

2015

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### Recommended Citation

Tewari, H. R.; Bhowmick, P K.; and McCormick, Melinda (2015) "Roles of Government and Community Support, Flood Experience, and Flood Education in Livelihood Resilience," *The Journal of Sociology & Social Welfare*: Vol. 42: Iss. 4, Article 7.

DOI: <https://doi.org/10.15453/0191-5096.3939>

Available at: <https://scholarworks.wmich.edu/jssw/vol42/iss4/7>

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# Roles of Government and Community Support, Flood Experience, and Flood Education in Livelihood Resilience

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*Flooding is a perennial problem in the state of Bihar, India with devastating impact on the livelihood of people. In spite of the government's measures of flood mitigation, households continue to live with suffering on account of severe damage to their material and non-material assets. In this background, the objectives of the study are: (1) to explore the differential role of the community and government support in livelihood resilience; (2) to assess the impact of flood experience and flood education in livelihood resilience; and (3) to explore the impact of level of education, reflected in average years of schooling of the male-headed households in livelihood resilience. The primary data were collected from 472 households by using a multi-stage random sampling technique over seven blocks in river basins of Ganga and Kosi in the district of Bhagalpur, Bihar. To analyze the data, descriptive statistics and structural equation modeling were used. The findings of the study show that prompt and spontaneous community action was more effective than government help. Flood experience also plays a crucial role in the revamping of livelihood. Flood education is not found to exist in the area; people learn the skills of survival during and after floods from their elders. Moreover, difference in*

*education among the male-headed households creates difference in the attitudes and awareness surrounding livelihood resilience.*

*Key words: Flood education, flood experience, livelihood resilience, community support, government support*

The frequency of flooding in India is more than half of the total number of floods occurring in Asia in each decade (Parasuraman & Unnikrishnan, 2000). Bihar, situated in the Ganga river basin, is the foremost flood-prone state in the country. About 36 percent of its total population is affected by floods (Government of Bihar, Finance Department, 2011-2012). The population of the state is 64.25 million within a geographical area of 9.381 million hectares of which 6.88 million hectares of land is flood-prone and one million hectares were perpetually water-logged (Tenth five-year plan of the Government of India [2002-2007]). Thirty out of the thirty-eight districts of Bihar are seriously affected almost every second or third year by flood. Flood-related damage rose by 54 percent from ₹ 9.49 million in 1989-1990 to ₹ 5,147.8 million in 1998-1999, according to the Eleventh Finance Commission of Bihar (2000). In Bihar, 89 percent of the population lives in villages and depends on agriculture for their livelihood (Census of India, 2011). The industrial growth of the state is far below the national average, and thus, does not create adequate employment opportunities for the people. Most of the people in the state are unskilled, illiterate, and belong to the lower socio-economic strata of the society. Small and marginal farmers, landless labor, and petty traders dominate the rural economy of the state, which suffers from extreme poverty conditions. The labor participation of workers is mainly in the primary sector. Low levels of education have had strong negative implications for economic growth in Bihar (Chanda, 2011).

Slow growth, dependency on agriculture, regional disparity, and poverty are the main factors that prominently contribute to the vulnerability of households in the area. Flood occurrence further brings misery to the livelihood of households and aggravates their poverty and pauperism like "a person falling from a Palmyra palm tree, stung by a scorpion at the ground." Bhagalpur is one of the most severely flood-affected districts in Bihar, which had the worst experience of flooding in 2011, with

massive water coverage from two different sides. While water in the Ganga River was on rise from the southern side, the Kosi River was also flowing above the danger level from the northern side. The water had stayed in the area for more than three months causing large-scale devastation to life and property affecting more than 100,000 households. Hordes of villages were totally washed away and massive land erosion had taken place in several areas (Sarkar, 2011). In view of the flood severity, the entire sub-division of Naugachia (Bhagalpur) was put on red alert by the Water Resources Department, Government of Bihar.

The effects of damages to life and property caused by flooding were severe for several years, resulting in livelihood vulnerability of a large section of the rural populace. Sharma (1995), on the other hand, argues that despite the losses due to floods, a poor industrial sector and paucity of public infrastructure, "the state's backwardness is more related to the iniquitous and exploitative socioeconomic structure, lack of political leadership, and almost total collapse of administrative law and order machinery—to the point that it is said that in Bihar 'the state has withered away'" (p. 2587). Against this backdrop, the present study intends to examine the role(s) of community and government support, and households' flood experience, flood education, and level of education of male-headed households in livelihood resilience.

### Literature Review

The role(s) of various agencies in livelihood resilience of the flood-affected households, and the factors that influence it, have been studied from different perspectives. Notable among them are the community and the government support which the affected households receive during or after floods, their experience of floods, flood education, and educational level of the male-headed households. The livelihood structure, which encompasses people's capabilities, assets, income and activities required to secure the necessities of life, is created after years of hard work by households. During floods, this structure is lost in no time, and its restoration takes longer than expected, depending on the pace and expediency of the relief assistance received from the external agencies (the government as well as

non-governmental organizations).

Flood effects have far-reaching implications on the livelihood of households, which is suddenly lost but which is felt for years (Comfort, Sungu, Johnson, & Dunn, 2001). Additionally, it severely affects natural capital (ruins agricultural land); physical capital (loss of housing, and tools); financial capital (loss of savings); human capital (loss of life, injury, and employment); and social capital of the households (damage to social networks) (Carney, 1998; Carney et al., 1999).

