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Climate Change and Bamboo: The Issues of Income, Productivity and Livelihood in North-East India

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Abstract: **In the context of climate change, bamboo plays an important role in the economy especially in South-East Asia and North East India. It is an economic resource having immense potential for improving the quality of life of rural and urban material for large industries like paper and pulp as well as for cottage and handicrafts industry communities with environment regeneration qualities like carbon sequestering. In the present study number respondents were 96 who have been selected randomly from the Hezamara block, west district of Tripura and total number of predictor variables were 19. The purposive sampling technique was followed in case of selection of district, block and village for generating relevant data. The income, productivity and livelihood generation were considered as the consequent variables for the study and nineteen different socio-personal, agro-economic and techno-managerial factor of the respondents were considered as the causal variables for the study. The data were processed into step down regression, factor analysis and canonical correlation analysis. The study reveals from the step down regression that the variables like Age(X1), Family size (X3), the cost of farm implements when purchased (X4), Land under agricultural crop(X7), Cropping intensity(X8), land under bamboo(X9), land under bamboo(X9), Material possessed(X10), Energy consumption(X16), Cost incurred in bamboo cultivation(X18) are the most important causal variable to interpret the variance embedded with the Family income from Bamboo enterprise(Y1), Family income from Agricultural enterprise (Y2), Productivity of Bamboo (Y3), Mandays generated from Bamboo enterprise (Y4), Wages generated from bamboo enterprise (Y5).The following factors have been identified through PCA as to have substantive contributions on the cumulative variance of the livelihood and productivity of bamboo enterprise. These are: Family Resource Entrepreneurship, Input Media Interaction, Home and Human Resource Support and Resource status, Input Enterprise. From the cross loading of the canonical covariates, it can be inferred that, while the entire Y set of variable are in interactive relationship, the two left side variables i.e. Family income from bamboo enterprise(Y1) and Productivity of bamboo(Y3) have respondent and dovetailed some X set of variable. In case of Set-II From the cross loading of the canonical covariates, it can be inferred that, while the entire Y set of variable are in interactive relationship, the three left side variables i.e. family income from agricultural enterprise (Y2), mandays generated from bamboo enterprise (Y4) and wages generated from bamboo enterprise (Y5) have respondent and dovetailed some X set of variable.**

Keywords: **Bamboo, income, livelihood, production.**

1. INTRODUCTION

In the face of climate change, the erosion of biodiversity will take a deleterious shape. With the erosion of biodiversity, the food security will be at stake, simply because a narrow gene base can't sustain a comprehensive food security, not only to human being, but also to a score of animal diasporas. Bamboo (Bambusa spp) has not only being a traditional economic crop for North-East but also has proven to have tremendous bio-genomic resilience in combating the brunt of climate change. The present study has delved into its income, livelihood contribution through its productive behavior to sustain and expedite the rural economy of Tripura which has got spill over references to other states of North-East. Our North-Eastern region comprised of eight states which is abundant in Bamboo resources. Two third of country's bamboo resources are found in this region. The land area under bamboo resources accounts for 3.10 million ha in this region comprising od 89 species. This precious natural gift is embedded in the life and culture of the people of north-eastern region.(Facets of the North-east Bamboo for Economic Prosperity and Ecological Security with Special Reference to North-east India Kamesh Salam Director, CBTC, Guwahati).Bamboo has huge potential to mitigate the climate change phenomenon, it can accumulate organic matter, counteract soil and thus have reversed soil degradation in exploited landscapes. (Christanty, Kimmins et al. 1997; Zhaohua and Yang 2004; Singh, Zeng et al. 2006; Marsh and Smith 2007; Mohamed, Hall et al. 2007). Regulating water flows (Marsh and Smith 2007), filtering of waste water, controlling of sedimentation and pollution from agricultural runoff also can be done through bamboo.(Schoonover, Williard et al. 2006; Marsh and Smith 2007; Vigiak, Ribolzi et al. 2007). The root mats of bamboo are tightly woven which helps in offering shelter during earthquakes, floods, tsunamis. But not all the effect of bamboo are beneficial to environment, dense root mats in upper soil horizon may emit methane or isoprene and which may simultaneously contribute directly or indirectly in warming. (Dura and Hiura 2006; Lu, Liu et al. 2007).

