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RESEARCH ARTICLE

"I Decided to Exit the Industry": Exploring Flood Experiences Among Smallholder Farmers in Kelantan, Malaysia

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ABSTRACT

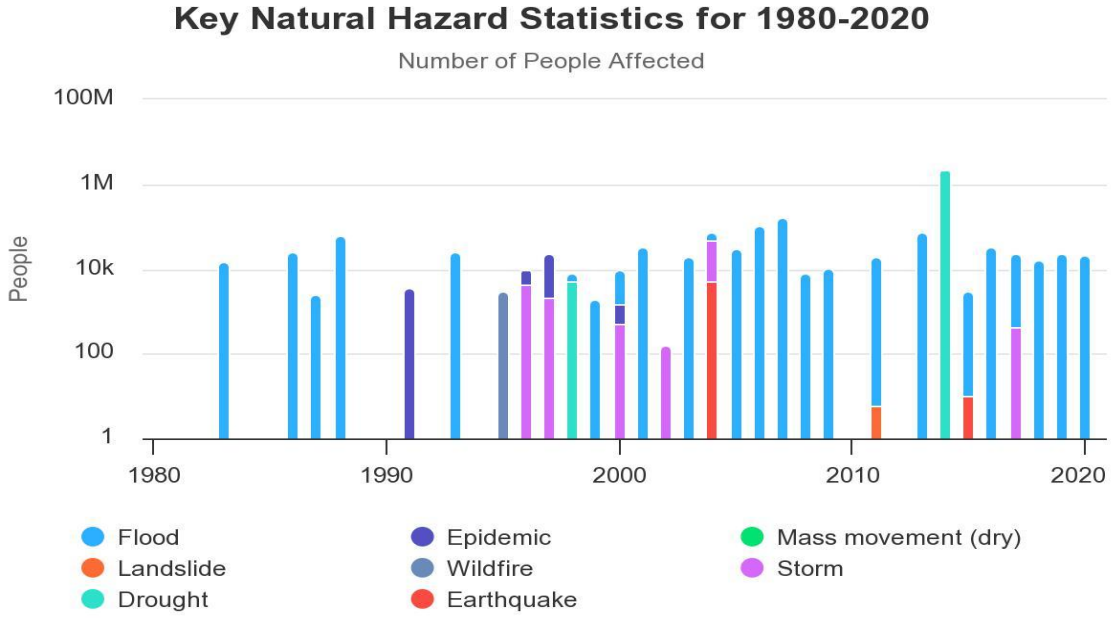
Globally, floods stand out as the most destructive natural disaster, posing significant threats to food security, infrastructure, and livelihoods. In Malaysia, regions like Kelantan face annual monsoon floods, impacting communities heavily dependent on agriculture. This study specifically delves into Pasir Mas, Kelantan, aiming to assess how monsoon flooding affects small-scale farmers. The study involved interviews with ten farmers in Pasir Mas, adopting a qualitative approach with descriptive analysis. These farmers predominantly rely on agricultural activities as their primary source of income, with chili cultivation being prominent, and a few engaging in crop rotation practices. The interviews provided a platform for farmers to share their experiences on the challenges posed by floods to crops, infrastructure and livelihoods. The study revealed varied effects of floods on the farmers, with one participant expressing a desire to exit the industry and explore alternative business ventures. The insights from these experiences are crucial, as they pave the way for developing effective risk management strategies and new policies.

Contribution/Originality: This study lays the groundwork for developing a flood vulnerability index, a topic still debated regarding indicator inclusion. It provides valuable insights into small-scale farmers' experiences in Pasir Mas, Kelantan, significantly contributing to the academic literature on district-level flood impacts and agricultural resilience.