Resilience is derived from the Latin word 'reseller,' which means 'jump back' or 'bounce back' (Paton & Johnston, 2006). It refers to the adaptive capacity of individuals and the ability of a system that enables households to learn and self-organize, which form the core of the livelihood resilience, its structures and functions (Butler, Morland, & Leskin, 2007). Livelihood resilience refers to persistence of a system (Holling, 1973); survival and recovery (Rockefeller Foundation, 2009); self-organization (Ostrom, 2009); preparation and performance (Foster, 2006); stability and learning (Resilience Alliance, 2009; Carpenter, Walker, Anderies, & Abel, 2001); convergence (Nelson & Finan, 2009); adaptiveness of the affected households (Turner, 2010); and sustainability (Birkmann, & Wisner, 2006).

In livelihood resilience strategies, households shift to safe places (periodically move households to minimize exposure to risk, and reallocate family homes when risk of flooding is increased); pool resources (share assets, infrastructures, resources, wealth, labor, and knowledge); select species (suitable to local environment); ration (limit consumption in times of scarcity, use of home garden), and diversify livelihood resources (intensify and extend agriculture, tap natural resources, non-farm activities, and mixed cropping) for restoring livelihoods after floods (Gomez-Baggethun, Reyes-Garcia, Olsson, & Montes, 2012). However, it is the resilience of the households (Saavedra & Budd, 2009) that matters the most in livelihood management (Srivastava & Laurian, 2006), because of their key role in coping with and recovering from the shocks caused by floods (Bosher, Dainty, Carrillo, Glass, & Price, 2009), according to the sustainable livelihood framework (Glavovic, Scheyvens, & Overton, 2002).

Flood effects are not confined to individuals alone; rather they engulf the entire community, which necessitates synergized efforts for flood mitigation, as any group response to disaster effectively lessens its impact on livelihood resilience of the affected households. The community bond among its members strengthens the community's role for its knowledge of members' requirements and availability of local resources. The stronger the 'bonding ties' within the community, the quicker community resources are mobilized and information and knowledge is disseminated across groups with regard to rescue and restructuring of livelihood. The 'degree of centrality' (Cassidy & Barnes, 2012), i.e., direct connection between and among members of a community, facilitates social learning and enhances resilience. The indirect connection between different groups, on the other hand, acts as a bridge in groups' 'betweenness', promotes innovation, and fosters livelihood resilience (Bodin, Crona, & Ernstson, 2006).

The community with common ethnic lineage and similarity in living conditions develops a strong socio-economic network, which facilitates its members to collectively act in critical flood situations. The actual support provided by the community to individuals further embeds them into a web of social relationships reflected in forms of love, care, and other visible and invisible support much needed and looked for at the critical hours of flooding (Hobfoll, 1988). The received supports are emotional (expression of interest, assurance, affection, and closeness); informational (information with regard to understanding the situation and knowledge about doing something); and tangible (money, transport, shelter, tools and equipment, meals, groceries and taking care of children, pet or other belongings) (Kaniasty & Norris, 1992).

The community improves the adaptive capacity of households in their livelihood resilience after floods, according to the 'Bottom-up' approach, (Smit & Wandel, 2006). The social network and social capital (Adger, Huq, Brown, Conway, & Hulme, 2003) are the two pillars that maintain a community's oneness, togetherness, and cohesiveness and keep its members strongly tied with each other. In a social network, actors (persons or organizations) are viewed as 'nodes,' and the relationship between actors as 'ties' (Davies et al., 2013) which

construct the networked structure of the society (Wasserman & Faust, 1994).

The role of social networks in sharing information and knowledge about natural resources is highlighted in several studies (Crona & Bodin, 2006). According to the theory of social network and social capital, while social networks bring households under one umbrella, social capital strengthens the relationship between individuals and neighbours (Dynes, 2005). The crucial and invaluable roles of social unity and support of neighbors, family, and kinship networks (Bosher et al., 2009) to households in their resilience efforts is well-established and acknowledged (Tse & Liew, 2004). Its nurturance, therefore, is of immense value and significance to households in their efforts to reconstruct livelihood (Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008).

The role of social capital in the reconstruction of livelihood, on the other hand, goes beyond any measure or description (Cassidy & Barnes, 2012). Therefore, the community in a stand-by position (something or someone that is always ready to be used if they are needed) offers by far the most effective support that households receive at the time of flood occurrence.

While the community support is like the 'first-aid treatment' of a patient in the primary health center of a village, the government's assistance is the treatment by a specialist doctor in a speciality hospital. The role of government support—with its rescue machinery, trained personnel, law-enforcing establishment, and above all, strategic resources at its command—is very crucial in livelihood resilience of households. Without government support, livelihood of a large number of households may be seriously jeopardized (Anderson, Karar, & Farolfi, 2008). Any delay in intervention by the government may result in catastrophe. It may not only destroy the households' carefully preserved assets accumulated over the years of hard work, but it may also annihilate the entire population. The supports of the community and the government include emergency help, construction of a village grain bank, an awareness campaign, childcare, sharing shelter, and recreation of livelihood bases.

