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Structural modelling of collective action behavior of farmers for natural resource management

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ABSTRACT

Community engagement is a crucial element for effective management of natural resources. This study is aimed at determining the factors and analyzing their path for collective action behavior of farmers towards natural resource management. Two cases of community based natural resource management were conducted in Phek and Kohima districts of Nagaland during 2020 and with thematic their analysis of activities, the probable factors of collective action among the communities were listed. Through participatory rural appraisal, focus group discussion and personal interview method data, was collected with a total sample size of randomly selected 106 farmers. The composite reliability for the explanatory variables, viz. social cohesiveness, normative belief, collective action for resource management, trust, community orientation, social relationship, and shared values were 0.79, 0.81,0.92, 0.6, 0.72, 0.78, and 0.52, respectively. Exploratory factor analysis resulted in 7 factors with 63.7% of the total variance explained. The obtained factors were validated through measurement modelling by confirmatory factor analysis. The structural model had goodness of fit with acceptable values of RMSEA (0.09), GFI (0.96) and CFI (0.92). The relationship of community orientation was found highly significant with normative belief (Z=6.36**); social cohesiveness (2.27**) and collective action (Z=3.47**). Emphasis should be laid upon promotion of normative beliefs, local institutions, and social values for augmentation of collective action for natural resource management.

Keywords: Collective action, Natural resource management, Structural equation modelling

Change in land use pattern with increasing population, intensification of cropping system, market-orientation, and demand for local development as well as climatic variability have led to immense pressure on natural resources and posed challenge to local forms and practices of resource management. The environmental degradation has been assumed to be the result of the imbalance between of the community and its natural environment. Community based natural resource management (Armitage 2005) has been seen as a solution for restoring this environment and societal relations. Social learning has been found to be very effective in environmental management through community's collective action and reflection that directed towards improving the management of human and environmental interrelations (Keen *et al.* 2005). Social learning plays a key role in natural resource management. The study of Blackmore *et al*. (2014) has proven the role of social learning in tackling the water management complexities in Europe. The present study is aimed in determining the factors of collective action through social learning in community based management of land, water and forest in the hill ecosystem of Nagaland, which is rich in biodiversity and dominated by tribal people, who are entirely dependent on natural resources for their livelihood.

MATERIALS AND METHODS

The case studies of *Zabo* System of farming in Kikurima village of Phek district and Alder based *Jhum* cultivation of Khonoma village in Kohima district of Nagaland were conducted during 2020 to have an in-depth understanding of the process of collective action. A combination of participatory rural appraisal tools (transect walk and resource mapping), focus group discussion and survey with personal interview methods was used to collect the data with a total sample size of randomly selected 106 farmers. Based upon the two case studies and thematic analysis of activities, the probable factors of collective action among the communities were listed. The factors were written in form of statements/ items and were administered to the respondents for seeking their response on a continuum of strongly agree, agree, undecided, disagree and strongly disagree with relative

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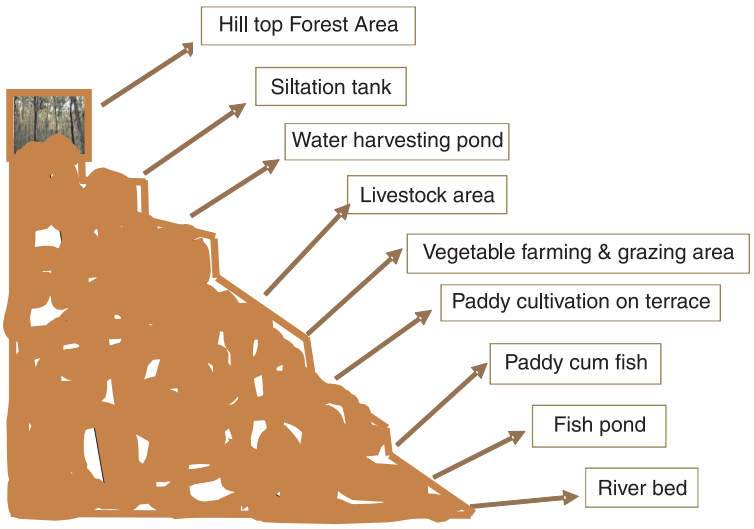

Fig 1 Zabo system of farming.

weightage of 5,4,3,2, and 1, respectively. An Exploratory Factor Analysis (EFA) was conducted in order to determine the dimensionality of the statements. Later, Confirmatory Factor Analysis (CFA) was performed using LISERAL version 8 software to validate the measurement model by assessing the unidimensionality, validity and reliability of the latent constructs derived from EFA. A hypothesized model was developed using the factors obtained through EFA and CFA to analyze the path for collective action behavior. Structural equation modelling was used for testing the model fit using the indices of model fitness, model comparison (CFI, IFI and NFI) and model Parsimony fit, besides testing of the hypotheses.

