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RESEARCH ARTICLE

ENVIRONMENTAL IMPACT AND TRANSFORMING SOCIAL ECOLOGY IN TEA GARDEN OF INDIA: THE DICTUM AND DIRECTION

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ABSTRACT

The social ecology of tea gardens in north-eastern part of India has been characterized with polymorphic interactions amongst and between three sets of sub- ecological cybernetics viz physical ecology(x), biological ecology (y) and social ecology (z). Each of these sub- ecosystems is being comprised of sets of constituent characters. The present study has envisaged polyhedral interactions amongst and between the constituent characters of these three sub-ecological characters. Accordingly, the above mentioned sub- ecologies (x,y,z) have been conceived to have sub-systems. The variables pertaining to all these sub-ecologies again have been articulated into the set of socio-economic characters(X) of respondents. All these have been done to establish and estimate the pattern, direction and intensity of interaction to ultimately estimate the ecological behaviour of that tea garden setup. The respondents have been selected through both purposive and random sampling approaches to ultimately derive and elicit their behavioural traits in the changing meteorology, biological and physical setup. The results depict that a change in physical ecology, like, a change in rainfall pattern conspicuously enters the social echelon by impacting on income, market behavior and strategic interactions. The biological components like declining fish species and local weed sp. have entered the social echelon, by setting its livelihood generation to a new direction. So, the interdependent and mutually synchronized relationship amongst and between the physical, biological and social echelons have been the prime mover for ushering a social change viz. a viz. an ecological transformation as well. All these analytical outcomes can be networked to formulate a policy echelon to make clandestine intervention to protect the ecological health of that tea garden based mega-ecological setup from both decadence and destruction. The study would go a long way to make a series of interventions here in this area or can be replicated elsewhere having the same or near similar ecological setups and operational interactions.

INTRODUCTION

The study of social ecology has gained a new momentum after social system theory came into operationalization. Extension is basically a science of knowledge system where in a continuous and evolutionary interaction is occurring between knowledge and "social space". In this complex system the other components are adoption and adoption period, Rejection, Discontinuance, reinvention crop and crop enterprises, market and market intelligence, meteorological components and cognate biological components. All these components are inextricably interacting with each other to ultimately characterize the journey of knowledge into social space. The biotic features in an ecosystem for example trees , fishes, or crop varieties are being impacted by the socio-anthropogenic as well as behavioural factors; like food habits, poverty, migration, settlements, communication etc. The concept of social ecology lays emphasis on the relationship between man and nature surrounding him. The complexity of relationships between people and nature was emphasized by Murray Bookchin (Bookchin, Murray, 1964) in his article"*New directions in Libertarian Thought*". Later on Gregory Bateson applied cybernetics to the field of ecological anthropology and concept of Homeostasis. He considered the world as a series of system containing those of individual, societies and ecosystems (Bateson, Gregory, 1972) in his book *Steps to an Ecology of Mind"*. A broader perspective of research in human development was started by Urie Bronfenbrenner and he focused on progressive accommodation, throughout life span between the growing human organism and changing environment in which it actually lives and grows (Bronfenbrenner, Urie, 1977). Scientists like Lorne Leslie, Neils Evernden, 1986 in the book *"The Natural Alien"* have stressed on the fact that nature is as much a social entity as a physical one. It underpins our contemporary understandings of nature (Evernden, Neils, 1992) in his book *"The social creation of Nature"*. The role of social ecology in modern extension science can well be accommodated in studying in a domain of space and knowledge cybernetics wherein, an inclusive study can incorporate the relational behaviour of traditional knowledge

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and biodiversity protection shift and change of water bodies and migration of human population and cattle, erosion of biodiversity and decadence of livelihood, meteorological behaviour their changes and its impact on food security, livelihood security and health status across the communities and diaspora.

General Objectives

To Estimate and analyse the change Dynamics of social ecology of Tea garden.