2. OBJECTIVES

- To assess the productive performance of bamboo enterprise in terms of livelihood.
- To assess the agro-economic, socio-personal and management characteristics of respondents as the causal variables.
- To assess and evaluate the relation between the causal and consequent variables both at inter and intra level.
- To derive some strategies for micro level interventions.

3. METHODOLOGY

The present study was conducted at Hezamara block of West district (Tripura). The district, block and village were selected purposively due to the availability of the bamboo entrepreneurs in this area. The purposive as well as simple random sampling techniques were adopted for the present study. It may be termed as multistage and random sampling procedure. The districts, blocks and villages were purposively selected for the study. The West district and the block Hezamara were considered. Under the Hezamara block Sharat chowdhury para village was selected. From Sharat chowdhury para village 96 bamboo growers had been selected out of 1500 bamboo growers following simple random sampling(list sampling and class interval). Various dependent and independent variables namely Age(X1), Education(X2), Family size(X3), Average cost of farm implements when purchased(X4), Average cost of farm implements at present(X5), Homestead land (X6), Land under agricultural crop(X7), Cropping intensity (X8), Land under bamboo (X9), Material possessed (X10), Annual income before bamboo (X11), Mass media exposure (X12), Number of rhizome planted (X13), Number of rhizome grown to the fullest (X14), Training received(X15), Energy consumption (X16), Distance to market(X17), Cost incurred in bamboo cultivation(X18), Mode of selling(X19), Mandays generated in bamboo enterprise (Y3), Wages generated in bamboo enterprise (Y5) were selected in the present study..

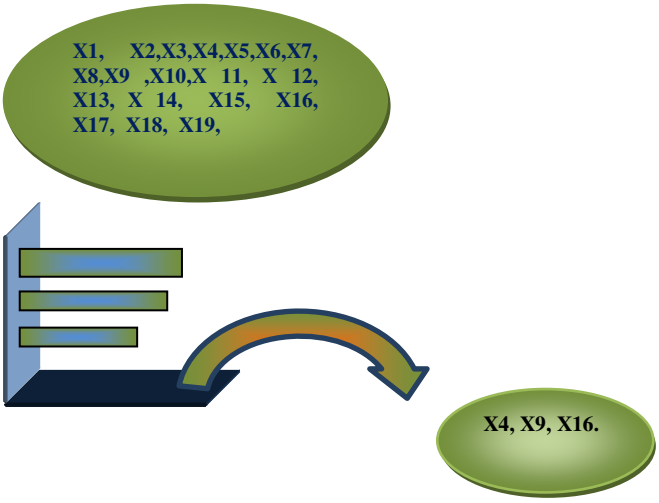
Methods of data collection

The primary data in the present study were collected directly from the farmers with the help of structured schedule through personal interview methods. Only the functional head of the household were taken as respondents for the study. The personal interview method was followed during the month of May and October 2013 to collect the relevant information from targeted respondents. **Statistical tools used for analysis and interpretation of data:** Statistical Package for the Social Sciences (SPSS) had been used for the analysis of the data.

Results and Discussion:

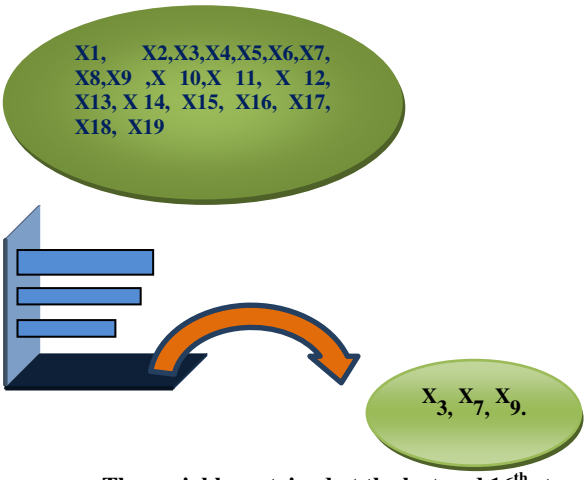
Paradigm of step down Regression: Causal Effect of independent Variables on Family income from Bamboo enterprise (Y1), the consequent variable.

