TO INVESTIGATE INTERRELATIONSHIP AMONG SOCIO ECONOMIC VULNERABILITY, GEOGRAPHICAL VULNERABILITY AND FLOOD VULNERABILITY: A STUDY FROM GEOGRAPHICAL PERSPECTIVE OF MALAYSIA

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ABSTRACT

Vulnerability research frequently evaluate the risk which effects the ability of system to respond in the case of a hazardous event. Risk is commonly associated with the system's social, physical, and economic components. Floods are a type of climate-related danger with an added spatial dimension. Therefore, the study objective is to check the interrelationship among socio economic vulnerability, geographical vulnerability, and flood vulnerability of Malaysia. To get this objective, the data was collected from the 250 social vulnerability of household by using a convenient sampling technique. Using cross sectional research design and quantitative research approach. The study proposed the Partial Least Square (PLS)-Structural Equation Modeling (SEM) technique along with several latent variables. The results had shown that social indicators get a proper significant contribution which is mainly from the direct impact of spatial neighborhoods and socio-economic conditions and indirect impact land tenure and demographics. Based on these findings, it is concluded that PLS-SEM is successfully amalgamated the joined vulnerability from the geographical and social factors. The SEM allowed an integrative evaluating

vulnerability variable through various disciples and scales and therefore, offers a creative prospect for creating the more custom-made policies to the combat hazards.

INTRODUCTION

The flood vulnerability is considered to be a unique characteristics with the respect to individual and groups perspective with respect to exposure and resilience from the flood hazards impact (Blaikie et al., 1994). This is reason, the exposure is being referred to be an individuals and surroundings within the flood prone space which is subjective to be potential losses by the event of flood (Wannous & Velasquez, 2017). On the other hand, the susceptibility is an important tendency of the individuals and with their belongings, containing a proper infrastructure to effect through a hazard due the community crumbliness of the geographical perspective communities and capacities. While, the resilience is an capability of the system to manage along with the repel and improve for talking the stress of disaster (Siebeneck & Cova, 2012). The city authorities could develop a proper effective policy for the management to confirm the safety and for people wellbeing and equivalent environment in the hazards areas. An important pre flood movement to achieve this proper objective that could differentiates vulnerability of persons flood possible exposure (Liu et al., 2017). This could have an immense effect on the reduction of vulnerability and enhancing resilience.

Furthermore, the social vulnerability refers to a community's susceptibility in relation to economic, sociocultural, and even political factors that influence an individual's or a society capability to react to dangers. In addition, Geophysical vulnerability, also known as location or geographical vulnerability there in research, classifies the hazard possibility based on its geographic area, such as site characteristics and accessibility towards the hazard source (Chatterjee, 2010; Tingsanchali & Karim, 2010). As a result, their data quality criteria for disciplines, platforms, procedure scales, and assessment standards are frequently highly diverse. Performing comprehensive evaluations of social and environmental risks is difficult (Armenakis et al., 2017).

Therefore, social vulnerability seems to be a very local phenomenon that is frequently studied by research evidence like demographic survey. On the other hand, geophysical vulnerability frequently relates to ongoing phenomena such as elevation, incline, and other topographical and meteorological factors. Measurements on such characteristics are frequently GEO-referenced then transformed into raster format enabling spatial studies in Geographic information system (GIS) context. The procedure of weighing diverse social and economic measurement of social vulnerability may not be as simple as it is for geophysical vulnerability. Collaboration with community members, government entities, as well as other key stakeholders is frequently required (Rufat et al., 2015). Most of this makes it extremely difficult for implement strategies for integrating hazard indicators from many disciplines, styles, and sizes. The easiest way for evaluating flood susceptibility is to use disaster data or information for correlate actual flood threat to anticipated events (Moreira et al., 2021). However, caused by faulty damages and losses that is generally reported unevenly, the judgments could be inaccurate (Downton & Pielke, 2005). Different techniques Balica and Wright (2010);Khan (2012) build measurement and reporting with or without weighting using a variety of indicators. Despite their widespread usage in flood vulnerability research, assumption evaluations have significant challenges in terms of consistency, and weighting, overall aggregation methodologies (Nasiri et al., 2016).

