



RESEARCH ARTICLE

CLIMATE CHANGE SCENARIO AND GENERATION OF LIVELIHOOD AS WELL AS INCOME  
FROM BAMBOO ENTERPRISE: AN ESTIMATION FROM A SCORE OF SOCIO ECONOMIC AND  
AGRO ECOLOGICAL VARIABLES

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ABSTRACT

Bamboo enterprise plays an important role in the rural economy of Tripura by providing subsistence activities, employment generation and household income. It is the most suitable subsistence resource for about 28,000 families engaged in shifting cultivation each year. Keeping this in view, the present study was carried out with the objective to assess the livelihood and level of income of bamboo plantation by farmers of small holding. 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 data were collected through pilot survey, structured interview, and questionnaire, participatory approaches. The study reveals that the predictor variable viz. family size (X3), land under agricultural crop (X7), land under bamboo (X9), annual income before bamboo (X11), energy consumption (X16), cost incurred in bamboo cultivation (X18) are some of the variable which has recorded significant association with income from bamboo as well as mandays and wages generation from bamboo. 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*. The variable Age (X1), family size (X3), Land under agricultural crop (X7), Cropping intensity (X8), land under bamboo (X9), Material possessed (X10), energy consumption (X16), cost incurred in bamboo cultivation (X18) have been retained in the step down regression to imply that these variable is extremely important to these causal variable to interpret the reason and spectrum of variance of the consequent variable in its behavior and performance.

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INTRODUCTION

Bamboo has been a familiar natural resource to the local communities over the millennia with 1500 documented applications/ uses. Known, as *venu* in Sanskrit, it was used for construction of *yajna shalas* (prayer shelter for religious rituals) and consecration of saintly persons in *vedic* era (circa 1000 BC). It has been often been referred to as a “poor man’s timber”, due to its ubiquitous distribution and ease of working with the simplest of tools, and this diminished the attention of the planners and resource managers. However, with the disquieting loss of forest cover and overall environmental degradation, it has again emerged as a panacea for wood substitution and promoting ecological and environmental security. The bamboo industry with immense economic potential in a labour surplus Indian economy has an important role in both the traditional and non-traditional sectors. In Tripura, bamboo has many domestic, agricultural and commercial uses and cultural linkage with the bamboo dependent and indigenous people. The artisans in this sector make bamboo products for their sustenance and they are endowed only with traditional skills, tools and work experience. Their bamboo based productive activities mainly involve the four stages of procurement, processing, production and marketing. The raw material requirement of the bamboo dependents is mainly sourced from natural areas/forest depots, private depots, local market and home gardens.

OBJECTIVES

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

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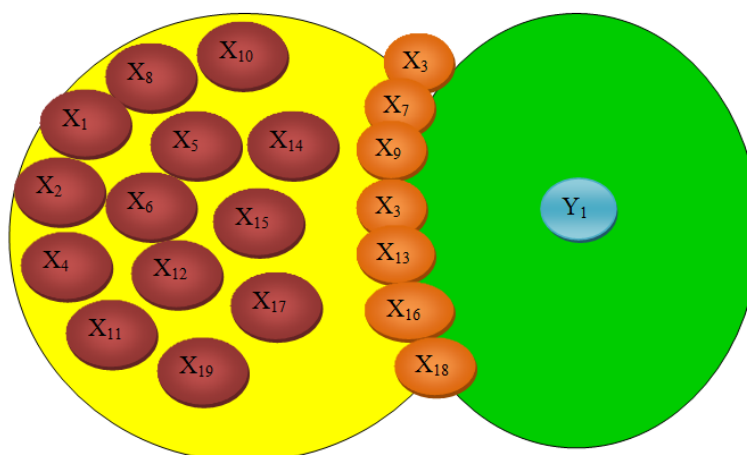
## MATERIALS AND METHODS

- These are the methodological inputs followed for conducting the study
- Locale of study
- Sampling design
- Pilot study
- Variables and measurements
- Method of data collection
- Statistical tools used for analysis and interpretation of data.

The 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 West district and the block Hezamara were considered. Under the Hezamara block Sharat chowdhury para village was selected. From Sharat Chowdhury para village 96 samples have been selected out of 1500 bamboo grower. Various dependent and independent variables are: 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 (Y1), Wages generated in bamboo enterprise (Y2).

## RESULTS AND DISCUSSION

### Co-efficient of correlation between The Family income from Bamboo enterprise (Y1) and other 19 exogenous variables



The variable family size (X3) has been found negatively but significantly correlated to imply that family income from Bamboo enterprise (Y1) has gone higher for a small size family. Small size family has got relatively less family cost to incur and hence higher level of savings and surplus.

