities in order to enable the *jhumias* in meeting livelihood requirements and thus restoring the length of fallow, forest and environment.

Keywords: Environment, Forest, *Jhum*, *Jhumia*, Logistic regression, Negative consequences

Introduction

The North Eastern Region of India comprising of eight states, occupy 7.8% of the country's total geographical area (262,179 sq. km) and about 24.51% of the country's total forest cover (171,964 sq. km.) (FSI, 2015). More than 70 per cent of the region's land is hilly and 65.59 per cent of geographical area is under different types of forests- very dense, moderately dense and open. The region therefore is characterized by its undulating topography, forests, enormous biodiversity, ethnicity, extreme remoteness and marginality. Shifting cultivation also known as 'slash and burn' and popularly as *'jhum'* cultivation, is a predominant form of farming in North East India, practiced since time immemorial. An enormous amount of land (386, 900 ha.) is estimated to be brought under *jhum* cultivation in North East region every year and nearly 4.43 lakh families comprising of almost all the major tribes in the region earn their livelihood primarily from *jhum* cultivation (Choudhury and Sundriyal, 2003). *Jhum* cultivation is undertaken in an area not less than 1.96 mha in the region (Tripathi and Barik, 2003). The ever shortened *jhum* cycle in the region since the last few decades has put tremendous pressure on natural resources, resulted in drastic decline in soil productivity and has left several detrimental effects on both forest and environment (Toky and Ramakrishnan, 1981; Arunachalam and Pandey, 2003; Lele and Joshi, 2009). An estimated 3 million hectare of land in the region is under different types of soil erosion hazards as a result of *jhum* cultivation (Mondal, 2011). With the ever increasing demand for food, it is therefore quite challenging to restore the forest cover, conserve the environment and biodiversity in the region. There was a need to assess the extent of awareness among the *jhum* practitioners *(jhumias)* regarding the negative consequences of *jhum* cultivation on forest and environment. The present study was undertaken to gauge the negative effects of *jhum* as perceived by the *jhumias,*

to trace out the aspects shaping the *jhumias'* perception and thereby suggests some policy measures for restoration of *jhum* cycle, conserve forest and environment.

Materials and Methods

Area of study and designing: The study was conducted during 2015-16 in the *Jhum* dominated North Eastern region of India. Primary data were collected through Participatory Rural Appraisal (PRA), extensive household survey including personal interview and focused group discussion using a pretested structured personal interview schedule in randomly selected forty four villages from eleven districts of seven North Eastern states. Fifteen *Jhumia* farm families from each of the forty four villages were randomly selected for interview and thus the sample size of the study was six hundred and sixty (N= 660) across fifteen different tribes (Table 1). The study followed an *ex-post-facto* research design. An *ex-post-facto* design in the context of a social research seeks to reveal possible relationships by observing an existing condition or state of affairs and searching back in time for plausible contributing factors (Kerlinger and Rint, 1986).

Table 1. Distribution of respondents across tribes in the study area (N=660)

State	Name of tribe	Frequency	Percentage
Arunachal Pradesh	Nyshi	60	9.09
	Idu	30	4.55
	Adi	30	4.55
Assam	Karbi	60	9.09
Manipur	Tangkhul	60	9.09
	Monsang	15	2.27
	Moyon	15	2.27
	Maring	15	2.27
	Kuki	15	2.27
Meghalaya	Garo	60	9.09
Mizoram	Mizo	120	18.18
Nagaland	Sumi	60	9.09
	Lotha	60	9.09
Tripura	Halam	30	4.55
	Reang	30	4.55

Source: Authors' calculation

Statistical analysis: Descriptive and inferential statistical tools helped in analyzing the collected data and reaching meaningful interpretation. The data analysis software SPSS (ver.21.0) was used for the purpose of data analysis

