Livelihood Security, Diversification and its Determinants in National Calamity Affected Area of India : Sustainable Lessons Learnt from Past to Combat Covid-19

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Abstract

Kosi River is known as the sorrow of Bihar, India but the devastation of 18th August, 2008 was never seen or heard before. 2008 flood is the only calamity in the annals of India to be officially stated as a "National Calamity"! So, the study was purposively conducted in the flood affected region following the exploratory research design, comprising 160 respondents. Livelihood security (LS) Index was used under an exhaustive list of 7 sub-indicators and it depicted that only one sub-indicator *i.e.,* educational security had crossed the barrier of halfway mark, which explicitly suggested improvement possibilities in almost every sub-indicator of LS. Finally, the factors which influenced the LS of the respondents were identified through standardized multivariate regression (SMRA) model. Out of 18 predictive variables only 13 variables were fitted in SMRA model, whose communalities after extraction form exploratory factor analysis were greater than 0.7 in the preliminary study. SMRA model revealed that dependency ratio, health index, migration, women employment in a household, livelihood diversification, cropping intensity, innovativeness and lean season employment should be given utmost priority in order to boost LS. So, the unemployment crisis arouse due to reverse migration during covid-19 can be tackled if one can explore the livelihood opportunities as did by farmers affected by 2008 calamity. Thus, if administration wants to combat covid-19 crises dependency ratio should be reduced moreover high livelihood diversification, women employment in a household, innovativeness and lean season employment should be promoted. Manuscript concluded by proposing recommendations to ensure LS by exploring employment opportunities in alternative livelihoods options.

Key words : Covid-19, diversification, livelihood security, migration, natural calamity.

Introduction

Indian subcontinent is highly vulnerable to major natural disasters such as earthquakes, tsunamis, cyclones, floods, droughts, landslides and bushfires and these calamities severely affect the farming communities (1,2). The Kosi flood, which affected Bihar in 2008, was declared as "National Calamity" and so far, it is the single calamity in the history of India to be officially declared as a "National Calamity" (2). Subsequent years (2009, 2010 and 2013) in the same region were seen as dry years and were declared as drought hit areas in Bihar (3). In addition, this type of perennial flood further worsens the already precarious situation such as poverty, high population growth, low development, poor infrastructure, low food production, and hunger in the most backward region of India or any other part of the world (1).

Although, Kosi River is known as the sorrow of Bihar [3] from pre-historic time but 'the Kosi flood of 2008' was the most devastating one because as per official estimates approximately 493 lives were lost and 3,500 were reported missing after the disaster (3). In nutshell, the devastation was of such a magnitude that it took almost 2 years for Government of Bihar to finalize economic-need assessment report and to submit it to World Bank (3). No follow-up study is usually conducted to record the consequences of a natural calamity in the life of the farmers vis-a-vis LS. It was consequently considered appropriate to investigate the current livelihood status, its extent of vertical and horizontal livelihood diversification and factor influencing it in the study area.

Materials and Methods

Research was conducted in the purposively selected '2008 flood' affected region of Bihar State of India. Two most devastated districts were purposively selected, *viz.,* Supaul and Madhepura for the study. A multistage sampling technique was applied for selection of blocks, villages and respondents. Two affected blocks from each district and two villages from each block were selected randomly. An enumerated list of respondents was prepared who had faced the fury of calamity but still pursuing agriculture as an occupation in all the eight selected villages. From each village 20 respondents were selected randomly comprising a total 160 respondents as sample for the study. Hence, study was performed on 160 respondents in 8 villages following the exploratory/ formulative research design during the period 2013-2014.

Table-1 : Distribution of respondents on the basis of different sub-indicators of LS.