According to Aerts et al. (2018) vulnerability line which experimentally compares flood hazards to items at hazard by real damage assessment is a significantly more accurate technique utilized in literature. However, acquiring relevant information seems time consuming as well as labor intensive. The data envelopment analysis (DEA) procedure seems to be a comparatively recent data-driven strategy that uses a modeling framework to get weights to every decision-making component (Huang et al., 2012). Even though DAE technique simplifies overall subjectively weighing process in comparison to complicated indices, key decision-making elements were always generated from socioeconomic underlying flood events. In general, such techniques emphasize social vulnerability rather than geophysical danger. Together in GIS setting, geographical models evaluate the frequency, size, and area of the hydraulic model to determine geophysical flood risk or vulnerability of regions or structures. They employ in-situ or remote sensing data to create clear distinction of topographical parameters (like, gradient-slope, altitude, plan curving, water runoff), vulnerability (polygons representing flood event, flood level and speed), geological and earth images, as well as land use land covering maps (for example, satellites, airplane, and unmanned above ground means of transportation).

Various methods had been discussed in the previous literature like Predictive methods (Blanco-Vogt & Schanze, 2014; Morelli et al., 2014), simulator models including hydro, hydrological, especially worldwide hydrodynamic (Chini et al., 2014; Grimaldi et al., 2013), including multi-criteria decision making tools Fernandez et al. (2016) were examples of model driven methodologies. In addition, non- stationary models, such as regionally weighted regression, surpassed traditional regression for describing flood vulnerability variance, indicating that the link between flood susceptibility and environmental risk variables may not be stable across time (Chun et al., 2017). It does, however, have limits at that time when it comes to understanding complicated and indirect impacts of factors. Gradient boosting vehicles Tehrany et al. (2015), massively increased algorithms Coltin et al. (2016), convolutional neural networks, arbitrary, and massively increased structures Lee et al. (2017), as well as learning techniques Gebrehiwot et al. (2019) are examples of data-driven approaches. Those approaches are focused mostly on physical circumstances, but social factors could be more strongly linked to homes. Geophysical flood vulnerability was a part of managing risk for a long time.
Integrating social or environmental vulnerability was already advocated as a way to overcome their methodological flaws (Kusenbach et al., 2010). An "Analytical Hierarchy Process (AHP)" (Ouma & Tateishi, 2014) and "Structural Equation Modeling (SEM)"(Liu et al., 2017) both have advantages and disadvantages.

Therefore, AHP is commonly used during GIS research to visualizing flood hazards (Radwan et al., 2019) as well as susceptibility (Souissi et al., 2020) mainly because of its simplicity.

Moreover, it has a lot of shortcomings, such as the unwillingness to accept a complex problem, assess connections and indirect influence among many socioeconomic and geophysical factors for flood susceptibility, test hypotheses, and evaluate models. These constraints are overcome with SEM. Therefore, presuppose a generalized data is normally distributed, which socioeconomic factors frequently refuse to uphold. Nevertheless, due of significant operating costs, it necessitates a big sample size, which is sometimes impossible to achieve. The Partial Least Squares (PLS)- Structural Equation Modeling (SEM) does not necessitate these constraints (Hair Jr et al., 2014).

PLS-SEM is gaining traction in management as well as cognitive science as a more feasible alternative to SEM for analyzing contextual factors. Only a few research Ha Anh et al. (2018) have used the SEM technique for identify vulnerability toward flooding threats, whereas nearly none of them have done so in a spatial setting. The PLS-SEM technique has been used in the research to model integrated vulnerability, in which various observable and hidden variables represent the social vulnerability for families to flood occurrence. Other geographical factors utilized as GIS elements define the geophysical vulnerability in dwellings to incorporate spatial influences on the vulnerability state. The "Digital Elevation Model (DEM)" data have been used in place of as a proxy for analyze how house plinth level of goods and services to homeowners' susceptibility to a flood occurrence. Moreover, the previous studies had major focused on other economies like developed economies (Fekete, 2010; Rufat et al., 2015) while had little attention on developing economy like Malaysia. Along with previous models and gaps, this study could be considered a pioneer study with respect to Malaysia because previous studies had a major focused on other countries except Malaysia. Therefore, based on previous discussion, the objective of this research is to check the interrelationship among socio economic vulnerability, geographical vulnerability, and flood vulnerability of Malaysia. The study was divided into five sections, introduction, literature review, research methodology results and conclusion.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

This section had been formulated the literature based on both theoretical and empirical perspective.