The government of Bihar initiated Kosi Reconstruction Rehabilitation Program covering a district based on a pilot

project implemented by ODR (Owner-driven Reconstruction) Collaborative, a network of organizations supporting the Government, and an owner-driven reconstruction policy was formulated to support each family with ₹ 55,000 to construct their own house. In agreement with the World Bank in January 2011, this program has been up-scaled to cover 100,000 families for reconstruction of hazard-safe houses. The cost per house will be ₹ 55,000, with an additional cost of ₹ 2,300 for a toilet and ₹ 5,000 for solar-powered lighting. In cases where beneficiaries do not own land, the Government of Bihar will provide additional assistance of ₹ 5000 for the people to buy the land. Towards this project, the World Bank has contributed ₹14517899000.00 (World Bank, 2014). The Government of Bihar has also collaborated with ODR Collaborative and UNDP to continue the social and technical facilitation and capacity building for this owner driven reconstruction program. Technical guidelines have been brought out to enable owners to build houses with various local materials, including bamboo. The rehabilitation work has been incredibly slow. Out of a total of 100,000 houses to be constructed by the government in the Kosi region, only 12,500 were erected by February 2014.

Thus, the role of the community and the government in reorganizing livelihood (Osbaahr, Twyman, Adger, & Thomas, 2010) and in enhancing the capability of households for livelihood resilience has become very crucial (Colten, Kates, & Laska, 2008). In spite of its important role, however, researchers have not adequately looked into livelihood resilience. Against this background, the hypothesis is formulated.

H1: The government and the community support would differentially influence households in livelihood resilience.

The households' experience of floods gained over the years is another crucial factor that provides them strategic advantage (Waller, 2001). Households with experience develop ways and means to minimize damage and devise livelihood strategies in view of their experience of and learning from flood occurrences. They learn to make optimal use of available resources according to their capability. Furthermore, the experience of



living with uncertainty and their knowledge of the social and physical environment not only helps households in learning to accept the inevitable, but also enables them to work out ways to minimize the adverse effects of flooding. Over the course of time, this socializes households, and generates enough strength in them to bravely withstand the unstable situation of livelihood being washed away (Tuohy & Stephens, 2012), according to the social constructionist theory (Loseke, 1999). Thus, knowledge and experience of disaster are of immense value to the affected households in their efforts to explore mitigation of flood effects (the theory of bounded rationality), and comes in handy to adapt suitable livelihood measures in accordance with availability of resources situational requirements (Tapsell, 2001).

Households with long experience of flooding become much more knowledgeable in comparison to those with no experience (Brilly & Polic, 2005). This further alerts and motivates them to remain ready with emergency preparedness to meet flood eventuality (Mileti, 1999). The social constructionists explain how, through their personal experience and interaction, households respond to disaster (Stallings, 1995). The elderly flood survivors with their experiences of flooding are better equipped to overcome flood problems in comparison to relatively inexperienced persons (Wilson, 2012). The social risk management (SRM) approach also emphasizes the advantages of risk experience and sensitivity in management of livelihood resources (Heltberg, Jorgensen, & Seigel, 2008). Households' degree of direct experience of floods (in terms of threat to life and property, sight of nearby villages being washed away, or narrowly escaping being washed away, death of relatives, or having witnessed or heard from someone about households being injured or dead, seeing fully or partially damaged houses, experiencing financial loss, and experiences of relocation and livelihood creation, etc.) all hold up to flood experience (Bland, O'Leary, Farinaro, Jossa, & Trevisan, 1996). Thus, experience and learning of floods, (Nelson & Finan, 2009) aside from the community and the government support, always provides courage and strength to households in overcoming flood crisis (Eriksen, Brown, & Kelly, 2005).

H2: Flood experience would positively affect households in livelihood resilience.

Education broadens households' understanding of the social and physical world around them, in general, while flood education creates awareness with regard to various issues related to flooding and its impact on livelihood resilience, in particular. Education increases households' capabilities and knowledge for marshalling political and economic advantages and aids in their rescue and livelihood resilience efforts (Srinivas, 1996). The knowledge and awareness of potential hazards keeps households ready with contingency plans to meet challenges arising from floods (Bauman, 1983). Flood-mitigating instructions (Asghari, 2004), awareness creation, and issuance of flood warnings all play crucial roles (Elliott et al., 2003) in mitigating flood impacts. Webber and Dufty (2008) identified 'preparedness conversion' (learning related to the preparations and commencing of flood); 'mitigation behaviors' (learning and putting into practice the appropriate actions to be taken before, during and after a flood); 'adaptive capability' (learning how to change and maintain adaptive systems (warning systems); 'community competencies' (to minimize flood impacts); and 'post-flood learning' (how to improve the preparedness level, mitigation behaviours and adaptive capability after the flood) as important outcomes of functional education.

The Life Skills Training program was initiated by the Bihar Education Project Council (BEPC), Government of Bihar (GoB), in collaboration with UNICEF for adolescent and young girls to be trained in essential life skills. Unfortunately, this has not been fruitful because the infrastructure of almost all existing schools were completely wiped out or damaged by the floods that swept large areas of the Indian state of Bihar (Unicef India, n.d.). A set of guidelines for disaster education (United Nations International Strategy for Disaster Reduction, 2009) may be more useful to households as well as the government in their efforts to minimize flood impact. However, in most of the studies, flood education and its functions in building livelihood resilience are not adequately addressed.

H3: Flood education would positively affect households in livelihood resilience.

In addition to flood education, level of education reflected in average years of schooling of the male-headed households plays a significant role in the household's effort to achieve livelihood resilience. Households with elementary education are less likely to succeed in coping with floods and in exploring possible opportunities for income generation. On the other hand, improved education enhances a community's adaptive capabilities in making optimal use of the locally available resources in the changed scenario. It is further helpful in diversifying the income basis and in reducing dependency of the households on government support (Alderson, 2001). However, the relationship between level of education in terms of schooling of the male-headed households with regard to migration (Ananta, 2001), age (Cassidy & Barnes, 2012), and sex (female-headed household) (Ananta, 2001), though found in the literature, is not sufficiently taken into consideration in livelihood resilience.