the step down regression analysis to imply that, which are the few variables out of the whole plethora of variables have been retained at the last step (16^{th}) to contribute substantially on the consequent variable that is family income from bamboo enterprise. So, the cost of farm implements when purchased (X4), land under bamboo(X9), Energy consumption(X16), are the 3 most important causal variable to interpret the variance embedded with the Family income from Bamboo enterprise(Y1).



The variables retained at the last and 16^{th} step

Paradigm of step down regression: Causal Effect of independent Variables on Family income from Agricultural enterprise (Y2), the consequent variable.

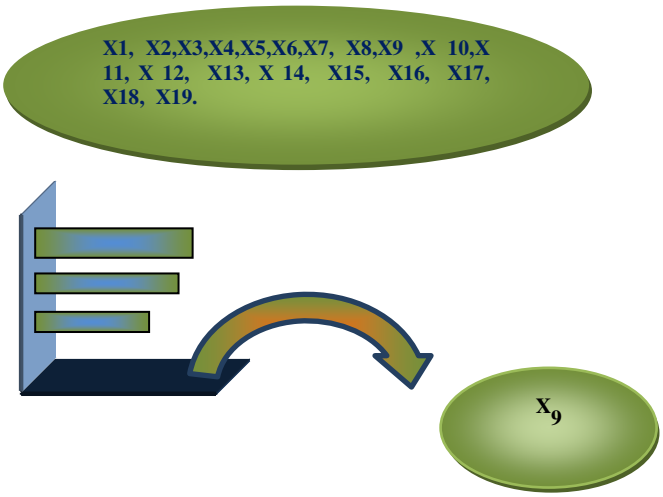


The variables retained at the last and 16^{th} step

the step down regression analysis to imply that, which are the few variables out of the whole plethora of variables have been retained at the last step (16th) to contribute substantially on the consequent variable that is family income from Agricultural enterprise. So, family size (X3), land under agricultural crop(X7), land under bamboo(X9), are the 3 most

important causal variables to interpret the variance embedded with the Family income Agricultural enterprise (Y2), the consequent variable.

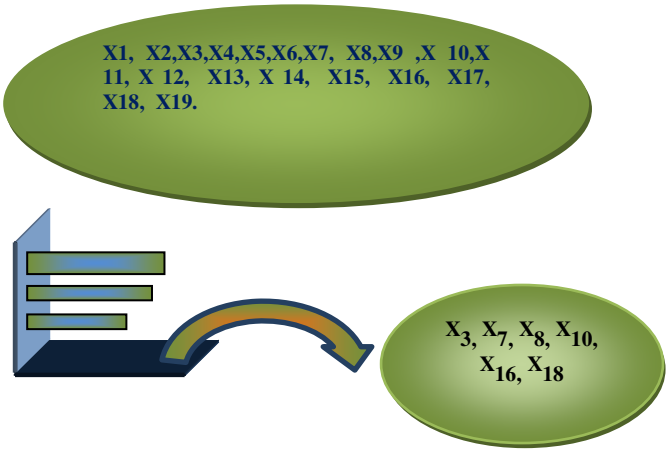
Paradigm of step down regression: Causal Effect of independent Variables on Productivity of Bamboo (Y3), the consequent variable.



The variables retained at the last and 18th step

the step down regression analysis to imply that, which are the few variables out of the whole plethora of variables have been retained at the last step (18th) to contribute substantially on the consequent variable that is Productivity of Bamboo (Y3).So, land under bamboo(X9), is the most important causal variables to interpret the variance embedded with the Productivity of Bamboo (Y3).