THEORETICAL BACKGROUND

Latent variables were employed in the study which may be quantified indirectly by their indicators. We chose latent variables as well as indicators related to the three key components of vulnerability. In other words, exposure, susceptibility, and resilience, that make human systems vulnerable towards floods (Birkmann et al., 2013; Pandey et al., 2010), based on a thorough examination of the literature. In addition, flood vulnerability is mostly comprised of the physical and social threads of communities' potential damages and calamities (Paul, 2013). The susceptibility of households to flood occurrences is often influenced by living standards and shelter capacity as measures of resilience.

Flooding causes physical damage to homes, infrastructure, and households, according to previous study (Dewan, 2015). When floodwaters reach the homes and settings of flood-prone areas, the number of reported animals that are killed rises. The major hidden variable of this research is flood vulnerability, which has indications for exposure, susceptibility, as well as resistance. As more than just a result, indicators pertain to the resource being built, height of the flood. This current paper presents the factual foundation for examining the impact on geophysical flood hazards and susceptibility on flood-prone places, such as areas or residential buildings. Land tenure, economic level, risk awareness, health conditions, coping capability, and household demographics are among the characteristics that affect societal vulnerability.

Empirical Review and Hypothesis Development

The following are key variables and the hypotheses that study is based on. Land tenure (LT) depends on the legal context whereby a person holds land. It establishes who is the landowner, as to how longer, and on what terms. Individual and family susceptibility for natural catastrophes are influenced by LT (Reale & Handmer, 2011). The LT increases resistance to the effects of floods (Lim et al., 2013). The LT in Pakistani is a legal structure that keeps track of landowners as well as residents who work the property. Because developed and non-developed lands exist in flood-prone locations, this study focuses on those to assess the influence of LT on a household's flood risk. Private property and possession enable support claims on post-disaster cultivated crop assistance to help displaced persons reclaim their livelihoods (Mitchell et al., 2018). Different preventive actions are used by landowners and renters for damaged farmed land and crops (Brouwer et al., 2007). Landlords are more vulnerable for economic losses than owners, resulting in severe flood vulnerability. The LT creates barriers to employing preventative measures and mitigating damages while also educating people with coping skills (Rufat et al., 2015).

Socioeconomic status (SS) refers to a household's financial and social situation in relation to income, profession, and learning. The livelihood for disadvantaged households is often affected by the occurrence and intensity from flood damage (De Silva & Kawasaki, 2018). Numerous researchers have discovered substantial correlations among vulnerability and various socioeconomic groups' susceptibility to natural disasters (Tahira & Kawasaki, 2017). The majority of such research found that various socioeconomic factors have negative impacts upon household vulnerabilities. Not only is socioeconomic position a representation of one's income, but it also suggests geographical and natural resource reliance (Pandey et al., 2010). Monthly income, earnings, education level, as well as housing construction method are all indices of socioeconomic position inside this research. In particular for impoverished households residing in flood-prone locations, socioeconomic variables link amplification elements of social vulnerability also including livelihood (Dilley, 2005). Floods in rural parts of the country have a direct impact on agriculture, which has an indirect impact on low-income person's life support (Aerts et al., 2018; Neumayer & Plümper, 2007).

Individuals' subjective assessments regarding the seriousness of a danger derived from previous flood experience are known as risk perception (RP) (Siebeneck & Cova, 2012). Therefore, it is widely cited as a motivator for improving flood-prone households' considering the impact. Households by a greater perception about risk seem to be more likely to flee flood-prone locations in a timely manner (Kondolf & Podolak, 2014). Previous flood damage experiences are linked to a greater degree of flood hazard perceptions and experiences among families (Fuchs et al., 2017). In order to connect a household's perceived risks on their social vulnerability, preparation, major flooding, and risk assessment must all be considered (Wang et al., 2018).

Health Vulnerability (HV) has linked to negative health effects on households (Rufat et al., 2015). In addition, this corresponds to either a flood-prone household's and community's total physical, emotional, and economic well-being (Khan, 2012). Infected diseases like as gastroenteritis, skin allergies, vomiting, other respiratory infections spread very quickly in flood-affected regions (Fang et al., 2021; Zoleta-Nantes, 2000). Furthermore, humans must deal with shock, worry, dread, and instability (Aragonés-Jericó et al., 2020; Khoma & Vdovychyn, 2021; Kyurkchiev, 2020; Linehagen, 2018; Van Schalkwyk & Bevan-Dye, 2020). In particular, poor physical condition, hygiene, especially water supply services make households more vulnerable (Huang et al., 2012). Measurements indicating limited and maybe no availability of resources like as potable water and health care services, as well as insufficient adaptation capacity, should be utilized for measure overall negative effects of floods at health thus, like a consequence, household social vulnerability. As a conclusion, our hypotheses under this research are concerned with the effects of medical issues for vulnerability and coping capabilities between and after flood rescue (Chen et al., 2007).

