The Perception of Climate Change: the Hill Ecology and the People in India

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Abstract

The brunt of climate change on the hill ecosystem is very conspicuous and discernible across the world. The melting of the snow cover, the rise of mean temperature, the loss of biodiversity etc, are the evidences of imminent losses and deleterious impact on agriculture, human life and biodiversity which may be elicited as social ecology. In the present study, the Hill ecosystem of North Sikkim has been selected as a research locale to estimate the people's perception on the impact of climate change on this fragile ecosystem. The variables Y_1 (Climate change perception), Y_2 (Yield change perception), Y_3 (Water bodies perception), Y_4 (Health problem perception), Y_5 (Species decline perception), Y_6 (Perception indicator change), Y_7 (Landslide perception), Y_8 (Distance perception), Y (Comprehensive climate change perception) have been selected and customised as core of Predictants, against which the variables X_1 (Age), X_2 (Education), X_3 (Family size), X_4 (Media interaction), X_5 (Per capita holding size), X_6 (Cropping intensity), X_7 (Technology socialization status), X_8 (Family income), X_9 (Expenditure on health), X_{10} (Animal health mentoring), X_{11} (Location of the market), have been selected as having causal impact on the above stated perceptual variables. It has been found that the variable X_2 (Education) has got decisive impact on climate change perception, while path analysis has revealed that the variable X_3 (Family size) has exerted the HIDE (Highest Indirect Effect) on climate change perception. The correlation analysis has evinced that the variables X_2 (Education), X_6 (Cropping intensity), X_8 (Family income), have been significantly correlated with climate change perception. Canonical correlation analysis has been conducted to determine whether two set of variables are independent of one another or conversely determining the magnitude of the relationship.

Introduction

Climate change and Global Warming have taken the civilization by storm; any sensible mind anywhere in the world is now taking Climate Change as an effective threat to its own existence and surroundings. Experts across the world claim that the present global warming scenario is mostly due to anthropogenic factors. The change in night temperature, rainfall pattern, onset of monsoon and winter, withdrawal of snowlines from its previous expansion, are all indicators and predictors of climate

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change. Due to global warming, the yield of most of the conventional crops shall decline, floral and faunal diversity would be affected, the coastal lines will be inundated enough to promote migration.

The Hill Ecosystem is possibly going to be the worst hit. The melting of snowlines and its movement, the change of river courses and drying out of water bodies, the decline of productivity and bio-diversity, increased seismic vulnerability all would take the ecosystem with higher fragility and vulnerability. The unplanned urbanization in hill ecosystem, mindless construction work including depletion of dolomite and multi-storied buildings are being associated with deleterious impact of global warming. The hill ecosystem is now at the crux of global concern. Any global threat should not be confined only to minds of experts or scientists, the threat of climate change must properly be perceived by the people across the profession and pursuits. Perception is experience based disposition of learning and idea. Even with increasing propensity of cyclones, extreme summer and winter, rising of sea levels, landslides and avalanches, people do not perceive it from the point of global warming and climate change, yet. A befitting extension strategy has also been the need of the hour to involve people in the movement to mitigate climate change risk and disaster. So the present study envisages people's perception down the line of experience and elements of learning. People's perception should be conceived as one of the most important predictants to be estimated through a set of exogenous variables in estimating climate change and its effect on social ecology as well as natural ecological set up at length.

There is worldwide consensus that global warming is a real, rapidly advancing and widespread threat facing humanity this century. Scientists have presented evidence and tested models to substantiate this truly alarming fact (Chaudhary & Aryal, 2009). In order to understand how human beings would respond to climate change, it is essential to study people's perceptions of climate and the environment in general. (Vedwan et al.2001). Human expectations regarding weather and climate sometimes lead to perceptions of climate change which are not supported by observational evidence (Rebetcz 2000). Studies focusing on the socio economic aspects of climatic change are sparse and have almost exclusively restricted their analysis to the impact of environmental modifications on agricultural production (Scott et al. 1990). Micro-level studies of the impact of climatic variability on people's livelihoods and their consequent responses are relatively few. Thus, this study is important in a way that it takes into account local people's awareness of weather fluctuations and aims at understanding the localized impact of the climate in this region which is not directly visible but changes, nevertheless, are happening

indirectly. This kind of study can prove to be vital to arrive at an understanding of patterns in human responses, for future studies. This sort of work was needed to know- 'what one thinks' and 'how one thinks' about the changes in climatic patterns and their impacts; and to give an account of the understanding and responses about the changes in the plains. It is increasingly argued that many climate change studies, whilst effective in alerting policymakers to the possible effects of climate change, have had limited usefulness in providing local-scale guidance on adaptation, and that the climate change community should learn from experiences gained in food security and natural hazards studies (Richard, 2004). The analysis begins with the recognition that vulnerability exists today, vulnerability that will not disappear on its own and may indeed be growing, and with the desire to make active interventions to reduce the vulnerability (Richard, 2004). The scientific knowledge on impacts of climate change is increasing all the time, as are practical experiences in responding to adaptation needs. This knowledge needs to be exploited.