Paradigm of step down regression: Causal Effect of independent Variables on Mandays generated from Bamboo enterprise (Y4), the consequent variable.

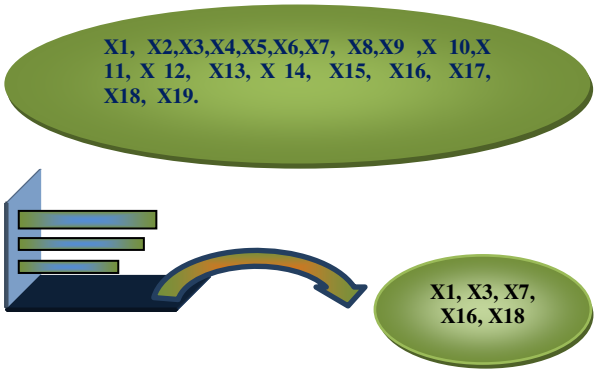


The variables retained at the last and 13th step

the step down regression analysis to imply that, which are the few variable out of the whole plethora of variables have been retained at the last step (13th) to contribute substantially on the consequent variable that is Mandays generated from Bamboo enterprise.

So, Family size (X3), Land under agricultural crop(X7), Cropping intensity(X8), Material possessed(X10), Energy consumption(X16), Cost incurred in bamboo cultivation(X18)are the 6 most important causal variable to interpret the variance embedded with the Mandays generated from bamboo enterprise.

Paradigm of step down regression: Causal Effect of independent Variables on Wages generated from bamboo enterprise (Y5), the consequent variable.



The variables retained at the last and 14th step

the step down regression analysis to imply that, which are the few variables out of the whole plethora of variables have been retained at the last step (14th) to contribute substantially on the consequent variable that is Wages generated from bamboo enterprise. So, Age(X1), Family size (X3), Land under agricultural crop(X7), Energy consumption(X16), Cost incurred in bamboo cultivation(X18)are the 6 most important causal variable to interpret the variance embedded with the wages generated from bamboo enterprise.

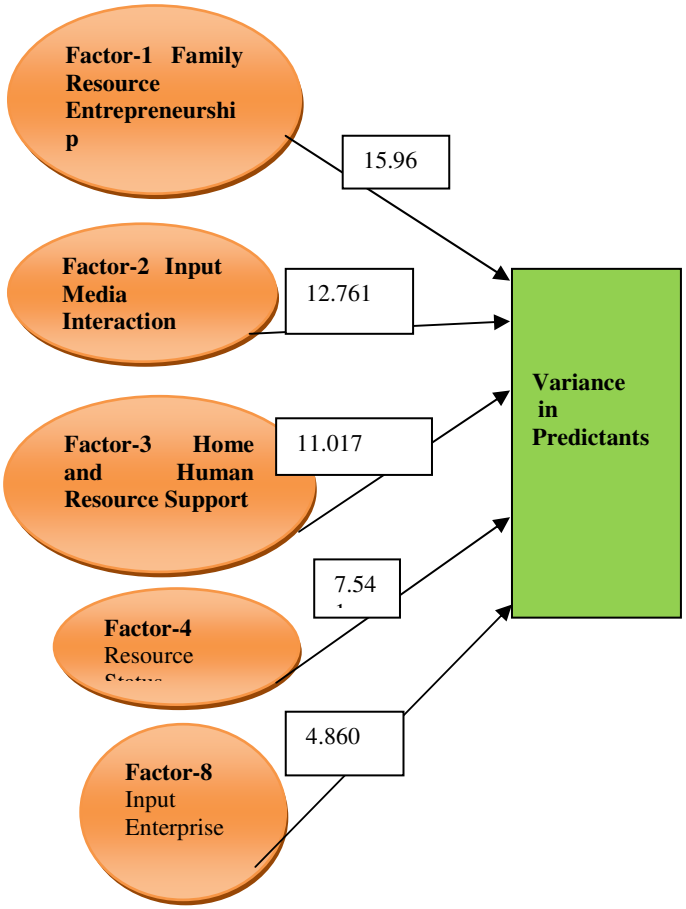
Factor analysis: Conglomeration of variables based on factor loading and renaming of factors.