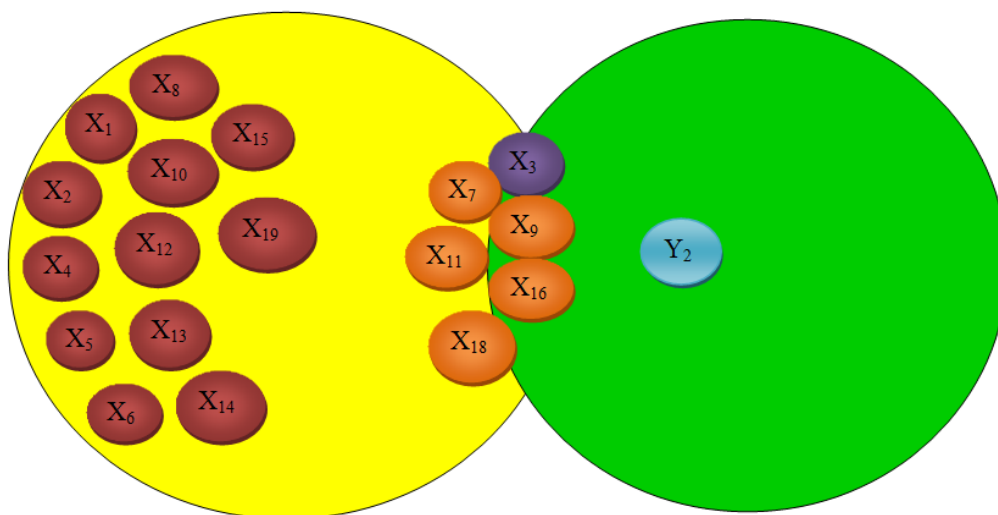
Land under agricultural crop (X7) and land under bamboo(X9), on the other hand, have recorded a positive but significant correlation to imply that for the respondents having higher size of land holding, are also generating higher level of income.

Number of rhizome planted (X13) and number of rhizome grew to the fullest(X14) have been found to have positive but significant correlation to imply that for the respondents who planted and retained higher number of rhizome have acquired higher level of income.

Energy consumption (X16) has been emerged as an important economic indicator to estimate the income from family income from Bamboo enterprise (Y1) of the respondents. This implies that higher degree of energy consumption has gone positively with the income from the bamboo enterprise.

### Co-efficient of correlation between Mandays generation from Bamboo enterprise (Y2) and other 19 independent variable

The variable family size (X3) have been found negatively but significantly correlated to imply that Mandays generated from Bamboo enterprise (Y2) has gone higher for a small size family. Small size family has got relatively less family cost to incur and hence higher level of savings and surplus. X3 has recorded highest significant association.



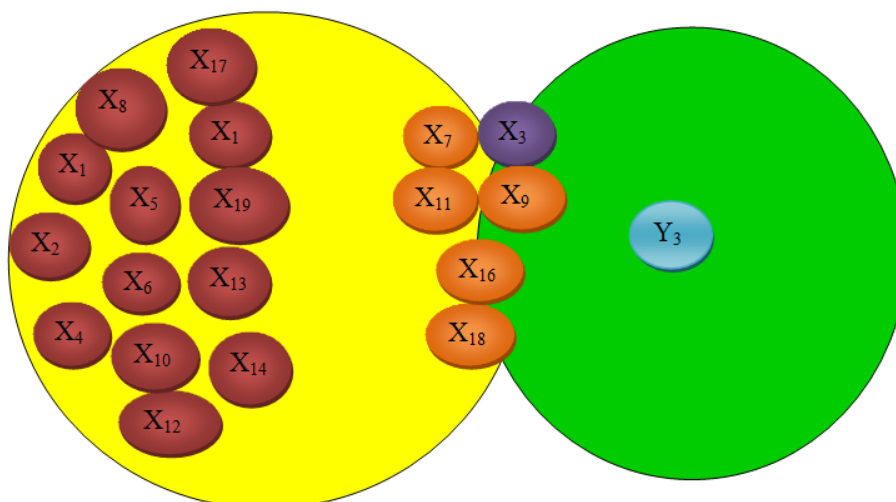
Land under agricultural crop (X7) and land under bamboo (X9), on the other hand, have recorded a positive but significant correlation to imply that all type of lands are providing the resource support for the optimum farm operation and the generation of farm income. The size of land acts in the form of a volume of operational resources, and hence can ensure better income and absorb any kind of risk.

Annual income before bamboo (X11) has been found to have positive but significant correlation with Mandays generated from Bamboo enterprise (Y2). This is to imply that it has got congenital impact.

Energy consumption (X16) has been emerged as an important economic indicator to estimate the income from Mandays generated from Bamboo enterprise (Y2) of the respondents. This implies that the mechanization vis-a-vis energy intensification has gone positively to generate higher per unit Mandays generation from Bamboo enterprise.

Cost incurred in bamboo cultivation(X18) has recorded to have positive but significant correlation with Mandays generated from Bamboo enterprise (Y2). This implies that respondents those who have invested high amount in bamboo plantation got higher income as well as higher Mandays generated thereafter.