1. Introduction

Climate change, which refers to the long-term alteration in Earth's weather patterns, is a complex global phenomenon influenced by various factors (Intergovernmental Panel on Climate Change, 2021). The consequences of climate change can exacerbate and contribute to various natural disasters (Benevolenza & DeRigne, 2019). One of the subcategories of natural disasters is hydrological disasters, encompassing floods and droughts (Teh & Khan, 2021). Floods are ranked as the most destructive global natural disaster (Munawar, 2020) and are also identified as the second-leading cause of livestock and crop production losses (Food and Agricultural Organization, 2021). Data from World Bank (2023) provide evidence that floods rank as the most frequent natural disaster, posing a greater threat to the community than other types of natural disasters. These statistics are illustrated in Figure 1. They occur due to primary factors, with storms being a leading cause attributed to high rainfall (Breugem et al., 2020; Asiedu, 2020). Other contributing factors to this disaster include topography (Tehrany et al., 2019), climate change (Zhou et al., 2019), engineering structures (Kundzewicz et al., 2018) and geomorphological changes (Das & Gupta, 2021). Additionally, floods have resulted in thousands of fatalities (Petrucci et al., 2019; Hu et al., 2018; Yari et al., 2020), economic losses (Dottori et al., 2018; Willner et al., 2018; Kron et al., 2019), health implications (Paterson et al., 2018; Louw et al., 2019) and have also impacted livelihood well-being (Yang et al., 2018; Hudson et al., 2018).

Figure 1: Key Natural Hazard Statistic from 1980 to 2020



Source: World Bank (2023)

In Malaysia, two significant water-related challenges significantly impact the nation: excess water leading to floods (Fulazzaky et al., 2023) and water scarcity leads to droughts (Hafizi et al., 2018). Among these challenges, floods emerge as the most notable natural disasters (Muzamil et al., 2022). Malaysia faces regular flooding during the monsoon season (Rosmadi et al., 2023). Fortunately, its geographical location near the equator shields it from other types of disasters such as cyclones, typhoons, and volcanic eruptions (Zamree et al., 2018). Since the 1980s, Malaysia has experienced several

devastating flooding disasters, causing approximately 90% of the losses due to these incidents (Rosmadi et al., 2023; Department of Irrigation and Drainage Malaysia, 2018). The heavy and continuous rainfall during the monsoon season causes water overflowing riverbanks and other water streams, leading to inundation (Banu, 2021). Floods are characterized by their prolonged duration, frequent occurrence, vast area coverage, and substantial impact on the population and socio-economic structure of the country (Sulaiman, 2007). The average damage caused by flooding in Malaysia is estimated at about US$100 million (Sadeka et al., 2023).

Kelantan is highly prone to annual monsoon floods from November to February due to its location. The majority of households in the area rely on agriculture as their main source of income (Bahar et al., 2020). Kelantan, covering an area of 15,099 km^2, faces recurring flooding caused by a river that consistently overflows (Sidek et al., 2021). Four tributaries river in Kelantan, the Galas River, Nenggiri River, Pergau River and Lebir River, significantly impact the region's hydrology (Abdulkareem et al., 2018). The rivers, with a length of 248 km and an area of 11,900 km^2, features observation stations at Guillemard Bridge and the Korbu Mountain Peak, which rises to 2,183 meters (Majid et al., 2021). These geographical details contribute to the specific challenges posed by flooding in Kelantan. The region is also characterized by a predominantly low-lying topography, featuring extensive flat floodplains and being traversed by sizable rivers. As a consequence, over 25% of the state is susceptible to flooding (Kayode et al., 2019).

Table 1: The summary of flooding events from 1967 to 2022 in Kelantan.

Year	Damage (Rm Million)	Number of Deaths	People Evacuated	Source(s)
1967	199.30	38	320,000	Gasim et al. (2014); Sulaiman (2009)
1988	33.00	29	36,800	
2005	240.10	14	99,405	
2006	316.10	22	36,143	
2014	200.00	21	354,800	Baharuddin et al. (2015); NADMA (n.d.)
2016	33.07	NA	40,236	
2017	13.63	NA	22,340	Zulkepli et al. (2022)
2019	18.29	NA	18,683	
2022	172.30	10	63,226	Islam & Wong (2017)

Yearly monsoon flooding in Kelantan poses significant threats, including the destruction of crops and farmland, property and infrastructure losses, and potential food security issues (Mcdowell & Hess, 2012). The entire agricultural value chain, from planting to transportation, is vulnerable to disruption by floods. As a result, any decrease in agricultural productivity can have a substantial impact on the food security, income, and overall well-being of smallholder farmers (Colaizzi, 1978). Understanding how flood disasters affect agriculture and food security for smallholder farmers is essential for governments, policymakers, and stakeholders. This insight empowers them to develop and implement effective strategies to mitigate the impact of such disasters.