RESULTS AND DISCUSSION

Case study and thematic analysis: *Zabo* System of farming is a combination of forest area on hill top, agriculture on terrace area, fishery and animal husbandry with well managed soil and water conservation (Fig 1). As this system is managed by community, the factors like trust, social relationship and people's participation seem very important.

Alder based Jhum cultivation is unique as the farmers do not burn the jhum area completely. This model is an integration of terrace farming of wetland rice and vegetables on upper terraces of lower altitude till 1000m from mean sea level, Alder tree based jhum cultivation in height range of 1000 m to 1500 m mean sea level and above 1500 m till 2500 m-3000 m, a conserved community forest area is maintained. Angami tribe demonstrated community approach in conservation of forest and group approach in sharing of resources. Through the thematic analysis based upon the narratives of both the case studies, the factors of collective behavior were extracted (Table 1).

Factor analysis: EFAof the responses of farmers to a set of 29 statements related to collective action in natural resource management showed a significant value ($P<0.01$) of Bartlett's test of Sphericity (1495.05) and Kaiser-Meyer-Olkin measure of sampling adequacy value greater than 0.7. These values suggest the appropriateness of using factor analysis. Seven factors were extracted using the Eigenvalues greater than one and the scree plot criteria. The Eigenvalues for these 7 factors ranged between 6.7 to 1.3 with 63.7% of total variance explained. Having performed the varimax rotation and Kaiser Normalization, the rotated factor loadings for each of the seven factors were examined and the variables with factor loading value greater than 0.5 were chosen as suggested by Portney and Watkins (2000).

The first factor comprised of 4 items (Table 2) with factor loadings (FL) in range of 0.560 to 0.841, 23.99% of the total variance explained (TVE) and the Eigen-vector value (EVE) of 6.96. Following the shared fluency theory of social cohesiveness (Reber & Norenzayan 2018), the first factor was labelled as social cohesiveness. The second factor comprised of three items with FL in range of 0.773 to 0.844. These items reflected the belief of individuals about their well-being. Therefore, this factor was labelled as shared normative belief. The four items with FL in range of 0.541 to 0.778 comprised the third factor. These items are related to sharing of resources and responsibilities. These items were labelled as collective action for resource management (CARM). The fourth factor comprised of three items with respective FL of 0.563, 0.789, and 0.829. Mollering (2006) conceptualized a psychological state as "Trust" where one factor accepts some form of vulnerability based upon positive expectations of the intentions or behavior of another despite the presence of some uncertainties. In these items power to discriminate reliance and positive expectations are present, so the fourth factor was labelled as trust. The fifth factor comprised of three items, with FL of 0.608, 0.743 and 0.556. Matthies *et al.* (2011) defined the situation as community orientation when people of a community have strong willingness to engage in common goods, have interest in active participation for community work, and resolve conflict within the group. As the items had similarity with concept, they were labelled as community orientation. Two items with FL of 0.773 and 0.830 constituted the sixth factor.

Table 1 Thematic analysis and identification of factors related to collective management of resources

Resource	Activities		Thematic pattern
	Zabo system	Alder based *Jhumming* system	
Land	Land sharing for water catchment and cattle rearing areas	Land sharing for pond and water channel	a
Water	Construction and maintenance of water harvesting structures by community		b
	Sharing of irrigation water		a
Seed	Exchange of quality seeds		a, e, f
Labour	Helping each other in agricultural activities	Helping each other in agricultural activities, without hiring labours from outside	c, f, g, h,
Money	Borrowing of money from neighbors, relatives and SHGs; rarely from bank		h
Forest	Forest area divided and allotted to each family for its management.	Youth committee and Nature conservation and Tangopang sanctuary committee to look after the forest area conservation.	b, c, e, i
	Planting a tree in name of a family member for personal attachment.	Forest in Jhum area divided into families, allotted families take care.	
	Village committee looks after conservation activities.	Severe punishment by village council for hunting of birds, cutting of trees from protected area	
	Appreciation award for best management of forest.		
Livestock	Cattle area at upper reach of water harvesting pond is shared by 10-12 families on rotation basis	-	f, g, h
Knowledge	Social learning	Knowledge dissemination through *"Thesu"* group consisting of children of age group 9-10. Each group is allotted an agricultural labour, known as Parent for that group. He facilitates learning of farming skills, rules, regulations, rituals of the village.	a, c, e, j,
Social capital	*Funye*	*Terhunyi*	c, e, g
	It is a thanks giving festival to Nature God for good harvest. They also thank to those have helped in their fields by exchanging fish curry and rice.	It is also a thanks giving festival after harvest	