H4: Differences in level of education would have differential impact on the male-headed households' in livelihood resilience.

These hypotheses are based on the gap which is found in the previous research studies, in which they were unexplored, and are based on exploratory guesswork.

### Research Objectives

This research had three objectives: (1) To find out the role of the community and government support in livelihood resilience; (2) To assess the impact of flood experience and flood education in livelihood resilience; and (3) To explore the impact of level of education reflected in terms of schooling of the male-headed households in livelihood resilience.

### *Sample Areas*

The study was conducted in the district of Bhagalpur,

Bihar. It has an area of 2570 sq. km., and the Ganga and Kosi rivers traverse through the district. The district has 16 blocks, 13 of which were most affected by flood.

At first, the severely affected blocks were identified based on information obtained from the Bihar Disaster Management department and after discussion with Block Development officers (BDOs). Then the villages were selected based on their size. The primary data were collected between September and December, 2011 from seven blocks of the district (i.e., Bihpur, Ismailpur, Gopalpur, Rangra Chowk, Kharik, Narayanpur and Naugachia). The head of each household was interviewed for 2-3 hours to ascertain their opinions. Before the data collection, a pilot study was conducted on a sample of 50 randomly drawn respondents from the seven blocks of the district. The responses were analyzed to test reliability and validity of the items. The final measurement scales and the design of the interview schedule were then confirmed. The data were collected from 504 households, 72 households from each of the seven blocks of the district, based on multipurpose random sampling. After eliminating the incomplete schedules, 472 were retained for further statistical analysis.

### *Measures*

The scale was translated from English to Hindi. The survey was based on an interview schedule, therefore the researcher conducted face-to-face interviews to collect data. The following section details the measurement scales.

*Community Support.* A 5-item scale adapted from Patnaik and Narayanan (2010) was used to measure the community support. This has been measured on a scale of 1 = *not at all* to 5 = *always*. The community support is addressed through the following questions: "Do you share shelter with others?" "Do you lend agricultural tools and money to others?" "Do you share and provide help within households and support other households within the community after a flood?" "Do you share knowledge and information, warning of floods with others?" and "Do you get help from neighbors and relatives?"

*Government Support.* A 9-item scale has been used to measure government support (Patnaik & Narayanan, 2010). This has been measured on a scale of 1 = *not at all* to 5 = *always*.

The government support was addressed through following questions: "Do you get emergency help like fund or food from government after a flood?" "Do you get help from government in flood warning and mitigation from flood?" "Do you get help from government in income generation?" "Do you get help from government to rebuild public service?" "Do you get help from government for construction of a village grain bank?" "Do you get help from government for construction of dyke?" "Do you get help from disaster awareness campaign?" and "Do you get help from rescue team of government?"

*Flood Experience (FLEX)*. Flood experience has been measured by using a 14-item scale derived from Tyler and Hoyt (2000) and Norris and Murrell (1998). This has been measured on a scale of 1 = *not exposed to flood* to 5 = *very severely exposed to flood*. The flood experience was dealt with through the following questions: 'Have you experienced exposure to flood other than this one?', 'Do you perceived threat to life?', 'Is there any loss of household property or crop loss?', 'Do you narrowly escaped from being washed away?', 'Do you see the nearby village being washed away?', 'Is there death of relatives in flood, witnessing being injured or dead?', 'Do you heard of someone in the town or village who was injured or died in flood?', 'Do your house damaged fully or partially?', 'Have you had to temporarily evacuate or move out of your home because of problems with water or flooding?', 'Did you get water in your home from the flooding?', 'Was there water on your property?', 'Were you temporarily or permanently out of work due to the flood?', 'Did you lose water service due to the flood?', 'Did you or other household members lost income due to the flood?'

*Flood Education (FLED)*. A 6-item scale adapted from Dufty (2008) and Mishra and Suar (2005) and a report from Bihar Disaster Management Department was used to measure flood education. This has been measured on a scale of 1 = *not at all difficult* to 5 = *extremely difficult*. The following questions were used to address flood education: 'Do you have knowledge about what your state flood warning system is?', 'Do you know what measures to take after getting a flood warning?', 'Do you know what precautions to follow to avoid the risk?', 'Do you know the importance of trees in flood prevention?', 'Do you have knowledge about danger signals?', and 'Have you seen

the flood hazard zone map of the district or state?'

*Livelihood Resilience (LVRS)*. A 15-item scale was developed from the following: the Household Questionnaire: Survey of Living Conditions in Uttar Pradesh and Bihar (World Bank, 1997); Hahn, Riederer, and Foster (2009); District Household Survey (DHS) (2006); Roll Back Malaria Partnership (RBM) (2006); Ellis (1998); Little, Smith, Cellarius, Coppock, and Barrett (2001); and Scoones (1998). This scale was used to measure livelihood resilience. This has been measured on a scale of 1 = *Not at all* to 5 = *Much more than usual*. Local households' strategy to recover was also obtained from participatory research using in-depth interviews with key informants.

## Results

The demographic characteristics of the sample contain information regarding gender, age, years of residence, household type, and employment status. The respondents were comprised of mostly males (99%), with only four females in the sample of 472 respondents. The results indicate that the majority of the respondents (29%) were between the ages of 36 and 45 years. The respondents' length of residence in the area indicates that the majority of the respondents (49%) were residing in the area for more than 30 years. In terms of respondents' employment, 78 percent of the respondents work in agriculture and its related activities and 35 percent were landless labor.