The capability of such a mechanism could deal and improve since the indications of stress which have the capacity to modify the design or operations system is known as coping capacity (CC) (Few, 2003). This was the most important factor in determining the amount of susceptibility and resilience of a home or community to flood catastrophes (Cutter et al., 2008). This is usually calculated to lessen susceptibility by looking at preventative efforts during emphasis is placed (Linnekamp et al., 2011). On the other hand, the geographical area and LT nature of these preventative interventions are frequently constrained (Birkmann et al., 2013). The majority of research (Chakraborty et al., 2005; Działek et al., 2019) looked at coping abilities for the purpose of structural reduction of dwellings by elevating the foundation inside the house (Kithatu-Kiwekete & Phillips, 2020; Muller & de Klerk, 2020; Romulo B. Magnaye, 2020; Sudarmanto & Meliala, 2020; van der Westhuizen & Ntshingila, 2020).

Normal cultural vulnerability measures included "demographic characteristics (DC)"(Rufat et al., 2015). Age, male-to-female ratio, schooling, family structure, gender dependents are among the primary demographic factors employed in analyses (Cutter et al., 2008). According to previous research, the role of demographic variables in determining the negative impact of flood occurrences varies (Lim et al., 2013). Individuals and families are vulnerable to varying degrees depending on the number of household members (Wang et al., 2018). As a reason, bigger families are more likely to be poorer socioeconomically, even if they might benefit from previous disaster experiences. Babies and young children, particularly non-adult children, become easier targets in natural disasters since they rely on their parents for assistance and safety. Flood recovery is generally challenging for families with a significant number of dependents. Elders, therefore, seem to be the most vulnerable members of the family, since individuals face ageing challenges in supportive relationships and medical problems that limit their independence (Harvatt et al., 2011). The old indigenous population, however, get the benefit of life experiences, particularly contributes to social vulnerability variance. Women seem to be more vulnerable due to limited access and economic position, especially combination with older adults as well as non-adult eligible dependents (Działek et al., 2019). Females, on either contrary, are known for taking care of their families and having greater coping abilities (Fekete, 2009). Those factors have a direct impact upon socioeconomic position & flood susceptibility, as well as resilience (Rabiu et al., 2020; Zhanbulatova et al., 2020; Zhuo & Salleh, 2020).

The term "geophysical vulnerability" refers to the number of people who live in close proximity to one other. Flood risk was screened by geographical settings like as site characteristics and river proximity. The geographical area conducive towards resilience as defined by the presence on road networks, key recommendation, quality of housing, and connectedness in flood-prone neighborhoods (Paul, 2013). In order to assess flooding susceptibility, it is important to quantify the geographical neighborhood (Ouma & Tateishi, 2014). Households are more likely to all be maintained in an appropriate spatial neighborhood, resulting in home safety mitigation and simple transportation (Rufat et al., 2015). House topographic features (such as plinth elevations and slopes) reduce household adaptability (Imran et al., 2019; Lee et al., 2017).

Based on previous discussion, the following research hypothesis of the study are formulated.

H1: Increasing land tenure has direct and favorable effect on reducing local household flood risk.

H2: Affordable land tenure has an indirect and favorable influence on local residents' coping capabilities.
H3: Land tenure that is advantageous has an indirect and beneficial influence on socioeconomic situation on local households.
H4: Affordable land tenure has an indirect and beneficial influence on local household demographics.

H5: Favorable socioeconomic circumstances has a direct as well as beneficial influence on reducing flood susceptibility, for example, local families with a higher socioeconomic level would be less vulnerable to flooding.
H6: Positive risk perception has positively effect in decreasing the flood vulnerability of local communities.
H7: The positive risk perception has a good influence on local populations' ability to cope.
H8: Good health has direct and beneficial influence on reducing flood vulnerability, for example, local households in good health would be much less vulnerable.
H9: A positive coping ability may reduce flood vulnerability that is, local households with a higher process as described would be less exposed.
H10: Positive demographic features can have a favorable influence on the socioeconomic position for local households in an indirect and positive way.
H11: Positive demographic factors would have a beneficial influence on local households' flood vulnerability.
H12: A positive spatial neighborhood can have a direct and beneficial influence on reducing local home flood risk.
H13: A positive spatial neighborhood would have an indirect and beneficial influence on local households' coping capabilities.