It presents the factor analysis to estimate the degree of conglomeration of apparently different exogenous variables, based on Eigen values into some discernible factor. It has been found that

Factor-1 has accommodated the following variables: Family size (X3), Land under agricultural crop (X7), Area under bamboo(X9), Energy consumption (X16), Mode of selling(X19). And this factor can be renamed as Family Resource entrepreneurship. This has contributed 15.96% of variance.

Factor-2 has accommodated the following variables: Mass media exposure (X12), Number of rhizome planted (X13), Number of rhizome grew to the fullest(X14).And this factor can be renamed as Input media interaction. This has contributed 12.761% of variance.

Factor-3 has accommodated the following variables: Age (X1), Education (X2), Homestead land (X6).And this factor can be renamed as Home and human resource support. This has contributed 11.017% of variance.



Factor-4 has accommodated the following variables: Material possessed(X10), Annual income before bamboo (X11).And this factor can be renamed as Resource status. This has contributed 4.86% of variance.

Factor-8 has accommodated the following variables: Average cost of farm implements when purchased(X4), Mode of selling(X19). And this factor can be renamed as Input enterprise. This has contributed 7.541% of variance. Since the rest of the factor have accommodated solitary variable in each of the cases, no renaming is required.

The cumulative variance is 87% which is fairly enough to explain any kind of interpretative variation as well as interaction amongst and between the whole plethora of variable including both dependent and independent variables.

4. CANONICAL CORRELATION ANALYSIS

From the cross loading of the canonical covariates, it can be inferred that, while the entire Y set of variable are in interactive relationship, the two left side variables i.e. Family income from bamboo enterprise(Y1) and Productivity of bamboo(Y3) have respondent and dovetailed these X set of variable.