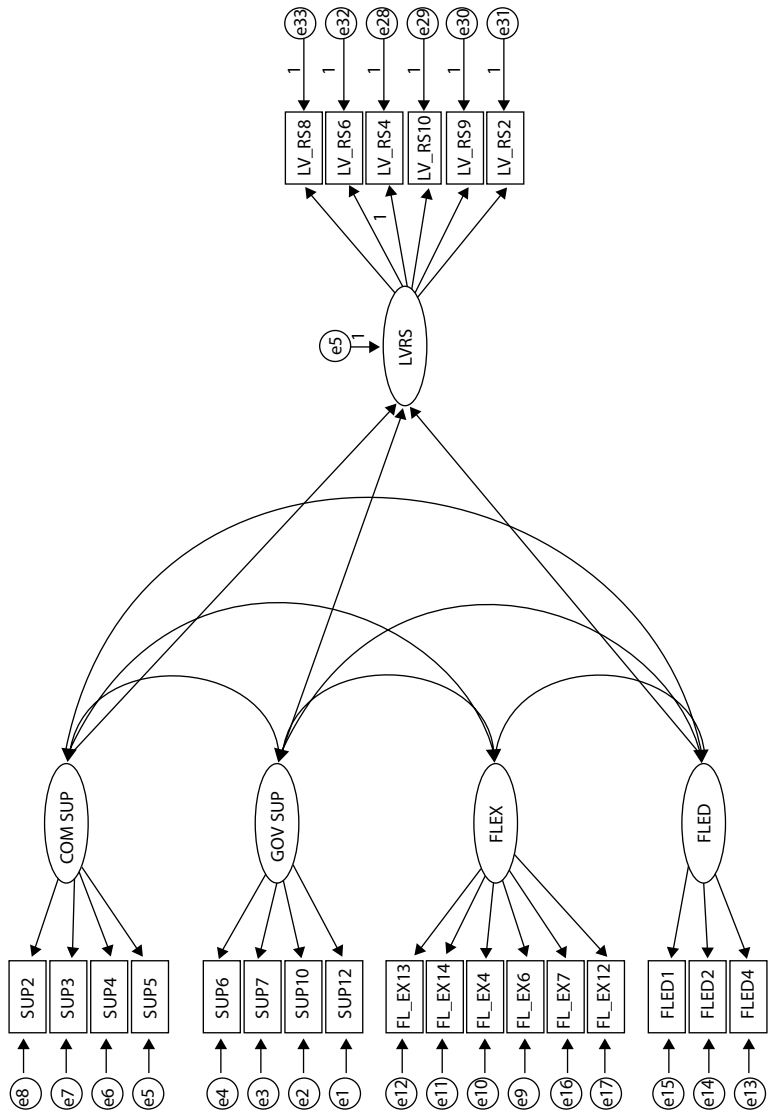
### *Preliminary Data Analysis*

The preliminary data analysis, reliability estimation, confirmatory factor analysis, and structural equation modeling were used to analyze and interpret the data. The descriptive statistics of the five constructs, i.e., community support, government support, flood experience, flood education, and livelihood resilience were also determined. The data were tested for skewness and kurtosis in terms of normality.

### *Exploratory Factor Analysis*

Factor analysis is an interdependent technique whose primary purpose is to define the underlying structure among

Figure 1. Revised Model



variables in the analysis (Hair, Black, Babin, Anderson, & Tatham, 2006). Livelihood resilience was a self-made scale, which was based on the discussion from the households of the study area. Therefore, in order to determine how and up to what extent the indicators were linked to the construct (livelihood resilience) in different contexts, exploratory factor analysis (EFA) method was applied to the sample ( $N = 472$ ). The sample was subjected to principal component analysis (PCA). Prior to performing PCA, suitability of the data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of correlation coefficients of .3 and above. The Kaiser-Meyer-Olkin value of all the constructs exceeded the recommended value of .6 (Kaiser, 1970) and the Bartlett's test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix (Hair, Anderson, Tatham, & Black, 1998). To achieve simpler and theoretically more meaningful factor solution, orthogonal approach with varimax factor rotation method was used, which attempted to minimize the number of variables that had high loading on each factor. The rotated solution revealed the presence of simple structure (Thurstone, 1947) with factors showing strong loadings. Thus, the loading of indicators on livelihood resilience was improved.

### *SEM Analysis*

The data were analyzed descriptively using structural equation modeling (SEM) to test the theoretical framework of variables. The SEM was applied because it shows the sequential relationship between series of independent and dependent variables and control measurement errors like random and systematic error. SEM is a model analysis technique encompassing methods such as covariance structure analysis, latent variable analysis, confirmatory factor analysis, path analysis, and linear structural relation analysis (Hair et al., 1998).

The two components of SEM are measurement model and structural model. Before testing the hypothesis by using path analysis in structural model, the link between factors and their measured variable was analyzed (Byrne, 2001). The measurement model specifies the posited relationship of the observed indicators to the latent construct. The measurement model



was evaluated by using Confirmatory Factor Analysis (CFA). In the model, the exogenous latent variable was the community and the government support, flood education, and flood experience and endogenous variable was livelihood resilience. Therefore, before testing the overall measurement model, each construct in the model was evaluated separately for respecification of the model. The model respecification procedure was used to identify the source of misfit and generate a model that achieved a better fit to the data. The respecification of the measurement model was modified by examining the standardized residuals (value-greater than 4.0 were dropped), modification indices (value-approximately 4 or greater indicates that the model fit could be improved), and the standardized loading estimates value  $> .05$  are acceptable (Hair et al., 2006). Each of the measures was examined together with the model fit indices to ascertain if respecification was needed. The model fit was examined using multiple indices such as chi-square test ( $\chi^2$ , value-the lower, the better), and the chi-square test by degree of freedom ( $\chi^2/\text{df}$ , value  $< 3$ ), goodness of fit index (GFI, value  $> .90$ ), confirmatory fit index (CFI, value  $> .95$  or  $.90$ ), tucker-lewis index (TLI, value  $> .95$  or  $.90$ ), and root mean square error of approximation (RMSEA, value  $> .06$  or  $.08$ ). After modification of the fit indices, the final CFA model was improved. The revised measurement model fits the data well. Further, when each construct had shown an acceptable fit to the model, then all constructs were evaluated together.