Results and Discussion

Perceived consequences in forest system: The results of the present study showed that as high as 80.61 per cent of the *jhumias* perceived negative consequences of *jhum* cultivation on forest in terms of significant reduction in forest area over the years (Fig 1). Even 44.55 per cent *jhumias* felt that there had been complete loss of forest in places due to indiscriminate *jhuming*. With increased demand for food and for satisfying other basic livelihood needs, the *jhumias* over a period of time tried to increase production from their *jhum* lands and chose shortening the fallow periods as the easiest option (Choudhury and Sundriyal, 2003). With shortened fallow periods, there was not enough time for forest regeneration and as an inevitable consequence the young secondary forests gradually replaced the older ones. Rapid deforestation over the years due to indiscriminate jhuming in the region has resulted in drastically reducing the forest cover. Within a period of ten years (1987-97) an estimated 1312 sq. km forest was lost in the region (Mondal, 2011). The rate of reduction gradually increased and within a period of only four years *(2011 to 2015) the region lost an estimated forest cover of 628 sq. km (FSI, 2015). Land degradation among many other consequences of forest loss is quite alarming and agroforestry is a potential option to minimize the impacts of the losses incurred. In fact, a more sustainable and resilient agricultural system like agroforestry is predicted to be the most viable future land management decision under accelerated land degradation and associated problems (Roy, 2016). Although varying from system to system, the land management system based on agroforestry immensely contribute in biomass production and carbon sequestration in the soil (Chaturvedi et al., 2016).*

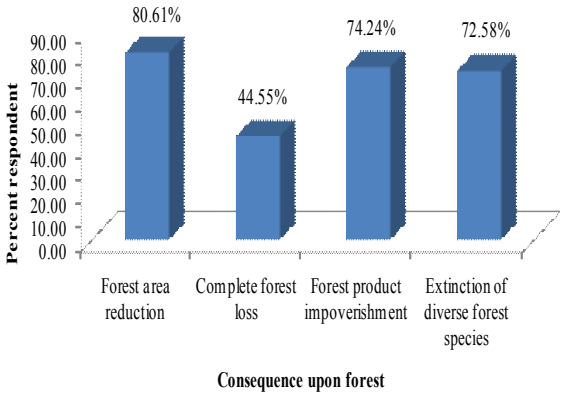

Fig 1. Perception of *jhumias* regarding negative consequences of *jhum* cultivation on forest

The most severe form of deforestation by shifting cultivation took place in two different ways: (i) clearing of new forests in adjacent areas for further cultivation, after keeping the land fallow where *jhum* cultivation was undertaken in the last season, and (ii) complete devastation of forests due to unintended forest fires, resulting from uncontrolled burning during land clearance. Adding further to the menace, the same resulted in extinction of a number of forest species in the region as perceived by majority (72.58%) of the *jhumias*. About 75 per cent *jhumias* opined that this land use pattern led to impoverishment of several naturally available indigenous forest products including honey, wax, bamboo, bamboo shoot, fuel wood and some medicinal herbs.

Consequences on the environment as perceived by jhumias: A majority (69.55%) of the *jhumias* witnessed overall negative environmental consequences of *jhum* cultivation (Fig 2). Deterioration of soil health and significant reduction in soil fertility status over the years due to indiscriminate jhuming was reported by 63.03 per cent of them. As high as 67.73 per cent *jhumias* perceived that *jhum* cultivation has resulted in soil erosion, enormous loss of top soil and soil nutrients.

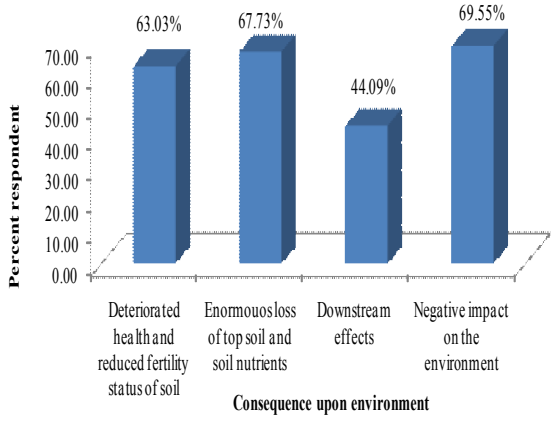

Fig 2. Perception of *jhumias* regarding negative consequences of *jhum* on environment

As the *Jhumias* in the region were practicing cultivation in relatively younger forest soils maintaining shorter periods of fallow, fertility status of the soil degraded to a larger extent with increased crop-weed competition and thus resulting in poor crop yield (Das and Das, 2014). Studies all over world has shown that scientists and policy-makers do not differ in the specific opinion that the current trend of shortening fallow periods under shifting cultivation, has led to significantly increased land degradation and watershed siltation due to soil erosion and losses, increased labor requirements for weeding, reduced crop yields, added environmental pollution and thereby has questioned the sustainability of the system (Grogan *et al.,* 2012). As perceived by 44.09 per cent of the *jhumias*, loss of top soil, landslides due to loss of vegetation, forest and plant cover and soil erosion resulted in various types of downstream effects, like siltation, deposition of gravels and blockage of irrigation channels in the fields of foothills and valleys, more number of floods etc. In an effort to understand whether the *jhumias* as a whole agreed to the fact that *jhum* cultivation was having negative consequences on forest and environment, the Kendall's coefficient of concordance (W) was worked out. The results of the analysis showed that there was significant agreement among the *jhumias* with respect to the negative consequences (Table 2).