Despite the critical importance of this issue, there exists a notable gap in research focusing on small-scale farmers, particularly those involved in cash crop cultivation in Kelantan. Therefore, the main objective of this study is to assess the impact of monsoon flooding on small-scale farmers in the region.

1.1. Research Objectives

The objective of this study is to assess the impact of monsoon flooding among small-scale farmers in Kelantan, Malaysia

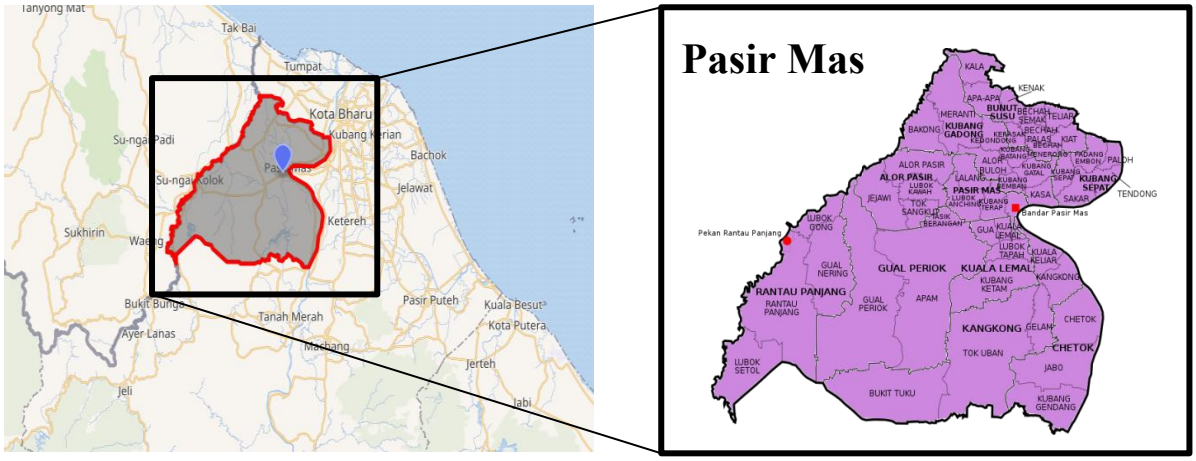
2. Research Methods

2.1. Study Sites

The study was conducted in Pasir Mas, a district in Kelantan known as one of the top five most flood-affected areas. Pasir Mas, the second-largest district in Kelantan, covers an area of 139 km^2 and has a population of 185,758. The region's vulnerability to yearly floods is due to its geographical features, lack of organized planning, and proximity to the South China Sea. This leads to a substantial annual evacuation of residents.

Figure 2 highlights Pasir Mas district in Kelantan, a key area for data collection due to its frequent monsoon flooding challenges (Hanan et al. 2020).

Figure 2: Map of Pasir Mas, Kelantan



Source: Kamaruzzaman et al. (2016)

2.2. Research Approach

This study employs a qualitative research design to explore the lived experiences of small-scale vegetable farmers in Pasir Mas, Kelantan, affected by monsoon flooding. The qualitative approach is justified as it allows for an in-depth understanding of farmers' personal stories, challenges, and adaptation strategies, capturing the nuanced impacts of floods on their livelihoods, which quantitative methods may overlook.

2.3. Population

The population of this study consists of small-scale vegetable farmers in Pasir Mas, Kelantan, Malaysia, who have experienced flooding. These farmers primarily cultivate cash crops on plots smaller than 2 acres and reside in areas prone to annual monsoon floods.

2.4. Sample Size

The study included 10 participants, determined to be sufficient for a qualitative study based on Guest et al. (2006), who suggest that 5 to 15 participants are adequate for achieving data saturation in qualitative research, particularly when exploring specific, homogenous experiences.

2.5. Sampling Method

The study applied a purposive sampling method to select participants. This method was chosen to ensure that all participants were small-scale vegetable farmers in Pasir Mas who had directly experienced flooding.