In the overall measurement model, all the four latent constructs and its reflective indicators were allowed to correlate with each other. This model represents a form of CFA (Brown, 2006) designed to evaluate the extent to which the configuration of latent variables, as defined by their observed indicators, reproduce data reasonably well. The initial model of the current study ( $\chi^2 = 2096.40$ ,  $\chi^2/\text{df} = 4.095$ ,  $p = .000$ , RMSEA =  $.08$ ; GFI =  $.78$ ; TLI =  $.78$ ; CFI =  $.80$ ) did not yield an adequate model fit to the empirical data. Then the model was examined to check whether respecification was required (Hair et al., 1998). The measurement model was re-specified and re-evaluated after each modification.

Based on the above assumptions, the indicators were examined to find out potential model modification. Finally, item numbers LV\_RS5, LV\_RS15, and FL\_EX8 were identified with

high standardized, residual covariance and were deleted from further analysis. After modifications, the fit indices of the corrected model improved and was deemed acceptable ( $\chi^2 = 12227.3$ ,  $\chi^2/\text{df} = 3.39$ ,  $p = .00$ , GFI = .94; TLI = .96, CFI = .98, RMSEA = .07). Therefore, a more parsimonious model was prepared after eliminating the non-significant path systematically. The revised model was confirmed as well as accepted for further hypotheses testing.

### *Hypotheses Testing*

Hypotheses testing was carried out to test the model. The significance of the hypothesis path was determined. The nature and magnitude of the relationship between variables were according to the theoretical expectations. The fit indices indicate that the fit of the hypothesized SEM was acceptable. Results show that all fit indices indicate that the hypothesized model fits the data very well according to the criteria suggested by Carmines and McIver (1981), Hair and colleagues (1998), and Hu and Bentler (1995). Hence, the fit indices were  $\chi^2 = 1723.83$ ,  $\text{df} = 810$ ,  $\chi^2/\text{df} = 2.56$ ,  $p = .00$ , SRMR = .05, TLI = .91, CFI = .90, RMSEA = .07;  $p < .05$ .

H1: The community and the government support would differentially influence households in livelihood resilience.

The two indicators of support, i.e., community and government support, were analyzed to find out which one was more influential in the livelihood resilience. The analysis shows the differential consequences of the community and government support in livelihood resilience: (a) the community support significantly accounted for variations in livelihood resilience ( $\beta^1 = 1.528$ ,  $p < .05$ , c.r. = 2.60), whereas (b) the government support shows negative but significant influence on livelihood resilience ( $\beta^2 = -.131$ ,  $p < .01$ , c.r. = -2.04). This means that both the community and the government support made significant contributions to livelihood resilience, but as government support showed a negative path (against expected direction), therefore H1 was supported. Thus, community support has a more significant role in livelihood resilience than the government support.

H2: Flood experience would positively help affected households in livelihood resilience.

Flood experience (FL\_EX) (H1:  $\beta^1 = .54$ , c.r. = 6.8,  $p < .000$ ), was significantly associated with livelihood resilience (LV\_RS), and, thus, H2 was supported.

H3: Flood education would positively help affected households in livelihood resilience.

The relationship of flood education with livelihood resilience was not significant (FL\_ED) (H3:  $\beta^3 = .13$ , c.r. = .89,  $p < .037$ ). Thus, the H3 was refuted.

The relations between the hypothesized paths were generally significant and supported. Hence, hypotheses 1 and 2 were supported, while hypothesis 3 was refuted (Table 6). The study deals with the impact of support (community and government), flood experience, and education for livelihood resilience. The results show that all the exogenous variables except flood education were significantly related to livelihood resilience and support it. Therefore, the results of the hypothesized structural model reveal that the initial model did not fit the data well, and so it was not accepted ( $\chi^2 = 1723.83$ ,  $\chi^2/\text{df} = 2.56$ ,  $p = .00$ , GFI = .94, TLI = .96, CFI = .98, RMSEA = .07;  $p < .05$ ). The results indicate that the flood education did not show any influence on livelihood resilience. Therefore, to develop a parsimonious model the insignificant path was removed from the initial model ( $\chi^2 = 1680.34$ ,  $\chi^2/\text{df} = 2.26$ ,  $p = .00$ , GFI = .92; TLI = .91, CFI = .90, RMSEA = .06).

#### *Education of the male-headed households and livelihood resilience*

To find out differences in the level of education in terms of schooling of the male-headed households' in livelihood resilience, one-way of ANOVA method was used. It compares the variance between the groups with variability within the group. In order to conduct the analysis, level of education reflected in schooling of the male-headed households was divided into five groups according to the level of schooling (Group 1: no schooling, Group 2: lower primary, Group 3: high school, Group 4: higher secondary, Group 5: beyond higher secondary). Table 7

shows that the majority of the male-headed households have education up to high school.