Socioeconomic characteristic and their association with perception of jhumias on jhum cultivation: A majority (83.33%) of the heads in the *jhumia* families were male, only 16.66 per cent of them were female (Table 3). One out of every four of the *jhumias* were illiterate whereas a majority (70.7%) of them had qualified up to primary or matriculation standard. A majority (64.39%) of the *jhumias* were in young to middle age group. A large majority (89.09%) of the respondent *jhumias* were married, 10.91 per cent were either unmarried or widowed. A majority (56.22%) of them had a family comprising of 4-6 members, 25.45 per cent having a

Table 2. Kendall's coefficient of concordance depicting extent of agreement among subjects w.r.t perception of consequences of *jhum* cultivation on forest and environment (N=660)

Test variable	Test statistic	Value
(1) Deteriorated health and reduced fertility of soil, (2) Enormous loss of topsoil and soil nutrients, (3) Downstream effects, (4) Negative impact on environment, (5) Forest area reduction, (6) Complete forest loss, (7) Forest product impoverishment, (8) Extinction of diverse forest species	Sample size (n)	660
	Kendall's coefficient of concordance (W)	.085**
	Chi-Square (χ^2)	391.014
	Degrees of freedom (df)	7
	Asymptotic Significance (p)	.000

Source: Authors'calculation

family size of less than or equal to 3 members and remaining 18.33% of the *jhumia* families consisted of more than or equal to 7 members. As high as 30.45% of the *jhumias* were landless, 53.18% were marginal to small, remaining (16.36%) had semi-medium to large landholding. About three fourth (73.03%) of the *jhumia* families had a per capita income of less than US$1 a day, only 11.97 per cent of them had a per capita income of more than US$ 2 a day.

Table 3. Selected socioeconomic characteristics of *jhumias* (N=660)

Variable	Frequency	Percentage
Age group		
18-35	115	17.42
35-55	310	46.97
>55	235	35.61
Sex of head of the family		
Male	550	83.33
Female	110	16.66
Educational status		
Illiterate	170	25.80
Primary	274	41.50
Matriculate	193	29.20
Higher Secondary	21	3.20
Graduate and above	2	0.40
Family size		
3 or below	168	25.45
4-6	371	56.22
7 or above	121	18.33
Marital status		
Married	588	89.09
Unmarried/ Widowed	72	10.91
Land possession		
Landless (0 ha.)	201	30.45
Marginal (<1 ha.)	224	33.94
Small (1-2 ha.)	127	19.24
Semi-medium (2-4 ha.)	58	8.79
Medium (4-10 ha.)	28	4.24
Large (>10 ha.)	22	3.33
Perday per capita income		
<1$	482	73.03
1-2$	99	15.00
>2$	79	11.97

Source: Authors' calculation

A binomial logistic regression was run in SPSS 21.0 to ascertain the effects of age, sex, education, marital status, family size, land holding size, income, credit linkage, extension contact and possession of ICT tools on the likelihood that *Jhumias* were aware about negative consequences of *jhum* cultivation on forest and environ-ment. The Wald test was used to determine statistical significance for each of the independent variables. Educational status (p=.002), family size (p=.040), marital status (p=.076), regular contact with KVK (p=.078) and contact with input agency (p=.081) added significantly to the model and overall prediction (Table 4).

The data in Table 4 clearly indicated that logistic regression model was statistically significant, χ^2 (16) = 58.591, *p*=0.000 and it explained 12.0% (NagelkerkeR^2) of the variance in *jhumias'* perception. It is very common to use binomial logistic regression to predict whether cases can be correctly predicted from independent variables; as in the present study 70.3% of the cases could be correctly classified and predicted.

