

## AN ANALYSIS OF FLOOD RESILIENCE STRATEGIES ADOPTED BY SMALL SCALE INDUSTRIES IN KERALA

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**Abstract:** Flood is considered one of the major hazards responsible for extensive damage across the globe. The number of flooding events is a constant rise over the past decades in India, with chances of a likely increase over coming years with the warming climate. These constant recurring floods are a burden to the economy. This study focuses on researching the flood resilience measures taken by small-scale industries in Kerala pre-and-post-2018 and 2019 flooding events; with a focus on the five largely inundated districts of Kerala during the period.

**Keywords:** Natural Calamities, Floods, Flood resilience, SME, Inundations.

### 1. Introduction

For ages, civilizations have been known to thrive and survive near water bodies exploiting their vast sustenance offerings. Settlements near water bodies have offered many benefits, but the threat of inundation came with it. However, with age, dwellings got constructed on higher grounds, and riparian people benefited from the floods, which enriched the soil (irrigation and nutrient supply) and helped agriculture, thereby learning to live in harmony with floods (Svetlana et al., 2015). But with the changing pace of the world, global warming, unscientific urbanization, and land use the once harmonized way of life are in peril. Extreme flood events have increased tremendously worldwide in a decade (Najibi & Devineni, 2018). Flooding has become a major global hazard. In developing countries like India, the impact brought about by floods is rather taxing than in developed countries having proper flood management and early warning systems. Not only do floods impact regular human living but also disrupt the economy. Inundations gravely hamper the functioning of businesses and, a bit more with small-scale industries that are often unprepared and require support to boost their pliability. In the years 2018 and 2019 the state of Kerala in the southern part of India faced major flooding events because of severe rains and several other human factors which resulted in human casualties and loss of infrastructure and livelihoods (NIDM, 2020; State Relief Commissioner, 2019). The loss to various businesses across the affected parts of the state amounted to thousands of crores of rupees. A study published in early 2018 showed that small-scale industries were thriving and becoming a vibrant sector of the economy (Ibrahim, 2018). Though the floods of 2018 and 2019 crippled small-scale industries in Kerala, they all managed to stay resilient and make a comeback. Hence it is imperative to analyze the resilience measures adopted by small-scale industries in the state that helped them get back

on track. This study aims to understand the resilience measures adopted by small-scale industries in the prime inundated areas in Kerala before and after the flooding events.

## 2. Review of Literature

(Saengnakhon, 2016): made a study on the topic ‘Understanding the resilience of small and medium-sized enterprises to flood risk in Ayutthaya, Thailand focuses on the impact of floods experienced by SMEs and identifies the actions undertaken by them in implementing measures to face flood risk by using statistical methods like questionnaire survey, two semi-structured interviews, quantitative and qualitative data analysis, etc... which gives an idea about the vulnerability and coping strategies adopted and to find out the degree of risk incurred in that area.

(Zaman, 2012): conducted a study on the topic ‘Impact of Recent Flood on the Economy of Small Business at Rockhampton’ to find the relationship between a location of the business and recent flood impacts by using a questionnaire and Pearson & Spearman’s correlation. Find out that the impact of the flood on small businesses is directly related to the location of the business and its turnover with limitations associated with costs and time.

(G. Wedawatta et al., 2014): made a study on ‘Small Business and Flood Impacts: The case of the 2009 flood event in Cockermouth’ with the objectives of finding the range of impacts by using the questionnaire survey and they concluded the investigation with a suggestion that the study will help policymakers curb and professional bodies to make decisions to improve the status of SMEs.

(Ingirige & Russell, 2015): made a research on the topic ‘Investigating SME resilience to flooding’ concentrates in a single village street in Braunton, North Devon to develop a customized extreme weather risk assessment and to understand the needs of SMEs in Braunton. By using seven case studies, cognitive mapping techniques, personal interviews, qualitative data analysis, etc..., the study analyses the progress made by SMEs in Braunton.

(Marks & Thomalla, 2017): made a study on ‘Responses to the 2011 floods in Central Thailand: perpetuating the vulnerability of small and medium enterprises with the objectives on floods affect in SMEs market and actions taken to reduce future floods and they concluded that socio-economic factors interacted negatively effect on SMEs.

(Gayan Wedawatta & Ingirige, 2012): conducted research on the topic ‘Resilience and adaptation of small & medium-sized enterprises to flood risk’ with objectives of adaptation to risk of flooding in community-level measures by using the qualitative and quantitative methods and found out that business continuity which shows requirements to show the desired level of protection.

(Bahinipati et al., 2015): conducted research on the topic ‘Flood induced economic loss and damage to textile industries in Surat City, India attempts a loss and damage assessment of Surat City by adopting methods such as census, stratified sampling, structured survey, etc... which indicates the magnitude of flooding to weaving business and the extent and frequency

of flooding they experienced and to understand the measures undertaken by weavers and textile associations post-2006 to rebuild the city.

### **3. Objective**

To analyze the resilience strategies employed by the small-scale industries in managing flood events before and after the 2018 and 2019 floods of Kerala.

