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Climate Change and Flooding in Upper Rupununi, Guyana: A Participatory Approach

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Abstract

This study uses a participatory, mixed-methods approach to investigate the impacts of seasonal flooding on the indigenous Wapichan village of Aishalton, Guyana. It combines local knowledge from focus groups and interviews with remote sensing and GIS to map flood exposure and identify community-led coping strategies. The findings highlight the importance of indigenous knowledge in building resilience to climate-related hazards and informing disaster risk management.

Keywords

Climate Change, Flooding intensity, Indigenous People, Farming, La Niña Enos, South Rupununi

1. Introduction

The Rupununi savannah region experiences extreme seasonal changes between wet and dry seasons (Smock, 2018). Annual rainfall in the Rupununi is about 1800 mm per year; most of this occurs during the wet season (Smock, 2018). Frost (1968) states that the rainfall occurs in one distinct wet season, with a duration from May to September, with June and July receiving the heaviest monthly totals. Daniel (2001) indicated that during the rainy season, up to 83 percent of total annual rainfall sometimes occurs. The South Rupununi savannah transforms during the rainy season as permanent wetlands expand, reaching their fullest and becoming huge seasonal wetlands World Wildlife Fund (2016). Therefore, during this period, especially when rainfall is extreme, the floodwaters adversely affect the entire region, especially small villages close to the rivers.

This study explores the impacts of seasonal floods on the indigenous population of Aishalton and its surroundings in the South Rupununi Savannahs, as well as the village's adaptations to these surroundings as despite a reduction in annual rainfall, flood intensities have increased due to the effects of climate change. Flood mapping followed a participatory approach linked with remote sensing and GIS. The study aimed to deepen the understanding of the vulnerability and adaptation of the indigenous population to flooding in the context of climate change.

1.1. Specific Objectives

1) To determine the impacts of flood events intensity on Aishalton and the history of major floods.

2) To spatially determine historical flood exposure in Aishalton.

3) To identify the adaptation practices for flooding adopted by the village in relation to food security.

1.2. Research Questions

1) What are the impacts of flood events intensity on Aishalton?

2) What is the historical exposure of flood events at Aishalton?

3) How can the flood zones be spatially represented?

4) What coping practices have been applied to ensure food security?

2. Methodology

2.1. Study Area

The study area (**Figure 1**) is located within the administrative region Upper-Takutu-Upper-Essequibo River, South America. The village Aishalton is part of the South Rupununi Sub-district, Region 9, of the Cooperative Republic of Guyana and was given 166.038 sq. miles of titled land by the Government of Guyana. Goodland (1964) states that the Rupununi savannahs are an extension of the vast Rio Branco savannah of North-Eastern Brazil. The region is dominated by the savannah vegetation in the west but is forested in the east.

Figure 1. Study area.

The Rupununi Savannah is one of Guyana's most unique and diverse ecosystems, and among the last great wilderness areas on Earth (World Wildlife Fund, 2016). It is home to over 900 species, including over 2000 vertebrates and many species that are highly endangered globally (World Wildlife Fund, 2016). This high diversity is the result of the mixing of Amazonian and Guiana Shield fauna; extremely diverse and closely packed habitats; and marked seasonal variability, including extensive flooding (World Wildlife Fund, 2016). A large seasonally flooded grassland-shrub ecosystem in the western and central parts of the territory and an extensive tropical forest ecosystem in the south and east together support a rich mosaic of habitats and high biodiversity (David, et al., 2006). These seasonal wetlands absorb, filter, and store vast amounts of freshwater, recharging aquifers and keeping the surrounding forests and rivers healthy (World Wildlife Fund, 2016). Much of the landscape features weathered, acid, and infertile sandy and laterite soils formed over the Guiana Shield (David et al., 2006). The whole area is drained by major and minor rivers associated with permanent and seasonal wetlands that support a large variety of fish and other aquatic life, including the endangered giant otter and Arapaima fish, among others (David et al., 2006; Daniel, 2001; US Amry Corps Engineers, 1998).