2.6. Data Collection

Data were collected through semi-structured, face-to-face interviews with 10 farmers, each lasting approximately 30 minutes. Semi-structured interviews were chosen to provide flexibility, allowing participants to discuss flood-related experiences openly while ensuring key topics. A digital recorder was used to capture the interviews accurately, supplemented by detailed note-taking to ensure data reliability.

2.7. Data Analysis

The data were analyzed using narrative analysis, following the method outlined by Colaizzi (1978), which involved transcribing interviews, identifying significant statements, extracting meanings, and developing an exhaustive description of farmers' experiences. The analysis was conducted manually, without the use of qualitative data analysis software, to maintain close engagement with the data and ensure a deep, interpretive understanding of the farmers' stories, aligning with the study's focus on narrative depth.

3. Results

Ten male farmers, identified as *R1* to *R10*, participated in these interviews. Their ages were distributed as follows: 25-30 years (n=4), 31-35 years (n=3), and 41-45 years (n=3) (Table 2).

Table 2: Socio-economic profile of research participants.

N	Age	Gender	Status	Source of income
Participant 1 (R1)	28	Male	Single	Primary
Participant 2 (R2)	28	Male	Single	Primary
Participant 3 (R3)	30	Male	Single	Primary
Participant 4 (R4)	32	Male	Married	Primary
Participant 5 (R5)	35	Male	Married	Primary
Participant 6 (R6)	41	Male	Married	Secondary

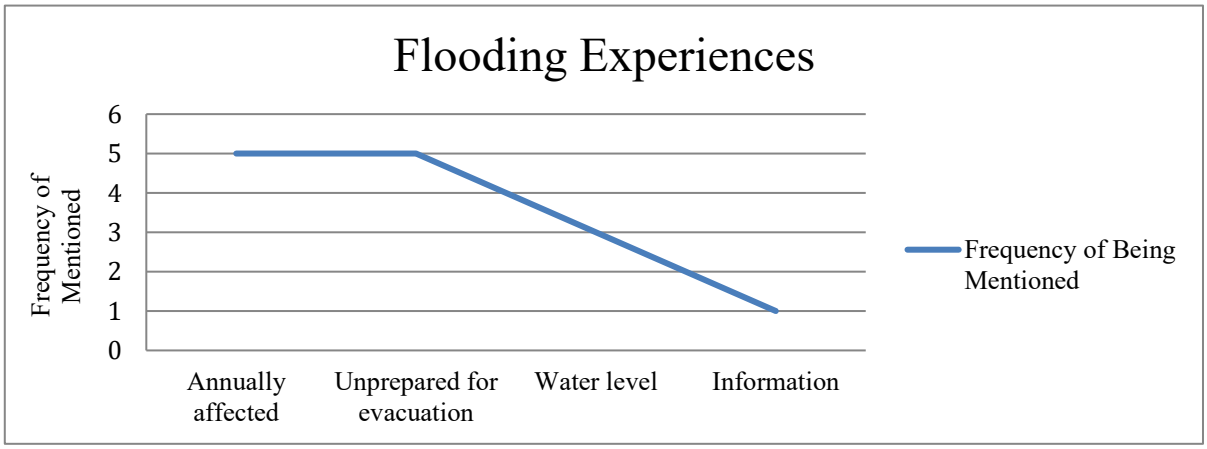
Participant 7 (R7)	43	Male	Married	Primary
Participant 8 (R8)	43	Male	Married	Primary
Participant 9 (R9)	32	Male	Married	Primary
Participant 10 (R10)	25	Male	Married	Primary

Among the participants, three were single (*R1*, *R2*, and *R3*), while the remaining seven were heads of their respective families. Only *R6* engaged in crop plantation as a secondary source of income. All participants reside in areas vulnerable to annual monsoon flooding. They cultivate cash crops on plots below 2 acres, primarily focusing on cucumber and chilli. Some rotate between cultivating cucumber and chilli (*R1*, *R2*, *R3*, and *R10*), while others engage in rotating crops, including cucumber, chilli, and eggplants (*R4*, *R7*, and *R8*). A few participants exclusively grow chilli plants (*R5* and *R9*), and *R6* tends to rotate a trio of crops: cucumber, chilli and bitter gourd.