A post-hoc comparison using Turkey HSD test indicates the difference in mean scores of Group 1 (M = 44.09, SD = 8.4); Group 2 (M = 48.5, SD = 7.9); Group 3 (M = 50.7, SD = 8.0); Group 4 (M = 52.8, SD = 8.4); and Group 5 (M = 50.4, SD = 7.3).

H4: Differences in level of education would have differential impact on the affected households' livelihood resilience.

The ANOVA result shows that there was a significant difference in the livelihood resilience at the  $p < .05$  level for different category of schooling level of male-headed households ( $F = 4,467 = 11.6, P = .00$ ). The result reveals that the male-headed households with high school education have the most influential role in livelihood resilience in comparison to others. The effect size calculated using eta squared was 0.05, which means that the impact of education on livelihood resilience was medium. The male-headed households with high school education were comparatively more disposed in adapting strategies for livelihood resilience. Therefore, with the increase in the level of education, the livelihood resilience can be strengthening. Thus, hypothesis 4 was supported.

Table 1: Summary of Hypotheses Testing

Testable Hypotheses		Standardized Regression Estimate	Unstandardized Regression Estimate	S.E.	Critical Ratio	Results
H <sub>1</sub>	LVRs <— COMSUP	(β <sub>1</sub> ) .288	1.528*	1.55	2.60	Supported
	LVRs <— GOVSUP	-0.72	-.131*	1.045	-2.04	
H <sub>2</sub>	LVRs <— FLEX	(β <sub>2</sub> ) .48	.54*	.08	6.85	Supported
H <sub>3</sub>	LVRs <— FLED	(β <sub>3</sub> ) .08	.13*	.15	8.91	Refuted

Note: \*p < .05; \*\*p < .01; \*\*\*p < .001

Discussion

The role of both the community and the government support in livelihood resilience of flood-affected households is found to be significant, as the results reveal. However, the

role of the community support in comparison to the government is more significant, due to its stand-by position and swift action in critical hours of flooding. On the other hand, the government which controls all the rescue, relief, and rehabilitation resources, always arrives late, for its excessive 'politico-administrative' concern and reliance on its technocrats and bureaucrats. The community's instant action at the same time provides much needed and immediate relief to the households who run helter-skelter and find themselves placed in extremely helpless and distressed conditions. The community collectively makes efforts to check the spread of floodwater and land erosion by laying sandbags (Figure 2), building levees (Figure 3), and laying boulders to divert floodwater (Figure 4)., as well as working together to divert floodwaters (Figure 5).

Table 2. One-way ANOVA

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	3035.300	4	758.825	11.676	.000
Within Groups	30349.480	467	64.988		
Total	33384.780	471			

Figure 2. Laying Sandbags to Check Spread of Floodwater



The results contradict the findings of the studies by Terpstra and Gutteling (2008), and Botzen, Aerts, and van den Bergh (2009) which found that the government is solely accountable for households' rescue, safety, and rehabilitation. The community support at the critical time of flooding is found to be

crucial in several respects. Its immediate involvement proves much more valuable, for it provides significant breathing room to households at the critical hours of flooding, compared to the support households receive from the government much later. Additionally, the government relief is often found to be far less than what households need in actuality.

Figure 3. Building Levees to Prevent Floodwater



Households in such a condition are left with no option other than to fall back on their traditional measures and utilize their indigenous knowledge in creating temporary shelter at safer places, i.e., bund (Narkatia dam in Kharik block), railway tracks (Narayanpur and Isamilpur blocks), and state highways. Households also create temporary shelters from plastics (Figure 6).

Figure 4. Laying of Boulders to Check Water and Land Erosion



They are further asked to sign on the dotted lines in the record book, and always given less than what is mentioned in the record book, be it food grains, oil, medicines, sugar, other materials, or even cash. In addition, the surveyors' team

(comprising government officials, NGOs, local politicians, and local important persons) constituted by the government and entrusted with the responsibility of enlisting the names of the affected households and assessing their requirements, often include the names of their friends, relatives, and locally active persons (politically or otherwise). Names of officials' and politicians' recommendees are given exaggerated assessments of their requirements. As a result, the relief assistance does not reach the genuinely needy households. It is often siphoned-off by the vested interest groups. The result is consistent with the studies (Pahl-Wostl, Mostert, & Tabara, 2008; Fatti & Patel, 2013) which had similar findings.

Figure 5. Households Working Together to Divert Floodwater



Figure 6. Flood Victims Creating Temporary Shelters



When households are in deep trouble and relief does not reach them, they resort to peaceful mass demonstration in protest, including blockade of the national highway 80, which passes through the area. Then the government steps into action when the danger has already passed. Surprisingly, government moves into the areas only after crisis has deepened

and damages have been caused. This results in an increase in waste and misappropriation of relief assistance, avoidable loss of life and property, and bitter experience of life and the government among people. Absence of regular maintenance of structural measures adopted to control flooding is a serious problem households face in the areas investigated. Even the embankments made on the Ganga River as early as 1952 are not found to be effective, for want of regular maintenance. Wherever they have been made, they are found to be in dilapidated condition, without exception. The main reason for the failure and ineffectiveness of the government measures lies in its excessive 'politico-administrative concern' and reliance on its bureaucracy and technocracy, as well as not involving the households who possess very crucial and tactical experience and indigenous knowledge with regard to meeting flood challenges.