**Co-efficient of correlation between Wage generation from Bamboo enterprise (Y2) and other 19 independent variable**



The variable family size (X3) have been found negatively but significantly correlated to imply that Wages generated from Bamboo enterprise (Y3) has gone higher for a small size family. Small size family has got relatively less family cost to incur and hence higher level of savings and surplus. X3 has recorded highest significant association.

Land under agricultural crop(X7) and land under bamboo (X9), on the other hand, have recorded a positive but significant correlation to imply that all type of lands are providing the resource support for the optimum farm operation and the generation of farm income. The size of land acts in the form of a volume of operational resources and hence can ensure better income and absorb any kind of risk.

Annual income before bamboo (X11), have been found to have positive but significant correlation with Wages generated from Bamboo enterprise (Y3). This is to imply that it has got congenital impact.

Energy consumption (X16) has been emerged as an important economic indicator to estimate the income from Wages generated from bamboo enterprise (Y3) of the respondents. This implies that the mechanization vis-a-vis energy intensification has gone positively to generate higher per unit Wages generation from bamboo enterprise.

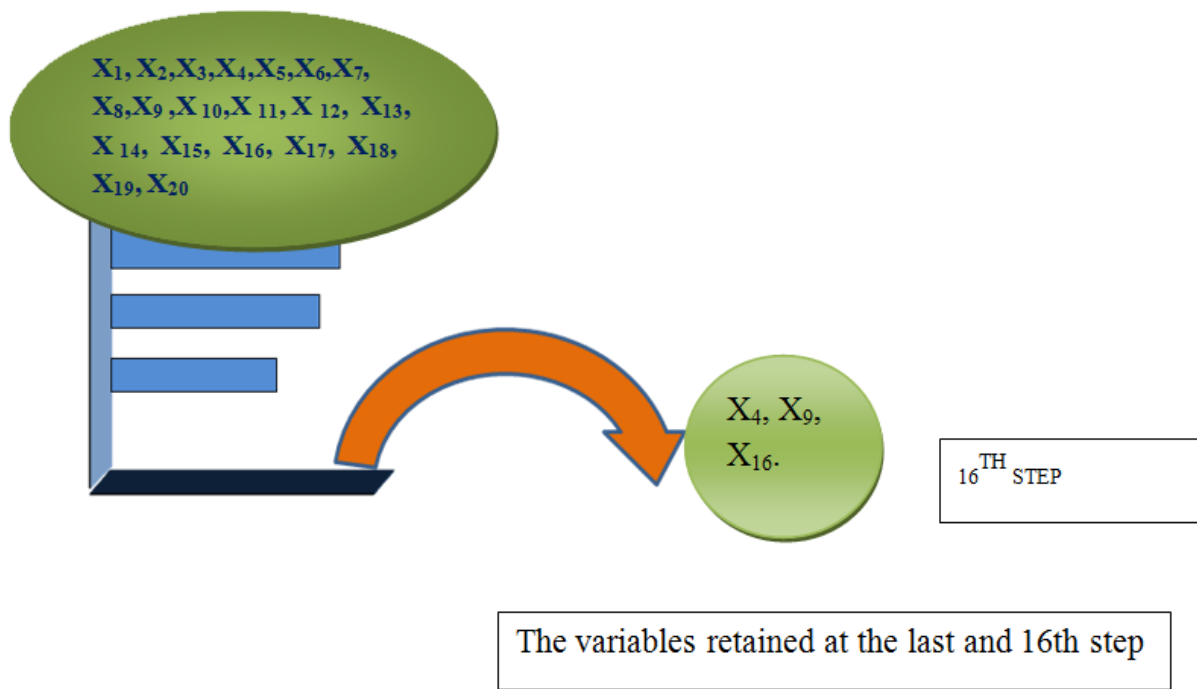
Cost incurred in bamboo cultivation (X18) has recorded to have positive but significant correlation with Wages generated from Bamboo enterprise (Y3). This implies that those respondents who have invested high amount in bamboo plantation got higher income as well as higher Wages also.

**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 (16th) to contribute substantially on the consequent variable that is family income from bamboo enterprise.

The variables X4 , X9 , X16 has been retained at the step 16 to imply that these variables are extremely important causal variable to interpret the reason and spectrum of variance of the consequent variable, in its behavior and performance.