(a) Community orientation, (b) Collective action, (c) Shared valued, (d) Community orientation, (e) Normative belief, (f) Social cohesiveness (g) Social relationship, (h) Trust, (i)Shared responsibilities, (j)Social learning

The networking ties that provide access to resources, access to people for knowledge exchange through interpersonal connections and anticipation of values in such exchange have been termed as social relationship. Following the social capital theory, it was labelled as social relationship. The seventh factor comprised of two items with FL of 0.623 and 0.549. Irvine *et al.* (2016) stated a situation of shared values where views of an individual are based on social preferences, formation and the expression of the views are integrated with human and ecological well-being. The seventh factor was labelled as shared values. Finally, the seven identified factors were taken as constructs for the study and were subjected to CFA for assessing unidimensionality, validity and reliability.

Measurement modelling through confirmatory factor analysis: With FL > 0.5 obtained for the items (Table 2), unideminsionality was established. The reflective outer model was tested by examining the internal consistency of each construct through the most common method of Cronbach's alpha and composite reliability with acceptable range of 0.6-0.7 (Hair *et al.* 2016). Cronbach's alpha for all the constructs were in acceptable range except for the construct "shared values". However, the construct "shared values", was retained for analysis based on criteria of an acceptable range of Cronbach's Alpha and FL i.e. >0.50 (Hamid *et al*. 2017). All the indices of fitness of measurement model were under the recommended range except for CFI and NFI. As Hu and Bentler (1999) suggested two-index format presentation, *i.e.* model should at least fulfill two criteria which must include RMSEA or RMR or NNFI or CFI; the measurement model was considered fit. The convergent validity was analyzed through Average Variance Explained (AVE), which ranged between 0.34 to 0.64. Kline (2011) had suggested an equal to or greater than 0.5 as the acceptable range of AVE for adequate convergence of the items, while Lam (2012) suggested that if AVE is less than 0.5 and reliability is more than 0.6, then the construct is acceptable. Discriminant validity was supported, as the AVE of each construct was greater than the shared variance (squared correlation) of all other constructs (Fornell and Larcker 1981).

Hypothesis development for structural modelling: Based

Table 2 Measures of exploratory and confirmatory factor analysis

Factors and statements	Factor Loading EFA	Standard loading CFA	CR	Cronbach's Alpha	AVE
Social cohesiveness			0.79	0.785	0.5
People feel responsibility for others and are willing to help each other	.841	0.86			
I actively participate in political and social institution and put our words	.655	0.64			
I feel strongly connected in our village	.659	0.72			
I have high level of confidence in local knowledge developed by our colleagues	.560	0.55			
Normative belief			0.81	0.81	0.6
I believe support of society is important to be success	.773	0.8			
When I learn from colleagues' experience it gives confidence	.844	0.79			
I get enthusiasm by seeing fellow farmers are doing well	.805	0.72			
Collective action for resource management (CARM)			0.74	0.92	0.43
I work according to the prescribed rule made by our local institutional body	.756	0.92			
We work on shared interest	.778	0.52			
I share resources among the member of the society	.541	0.39			
Responsibility for managing our environment is shared among different categories of member in our society	.773	0.67			
Trust			0.6	0.6	0.34
I can rely on my neighbor for my agricultural activities to be done when I am ill.	.563	0.29			
In our village, one has to be alert or someone is likely to take advantage of you.	.789	0.59			
In our village, people generally borrow money from neighbors when needed	.829	0.77			
Community Orientation			0.72	0.73	0.46
I will always to work together to bring harmony in the society	.608	0.66			
I help others so that everyone gets resources for their livelihood	.743	0.74			
I believe everyone should have equal opportunities in life, so I share the work and resources with my community	.556	0.63			
Social relationship			0.78	0.78	0.64
I easily find someone to help in my agricultural activities	.773	0.78			
There is person to whom I can turn to for advice about handling problems with my family	.830	0.82			
Shared values			0.52	0.75	0.4
I respect nature and integrate my views with others to protect it.	.623	0.79			
Protection of tradition and nature needs collective action	.549	0.36			