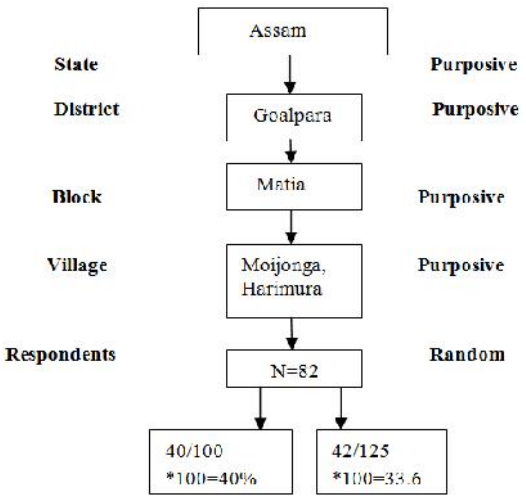
Specific Objectives

- To generate analysed and catalogued information may be used for policy intervention.
- To have a catchment area (niche) study in support of system – core functioning for better understanding of eco-dynamics.
- To study the composition and present status of tea garden based on ecosystem.
- To study the change dynamics over decades in terms of some preset parameters.
- To identify the factors contributing towards the system performances in terms productivity, livelihood, income, wage and biodiversity, para- enterprise.
- To study the inner and intra relationships of a set of prediction available.

METHODOLOGY

The present Study was conducted at Matia Block of Goalpara District (Assam). The Sampling design used were purposive as well as simple random sampling techniques were adopted for the present study. It may be termed as multistage random sampling procedure. The districts, blocks and villages were purposively selected for the study. The district Goalpara and the Block Matia were considered. Under the Matia block Moijonga and Harimura village were selected. An exhaustive list of respondents was prepared with the help of block officials for villages. From the prepared list to hundred respondents were selected randomly from each village for final data collection.

Sampling Scheme (Multistage Random Sampling)



A pilot study was conducted in the selected villages before constructing the data collecting devices. In course of this survey informal discussion was carried out with some farmers, local leaders and extension agents of the localities to get an outline of socio-economic background of the Tea Garden workers, community members, stakeholders, teachers, Managers and Supervisors of the concerned Tea Garden and its Adjoining villages, their opinion towards changing Tea garden ecosystem both in terms of biodiversity and social ecology. The variables used were classified into two viz. Predictor variables and Predictant variables. The predicted variables used were Age(x_1), Education (x_2), Family Size(x_3), Family Education Status(x_4), Size of Homstead Area (Katta) (x_5), House Status(x_6), Sanitation and Hygiene(x_7), Food Intake Value(x_8),Watching Television (hrs/day) (x_9), Listening to Radio (hrs/day) (x_{10}), Interacting with Cosmopolite persons. (x_{11}), Average Market Price of Rice and Vegetables (x_{12}), Average Market Price of Fish(x_{13}), Average distance to critical sites from respective residence (Market, School, hospital, Bank) (x_{14}), Home Innovation Index(x_{15}), Cropping Intensity(x_{16}), Off-farm investment(x_{17}).

The Predictant variables used were: Change in number of gardens (y_1),Change in Rainy days (y_2),Change in Rainfall (y_3),Change in number of Sunny days (y_4),Change in number of floods (y_5), Change in Average garden size (y_6), Change in total garden income (y_7), Change in Winter Temperature (y_8), Change in number of trees (y_9), Change in Icthiofaunal diversity (y_{10}), Change in visibility of birds (y_{11}), Change in cattle population (y_{12}), Change in creepers (y_{13}), Change in Availability of fishes(y_{14}), Change in Flowers (y_{15}), Change in Fruits (y_{16}) Change in Grasses and Water weeds (y_{17}), Change in Insect population (y_{18}), Change in Traditional rice (y_{19}), Change in Gender count male (y_{20}), Change in Gender count female (y_{21}), Change in income for Temporary labourers (y_{22}), Change in income for Permanent labourers (y_{23}), Change in Migration Index (y_{24}). The primary data in the present study were collected directly from the multiple stakeholders with the help of structured schedule through personal interview methods. Only the functional heads of the household were taken as respondents for the study. Thus, a total of 82 farmers formed the sample for the study. The analysis was done using Mean, Standard deviation, Coefficient of variation, Coefficient of correlation, Regression, Multiple regression (Step-wise regression and Backward regression), Factor analysis, Principal component Analysis and Canonical Correlation analysis.

RESULTS AND DISCUSSION

The data which is revealed in **Table 1** is that Change in fruit production (y_{16}), Change in income for temporary labourers (y_{22}), Change in visibility of birds (y_{11}), Change in grasses and water weeds (y_{17}),in the study area in Assam observed highest change in the decade 1970-1980 as indicated by the extraction value *0.986*, *0.986*,*0.938* and *0.900* respectively. The percentage variances having a significant impact in the first cohort (1970-80) for the above mentioned perceptual changes are *44.203*, *68.768*, *43.614* and *84.457*.