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)

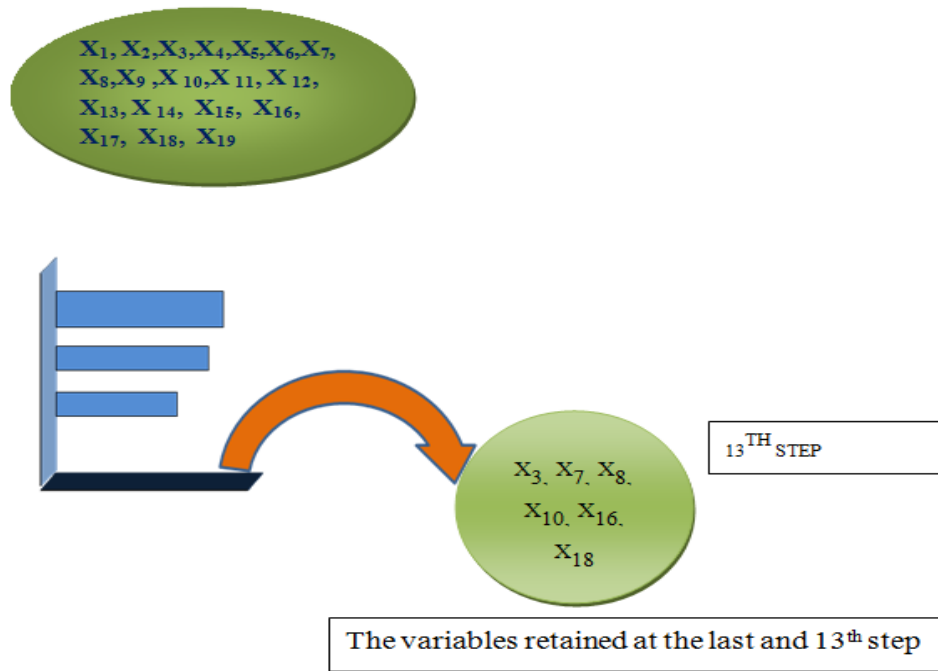


**Paradigm of step down regression: Causal Effect of independent Variables on Mandays generated from Bamboo enterprise (Y2), the consequent variable**

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

The variables X3 , X7, X8, X10, X16, X18 has been retained at the step 16 to imply that these variables are extremely important causal variable to interpret the reason and spectrum of variance of the consequent variable, in its behavior and performance.

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.

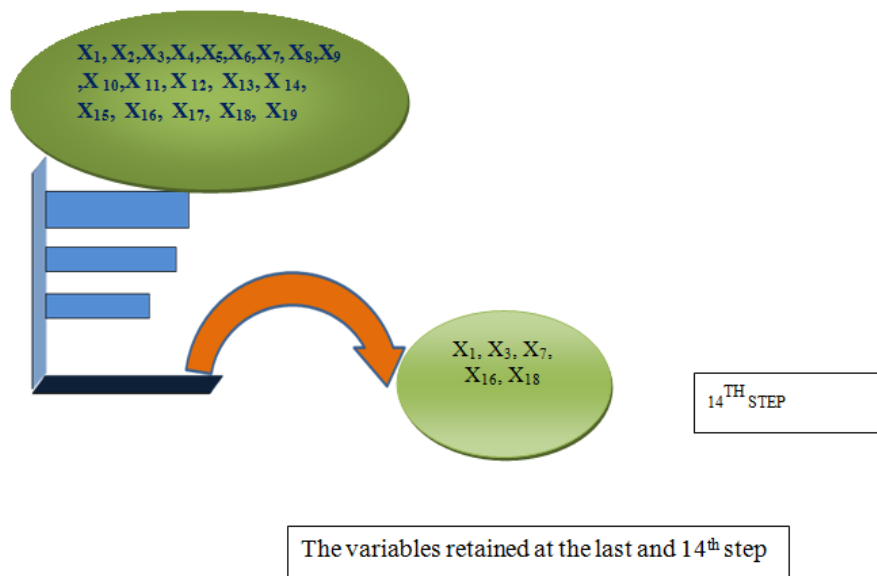


**Paradigm of step down regression: Causal Effect of independent Variables on Wages generated from bamboo enterprise (Y3), the consequent variable**

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 (14<sup>th</sup>) to contribute substantially on the consequent variable that is Wages generated from bamboo enterprise. Mass utilization of Bamboo and its use as craft in the industry has been a profitable venture (Cruz, V ,C. 1998).