Daniel (2001) states that the savannahs south of 4° latitude only experience one wet season; this area is classified as a Tropical Wet and Dry (Aw) based on the Trewartha Classification of climatic systems. Bernard (1999) added that, in addition to having one wet season, the rainfall is lower than average. The Rupununi Savannah is divided into two nearly equally sized parts by the Kanuku Mountains: the North and South Rupununi (World Wildlife Fund, 2016).

The movements of the Inter-Tropical Convergence Zone and mountain relief determine precipitation in the Rupununi (Watkins, Oxford, & Bish, 2010). From April to May, the ITCZ moves north, bringing rain to the whole area, and during August and September, it returns from the north, moving south (Watkins, Oxford, & Bish, 2010).

Jansen-Jacobs and ter Steege (2000) stated that the annual rainfall in the Rupununi Savannahs is 1500 - 2000 mm per year, of which 70% - 80% falls during the wet season from May to August. It is during this period that seasonal flooding in the Rupununi commonly occurs; both the north and south Rupununi landscapes experience flooding.

2.2. Methods

This research followed a mixed-method design approach. It was guided by similar studies by selecting the specific tools and techniques used by the authors (Ahadzie, et al., 2016; Mwape, 2009; Diez-Herrero, Lain-Huerta, & Llorente-Isidro, 2009; CDC, 2017).

The main part of the research took place directly in the field through focus group discussions and surveys (key-informant interviews). Secondary data were acquired through a desk review of relevant literature and data sets.

To attain the study objectives, selected methods were used to ensure accuracy and reliability.

2.2.1. To Determine the Impacts of Flood Events on Aishalton

1) Data collection:

Primary rainfall data and secondary flood events, desk reviews, surveys (interviews), and focus group discussions.

Daily rainfall data for Aishalton from 2000 to 2018 were acquired from the Hydrometeorological Office in Georgetown. There were no records for 2009, and some data were missing throughout a few years. GIS data were acquired from credited sources such as USGS, Google Maps, and OpenStreetMap. Additional information on usual flooding events was gathered from newspapers such as The Guyana Chronicle, Kaieteur News, Stabroek News, and the Department of Public Information. Interviews were held with elders using a prepared interview sheet.

The interviews were conducted in the Wapishana language at the homes of elders who lived within the boundaries of the village. With the assistance of local translators, all information was documented and translated into the English language. This exercise was completed over two separate visits to the village. The focus group discussion method aimed to obtain data from a purposely selected group of individuals rather than from a statistically representative sample of a broader population (Nyumba, Wilson, Derrick, & Mukherjee, 2018). In this setting, the researcher facilitates or moderates a group discussion between participants and not between the researcher and participants; the researcher takes a peripheral role (Nyumba, Wilson, Derrick, & Mukherjee, 2018).

2) Analysis:

MS Excel software was used for data analysis. Information about flood events was correlated with rainfall years, collected in primary research from archived documents, and contrasted with the presence of La Niña years. Descriptive and statistical measures, along with representational analysis, were used to make appropriate interpretations. Responses from the interviews were documented, coded, and then presented in tables, graphs, and summaries. Similarly, responses from the focus group discussion were documented, coded, and then presented in tables, charts, graphs, and summaries, and used to make appropriate interpretations and to produce flood maps that align with the research objectives.

Based on the results from the desk reviews, the dates, general locations, and impacts of flood events were identified, presented in tables, and summarized. These were cross-referenced with the rainfall data for the period of interest. Rainfall data collected from Hydromet (the hydrological service of Guyana's Ministry of Agriculture) were analysed using MS Excel to make descriptive statistical interpretations that were presented in tables and graphs. Data from the focus group discussion were coded and classified according to objective one, then presented in tables, graphs, and summaries.

2.2.2. To Spatially Determine Historical Flood Exposure at Aishalton

1) Data collection:

desk reviews, survey (interviews), and focus group discussions. Convenience sampling was used to select the participants for the focus group discussions. Knowledgeable and available persons were selected to be part of the focus group discussions. Selective sampling was used to select participants for the interview exercises. Elders from the village were interviewed.

2) Analysis:

Data acquired from the FGDs were coded and classified to align with the study's objective to spatially determine flood exposure.