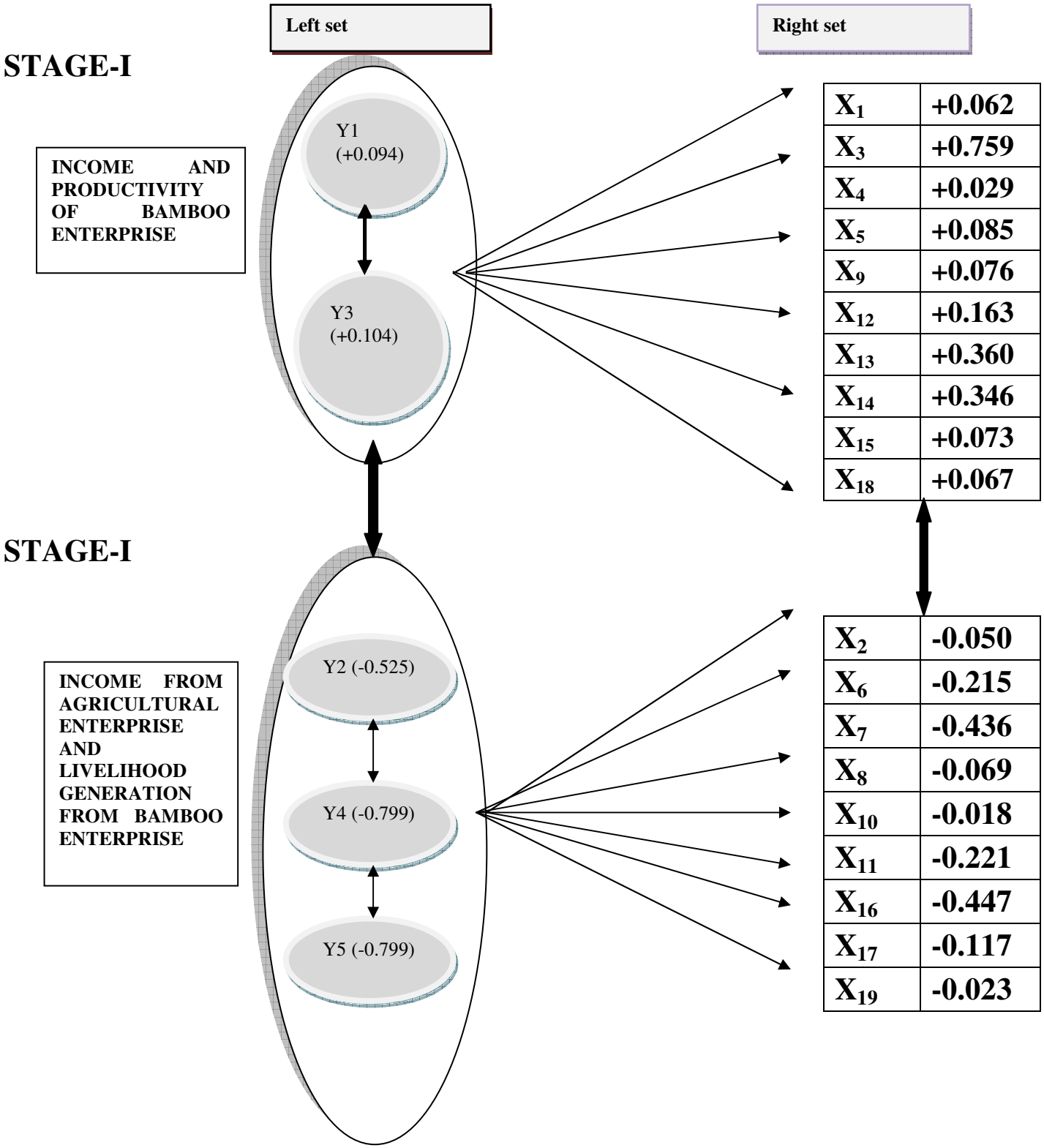
So, it can be concluded that the increase of income through increase of productivity needs a collective support from the causal variable like Age(X1), Family size (X3), Average cost of farm implements when purchased (X4), Average cost of farm implements at present(X5), Land under bamboo (X9), Mass media exposure(X12), Number of rhizome planted(X13), Number of rhizome grown to the fullest (X14), Training received(X15), Cost incurred in bamboo cultivation(X18). So the left set of variable (Y1 & Y3) combined can be branded as ***Productive Economy of Bamboo Enterprise*** with a clandestine support from ***Resource-Investment Factor.***

In case of Set-II From the cross loading of the canonical covariates, it can be inferred that, while the entire Y set of variable are in interactive relationship, the three left side variables i.e. family income from agricultural enterprise (Y2), mandays generated from bamboo enterprise (Y4) and wages generated from bamboo enterprise (Y5) have respondent and dovetailed these X set of variable. So, it can be concluded that the increase of income through increase of productivity needs a collective support from the causal variable like Education(X2), Homestead land (X6), Land under agricultural crop (X7), Cropping intensity(X8), Material possessed (X10), Annual income before bamboo(X11), Energy consumption(X16), Distance to market (X17), Mode of selling(X19). So the left set of variable (Y2, Y4 & Y5) combinedly can be branded as ***Farm Family Economy*** with a clandestine support from right side variable which also can be branded combined as ***Management –Communication Variable.***

5. CONCLUSION

Bamboo by becoming an ecologically resilient and economically viable crop of the north-east of India, merits an in depth study to generate empirical evidences on its su-generis traits, livelihood potentials and adaptive properties to mitigate climate change brunt on the increasingly fragile of north-east. The studies elicit that the bamboo based livelihoods of north-east have been impacted by exogenous variables like size of holding, cropping intensity, energy consumption, income from bamboo and so on. Thee study can well be cloned to other ecological niches of north-east and the

co-integration of all these micro level studies can generate a comprehensive policy text to make bamboo a more dependable means to earn sustainable livelihoods..a splendid blend of ecology-economy-livelihood of north-east India.



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