3.1. The Experience of Flood Incidents

The Graph 1 presents findings on the frequency of research participants mentioning similar occurrences during interviews about recent flooding experiences. Approximately half of the participants noted the annual occurrence of floods in Pasir Mas. This is supported by Diyana (2022), Ahmad and Abdurrahman (2015) that floods in this district happen annually. This observation aligns with the data reported by Walker et al. (2020) that nearly all parts of Kelantan face this disaster every year. Notably, the youngest individuals perceive these events not as disasters but rather as a form of entertainment (Abdullah & Wahid, 2022).

Graph 1: Farmer's flooding experience.



> ..... *I'm originally from here, and I've been living here for over 40 years. So, I can tell you for sure that the flood is bound to occur every single year.*
> R8

Despite the consistent annual occurrence of significant floods, the most recent flood reached an unusual scale (Badi, 2019). Conversely, half of the research participants reported rare instances of flooding in their village (Alias et al., 2020). Participants further highlighted the alarming rapidity of rising water levels compared to previous years. This

sudden rise poses challenges, as people are often unprepared for evacuation (Gao et al., 2020).

> *You know, normally, it takes about three consecutive days of rain for flooding to occur....but this year, the water level rose so quickly, and it was quite surprising.* R1

> *....Around 12:30 am, the water started creeping into our home and that night, we didn't get any sleep to stay alert, worried that something might happen. Next day, we decided to evacuate.* R2

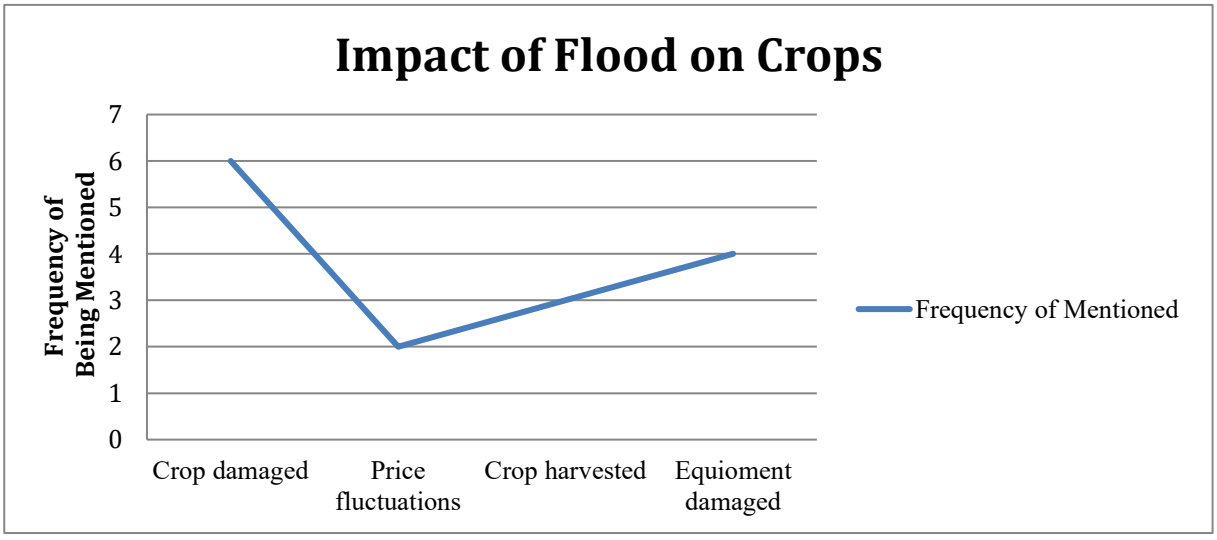
> *..... some residents didn't have much time to prepare for evacuation.* R3

Based on research participants' insights on flooding, it's important to establish reliable communication channels for efficient sharing of flood-related information. This ensures everyone is well-prepared for emergencies and possible evacuation. Badi (2019) highlighted internet connectivity issues in some Kelantan areas, including Pasir Mas. A stable internet connection would improve information dissemination (Raikes et al., 2019). Proper preparation is essential for minimizing fatalities (Rahman et al., 2021).

3.2 Impact of Flood on Crops

According to Graph 2, the frequencies of mentions regarding crop damage, price fluctuations, crop harvest, and equipment damage are 6, 2, 3, and 4, respectively.