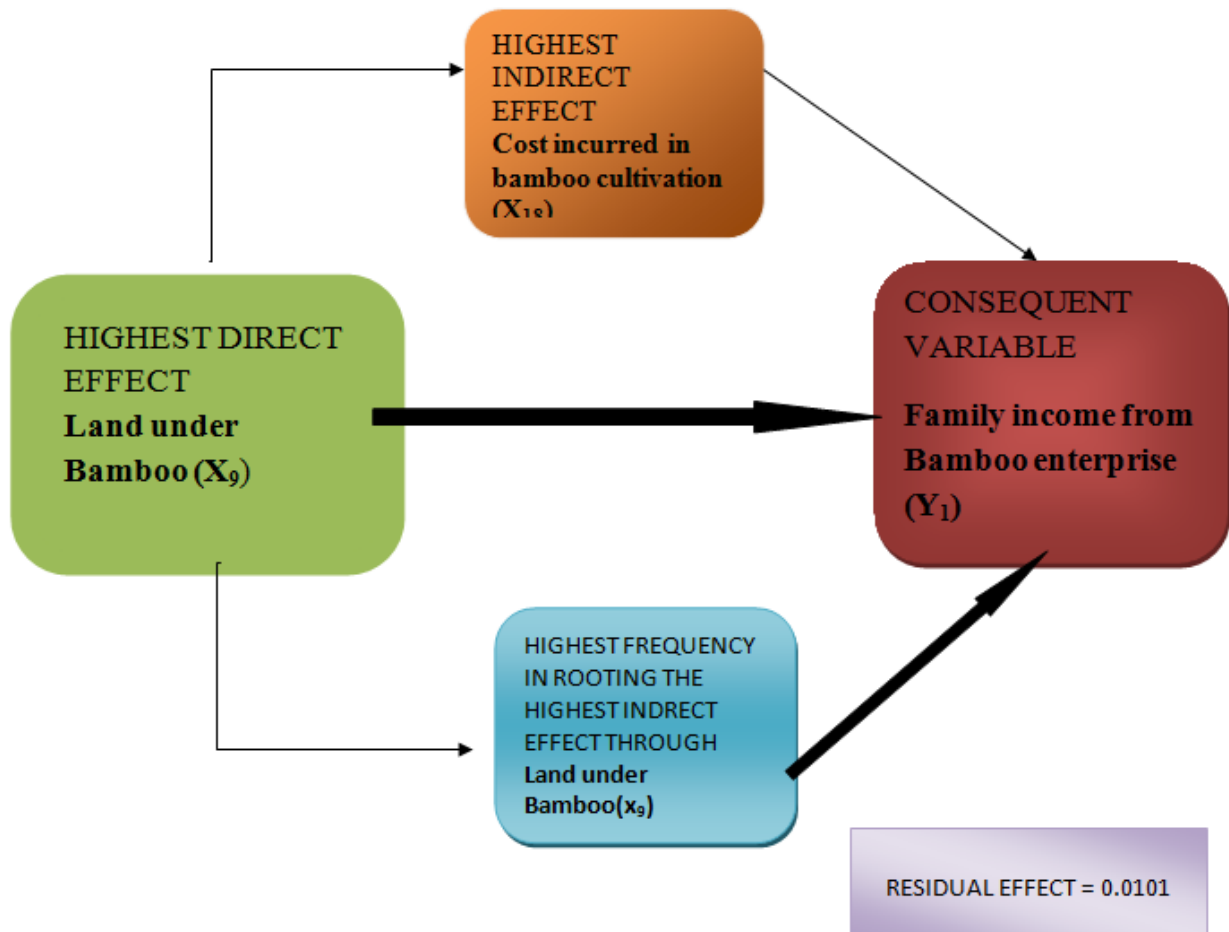
The variables X1, X3 , X7 , X16 , X18 has been retained at the step 16 to imply that these variables are extremely important causal variable to interpret the reason and spectrum of variance of the consequent variable, in its behavior and performance .

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.



**PATH ANALYSIS: Paradigm of path analysis of causal variable Family income from Bamboo enterprise (Y1) vs. other 19 exogenous variables**