Two focus group discussions were conducted on separate occasions, targeting 20 persons (farmers): youths and adults (both men and women). They aimed to collect data for objectives 1 and 2 and contained two exercises. The first exercise collected agricultural data about flooding, while the second involved a participatory mapping exercise.

During the first field visit, a focus group discussion took place with selected participants, while several interviews were conducted and farms were visited; only 5 participants showed up in the first discussion. During the follow-up field visit, a second focus group discussion took place, in which 12 persons participated. Additional interviews were then conducted and field observations were made. This was done to gather more data and to add to the previous findings.

Participatory mapping is a map-making process that attempts to make visible the association between land and local communities by using the commonly understood and recognized language of cartography (IFAD, 2009). Participatory maps are not confined to simply presenting geographic feature information; they can also illustrate important social, cultural, and historical knowledge (IFAD, 2009; Pita & Muino, 2014). Pita & Muino (2014) noted that participatory mapping usually complements traditional oral interviews and further helps to select key informants who are representative of the community. In the context of this research, the participatory mapping exercise allowed the data to be directly collected from key representatives of the community.

During the second exercise, respondents participated in a participatory mapping exercise. Participants documented the severity and frequency of flood events based on their experiences. The severity was determined by factors such as past flood duration, depth, and impacts on their livelihoods.

Using a rating scale adapted from the Oregon Emergency Management Hazard Assessment, which was also applied to Region IX by the CDC (2017), participants were able to highlight the flood impacted areas. Scale is shown below:

Severity of flood events	Assigned score
Low severity	1 - 3
Moderate severity	4 - 7
High severity	8 - 10

Continued

Frequency of flood events	Assigned score
Low frequency	1 - 3
Moderate frequency	4 - 7
High frequency	8 - 10

Knowledgeable persons were selected to participate in the mapping exercise which included past leaders and farmers. Through a facilitated group discussion, the participants delineated flood exposure within Aishalton into, severity and frequency. Using Google Earth imagery of the study area, the severity and frequency of the flooded areas were delineated. Participants highlighted the severity and frequency of severe flood events on the map by using the above scale on the map. E.g., the code F4, S9 indicated that, in the area highlighted, floods are very severe but occur with a medium frequency. The delineated physical maps acquired from the mapping exercise provided the data for input and conversion into electronic data using GIS software.

The frequency and severity data gathered were inputted into ArcMap and used to create flood maps. GIS datasets acquired from open sources were utilized as base maps and for referencing when creating the maps.

To ensure accuracy and reliability of the data collected from the mapping exercise, a ground truthing exercise was conducted to all the areas delineated. Using a mobile device for geo-referencing, and under the guidance from participants of the mapping exercise, the researcher cross referenced the areas delineated with those on the ground. Adjustments were done as necessary when noted during the ground truthing exercise.

3) Ethical considerations

Three months prior to fieldwork, consent was acquired from the village council to conduct research within the village; the researcher dispatched an early letter to the council seeking permission to conduct the research. The researcher acknowledged that all village rules and ethical considerations would be adhered to and considered when executing practical exercises. Additionally, all property rights were acknowledged.

Before the exercises, the researcher explained to all the participants that the research was for academic purposes and that no compensation would be given for participating in the process. Those who participated in the research were mostly farmers: elders, adults, females, and youths. All data gathered during the exercises remained confidential.

2.2.3. To Identify the Coping Practices Adopted by the Village for Agricultural Security

1) Data Collection:

Focus Group Discussions and Key Informant Interviews.

2) Analysis:

Thematic classifications were made based on coping strategies adapted to flooding and agriculture. Coping strategies were presented in tables and summaries and were used to discuss agricultural security.