Graph 2: Impact of Flood on Crops



> *I can't believe how bad the flood is this year. It's having a huge impact on my farm....*
> R5

> *....During the flooding, all the crops I had planted were growing nicely, but sadly, the floodwaters destroyed them completely. They couldn't survive those tough conditions, and it was so disheartening to see all my hard work go to waste.* R6

> *... it was tough, really tough. None of my chili plants survived.* R9

Various studies have highlighted the tendency of floods to cause multiple agricultural challenges. Merz (2021) observed that floods can lead to crop damage, while Romali and Yusop (2021), Davis et al. (2021) pointed out the potential for price fluctuations and equipment damage. The fluctuations in prices during flooding events may be attributed to the low supply of crop products (Kanike, 2023) often caused by transportation failures during flooding (Zhou et al., 2020).

Waterlogging during flooding events can further delay crop growth (Zhang et al., 2021) and disrupt the physiological processes and overall development of crops, resulting in damage (Sajid et al., 2018). Numerous studies have reported that waterlogging can induce fungal diseases like *Fusarium* wilt, *Phytophthora* root rot, and *Rhizoctonia* root rot. These diseases can lead to substantial crop losses and have long-term effects on soil quality and fertility (Mazid et al., 2019; Li et al., 2020; Hassan et al., 2020). In response to these challenges, farmers should take proactive measures, such as applying pesticides or fungicides, to control the spread of these diseases.

3.3. Flood Management and Adaptation

Based on the statements provided by the farmers during the interviews, it can be deduced that some of them apply supply and demand principles. The occurrence of flooding impacts the transportation of crop yields, leading to a reduction in the supply of fresh vegetables. Plus, in the flood season, people still need to eat and carry on with their lives, which create a demand for sufficient food supplies (Lee et al., 2019). As a consequence, market fluctuations occur, resulting in price increases. It is consistent with findings from Kartika and Helmi (2019), that flooding can cause market volatility and price fluctuations. In conclusion, there is a need for policies and initiatives aimed at assisting farmers in managing risks and enhancing resilience to cope with floods. This is supported by Palmioli et al. (2020) that the absence of adequate flood management measures in Malaysia has resulted in substantial economic losses for farmers residing in flood-prone regions.

3.4. Farmer's Future Plan

The research participants' future plans can be grouped into two categories: staying in the agricultural industry and exiting the agricultural industry. Most participants prefer to continue in this industry as it is their main source of income, and they lack experience in other fields.

> *After getting hit twice by severe flooding, all the infrastructure and equipment I have for fertigation got destroyed, plus, losses amounted to almost RM70,000, I chose to exit this industry…* R5

> *…still want to continue planting my current crop. It's tough, but right now, it's my main source of income, and I can't think of anything else*. R3

> *I have to do what's best for my family. I have children to feed…and honestly, jobs are hard to come by here. So, even with all the challenges and uncertainties in farming, I chose to stay*. R7

From the interviews, a certain percentage of farmers have expressed a desire to leave the agricultural industry. However, according to Mbow et al. (2020) fewer people engage in farming activities will impact food security and the self-sufficiency level for agricultural

products. Food security is classified into three components: the availability of significant quantities of food, access to resources, and adequate dietary intake (Godenau et al., 2020). A low self-sufficiency level in a particular product will have the tendency to be imported (Pereira & Oliveira, 2020). Hence, food insecurity will lead to an increase in food prices (Leddy et al., 2020), influencing health levels (Ado et al., 2022) and also livelihood.

5. Conclusion

The flood events in Pasir Mas, Kelantan were caused by the monsoon season. Unfortunately, many small-scale farmers reside in flood-prone areas. This study has provided valuable insights, including the impacts on crops and the consequences for infrastructure. Based on these insights, it is recommended for farmers to consider investing in better seeds or changing to crop types that are less susceptible to inundation. There is also a call for policymakers to incorporate insights into economic risks faced by small-scale farmers. For future studies, it is recommended to conduct in-depth research on the effectiveness of current non-structural and structural mitigation practices. This would enable the government to plan proactive measures beneficial for the future.

Ethics Approval and Consent to Participate

This study received ethical approval from the Universiti Teknologi MARA (UiTM) Research Ethics Committee and all participants provided informed consent to participate.

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Conflict of Interest

The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest.

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