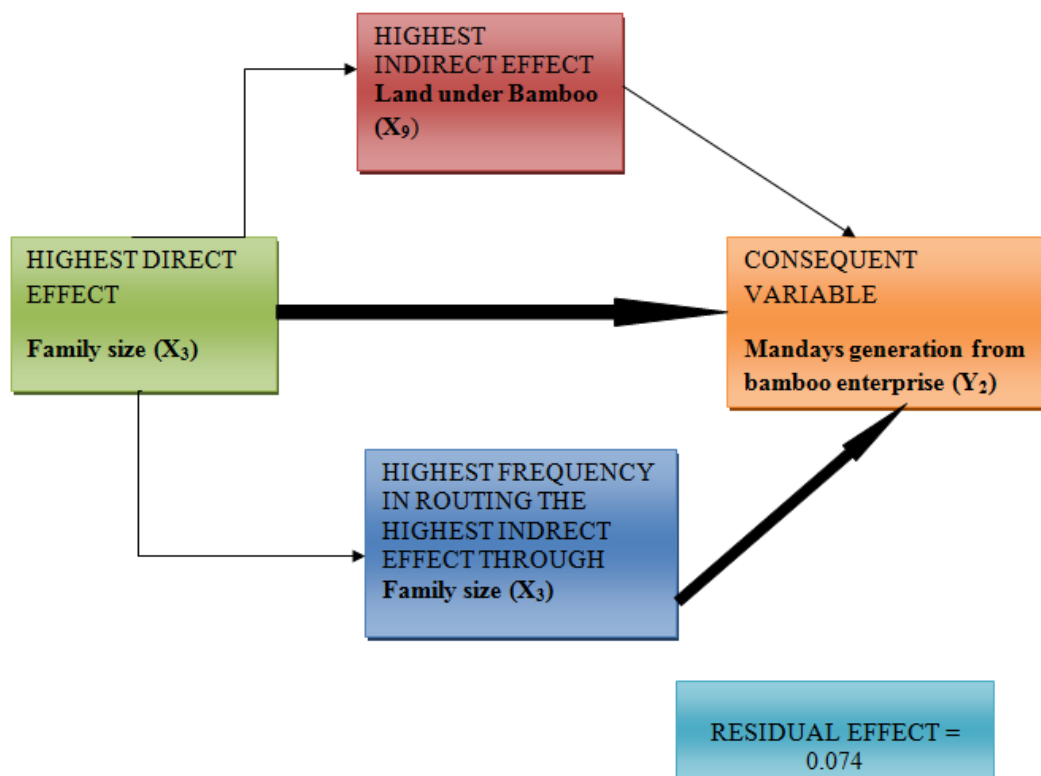
Bamboo contributions have benefited poor as well as rich groups, and these contributions have moved many households from the poorer to the richer classes. Bamboo sector reforms have reduced the inequality in bamboo land and bamboo income but the share of bamboo income in the total income inequality has increased(Kant,-S; Chiu,-M ,2000).It has been found that the variable land under bamboo (X9) has exerted the highest direct effect to characterize the income from bamboo. It is well discernable that the land size of the bamboo orchard is extremely proportionate with its income generating capacity.



The variable cost incurred in bamboo cultivation(X18) has also been exerted the highest indirect effect to imply that this variable has got highest associational property to characterize the income from bamboo enterprise.

Again, it has been found that the variable land under bamboo (X9) has routed highest indirect effect of all the variables to ultimately functionalize the performance of income from bamboo enterprise. This indicates the behavioral as well as operational viscosity of this variable income from bamboo enterprise. The value of the residual effect indicates that with the combination of these 19 variables, more than 98% variance of family income from bamboo enterprise (Y1) has been explained.

## PATH ANALYSIS: Man days generated from Bamboo enterprise (Y<sub>2</sub>) and other 19 exogenous variables



Bamboo plays an important role in its rural economy by providing sustenance employment and household income. Bamboo based management can generate 6.1 million man days employment per annum producing annual value addition of Rs. 55.34 crore. More than 70% work force comes from rural areas. (Gupta, A. K, 2008). It has been found that the variable family size (X<sub>3</sub>) has exerted the highest direct effect to characterize the Man days generation from Bamboo enterprise. It is well discernable that family size presents both stress and motivation to go for labour intensive work in individual to elicit a better choice out of basket of commodity to support the family and earn better social status for the family.

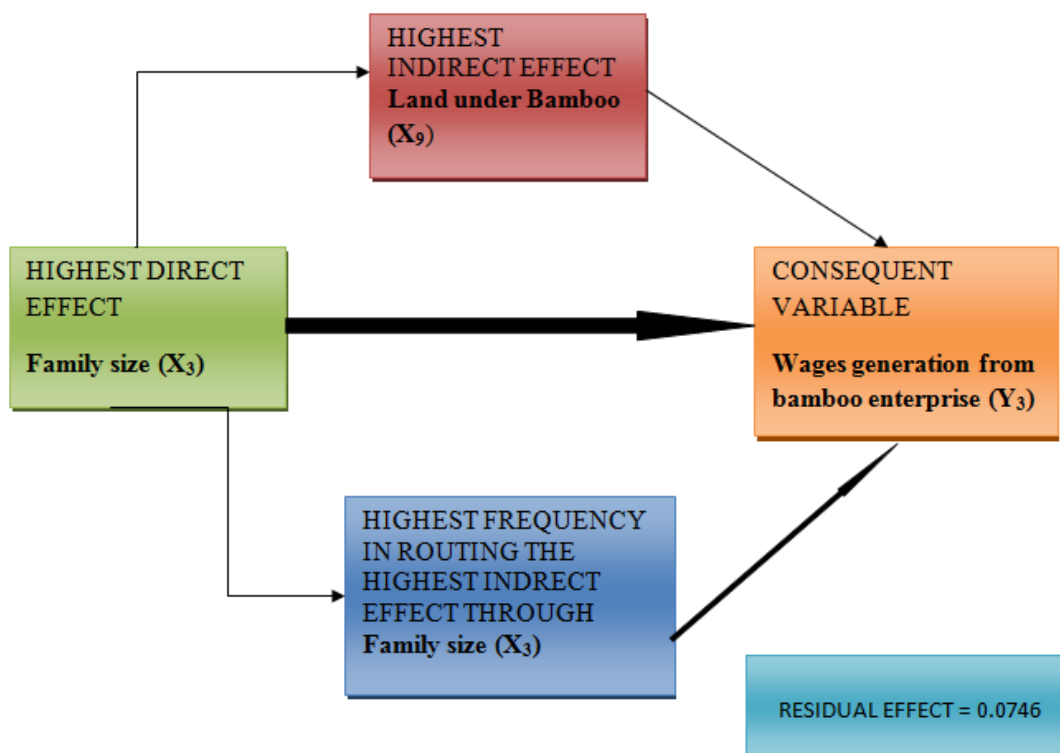
The variable land under bamboo (X<sub>9</sub>) has also been exerted the highest indirect effect to imply that this variable has got highest associational property to characterize the productivity of bamboo.