Jhum cultivation is the most primitive form of land use system and is invariably celebrated as a cultural heritage by the *jhumia* community. *Jhum* is basically practiced on the basis of 'shared knowledge' generated through century long observations and transmission along the family line. As found in course of the present study, higher education and larger family size was associated with an increased likelihood of exhibiting perception of *jhumias* indicating their awareness about negative consequences of *jhum* cultivation. Tribal societies being closely knit with strong family and clan network, labour and other resources are mobilized inside clans (Gupta, 2005). Family size, therefore, plays an important role in determining the extent of knowledge sharing and transmission which ultimately contributes in increasing awareness. Taking into consideration local or indigenous knowledge is very important while planning a programme for modification of such an integral part of socioeconomic system of *jhumias* (Borthakur, 1992; Ramakrishnan, 1993). *Jhumias* having no extension contact, *e.g.,* with the Krishi Vigyan Kendras (KVKs) and input agencies, were 1.5 times less likely to exhibit awareness than those having contacts with the same organizations. Unexpectedly, possession of ICT tools was found to be insignificant in shaping the perception of subjects. In other words, *jhumia* families possessing either of the ICT tools as studied, did not differ significantly in perceiving about negative consequences of *jhum* cultivation from those who did not possess the tools. It may be due to a number of reasons, the most prominent one assumed to be that the *jhumias* are people very close to nature, even subtle changes in the micro ecosystem do not go unobserved by these native foresters, hence they might not have required any further information to be transferred through ICT tools describing the probable

Table 4. Logistic regression coefficients and their significance showing extent of association between dependent and independent variables under the study (N=660)

Independent variables	B	S.E.	Wald	df	Sig.	Exp (B)
Age (Chronological age in years)	0.005	0.007	0.553	1	0.457	1.005
Sex of head of the family (Binary: Male=1, Female=0)	-0.337	0.248	1.850	1	0.174	0.714
Educational status (Nominal: Illiterate=0, Primary=1, Matriculate=2, Higher Secondary=3, UG and above=4)	0.389	0.123	9.919	1	0.002	1.475
Family size (Total number of members residing in the same holding)	0.120	0.059	4.226	1	0.040	1.128
Marital status (Binary: Widow/ Unmarried=0, Married=1)	0.600	0.338	3.151	1	0.076	1.823
Land holding (Nominal: Landless=0, Marginal=1, Small=2, Semi-medium=3, Medium=4, Large=5)	0.102	0.075	1.822	1	0.177	1.107
Average per day per capita income (in Indian National Rupees)	0.001	0.001	0.924	1	0.337	1.001
Alternate source of income (Binary: Yes=1, No=0)	-0.567	0.361	2.464	1	0.117	0.567
Access to credit (Binary: Yes=1, No=0)	0.209	0.190	1.221	1	0.269	1.233
Possession of ICT tools (Binary: Yes=1, No=0)	0.127	0.236	0.291	1	0.589	1.136
Regular Contact with KVK (Binary: Yes=1, No=0)	0.417	0.236	3.108	1	0.078	1.517
Contact with input agency (Binary: Yes=1, No=0)	0.369	0.211	3.047	1	0.081	1.446
Contact with financial organization (Binary: Yes=1, No=0)	0.501	0.318	2.478	1	0.115	1.650
Constant	-0.737	0.652	1.277	1	0.258	0.479

2 Log likelihood= 752.769; Cox & Snell R Square=0.085; Nagelkerke R Square=0.120 Source: Authors' calculation

menace, indiscriminate *jhuming* had contributed in the region. A second factor in this regard should not be ignored, *i.e.*, lack of infrastructure to support uninterrupted and smooth functioning of ICT tools, *e.g.*, adequacy in mobile phone towers, vividness in radio and TV satellite signals etc.

Table 5. Omnibus tests of model coefficients (N=660)

Step	Chi-square value	df	p
Step	58.591	16	0.000
Block	58.591	16	0.000
Model	58.591	16	0.000

Source: Authors' calculation

Conclusion

The present study clearly indicated that the *jhumias* in North Eastern region of India were well aware of the major negative environmental consequences of *jhum* cultivation, but were bound to continue *jhum* cultivation primarily due to their ethnic belief of cultural heritage and more importantly due to lack of alternate employment opportunities to sustain the family needs throughout the year. Gradual shortening of *jhum* fallow for meeting increased family demand bears testimony of the stated fact. There is a need to support the *jhumia* families with some secondary employment opportunities, such that

Table 6. Category prediction in terms of percentage accuracy in classification, specificity and sensitivity (N=660)

Observed		Predicted		
		Jhuming overall negative consequences on forest and environment (Yes=1, No=0)		Percentage Correct
Jhuming has overall negative consequences on forest and environment (Yes=1, No=0)	0	0	1	11.9
	1	24	177	95.9
Overall Percentage		19	440	70.3

The cut value is .500; Source: Authors' calculation

they can support their livelihood needs throughout the year. The same in turn will be a great stride towards curbing the menace of ever shortening of fallow period, and thus conserving forest and environment.

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