Table 1. Decadal Changes and Percentage Variance in terms of set parameters

Decadal Changes	Decade with Highest Extraction Value	Extraction Value		% Variance (in 1970-80)
		Initial	Extraction	
Change in number of tea gardens (y_1)	1970-1980	1.00	0.858	43.899
Change in Rainy Days (y_2)	1980-1990	1.00	0.591	44.973
Change in Rainfall (y_3)	1970-1980	1.00	0.846	37.915
Change in number of sunny days (y_4)	2000-2010	1.00	0.786	29.722
Change in number of floods (y_5)	1990-2000	1.00	0.842	51.501
Change in Average Garden size (y_6)	1970-1980	1.00	0.701	50.356
Change in total Garden income (y_7)	1970-1980	1.00	0.622	55.915
Change in Winter Temperature (y_8)	1970-1980	1.00	0.778	60.674
Change in number of Trees (y_9)	1970-1980	1.00	0.763	57.553
Change in Icthiofaunal diversity (y_{10})	1980-1990	1.00	0.536	47.184
Change in visibility of birds (y_{11})	1980-1990	1.00	0.938	43.614
Change in cattle population (y_{12})	1970-1980	1.00	0.537	47.747
Change in creepers(y_{13})	1980-1990	1.00	0.586	43.325
Change in Availability of Fishes (y_{14})	1980-1990	1.00	0.874	77.578
Change in flowers (y_{15})	1980-1990	1.00	0.511	39.614
Change in fruits (y_{16})	1990-2000	1.00	0.986	44.203
Change in grasses and water weeds (y_{17})	1980-1990	1.00	0.900	84.457
Change in insects (y_{18})	1980-1990	1.00	0.856	70.707
Change in traditional Rice(y_{19})	1980-1990	1.00	0.804	70.707
Change in gender Count male (y_{20})	1970-1980	1.00	0.836	56.979
Change in gender count female(y_{21})	1970-1980	1.00	0.770	68.768
Change in income for temporary labourers(y_{22})	1990-2000	1.00	0.986	68.768
Change in income for permanent labourers (y_{23})	1970-1980	1.00	0.530	44.742
Change in Migration Index (y_{24})	1970-1980	1.00	0.875	41.237

FACTOR RENAMING: HOME AND ACQUISITION

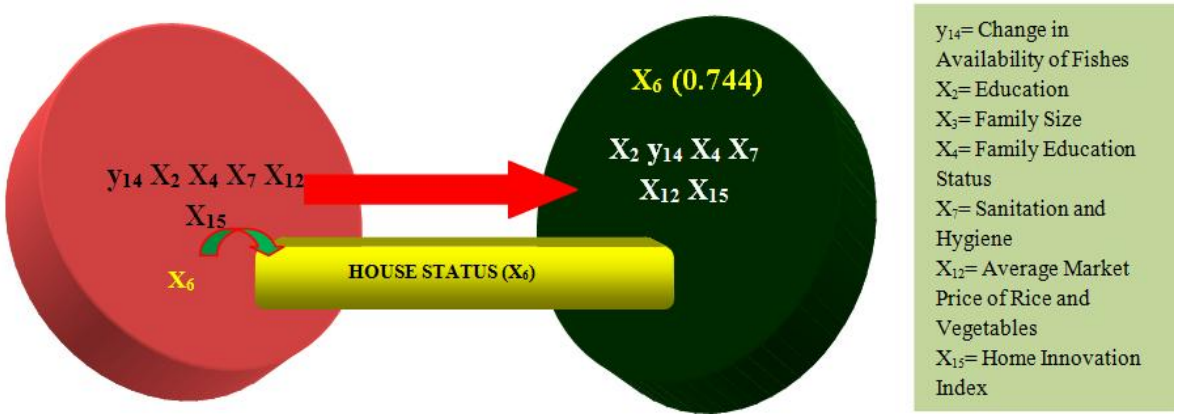


Figure 1. depicts a significant inclusion of the factor House Status (X_6) which is an important character in this Social Ecology. The colony of variables has been retained as Home and Acquisition Factor