Again, it has been found that the variable family size (X<sub>3</sub>) has routed highest indirect effect of all the variables to ultimately functionalize the performance of Man days generation from Bamboo enterprise. This indicates the behavioral as well as operational viscosity of this variable productivity of bamboo. The value of the residual effect indicates that with the combination of these 19 variables, more than 98 per cent variance of Man days generation from Bamboo enterprise (Y<sub>2</sub>) has been explained.

## PATH ANALYSIS: Wages generated from Bamboo enterprise (Y<sub>3</sub>) and other 19 exogenous variables

It has been found that the variable family size (X<sub>3</sub>) has exerted the highest direct effect to characterize the wages generation from bamboo enterprise. It is well discernable that family size presents both stress and motivation to go for labour intensive work in individual to elicit a better choice out of basket of commodity to support the family and earn better social status for the family.

The variable land under bamboo (X9) has also been exerted the highest indirect effect to imply that this variable has got highest associational property to characterize the productivity of bamboo.



Again, it has been found that the variable family size (X3) has routed highest indirect effect of all the variables to ultimately functionalize the performance of wage generation from bamboo enterprise. This indicates the behavioral as well as operational viscosity of this variable productivity of bamboo. The value of the residual effect indicates that with the combination of these 19 variables, more than 98 per cent variance of wages generation from (Y2) has been explained.

### 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 discernable 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.

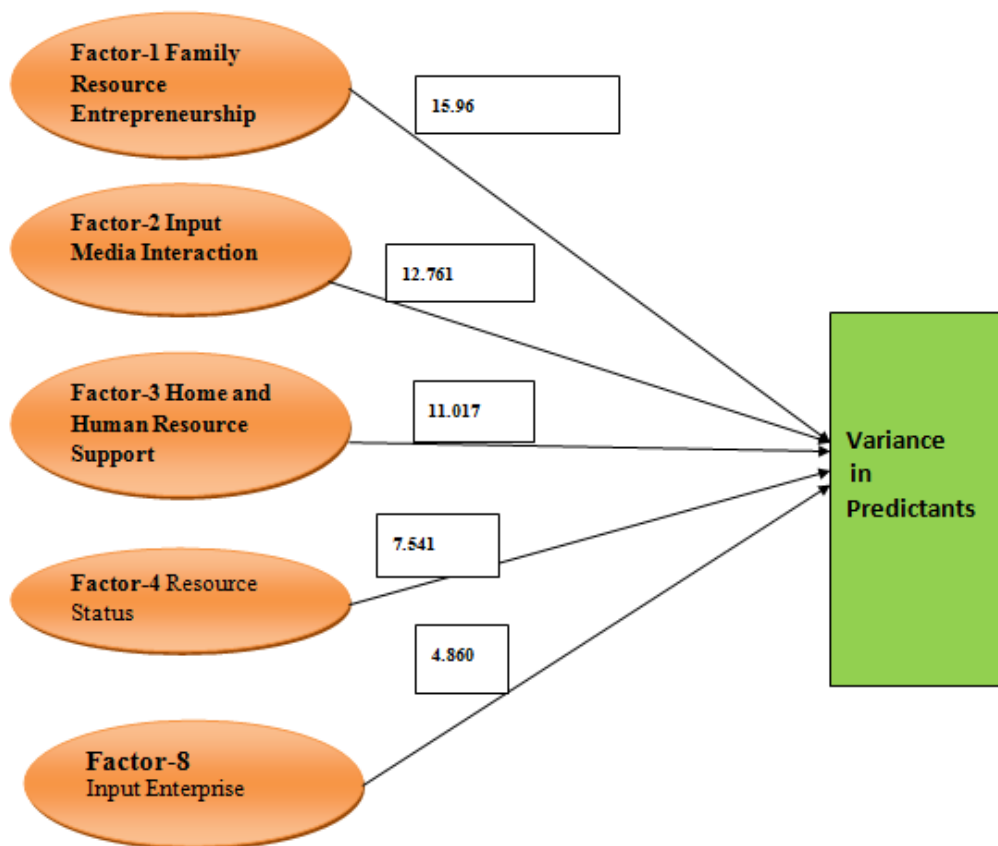
**Factor-2** has accommodated the following variables, Mass media exposure (X12), Number of rhizome planted (X13), Number of rhizome grew to the fullest (X14), and this factor can be renamed as *Input media interaction*. This has contributed 12.761% of variance.