The popular measures affected households adapt to livelihood resilience are transfer of money, and sale of livestock and other belongings and other valuables, including ornaments, as well as migration and diversification of livelihood activities, as the findings of the study reveal. Money transfer enables households to overcome financial loss. The money received from the sale of livestock is used to maintain daily expenditures and to rebuild livelihood bases. Mutual borrowing among neighbors, friends, and relatives is commonly practiced, both in kind as well as in cash. Rosenzweig and Wolpin (1993) report similar findings in their study. At critical times, households also take loans from private moneylenders on interest.

The pooling of resources, working as wage labor, money received, and knowledge of households protect them. The findings of the study are consistent with studies (Berke, Cooper, Salvesen, Spurlock, & Rausch, 2011; Burke & Lobell, 2010) which found that all options of farm management practices, including rescheduling of cropping pattern, and sowing schedule, expanding the area of cultivation, and increasing irrigation for livelihood resilience, are explored in the flooding condition. The study is also consistent with the study (Armah et al., 2010) which found that households move to other areas in search of livelihoods. The adverse circumstances created by flooding push rural people to migrate with the help of their community network, friends and relatives.



The strength of the community is firmly rooted in its social network and social capital, which help and offer unqualified support to each other, disseminate information quickly and keep the community together. This is reflected in the collective efforts of the community with regard to its livelihood resilience in the flooding situation. The mutual trust, support, and common interest between and within the community further facilitate households to collectively find ways and means to overcome flooding and assist each other in the critical hours of flooding. The community helps their fellow village men in several ways. It helps the affected households in transportation of life and property both. The results are similar to the results of the study by Patterson, Weil and Patel (2010) which highlighted the importance of the community role during and after Hurricane Katrina in helping and supporting each other for their survival and recovery. Mutual exchange of essentials of life freely takes place in the community of the affected households. Even cooked food is offered to children, seniors, and needy members of the households. A unique camaraderie is observed in flooding among households keeping aside their disputes and differences. The whole community is found to act like a complete cohesive unit. A 'Flood Defense Group' is found to be constituted with mandatory involvement of all the affected households to closely watch the pace and gravity of land erosion. The findings of the study are in line with the studies by Haines, Hurlbert, and Beggs (1996) with regard to the significant roles of social networks and social capital in coping with flooding.

Experience and knowledge of flooding advantage households in their efforts to reorganize their livelihoods. The study is consistent with the findings of Burke and Lobell (2010) and Gomez-Baggethun (2012), that experience increases the adaptive ability of households in flood mitigation measures, like on-farm adoption of management practices which include re-scheduling cropping timings, adapting suitable crops, expanding the area of production, increasing irrigation coverage, and tapping of natural resources to cope with flood. Households diversify their livelihood by exploring income opportunities in non-farm sectors, like working as daily wage laborers, pulling

rickshaws, seasonal migration, and sale of vegetables or fruits, to restore livelihoods. Level of education of the male-headed households provides them an edge over other households, as it is found that households with high school level education are more flexible in adapting resilience measures than households with elementary education, which is important in livelihood resilience. However, the capacity of households determines the pace of their adaptation of resilience measures in view of existing as well as emerging ground realities. Furthermore, flood education may bring in attitudinal change in households as well as creating awareness and flexibility in livelihood resilience.

### Conclusions

Flooding not only dismantles the livelihood structure of households, but also brings in several other problems, which make living conditions extremely challenging. The findings of the study highlight the crucial role of support households receive from the community and the government during floods in their livelihood resilience. While the role of the community is significant for its spontaneous action, the role of the government support is equally crucial, for its control over rescue and rehabilitation resources. However, the role of community support is found to be more significant, for its instantaneous involvement at the critical hours of flooding, whereas the government support, though very important, invaluable arrives late. Additionally, it is often far short of households' requirements and does not reach needy households. The significance of community support is further reiterated, for its 'always ready to act' position. At the critical moment of flooding, the community instantly comes forward with its limited resources to act before the arrival of other rescue agencies, including the government. The role of community support is further vital for its knowledge of local resources and requirements of the affected households. Knowledge and experience of households accumulated over the years from their frequent exposure to floods enables them to devise ways and means to achieve livelihood resilience. Dissemination of information with regard to potential options of livelihood can help households in

overcoming flood impacts. If the community is equipped with all the basic rescue and relief materials and is given essential training in rescue operations by the government, this will go a long way in saving the affected households from immediate collapse.

Flood experience of households and their knowledge work as strategic inputs in their livelihood resilience. Flood experience acquired from their frequent exposure is the most effective and powerful weapon which households use advantageously to fight against flood vagaries. They use it as a strategic resource input in their livelihood resilience. Dealing with flooding is a process of continuous learning, which creates confidence in households and enables them to adapt measures to meet any flood eventuality. As a result, they do not perceive floods as a threat because of their experience and knowledge and their confidence in finding ways to overcome them.

Although flood education is not found to exist formally, younger persons informally learn from the experience of senior persons about the preventive measures which are likely to be effective in coping with floods. Wide discussion takes place among the households and in the community with regard to proactive measures to control and mitigate flooding. The study also identifies the significance of level of education in terms of schooling of the male-headed households in livelihood resilience. The high level of education leads to positive linkage between households and livelihood diversification.

### Limitations

The study emphasizes the difference between government and community support in livelihood resilience, but it did not focus on the role of non-government organizations and voluntary agencies. Furthermore, the study did not apply comparative and cross-cultural approaches to explore differences in livelihood resilience methods adapted by households in other active flood zones. The study also did not emphasize difference in households based on social characteristics like caste and ethnicity, which can influence livelihood resilience.

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