Sub-indicators	Respondents (n=160)		Mean (Range)
	Frequency	Percentage	
Food Security Index			
Very Low (<0.351)	47	29.38	0.486
Low (0.351-0.450)	27	16.87	(0.217-0.843)
Medium (0.451-0.650)	34	21.24	
High (0.651-0.750)	35	21.88	
Very High (>0.750)	17	10.63	
Economic Security Index			
Very Low (<0.337)	59	36.88	0.441
Low (0.337-0.483)	39	24.37	(0.197-0.704)
Medium (0.484-0.578)	41	25.62	
High (0.579-0.653)	11	06.88	
Very High (>0.653)	10	06.25	
Health Security Index			
Very Low (<0.321)	21	13.13	0.497
Low (0.321-0.460)	43	26.88	(0.256-0.798)
Medium (0.461-0.650)	59	36.87	
High (0.651-0.740)	23	14.37	
Very High (>0.740)	14	08.75	
Educational Security Index			
Very Low (<0.351)	10	06.25	0.560
Low (0.351-0.461)	52	32.50	(0.314-0.845)
Medium (0.462-0.632)	57	35.63	
High (0.633-0.713)	25	15.62	
Very High (>0.713)	16	10.00	
Social Security Index			
Very Low (<0.321)	28	17.50	0.481
Low (0.321-0.431)	31	19.38	(0.279-0.743)
Medium (0.432-0.591)	56	35.00	
High (0.592-0.710)	35	21.87	
Very High (>0.710)	10	06.25	
Institutional Security Index			
Very Low (<0.302)	57	35.62	0.409
Low (0.302-0.413)	33	20.63	(0.214-0.698)
Medium (0.414-0.571)	40	25.00	
High (0.572-0.634)	20	12.50	
Very High (>0.634)	10	06.25	
Infrastructural Security Index			0.370
Very Low (<0.321)	59	36.88	(0.268-0.693)
Low (0.321-0.410)	47	29.38	
Medium (0.411-0.561)	33	20.62	
High (0.562-0.617)	17	10.62	
Very High (>0.617)	04	02.50	0.479
Overall LS Index value			

To measure LS of farmers, an Index developed by Parmanand (4) was used. It was based on 7 sub-indicators of LS, i.e., food security, economic security, health security, educational security, social security, institutional security and infrastructural security; was used with suitable spatio-temporal modification. To find out the weightage of different indicators of livelihood security, ranks were taken from the judges (who were experts in the field of Social Science such as scientists, professors from renowned agricultural university). For taking the judges' responses, schedule containing these 7 indicators having rank 1 to 7 was sent to 50 judges; out of which, 35 judges responded within the stipulated time period. To reduce the subjectivity and bias of the judges for assigning ranking of sub-indicators, set of rules were followed: judges were selected having almost similar academic background, had exposure about rural situation vis-à-vis LS, in addition operational definition of each sub-indicator along with brief background of the study area were attached with the schedule. Additionally, number of judges was sufficient to neutralize the effect of bias and subjectivity for the present study.

The ranks were converted into weightage by adopting the methodology given by (5) and the method was further elucidated by (6) by the construction of index. Thus, out of the 7 sub-indicators of livelihood security,

Table-2 : Model Summary of dependent variable i.e., Livelihood Security (LS) of the respondents.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.765	.585	.548	.072237264287906	2.212

a. Predictors : (Constant), Dependency Ratio (DR), Family education status (FES), Health index (including Body Mass Index), Experience (Exp), Social participation (SP), Migration, Women employment in a household, Availability of credit facilities, Livelihood diversification (LD), Cropping intensity (CI), Innovativeness, Closeness with agri-support system, Lean season employment (LSE).

b. Dependent Variable : LS

Table-3 : ANOVA value representing the suitability of regression model.

	Model	Sum of Squares	df	Mean Square	F	Sig.
1.	Regression	1.073	13	.083	15.815	.000
2.	Residual	.762	146	.005		
	Total	1.835	159			

food security had the maximum weightage of (93.61), trailed by health security (82.08), economic security (79.63), educational security (77.42), social security (69.07), institutional security (60.49) and infrastructural security (57.30) as per the index weight calculated by (4). The statements representing each particular sub-indicator of livelihood security were selected by sending statements to the judges. On the basis of suggestions given by the judges, the final selection of statements of each sub-indicator was made.

A range of predictor or criterion variables were also collected that might act as explanatory variables for LS of the respondents including 18 variables in toto viz., health including body mass index, employment generation, livestock number, annual income, family education status (FES), social participation, extension contact, experience, innovativeness, migration, availability of credit facilities, women employment in a household, closeness with agri-support system, livelihood diversification, size of land-holding, lean season employment, cropping intensity (CI) and dependency ratio. Thus, initially 18 predictive variables were taken but based on the preliminary survey in non-sample area only those variables were selected whose communalities after extraction form exploratory factor analysis were greater than 0.7 and thus only 13 variables were fitted in the final SMRA model viz., dependency ratio, family education status, experience, migration, livelihood diversification (LD), social participation, cropping intensity, innovativeness, lean season employment, availability of credit facilities, women employment in a household, closeness with agri-support system and health index (including Body Mass Index, BMI). Before applying SMRA model the importance of unstandardized regression coefficient (B) and standardized regression coefficient, Beta (â) were explored. The standardized regression coefficient, Beta (â), is more appropriate to use (7). So, the standardized beta coefficients were used to compare the importance of each variable in predicting LS. â values communicate the

direction (positive or inverse) and the weighting of the independent variable relative to the other independent variables in explaining the variation of the dependent variable.