### **4. Hypothesis**

H01: There is no significant difference among various types of industries regarding resilience strategies employed before the flood.

H02: There is no significant difference among the varied category of types of industry regarding resilience strategies employed by small-scale industries after the flood.

### **5. Methodology**

This Study is purely empirical research. Convenience sampling was adopted for the data collection and the study was conducted with a sample of 70 respondents. Both primary and secondary data were used for the study. Primary data constitutes the major source of information. The data were collected from businessmen of the Kottayam, Ernakulam, Idukki, Alappuzha, and Pathanamthitta districts. Primary data were collected through a questionnaire method. It includes questions regarding certain general information such as gender, age, education, income level, type of industry, and specific information regarding the techniques adopted by them before and after the flood. Interview schedules were administered to collect data from the respondents. The collected data are analyzed using various mathematical techniques and statistical tools like percentages, test., etc. The results of the analyzed data are represented by tables and graphs.

### **6. Analysis and Discussion**

#### **Resilience Strategies employed by small-scale industries (before the flood) among different types of industry**

To test whether there is any significant difference in the type of industry, the following hypothesis is formulated:

H<sub>0</sub>: There is no significant difference among the varied category of types of industry about resilience strategies employed by small-scale industries (before the flood)

H<sub>1</sub>: There is a significant difference among the varied categories of types of industry about resilience strategies employed by small-scale industries (before the flood)

**Table No.1: Resilience Strategies employed by small-scale industries (before the flood) among different types of industry**

	Type of industry	N	Mean Rank
Mitigation Efforts	wholesale	12	30.79
	Retail	42	38.70
	Service	16	30.63
	Total	70	
Infrastructure	wholesale	12	36.67
	Retail	42	37.01
	Service	16	30.66
	Total	70	
Technical Tactics	wholesale	12	35.88
	Retail	42	36.77
	Service	16	31.88
	Total	70	

Source: - Survey data N=70

**Table No.2: Resilience Strategies by small scale industries (before the flood) among different types of industry- Test Statistics<sup>b</sup>**

	Mitigation Efforts	Infrastructure	Technical Tactics
Chi-Square	2.639	1.188	.701
Df	2	2	2
Asymp. Sig.	.267	.552	.704

- a. Kruskal Wallis Test
- b. Grouping Variable: Annual Income

Above table (No.2) it is found that the p-value at a 5% level of significance in respect of mitigation efforts (.267) infrastructure (.552) and technical tactics (.704) is more than 0.05 then the null hypothesis is accepted and there is no significant difference among different type of industry about resilience strategies employed by small scale industries (before the flood)

**Resilience Strategies employed by small-scale industries (after the flood) among varied income groups**

To test whether there is any significant difference in income, the following hypothesis is formulated:

H<sub>0</sub>: There is no significant difference among varied income groups regarding resilience strategies employed by small-scale industries (after the flood).

H<sub>1</sub>: There is a significant difference among varied income groups regarding resilience strategies employed by small-scale industries (after the flood).

**Table No.3: Resilience Strategies employed by small-scale industries (after the flood) among varied income groups**

	Annual Income	N	Mean Rank
Architectural impact	Less than 1 lakh	9	39.22
	1-5 Lakh	41	41.10
	Above 5 Lakh	20	22.35
	Total	70	
Technological impact	Less than 1 lakh	9	35.22
	1-5 Lakh	41	41.21
	Above 5 Lakh	20	23.93
	Total	70	

Source: - Survey data

N=70

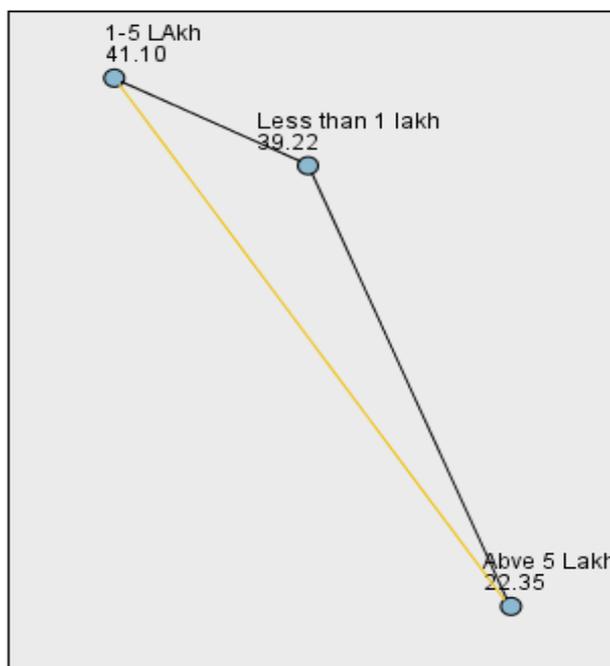
**Table No.4: Resilience Strategies employed by small-scale industries (after the flood) among varied income groups - Test Statistics<sup>b</sup>**