FACTOR RENAMING: PERFORMING PHYSICAL ECOLOGY

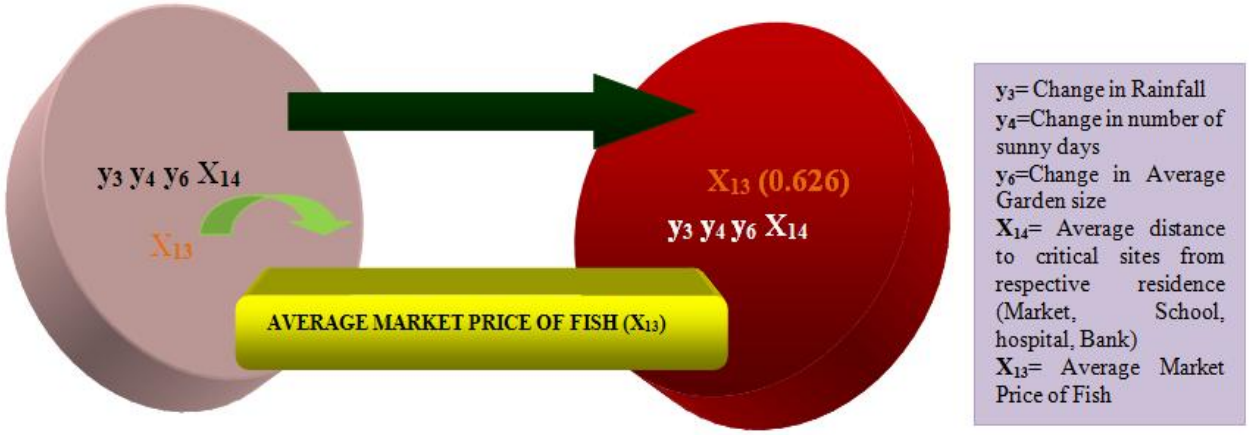


Figure 2. A significant inclusion in this factor is Average Market Price of Fish (X_{13}) which is an important character in this Social ecology. This conglomeration of variable has been renamed as performing physical Ecology. This is to take note that the physical factor, change in number of sunny days, has entered the domain of social ecology by impacting on the average market price of fish

Table 2. Co-efficient of Correlation: Change in Income of Permanent Labourers (y_{23}) vs (X_1-X_{17}) Independent Variables

Variables	'r' Value	Significance level (2-Tailed)
1.Age(X_1)	0.257'	0.020
2.Education (X_2)	0.062	0.583
3.Family Size (X_3)	-0.192	0.085
4.Family Education(x_4)	-0.024	0.828
5.Size of Homstead Area (X_5)	-0.075	0.501
6.House Status (X_6)	0.261'	0.018
7.Sanitation And Hygiene (X_7)	0.108	0.335
8.Food Intake Value(X_8)	0.217'	0.050
9.Watching T.V(hrs/day*frequency) X_9	-0.104	0.352
10.Listening Radio(hrs/day*frequency) X_{10}	-0.238'	0.031
11.Interacting with Cosmopolites(X_{11})	-0.013	0.909
12.Average Market Price of Rice and Vegetables.(X_{12})	0.007	0.949
13.Average Market Price of Fish. (X_{13})	-0.026	0.814
14. Avg. distance to critical sites from respective residence (X_{14})	-0.094	0.401
15. Home innovation Index (X_{15})	0.037	0.738
16. Cropping Intensity (X_{16})	0.053	0.635
17. Off – farm Investment (x_{17})	-0.074	0.507

" Correlation is significant at the 0.01 level (2-tailed)
' Correlation is significant at the 0.05 level (2- tailed)

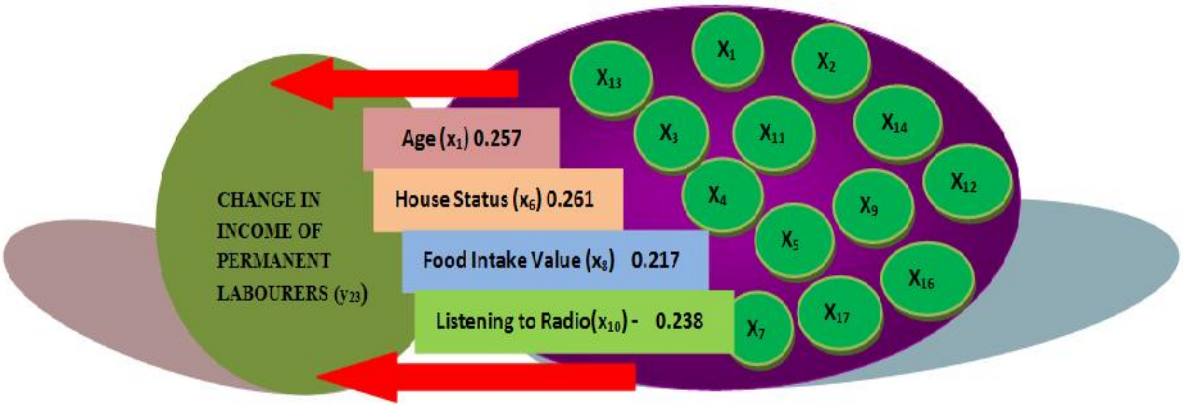


Fig. 3.