Results and Discussion

Livelihood security (LS) in the study area : LS had been conceptualized as an index comprising of 7 sub-indicators and all these securities were contributing in achieving the LS of a respondent. The level and distribution of respondent in each sub-indicator of LS have been presented under the following sub-indicators (Table-1).

Food Security Index : Value revealed that the highest percentages of respondents were having very low level of food security *i.e.,* 29.38 percent. At the same time, it was also found out that 21.88 percent were having high level of food security and 34 respondents (*i.e.,* 21.24 percent) were having medium level of food security, in the study area. Precisely, 16.87 percent of the respondents were having low level of food security and only 10.63 percent of the respondents were having very high level of food security, in the study area. The overall extent of food security in the study area was 48.60 percent. Results indicate that only 32.51 percent of respondents had high to very high level of food security, in the study area, while 67.49 percent of the respondents were having medium to very low level of food security, which depicts the vulnerable condition of the respondents towards the food security, in the study area.

Economic Security Index : A perusal of the figures in the Table-1 indicated that the highest percentages of respondents were having very low level of economic security i.e. 36.88 percent. It was also found out that 25.62 percent were having medium level of economic security and 39 respondents (i.e. 24.37%) were having low level of economic security. Precisely, 6.88 percent of the respondents were having high level of economic security and only 6.25 percent of the respondents were having

Table-4 : Multivariate regression analysis of independent variables with livelihood security of the respondents.

S.No.	Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value (Sig.)	99.0% Confidence Interval for B	
		B	SE				Lower Bound	Upper Bound
	(Constant)	.120	.050		2.397	.018	-.011	.250
1.	DR	-.003	.001	-.174	-2.859	.005***	-.006	.000
2.	FES	.000	.000	.052	.922	.358	.000	.001
3.	Health	.007	.004	.126	1.734	.085*	-.004	.018
4.	Experience	.001	.001	.099	1.435	.153	-.001	.002
5.	SP	-.006	.017	-.027	-.340	.734	-.050	.038
6.	Migration	.042	.014	.200	2.981	.003***	.005	.079
7.	Women	.009	.005	.155	1.757	.081*	-.004	.021
8.	Credit	.000	.001	-.020	-.345	.731	-.002	.001
9.	LD	.005	.002	.218	2.651	.009***	.000	.010
10.	CI	.005	.003	.186	2.046	.043**	-.001	.012
11.	Innovativeness	.006	.003	.228	2.032	.044**	-.002	.014
12.	Closeness	-.003	.003	-.134	-1.221	.224	-.010	.004
13.	LSE	.008	.005	.115	1.769	.079*	-.004	.021

a. Dependent Variable : LS

*,** and ***, depict value is significant at 10, 5 and 1% levels respectively (2-tailed). Nomenclature of variables are given in Table-3.

very high level of economic security, in the study area. The overall extent of economic security in the study area was 44.10 percent. Results indicate that only 13.13 percent of respondents had high to very high level of economic security, in the study area, while 86.87 percent of the respondents were having medium to very low level of economic security, which indicated the urgency of increasing the economic opportunities of the respondents by imparting skill and by providing better market facilities to sell their produce.

Health Security Index : A close analysis of the Table-1 revealed that highest percentages of respondents were having medium level of Health security i.e. 36.87 percent. It was also established that 26.88 percent were having low level of health security and 21 respondents (i.e. 13.13%) were having very low level of health security, in the study area. In particular, 14.37 percent of the respondents were having high level of health security and only 08.75 percent of the respondents were having very high level of health security, in the study area. The overall extent of health security in the study area was 49.70 percent. Results indicate that precisely 59.99 percent of respondents had medium to very high level of health security, in the study area. It would be worth revealing that soon after flood there was water-borne disease outbreak but it was soon controlled by the combined efforts of international and national relief organizations, NGOs, civil society, state governments and National Rural Health Mission (NRHM) activists. ASHAs (Accredited social health activists) workers were doing commendable job in the study locale under NRHM by providing Weekly Iron and Folic acid Supplementation (WIFS) to Hepatitis-B vaccination; they were doing their level best to improve the health condition of the villagers, especially women and children. The condition of 'additional primary health centre' (APHC) and district (Sadar) hospital had enhanced a lot in the past few years. State health society, Bihar was committed for the health of every individual in the most vulnerable region of state.