Objectives

The objectives of this study are:

1. To estimate the People's Perception on Global Warming and Climate Change and their effect on Hill Ecosystem.
2. To estimate the people's perception on Global warming through a set of predictor variables.
3. To assess the interactive relationship between Predictors and Predictants variables, both intra and inter levels.

Methodology

Locale of research

The present study was conducted at Phodong forest block and Mangan forest block (Mangan sub-division) of North District (Sikkim). The district, block and three villages, one from each of the blocks were selected purposively. The rationale for selection of villages are, a) Easy accessibility b) Preponderance of local knowledge amongst the villagers c) Close interaction with natural resources and ecology for the sustenance of livelihood.

Sampling

Purposive as well as simple random sampling techniques were adopted for the present study. It may be termed as multistage random sampling procedure. There were a total 66 respondents, selecting 22 respondents from each of the selected villages. The criteria for selection of respondents are, (a) Livelihood characters

(b) Accessibility to natural resources (c) strong perceptual and cognitive ability of the respondents.

Pilot study

A pilot study was conducted in the selected villages before constructing the data collecting devices.

Variables and their measurement

Independent variables: These included Age (X_1), Education (X_2), Family size (X_3), Media interaction (X_4), Per Capita Holding size (X_5), Cropping intensity (X_6), Technology socialization status (X_7), Family income (X_8), Expenditure on health (X_9), Animal health mentoring (X_{10}), Location of the market (X_{11}).

Animal health mentoring includes both care and observation; it was measured through the frequency of feeding, amount of feed and frequency of health check up for the livestock. The location of the market indicates both the geographical distance and spatial characters as to estimate the role of a market in a typical hill ecosystem in presenting the natural data on market landing of different flora and fauna, the decline or increment of certain species of vegetables, fishes etc.

Dependent variables: Climate Change Perception (Y1), Yield Change Perception (Y2), Water Bodies Perception (Y3), Health Problem Perception (Y4), Species Decline Perception (Y5), Perception indication change (Y6), Land slide Perception (Y7), Distance Perception (Y8), Comprehensive Climate Change Perception (Y) were the dependent variables. All these perception variables were customized through an item analysis so as to ascertain which experiential statements are really predictive on climate change. The digital value as rated against a five point scale has undergone z-transformation as to transform into an analyzable parametric test.

Methods of data collection

The primary data in the present study were collected directly from the farmers with the help of a structured schedule through personal interview method.

Statistical tools used for data analysis

Tools used for data analysis were Descriptive analysis, Co efficient of correlation, Path analysis, Factor analysis, Regression, Canonical correlation analysis.

Results and Discussion

Table 1. Co-Efficient of Correlation between CCCP (Y) and Eleven Independent Variables(X_1.....X_{11})

Sl. No.	r-Value
Age (X_1)	-0.08
Education (X2)	**0.343****
Family Size (X3)	0.019
Media Interaction (X4)	0.008
Per Capita Holding Size (X5)	-0.195
Cropping Intensity (X6)	**-0.242***
Technology Socialization Status (X7)	0.011
Family Income (X8)	**0.253***
Expenditure on Health (X9)	0.094
Animal Health Mentoring (X10)	0.145
Location of the Market (X_{11})	-0.089

CCCP= COMPREHENSIVE CLIMATE CHANGE PERCEPTION
(Significance of r at 0.05 level= 0.242)*
(Significance of r at 0.01 level= 0.315) **

Result

Revelation

Table 1 presents the coefficient of correlation between Comprehensive Climate Change Perception (Y) and eleven independent variables. It has been found that the variables Education (X2) and Family income (X8) have recorded positive and significant impact on Comprehensive climate change perception. The other variable Cropping Intensity (X6) has recorded significant but negative impact on Comprehensive climate change perception (Y).