on social capital theory (Häuberer 2010); expectancy-value theory (Fishbein and Ajzen 1980); and social learning theory (Bandura 1971); a conceptual framework was developed to understand the collective action behavior for natural resource management. The key ingredient of social learning for resource management are social relationship, trust, value sharing, awareness and common understanding of the complexities present in management system (Pahtl-Wostl and Hare 2004). Social environment significantly contributes to the creation and sharing of knowledge, if it is rich in social capital as identified by shared behavioral norms, social network, reciprocity, and respect. So, it was hypothesized that social relationship, trust, shared normative beliefs and shared values acted as pre-requisite for the participation in welfare orientation actions. Social relationships or social ties create cohesive social network which facilitates action of individual in group. Therefore, social relationship are considered as precursor for social cohesiveness. Based on

previous studies, 6 hypotheses were developed to determine the path of collective action behaviour by the process of social learning. H_1: Social relationship positively influences social cohesiveness. H_2: Normative belief positively influences community orientation. H_3: Trust positively influences community orientation. H_4: Shared values positively influences community orientation. H_5: Social cohesiveness positively influences community orientation. H_6: Community orientation positively influences collective action for resource management.

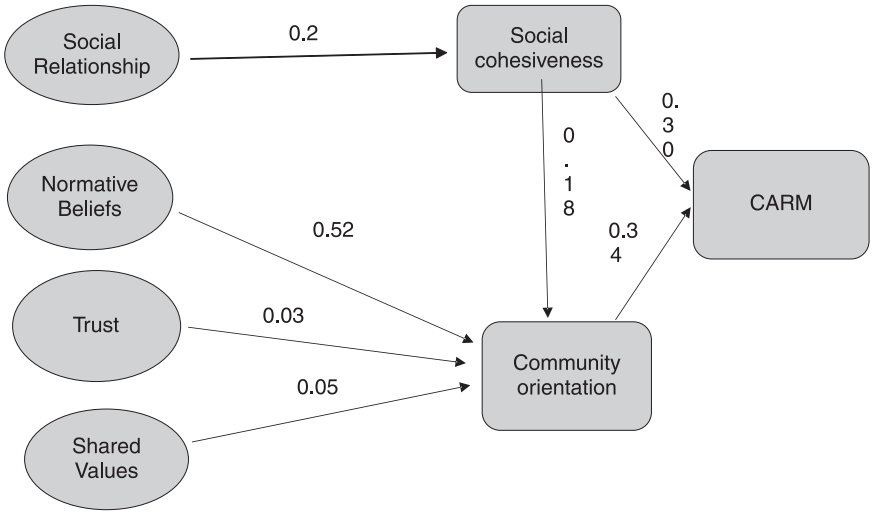

Fig 2 Standard Loadings of Paths.

Path analysis suggested creating an additional path from social cohesiveness to "collective action for resource management" for better model fit. So, this path was created and the result was analyzed. The model fit indices were RMSEA=00.09, GFI=0.96 and non-significant chi-square. The model had the values as 0.92, 0.93 0.86 for CFI, IFI and NFI, respectively. The parsimony index (comparison of chi-square and degree of freedom) value was 1.9. Fitness indices were within the recommended range, thus model had perfect fitness. Further hypothesis testing was done.

The path coefficients were examined to identify if they were significantly different from zero. The parameters whose Z-values were >= ±2 were considered significant (Joreskog and Sorbom 1986). The model (Fig 2) shows that social relationship has significant relation with social cohesiveness (Z=2.15*). Similarly, normative belief had significant relation with community orientation (Z=6.36**). Whereas, trust and shared values showed a non-significant but positive relation with community orientation. It could be due to small sample size. The relation between social cohesiveness and community orientation was found significant (Z=2.27**). Further, the relationship of social cohesiveness (Z=3.47**). and community orientation (z=3.98**) with collective action for resource management were found significant Thus, social relationship, normative belief, community orientation and social cohesiveness were found important precursors for collective action by the community people for resource management. The farmers in the study area had a strong sense of community orientation and cohesiveness as revealed in their habits of sharing, reciprocity in labour exchange, and adhering to the social norms in conflict management.

The study shows that social factors, viz. social relationship, trust, social cohesiveness, shared values, shared normative beliefs, and community orientation were identified as important factors. Case analysis of *Zabo* sytem and Alder based jhum cultivation suggested that the regulatory mechanism through community institutions and customary resource management practices need to be tapped in local planning and interventions. Augmentation of community participation in decision making as well as empowerment of local institutions hold the key to effective regulation of practices and conservation of natural resources. Social capital, trust and network of civil engagement could promote cooperation and collective action. Therefore, there is a need to strengthen the trust, reciprocity, shared value orientation towards conservation for better and effective community engagement in natural resource management.

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