Educational security Index : Lucid examination of the Table-1 shows that highest percentages of respondents were having medium level of educational security i.e. 35.63 percent. At the same time, it was also found out that 32.50 percent were having low level of educational security and only 10 respondents (i.e. 6.25%) were having very low level of educational security, in the study area. In particular, 15.62 percent of the respondents were having high level of educational security and 10.00 percent of the respondents were having very high level of educational security, in the study area. The overall extent of educational security in the study area was 56 percent, which was highest among all the 7 sub-indicators. Results indicate that precisely 61.25 percent of respondents had medium to very high level of educational security, in the study area. In Bihar literacy rate was 47 percent in 2001 but in 2011 it was 63.82 percent i.e. decadal growth of 35.78 percent (8,9). This data supports the fact that in the study area more than 61 percent had medium to very high level of educational security.

Social Security Index : An examination of the figures in the Table-1 indicated that the highest percentages of respondents were having medium level of social security i.e. 35.00 percent. It was also found out that 19.38 percent were having low level of social security and 28 respondents (i.e. 17.50%) were having very low level of

social security, in the study area. Precisely, 21.87 percent of the respondents were having high level of social security and only 6.25 percent of the respondents were having very high level of social security, in the study area. The overall extent of social security in the study area was 48.10 percent. Results indicated that only 28.12 percent of respondents had high to very high level of social security, in the study area, while 72.88 percent of the respondents were having medium to very low level of social security, which indicates the necessity of increasing the social security for the farmers in the study area. Low level of social security was due to the fact that awareness about one's right to utilize public resources was dismal and few of the respondents even faced discrimination by government officials on the basis of their caste, creed and gender.

Institutional Security Index : Table-1 divulged that most of the respondents (35.62%) in the study area reported that there was very low institutional security in the locality; while 25.00 percent reported that there was a medium level of institutional security and 20.63 percent had low level of institutional security. Precisely, 12.50 percent of the respondents were having high level of institutional security and only 6.25 percent of the respondents were having very high level of institutional security, in the study area. The overall extent of institutional security in the study area was 40.90 percent. The results indicated that there was a need of reconstruction of destroyed administrative institutions during flood and building more academic institutions to improve the access of respondents to different institutions available in their locality.

Infrastructural Security Index : A glances at Table-1 divulged that regarding the availability and accessibility of the respondents to various infrastructural facilities available in their vicinity, it was found that maximum number of respondents (36.88%) had very low level of infrastructural security; whereas 29.38 and 20.62 percent of the respondents reported that they were having low and medium levels of infrastructural security, respectively. The overall extent of infrastructural security in the study area was 37.00 percent. The results necessitate there was an urgency of building more infrastructural facilities like: roads, irrigation canals etc. and improving the access of respondents to different infrastructure available in their locality like: mobile and internet facilities for improving the level of infrastructural security of the respondents. Infrastructural security had worst index value in the study locale i.e. only 0.370 as many of the roads, bridges and irrigation canals that were washed away or damaged during 2008 calamity were still not built or repaired. Even

many ponds were choked up due to silting and sand-casting in the study area. Not even a single food processing industry was there and there was a huge post-harvest loss in the study locale. Cold-storages and godowns were available only to big farmers and that also at higher price. Even marketing facilities were pathetic, so they were not getting fair price of their product. Hence combining all the 7 sub-indicators the value of overall livelihood security of the farmers in the study area was 0.479 or 47.9 percent.

Robustness of the regression model : The significant F-value (15.815), meager standard error of the estimate and high R^2 value show that the overall fit of the model was satisfactory (Table-2 and 3). Table-2 revealed that multiple correlations (R) are .765 and the R square is 0.585, which is 58.5 per cent of the variation in LS among the sample of 160 respondents is explained by these thirteen variables working together.

Relational analysis of LS and selected independent variables : The regression analysis fitted to the data to analyze the LS gave interesting findings (Table-4). In contrary to a priori expectation; family education status (FES), experience, social participation, availability of credit facilities, closeness with agri-support system were not found to have a significant influence on LS. The variables which had significant influence on LS are explained in details:

Dependency Ratio (DR) : DR was found to be statistically significant at $p<0.01$, with 't' statistics value of minus 2.859. The probability of LS was likely to decrease by a factor of 0.174 with unit increase in dependency ratio, which is in line of the expectation because non-earning members were burdensome to farm families.

Health Index (including BMI) : It was found to be statistically significant at $p<0.10$, with the 't' statistics value of 1.734. The probability of LS was likely to increase by a factor of .126 (-value) with unit increase in the Health Index value.