RESEARCH METHODOLOGY

The current section had presented the methodology of the current study that had been implemented for the current study. The quantitative approach had applied for this study in which the positivism research approach had been used. It is explained in the extant literature that quantitative research approach is considered to be a more appropriate approach as compare to qualitative approach. Moreover, the current study had applied cross sectional research design. The data was collected by using an online survey by using a Google form because at the pandemic situation the respondents were unable to give the response face to face. The data collection campaign was being started in August 2021 from the social vulnerability of household by using a convenient sampling technique. The seven states in Malaysia were hit by floods on Sunday and thousands of people were evacuated, taking the total affected by heavy rain in the past two weeks to more than 125,000, the National Disaster Management Agency said. The agency said in a statement that Kelantan, Terengganu, Pahang, Johor, Malacca, Negeri Sembilan and Sabah were still affected by floods, and 8,727 people were taking shelter at 128 relief centers (Flood in Malaysia, 2021). For the data collection, the questionnaire was adopted from pervious studies. The spartial neighbourhood (SN) was measured by 4 items, land tenure (LT) was measured by 4 items, health vulnerability (HV) was measured by 4 items, demographica characteristics (DC) was measured by 4 items. In addition, the risk perception (RP) was also mearued by 4 items, flood coping capacity (FCC) was being also measured by 4 items, socio economic status (SES) was meaured by 4 items, and lastly flood vulnerability (FV) was also measured by 4 items. These items was adopted from previous research (Imran et al., 2019)where these was already used. Therefore, this instrument had more reliability and validity. The questionnaire was measured on five point likert scale from strongly disagree to strongly agree (Talan, 2020; Tolić, 2020; Vergara, 2020; Yavuz, 2020).

DATA ANALYSIS AND RESULTS

Convergent and Discriminant validity

This study employed the PLS-SEM technique to analyses the proposed model of this study as suggested by the previous researchers (Ahmad et al., 2019; Ahmad et al., 2020; Bhatti et al., 2019). Researchers (Arshad, Ahmad, et al., 2020; Arshad, Meirun, et al., 2020) further suggested that, it is important that all elements of a research document structure are strongly correlated. To this end, a convergent validity test has been performed and the findings showed that the articles taken of all construct have a high correlation. The result shows AVE values and alpha and composite reliability values are in acceptable range. This correlation is said to be great when all variables are greater than 0.70, with alpha and composite reliability, and the same was the case in our analysis. Also, a value AVE of all structures reaches 0.5 and indicates that the correlations between variables are important. The table below shows the convergent validity findings (Sonar et al., 2020; Tumitit, 2020; van Vuuren, 2020; Worsley, 2020; Yasemin, 2020).

The discriminating validity is the second step in developing the measuring model. The Two important recommended procedures are used to for the assessment of discriminant validity Fornell and Larcker (1981).The square roots of AVE and the values of correlation are determined using parameters. Second, cross-loading is used to evaluate the build when the real construct is not more than the base construct. Furthermore, (Henseler et al., 2015) introduced the Hetrotrai-Monotrait approach as the third way in discriminant validity analysis (HTMT). Where the values for each construct should not exceed 0.85 (Henseler et al., 2015). The square root of AVE values and cross-loadings, on the other hand, are calculated according to Fornell and Larcker's criterion (1981). The HTMT values of all buildings are also within the 0.85 range. Which shows that in this study all the criteria on the discriminant validity of constructs are met as shown in Table 2 and 3 below.

Table 1: Measurement model

Variable	**Item**	**Loading**	**Cronbach's Alpha**	**Composite Reliability**	**AVE**
Land Tenure	LT1	0.828	0.85	0.892	0.685
	LT2	0.865			
	LT3	0.827			
	LT4	0.761			
Health Vulnerability	HV1	0.812	0.777	0.855	0.697
	HV2	0.832			
	HV3	0.747			
	HV4	0.713			
Demographic Characteristics	DC1	0.741	0.858	0.898	0.639
	DC2	0.771			
	DC3	0.845			
	DC4	0.826			
Risk perception	RP1	0.888	0.834	0.897	0.744
	RP2	0.871			
	RP3	0.827			
Flood Coping capacity	FCC1	0.891	0.780	0.890	0788
	FCC2	0.904			
	FCC3	0.675			
	FCC4	0.895			
Socio economic status	SES1	0.823	0.888	0.922	0.748
	SES2	0.878			
	SES3	0.884			
	SES4	0.873			
Spatial Neighborhood	SN1	0.567	0.847	0.893	0.677
	SN2	0.678			
	SN3	0.568			
Flood Vulnerability	FV1	0.747	0.789	0.905	0.783
	FV2	0.834			
	FV3	0.879			
	FV4	0.826			