Implication: The following variables from social ecology have a journey into the echelon of change in income of permanent labourers

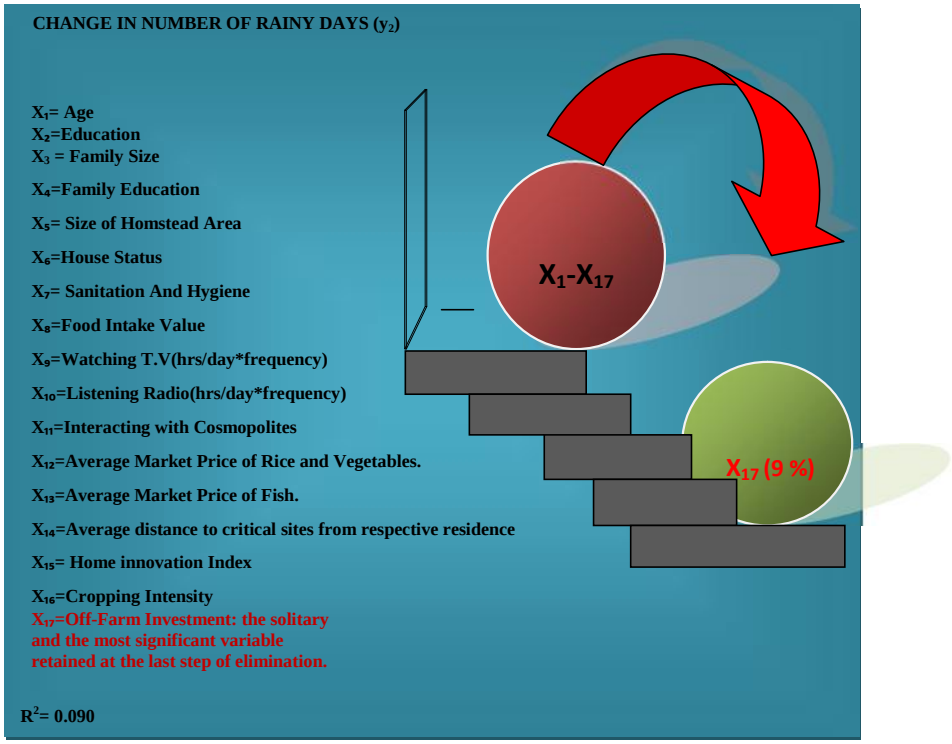


Figure 4. Explains the impact of changes in Rainy Days on off-farm activity which can be estimated to an extent of 9% (R^2= 0.09)

Table 3. Regression Analysis (Step down): Screening of Variables having significant efficacy for characters change in number of Rainy Days (y_2)

Variable	'β'	't'	Significant
1.Off- farm Investme-nt (x_{17})	0.300	2.814	0.006

Table 4. Model Summary

Model	R	R^2	Adjusted R^2	Standard Error of the estimate
1.	0.300	0.090	0.079	22.816

Table 5. Positive Values of Variables (Left and Right have gone selectively attuned to each other through Canonical Covariates)

Socio-Economic Characters(Left side Variables)	Value	Ecological Characters (Right side Variables)	Value
Education (x_2)	+0.334	Change in Rainfall(y3)	+ 0.403
House Status(x_6)	+0.173	Change in number of Sunny Days (y4)	+0.178
Watching T.V. (x_9)	+0.241	Change in number of occurrences of flood (y5)	+0.259
Avg. M.P. of Rice and Vegetable (x_{12})	+0.020	Change in Winter Temperature(y8)	+0.028
		Change in cattle population (y12)	+0.131
		Change in Flowers(y15)	+0.083
		Change in Grasses and Water Weeds (y17)	+0.041
		Change in income of temporary labourers(y22)	+0.618
		Change in Migration Index(y24)	+0.332