Implication

Education in tandem with family income also projects a massive impression on CCCP by promoting effective understanding of the ongoing natural and meteorological phenomenon. Education, cropping intensity and family income are three such independent variables which have been interwovenly impacting on CCCP. The operational link can be due to the fact that Education provides a pseudo urbanite disposition and a utilitarian role in increasing cropping intensity by adapting modern technology being supported by family income. These altogether have driven the educated and trained mind for guessing and estimating climatic change in a comprehensive manner.

Table 2. Path Analysis: CCCP (Y) VS Eleven Exogenous Variables

Variables	Total Effect	Direct Effect	Indirect Effect	Dominating Individual Effect		
				I	II	III
Age (X_1)	-0.08	-0.165	0.085	0.053 (X10)	0.039 (X3)	-0.021 (X2)
Education (X2)	**0.343**	0.245	0.098	**0.092 (X3)**	0.079 (X8)	0.33 (X6)
Family Size (X3)	0.019	**0.252**	**0.233**	**-0.089 (X2)**	-0.072 (X8)	-0.048 (X11)
Media Interaction (X4)	0.008	0.016	0.008	**0.055 (X3)**	-0.034 (X1)	0.029 (X10)
Per Capita Holding Size (X5)	-0.195	-0.131	0.064	**-0.056 (X2)**	-0.018 (X8)	0.010 (X1)
Cropping Intensity (X6)	-0.242	-0.076	0.166	**-0.108 (X2)**	0.077 (X3)	-0.069 (X8)
Technology Socialization Status (X7)	0.011	-0.002	0.009	0.026 (X1)	-0.025 (X8)	0.020 (X5)
Family Income (X8)	0.253	0.206	0.047	**0.094 (X2)**	-0.088 (X3)	0.025 (X6)
Expenditure On Health (X9)	0.094	-0.003	0.091	**0.094 (X3)**	0.073 (X10)	-0.050 (X1)
Animal Health Mentoring (X10)	0.145	0.168	0.023	-0.052 (X1)	0.036 (X3)	-0.023 (X11)
Location Of The Market (X_{11})	-0.089	-0.129	0.04	**0.094 (X3)**	-0.052 (X2)	0.030 (X10)

Residual calculation= 0.376

Result

Table 2 presents the path analysis by decomposing the coefficient of correlation into direct, indirect and residual effect. It is depicted that the variable Family size (X3) has exerted the highest direct effect and the variable Education (X2) has exerted the highest total effect on Comprehensive Climate Change Perception (Y). Both the variables Family size (X3) and Education (X2) have routed the highest effect of as many as 4 times for each on the CCCP. Family size and Education, both represent persuasive capability to generate ediation on CCCP by steering their associational

impacts. So, in studying the CCCP, these two variables can be considered to have their strategic role in estimating CCCP.

Table 3. Regression Analysis (BACKWARD): CCCP (Y) Vs Eleven Causal Variables

VARIABLES	B VALUE	t VALUE
X2 (Education)	0.59	2.92

MODEL SUMMARY:

MODEL	R	R^2	ADJUSTED R^2	SE
1	0.34	0.12	0.10	6.20

Result

Table 3 presents stepwise regression to estimate the causal impact of pre dominant variable over the consequent variable Comprehensive Climate Change Perception (Y). Education (X2), formal, informal or traditional, whatever may it be helps perceive and analyse the surroundings and the set up in which a man is thrown into, survives, excels or gives in. Here education has been retained as a solitary but very important factor to characterize Comprehensive Climate Change Perception (CCCP). A CCCP has become resultant to the interactions amongst and between the 8 dependent variables viz. Y1-Y8. This has incorporated the perception about whether the climate is really changing or the health problems of animals are increasing. The bio-diversity aspects have also been covered including occurrence of landslides and local indicators for climate change. These all indicate the need for responses in the form of cognitive learning, motor learning and perceptual learning and ultimately to be integrated and reticulated called CCCP (Y). So, Education (X2) here has worked as the synergistic character and as well as an integrated process to ultimately build up a canopy of CCCP.

Table 4. Canonical Covariates: Interactional Selectivity Between '+X' Set and '+Y' Set of Variables

LEFT SIDE VARIABLE	RIGHT SIDE VARIABLE
Y1 (Climate Change Perception) + 0.062	X_1 (Age) + 0.829
	X_3 (Family size) + 0.283
Y2 (Yield Change Perception) +0.471	X2 (Education) +0.361
Y6 (Perception Indicator Change) +0.024	X7 (Technology Socialization Status) +0.015
	X_{11} (Location of the Market) +0.274

Table 4 depicts that with the change of the left side variables viz. Y1, Y2, Y6, the following variables viz. X_1, X2, X3, X7, X_{11} from the right side set of predictors are

being impacted. This will provide both strategic and operational support for handling with different set of variables within a domain of interaction and variability behaviour of the total scope of variables.