**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.

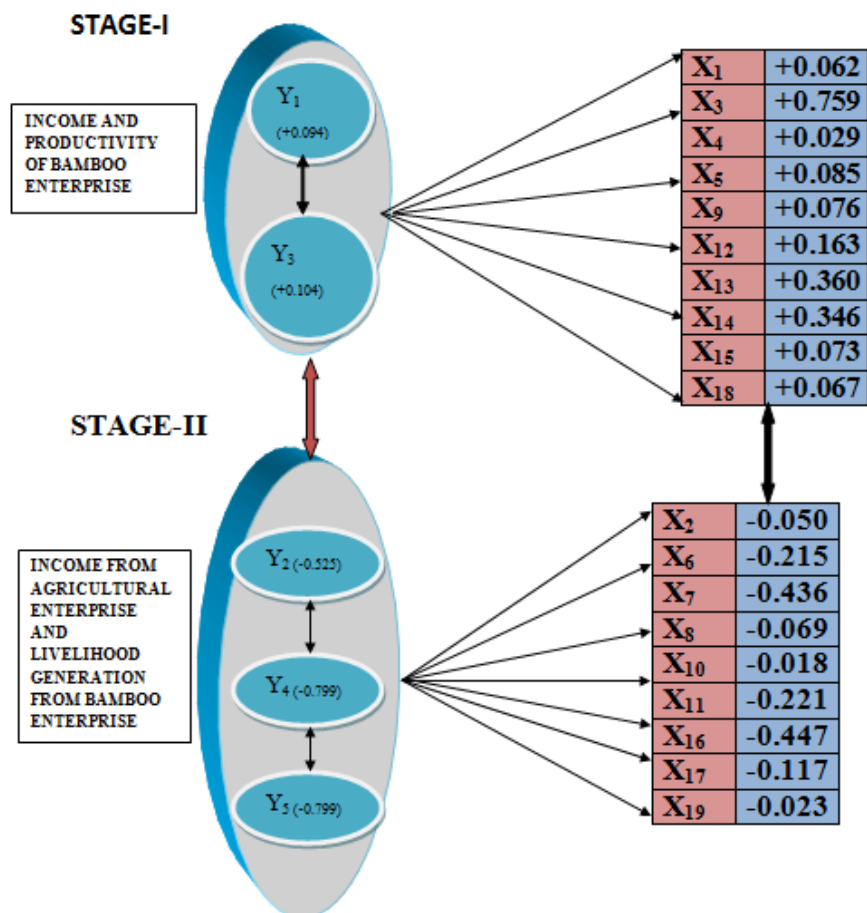
**Factor-4** has accommodated the following variables, Material possessed (X10), Annual income before bamboo (X11), and this factor can be renamed as Resource status. This has contributed 4.86% of variance.

**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.





### CANONICAL CORRELATION ANALYSIS



Canonical covariate analysis has been carried out to depict the clandestine interactive and combination between two sets of variables i.e., left and right side sets of variables. This analysis has got tremendous strategic importance.

The model depicts that from the left side (Set-I) the following consequent variables viz; Y1= Family income from bamboo enterprise, Y3= Productivity of bamboo, Have got clear choices to select the following exogenous variable i.e. from right set of variables viz, X1=Age, X3 =Family size, X4= Average cost of farm implements when purchased, X5= Average cost of farm implements at present, X9= Land under bamboo, X12= Mass media exposure, X13= Number of rhizome planted, X14= Number of rhizome grown to the fullest, X15= Training received, X18 = Cost incurred in bamboo cultivation.

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) in combination 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), Man days 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) combination can be branded as Farm Family Economy with a clandestine support from right side variable which also can be branded as Management –Communication Variable.

## **Conclusion**

Livelihood generation is a complex process that undergoes a plethora of socio-economic and techno-ecological functions. In addition to livelihood generation bamboo also have positive environmental impact and used as substitute for wood in a wide range. Bamboo based industries can therefore provide the time and space for evolutionary development of the rural economy.(Hunter, I. R 2001).In studding the livelihood generation from bamboo enterprises, the variables contributed to it are institutional and managerial in nature, consisting of family size, land resources, cropping intensity, cost and energy consumption. This multidimensional interaction means and implies that livelihood planning needs to consider not only the enterprise it deals with but also the ecology it confronts with. A constructive livelihood process whatsoever basically keeps integrating resource- time - cost and technology while a coercive livelihood keeps depleting the resource based and creates a discord with the surrounding ecosystem. The same research can be cloned in different ecological and social set up in as much to develop a model based on bamboo enterprise towards prescribing a sustainable livelihood generation process.

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