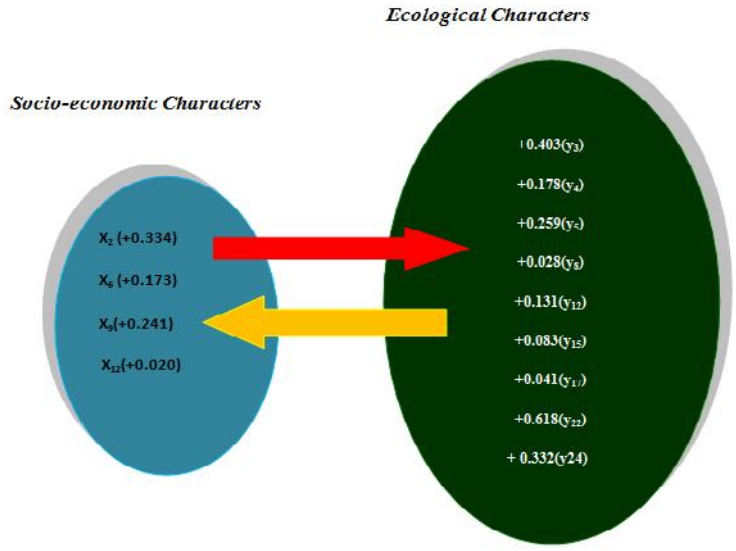


Figure 5. explains the sets of Variables (Left and Right have gone selectively attuned to each other through Canonical Covariates).It depicted that with the change of the left side variables viz. x_2,x_6,x_9,x_{12}. The following variables Viz. $y_3,y_4,y_5,y_8,y_{12},y_{15},y_{17},y_{22},y_{24}$ from 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 6. Canonical Proficiency in Interpreting Variance (5 in order of proficiency) from Left side variables (X_1-X_{17}):

Rank	Variables	Variance Explained (%)
1	Family size(X_3)	4.611
2	Education(X_2)	4.02
3	Age(X_1)	3.844
4	Family Education (X_4)	2.624
5	Size of homestead Area (X_5)	2.439

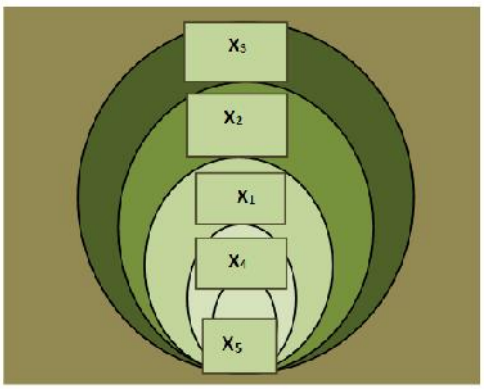


Figure 6. Explains the hierarchy of Canonical proficiency in hooking up variables from across the clusters. The variables Family size(X_3), Education(X_2), Age(X_1), Family Education (X_4), Size of homestead Area(X_5) have been arranged in ascending order and ranked accordingly. This reflects the proficiency of each variable in respect of the other for example the variable Family size(X_3) explains a variance of 4.611% and is the highest among the cluster of variables. Similarly, the variable Education(X_2) explains a variance of 4.02% in the ecosystem. Therefore, it is seen that Family Size(X_3) has played a vital role in explaining variance in the Tea based Ecosystem

Conclusion

The social ecology of a system studies polymorphic interaction at various intra and inter level. It is reflexive and normative, offering prescriptions and manifestoes about how humans ought to behave in relation to the environment, other species, and all extended ecological communities, so as to ensure their mutual co-exsistence. In a tea garden system also such polymorphic and polyhedral interactions do take place at a larger scale. Infact, a tea garden ecosystem in North East India is a perfect example of a dynamic system which is linked with social, physical and biological sub- systems. On studying the inter relationships and associations at various sub-system level in a Tea garden and its adjoining habitats, one can infer on its Social, physical and biological ecology and determine the driving factors that render the ecosystem degrading. The linked up factors are also indicators of changes both at micro and macro levels and on carefully examining it, a comprehensive solution can be made. The present study has considered the three sets of suigeneris variables, be branded as social, biological and physical constellation of characters, depict that a-

a) Change in physical ecology like a change in rainfall pattern and change in number of sunny days have conspicuously entered the social echelon by impacting on income, market behaviour and strategic interactions.
b) The biological components like declining local fish species and thus its reduced availability in the market have entered the social echelon by setting its livelihood generation to a new direction.
c) So, the interdependent and mutually synchronized relationship amongst and between the physical, biological and social echelons have been the prime mover for ushering a social change viz. a viz. an ecological transformation as well.

Extension science, being basically a science of system hierarchy and system functioning, pulls up the elements of knowledge-space interaction in a given volume of social cybernetics. The evolving extension science keeps on transforming from a monolithic transfer of technology approach to a polyhedral system approach to accommodate movement of knowledge within a given social space to make the social ecology more resilient and responsive to an egalitarian, inclusive growth of humanity.

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