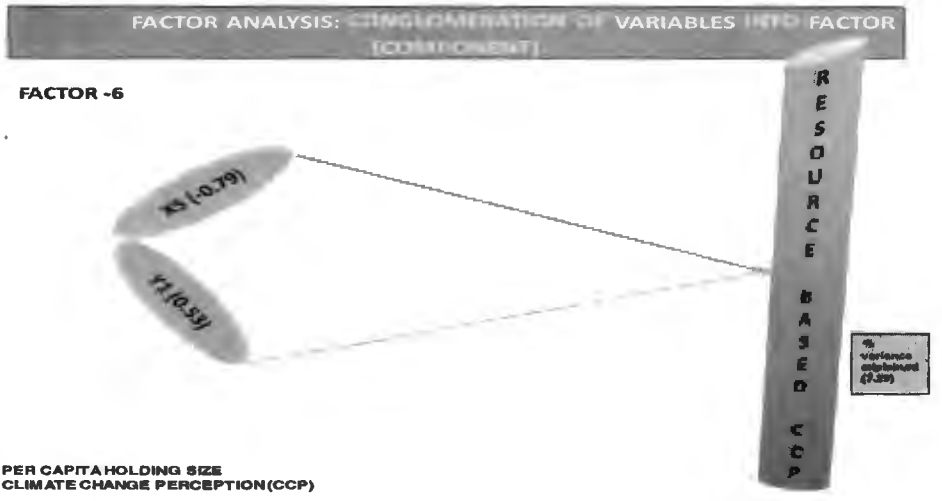
Table 5. Canonical Covariates: Interactional Selectivity between '-X' Set and '-Y' Set of Variables

LEFT SIDE VARIABLES	RIGHT SIDE VARIABLES
Y3 (Water Bodies Perception) -0.387	X4 (Media Interaction) -0.070
Y4 (Health Problem Perception) -0.278	X5 (Per Capita Holding Size) -0.192
Y5 (Species Decline Perception) -0.750	X6 (Cropping Intensity) -0.488
Y7 (Landslide Perception) -0.311	X8 (Family Income) -0.284
	X9 (Expenditure on Health) -0.003
	X10 (Animal Health Mentoring) -0.173

Table 5 depicts that with the change of the left side variables viz. Y3, Y4, Y5, Y7, the following variables viz., X4, X5, X6, X8, X9, X10 from the right side set of predictors are being impacted. This will provide both strategic and operational support for handling with different set of variables, within a domain of interaction and variability behavior of the total scope of variables.

The result shows that the left side criterion variables have formed an isochronous, interactive conglomeration and, at the same time have exerted their operational impact on the right side causal variable. Canonical covariate helps splendidly, when more than one dependent variable are interactive among themselves to establish a concurrent interaction with a set of causal variables.

PCA MODEL -1. It has been found that factor-6 has accommodated the following variables: X5, Y1 within a common bracket and has been renamed as Resource based climate change perception.



All the independent variables for this study have been confronted with factor analysis. The factor 6 has been presented here only to present the unique conglomeration of two variables based on their Eigen roots and the factor has been renamed as resource based climate change perception. The hill people are so close and integrated to natural resources, through their livelihood, cultivation practices and customs; their perception on climate change must demand empirical attention.

Conclusion

The Hill ecosystem by nature and operation is very complex and sensitive to even a tiny change in the entire atmospheric behaviour. As per IPCC observation the whole of North East India is very much prone to seismic behaviour and vulnerable to climate change and global warming. The present study with a kaleidoscopic vision has attempted to depict a pathway to construct people's perception. This has amounted to a policy formulating process wherein the variable found significantly attuned to climate change perception may be segregated and put to a policy formulation process. Education still remains a very critical input to make people aware of and operational enough towards making the ecology of the hill amply resilient in the face of climate change. The down to earth reality is that people are becoming increasingly knowledgeable about ecological health and its capability to absorb a third of climate change but it has turned very difficult to make them adequately operational to sufficiently perform for what is needed to be done right now. The outcome of the research thus would go a long way in institutionalising external efforts with that of internal potentials for creating climate managers at least one for each village so that a good leadership can be built up, both at the top and in a valley of the Hill ecosystem.

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