Note: LT-land tenure, HV-household vulnerability, DC-demographic characteristics, RP-risk perception, FCC-flood coping capacity, SES-socio economic status, FV-flood vulnerability, SP-spatial neighborhood

Table 2: Discriminant Validity (Fornell & Larcker, 1981)

	LT	**HV**	**DC**	**RP**	**FCC**	**SES**	**SN**	**FV**
LT	0.822							
HV	0.176	0.772						
DC	0.176	0.468	0.799					
RP	0.552	0.141	0.322	0.863				
FCC	0.175	0.488	0.624	0.313	0.865			
SES	0.004	0.345	0.274	0.036	0.336	0.823		
SN	0.105	0.560	0.524	0.324	0.035	0.175	0.788	
FV	0.114	0.326	0.373	0.436	0.336	0.204	0.327	0.775

Note: LT-land tenure, HV-household vulnerability, DC-demographic characteristics, RP-risk perception, FCC-flood coping capacity, SES-socio economic status, FV-flood vulnerability, SP-spatial neighborhood.

Table 3: Discriminant Validity (HTMT

	LT	**HV**	**DC**	**RP**	**FCC**	**SES**	**SN**	**FV**
LT								
HV	0.198							
DC	0.183	0.552						
RP	0.604	0.169	0.358					
FCC	0.195	0.591	0.694	0.358				
SES	0.062	0.168	0.31	0.045	0.389			
SN	0.384	0.392	0.034	0.120	0.342	0.421		
FV	0.649	0.531	0.452	0.563	0.193	0.181	0.53	

Note: LT-land tenure, HV-household vulnerability, DC-demographic characteristics, RP-risk perception, FCC-flood coping capacity, SES-socio economic status, FV-flood vulnerability, SP-spatial neighborhood

HYPOTHESIS TESTING

The Partial Least Square (PLS)- structural equation model (SEM) was used in this research to examine the factors that contribute to communities' flood risk. Furthermore, each build necessitates the measurement of a number of flood-vulnerability indicators. Demographics, socioeconomic status, LT, CC, RP, and HV were identified as six essential characteristics to determine social vulnerability in the study. GV factors are incorporated to the model by assessing a variety of geographical parameters, such as distances to flood and facilitating centers, and also geography characteristics of houses, such as height and slopes. Local household flood vulnerability is primarily influenced by four key model constructs: socioeconomic conditions, SN, LT status, and demography. The interrelationships between these notions show that each one reinforces the others. The evaluation of social and GV determinants lays the groundwork for prioritizing flood mitigation actions. As a result, these priority activities must be integrated into disaster risk management planning at all levels of government, as well as the policy implications at the local level...

Table.4: Hypothesis Results

Hypothesis	Direct	Indirect	Total effect	T Statistics	Decision
LT-> FV	0.1466	0.17967	0.3262	9.35	Supported
LT-> FCC	0.0522	0.00000	0.0522	4.13	Supported
LT ->SES	0.8270	0.50795	0.3190	2.10	Supported
LT->DC	0.8313	0.00000	0.8313	3.41	Supported
SES->FV	0.4263	0.00000	0.4263	1.99	Supported
RP-> FV	0.0054	0.00975	0.0152	6.74	Supported
RP-> FCC	0.0751	0.00000	0.0751	5.03	Supported
HV-> FV	0.0848	0.00000	0.0848	4.10	Supported
CC->FV	0.1299	0.00000	0.1299	4.13	Supported
DC-> SS	0.6110	0.00000	0.6110	8.73	Supported
DC-> FV	0.0444	0.00000	0.0444	2.33	Supported
SN-> FV	0.4720	0.11680	0.5888	1.97	Supported
SN-> CC	0.8992	0.00000	0.8992	5.88	Supported

Note: LT-land tenure, HV-household vulnerability, DC-demographic characteristics, RP-risk perception, FCC-flood coping capacity, SES-socio economic status, FV-flood vulnerability, SP-spatial neighborhood