	Architectural impact	Technological impact
Chi-Square	11.986	9.763
Df	2	2
Asymp. Sig.	.002	.008

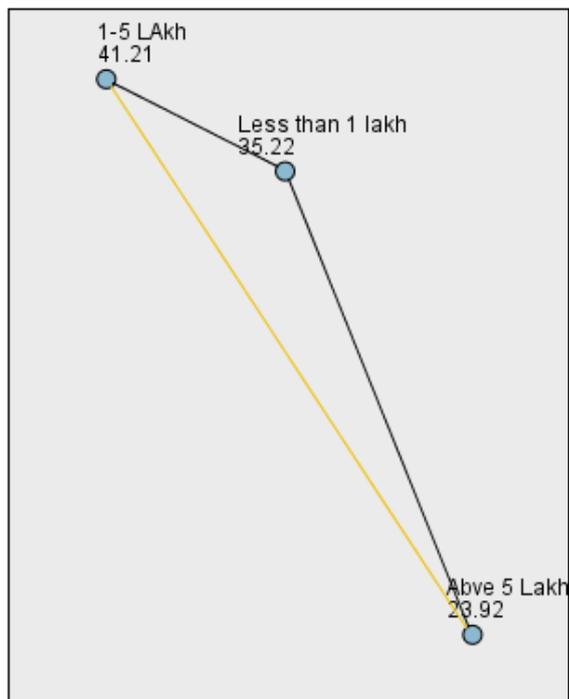
- a. Kruskal Wallis Test
- b. Grouping Variable: Annual income

Above table (No.4) it is found that the p-value at a 5% level of significance concerning architectural impact (.002) and technological impact (.008) is less than 0.05 then the null hypothesis is rejected and there is a significant difference among varied income groups about resilience strategies employed by small scale industries (after the flood).

**Figure No.1: Pairwise comparison of annual income and architectural impact**



**Figure No. 2: Pairwise comparison of annual income and technological impact**



The significant differences are highlighted using an orange line to join the two different groups in the diagram which shows the mean rank for each group. From the above figures, it is founded that the mean rank of architectural impact (41.10) and technological impact (41.21) is relatively higher compared to other income groups. So, the resilience strategies adopted by small-scale industries after floods regarding architectural and technological impact are mostly taken by the middle-income group (1 -5 lakhs).

### **Resilience Strategies employed by small-scale industries (after the flood) among different types of industry**

To test whether there is any significant difference in income, the following hypothesis is formulated:

H<sub>0</sub>: There is no significant difference among different types of industry regarding resilience strategies employed by small-scale industries (after the flood)

H<sub>1</sub>: There is a significant difference among different types of industry regarding resilience strategies employed by small-scale industries (after the flood)

**Table No.5: Resilience Strategies employed by small-scale industries (after the flood) among different types of industry**

	Type of industry	N	Mean Rank
Architectural impact	wholesale	12	31.92
	Retail	42	39.06
	Service	16	28.84
	Total	70	
Technological impact	wholesale	12	31.58
	Retail	42	39.43
	Service	16	28.13
	Total	70	

Source: - Survey data N=70

**Table No.6: Resilience Strategies employed by small-scale industries (after the flood) among different types of industry- Test Statistics**

	Architectural impact	Technological impact
Chi-Square	3.435	4.139
Df	2	2
Asymp. Sig.	.179	.126

- a. Kruskal Wallis Test
- b. Grouping Variable: Type of industry

Above table (No.6) it is found that the p-value at a 5% level of significance in respect of architectural impact (.179) and technological impact (.126) is more than 0.05 then the null hypothesis is accepted and there is no significant difference among different types of industry about resilience strategies employed by small scale industries (after the flood)

## 7. Findings & Suggestions

The study shows that out of 70 respondents, the majority of them (42) belong to the retail business and the least number of them (12) belong to the wholesale industry. The majority of the respondents constituting 32.9 percent of the total respondents belong to the Kottayam district and the least respondents were from Ernakulam district with a percentage of 8.6. It is identified that there is no significant difference in resilience strategies employed by small-scale industries (before the flood) about the type of industry and there is no significant difference in resilience strategies employed by small-scale industries (after the flood) about the type of industry. To suggest, according to the type of sector and business, more care should be given to expensive stock and equipment which will be impacted more by flood as compared to less expensive stock. Consideration is given to replacing the old drainage system with a more sophisticated system using separate pipelines for water and sewage and proper floodplain management including accurate floodplain mapping to reduce encroachment on vulnerable areas should be adopted. An early flood warning system should also be provided in flood-prone areas so that inhabitants can take preventive measures.

## 8. Conclusion

This research endeavor was concentrated on the objectives of identifying resilience strategies employed by industries before and after the flood. The study is based on age, gender, education, annual income, type of industry, and district of the industrialists. It is evident from the study that lack of preparedness increased the impact of floods in small-scale industries. There exists a need to provide effective and efficient support by the government to the industrialists to overcome the impact and contribute to the economic development of the nation. Industrialists need to act on devising and implementing proper measures to reinforce their resilience to any calamity faced.

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