Migration : After the calamity of 18th August 2008, several male farmers had no other option but to migrate in order to earn their livelihood. When they had migrated, the female member of their family including their children had looked after family farm and livestock. Inter-state migration was more prominent and the top destination of migration was Delhi followed by Bathinda, Jalandhar and Patiala in Punjab etc. The type of work ranged from laborer, mason, tiles/marbles masons, gunny bag lifter; polish cum painter of building, wooden furniture worker to line installers. It was found to be statistically significant at $p<0.01$, with the 't' statistics value of 2.981. The probability of LS was likely

to increase by a factor of 0.200 (-value) with unit increase in migration. So, the unemployment crisis arouse due to reverse migration during COVID-19 can be tackled if one can explore the livelihood opportunities as did by farmers affected by 2008 calamity.

Women employment in a household : After the calamity female counterpart from upper caste family came out possibly for the first time to help their male counterpart to improve their crumbled LS due to calamity, while women from lower caste were already helping their male counterpart in the study area. It was found to be statistically significant at p<0.10, with the 't' statistics value of 1.757. The probability of LS was likely to increase by a factor of .155 (-value) with unit increase in the selected variable.

Livelihood diversification (LD) : It was calculated using Simpson Index of Diversity (SID). It was explored that more the diversification of income to earn the livelihood, more livelihood secures the respondents are! LD was found to be statistically significant at p<0.01, with the 't' statistics value of 2.651. The probability of LS was likely to increase by a factor of 0.218 with unit increase in LD.

Cropping intensity (CI) : It was found to be statistically significant at p<0.05, with the 't' statistics value of 2.046. The probability of LS was likely to increase by a factor of .186 (-value) with unit increase in CI. After the calamity the CI was drastically decreased due to sand-casting, undulation, erosion and water-logging of fertile land but few farmers followed soil reclamation strategies to do double and multiple cropping.

Innovativeness : Few farmers in the study area had developed 'a form of group and social dynamics in order to do livestock rearing' and 'individual produce, common marketing strategy for attaining livelihood security', that falls under social innovation and it was helping farmers to earn better LS (2). It was found to be statistically significant at p<0.05, with 't' statistics value of 2.032. The probability of LS was likely to increase by a factor of 0.228 (-value) with unit increase in innovativeness.

Lean season employment (LSE) : Those respondents who were able to find employment during agricultural lean period within the vicinity of study area were found to be more LS than their counterparts. Few LSE were making bamboo (traditionally considered as the poor man's timber in India and its area increased vigorously in the spare land after the flood) products such as basket, sitting stool, and vase; tailoring, mat and shed preparation was also prominent in the study locale. It was found to be statistically significant at p<0.10, with 't' statistics of 1.769. The probability of LS was likely to increase by a factor of 0.115 (â-value) with unit increase in innovativeness.

Conclusions

The overall results of the paper portrayed that only one sub-indicator *i.e.,* educational security had crossed the designated cut-off of 50 percent, which suggested improvement possibilities in almost all sub-indicators of LS were imperative. Infrastructural security had worst index value of 0.370 as many of the roads, bridges and irrigation canals that were washed away or damaged due to calamity were still not built or repaired. The overall livelihood security index indicated that majority of the respondents had insecure livelihood generation with mean value of 0.479. The policy relevance of conducting present study and its recommendations are as follows :

Despite having wide diversity of LS sources, economic security of the respondents was pathetic which signaled towards better market facilities to sell farmers produce to fetch fair and remunerative price.

SMRA model reinforced that explanatory variables viz., innovativeness, livelihood diversification, cropping intensity and migration should be given due emphasis if the LS of the respondents has to be increased in all the 7 sub-indicators.

Dependency ratio was negatively significant, which implies smaller family with more earning member was with better LS than their counterparts. So, more and more member of the households should be promoted to engage in economic activity.

The study locale witnessed, upper caste women coming out of their home for probably the first time after calamity to help their male counterpart! The model is worth emulating in other parts of India and World, where they don't come out of their home for work due to shyness, social stigma or any other reasons.

Due to increase in bamboo area after the calamity, it can give employment in alternative livelihoods options in the non-farming sector to people in study area such as paper, handicrafts and the new emerging areas of eco-friendly products e.g. housing, tiles, flooring, bamboo shoots etc. (tools, toys and utensils) and furniture.

Health model to tackle water-borne disease outbreak after calamity would be worth imitating in other flood prone regions of India and worldwide.

World Bank approved project ran in full swing in the study locale and so the findings may be valuable in framing the policy intervention for any other project.

Kosi flood has been a perennial problem for the Indian plains in Bihar, so some permanent solution needs to be worked by opening an international diplomatic dialogue with Nepal.

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