Flood risk has increased as a result of the convergence of household demographics and socioeconomic level. Nevertheless, in the current study, the effect of of satisfactory demographics on household happiness is in the worst-case extent, resulting in increased vulnerability. The lack in flood management at the regional government is designated from the correlation between socioeconomic position and flood susceptibility. In addition, the indications from this activated socioeconomic condition could use to identify unequal financial resource allocation in order to manage flood vulnerability. Indirect consequences reveal that households' LT status has a significant effect on demographic characteristics and socioeconomic circumstances, additional contributing in the vulnerability. Households' agricultural land holdings are related to their monthly salary, earnings, education level, as well as construction form. Furthermore, households with a sophisticated socioeconomic position are further prospective to acquire agricultural land. However, in renter's case, LT has a negative impact on flood vulnerability and recovery. Flooding affects renters' socioeconomic status as well as their geographic locations, resulting in socio-physical vulnerability. With respect to land rationalization in the planning of disaster risk management, land tenure significantly contributes to flooding vulnerability. While surveying families, we discovered that large agriculture landowners channel floodwaters by unlawfully breaking earthworks to apart from their refined areas, demonstrating the authorities flood management lack limpidity.

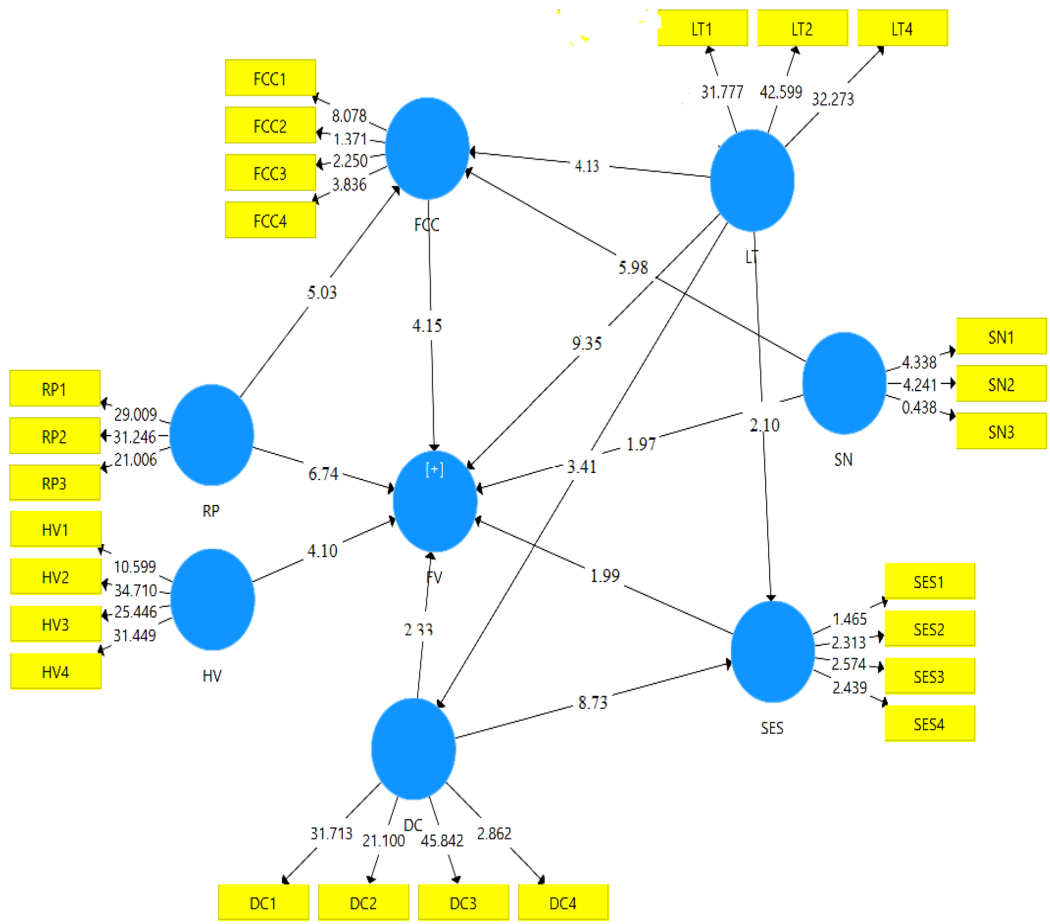

Figure.1: Structural Model

Aside from the physical placement of houses, the rainfall situations and drainage system capacity can have a considerable impact on their flood risk. A house, for example, is considered to be a less vulnerable although it is being located within a lesser geographical region along with substantial rainfall occurrence which are rare and the drainage classification could be handle the high rainfall concentration. The proposed method for assessing vulnerability of Kalang river was being investigated in this study. Flood vulnerability is greatly influenced by geographic variables put on the spatial neighborhood construct. Furthermore, due to a major close association along with type of construction and podium plinth level of houses inside the study area, it had a considerable impact on the CC of households. Furthermore, local residents' evacuation preparations are mostly determined by the distance between the relief camp and the availability of highways. Local household settlement patterns, as seen in mapping distances as of the previous social vulnerability, and flood extent. They suggest that the majority of people live in floodplains and that they return home after a flood. As a result, modelling household risk based on socioeconomic and geographic circumstances provides more information about their flood resilience. The spatial connection between the latent variables, on the other hand, is not explicitly taken into account. The current study analyses the capability of PLS-SEM to interactively estimate the household social vulnerability and GV of dwellings for measuring the rural community's flexibility in the occurrence of flood. The paper uses river floods to show the proposed strategy. Other forms of floods may necessitate a precaution collection of factors in order to explore socioeconomic, and the vulnerability of geophysical in areas of rural and urban as well as in a local or regional setting. The proposed solution can be scaled to each case situation using the selected variables.

CONCLUSION

Flood vulnerability mapping in Malaysia uses social factors derived from household surveys and correlates them with collocated value of different geographic parameters derived through the sensing of remote imagery and geographic information system (GIS) data sets. To overcome methodological limitations, we introduced the PLS-SEM technique framework that conglomerates of geographical vulnerability and social. Our findings show that connecting a household's socioeconomic problems to its geographic neighborhood provides better insight into developing long-term resilience plans. The analysis finds that direct effects of SN and socioeconomic conditions, as well as indirect effects of LT and demographics, contribute the most to social indices characterizing flood vulnerability. We find that perhaps the PLS-SEM effectively accounted for combination social and spatial vulnerability.

The researchers concluded that geographic indicators and socio-economic factors may not provide a comprehensive picture of flood susceptibility in various places. The results of combined evaluations of both types of susceptibility variables form the basis for prioritizing flood mitigation actions. Along with the effect of climate change, capacities of institutional and the various resources are needed to build a policy framework to assess the proper integration of vulnerability on the basis of location not centralized evaluation evaluations which was being done based on survey of Malaysia data. The geographic information system (GIS) use to assess vulnerability status can aid in the formulation of evidence-based policies based on demographics. Remote sensing can be used to build the various opportunities of cost-effective maps at the level of regional scales. We developed an explicit approach of geographical level for local household's mapping which were living in the prones areas of Malaysia by taking a complicated spatial data through the household survey and employed the PLS-SEM model. This technique may be applied to various domains and areas, and it will assist policymakers in making better policy decisions...

CONTRIBUTIONS AND FUTURE RECOMMENDATIONS

The current study's findings highlight the following important policy implications. Rather than centralized a proper assessment through collecting the data by survey from the national level, employing disaster reduction program and proper resilience planning at level of district must specifically build a proper framework of policy making for the evaluation of integrated vulnerability at the location level. The approach given in the present research is being provided a scientific foundation for assessing social vulnerability in relation to local circumstances. Flood-prone places would develop a proper policy that could support to the community restoration and resumption, neighborhood connection, a weaker socio-economic condition, and varied livelihood sources, according to the findings. Future research should look at localizing the a proper framework the reduction of the disaster risk which could be move away after disaster management and in the direction of adversity risk management for the achievement of sustainable able goals (SDGs). On the other hand, the policymaker preferred on indicator-based risk assessments, bottom-up strategies using geographical data could be fastly discover local patterns of vulnerability. However, when building resilience plans for developing countries like Malaysia, such data is typically scarce. As a result, governments must create policies for the creation and exchange of spatial data. Under the shed light of the household survey, there is a need of holistic survey to the proper evaluation of disaster risk managing system of Malaysia that could discourse vulnerability properly in both of spatial and temporal settings, especially given the country's substantial climatic change over the last decade. The various other developing countries faces huge disparities in public resources access, and a flood control system should take this into account. Furthermore, catastrophe risk reduction plans must take into account a far broader range of issues that affect the social system vulnerability, such as overlapping institutional functions, unequal resource allocation, and insufficient investment. Using communication tools and training, an early flood caution system could enhance acceptability within the communities.

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