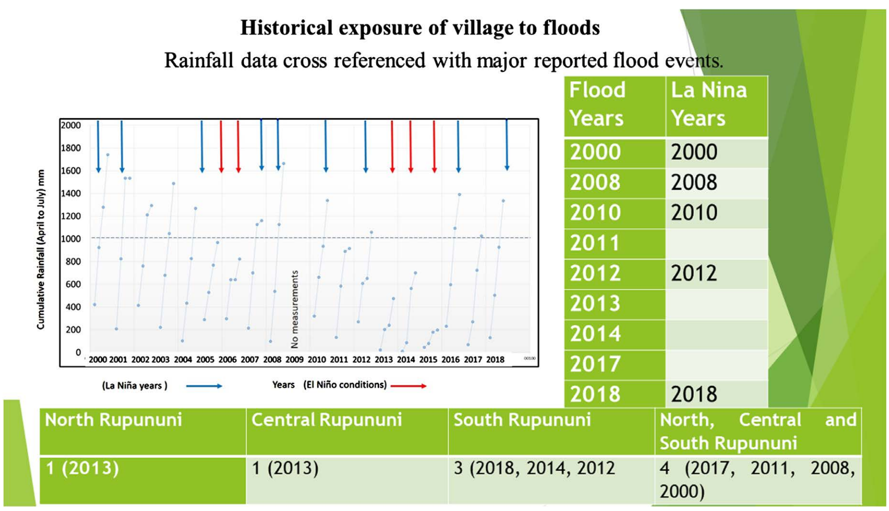
To collect relevant data, information was gathered from related literature, case studies, and reports to formulate the structure of the focus group discussion exercise and the selective interviews. The exercises were carefully prepared, in keeping with the objectives of the study. The questions and statements used were simple, direct, and easily understandable by the respondents. Coping strategies for floods were directly collected from the participants of the exercises, in the form of open questions.

3. Results

3.1. Impacts of flooding on Aishalton

Rainfall Records for Study Area

Since rainfall is the main cause of annual floods, rainfall data was collected from Hydromet for Aishalton, covering the period 2000-2018. Highest rainfall years correspond with La Niña, while the lowest correspond with El Niño. Bovolo et al. (2009) and other sources mention more rainfall in La Niña years (**Figure 2**). La Niña brings prolonged rainfall, flooding, road washouts, and erosion. Guyana experiences heavy rainfall during La Niña events. Brooshan (2016) predicts more floods due to climate change, while Velasco (2014) projects an increase in extreme weather events. Region IX (the Rupununi) experiences floods from April to August during the annual wet season. The highest average monthly rainfall was 23 mm in June 2001, but the data show a decreasing trend in annual rainfall patterns over the study period. While the data points to decreasing annual rainfall patterns, extreme floods due to climate change remains a primary risk/concern for Aishalton.



Flood Years	La Nina Years
2000	2000
2008	2008
2010	2010
2011	
2012	2012
2013	
2014	
2017	
2018	2018

North Rupununi	Central Rupununi	South Rupununi	North, Central and South Rupununi
1 (2013)	1 (2013)	3 (2018, 2014, 2012	4 (2017, 2011, 2008, 2000)

Figure 2. Cumulative rainfall at Aishalton (Source: Hydromet data).

Rainfall reports based on secondary data sources show severe flooding events in the Southern Rupununi over the period of study. Data were gathered from online archives of newspapers and a government news agency. From these reports, flooding years were cross-referenced with La Niña years, which show that Aishalton was affected by flooding in 9 out of 18 years. Other years were no-flood years due to El Niño conditions.

Information from reports of flooding in the Rupununi Region showed impacts in large parts, from the North to South Rupununi Region, affected in most cases. Yearly impacts and locations are listed in Table 1.

Table 1. Impacts of floods in the Rupununi.

Year	Impacts	Location
2018, 2017, 2014, 2013, 2012, 2011	Access across the region cut off: transportation between communities (Stabroek News, 2018; Guyana Times, 2017; Kaieteur News, 2014; Stabroek News, 2016, 2012, 2011).	South Rupununi, North Rupununi, Central Rupununi
2017, 2014, 2013, 2012, 2011, 2008	Farms destroyed (Guyana Times, 2017; Kaieteur News, 2014; Stabroek News, 2016, 2012, 2011, 2009)	North Rupununi, South Rupununi
2011	Increase in the prices of basic services (Stabroek News, 2011)	South Rupununi
2018, 2011	Destruction of bridges, roads, and culverts (Stabroek News, 2018, 2011)	South Rupununi,
2014, 2012, 2008	Residences affected (Kaieteur News, 2014, Stabroek News 2012, 2008).	Central Rupununi (St. Ignatius, Lethem, Tabatinga); South Rupununi (Aishalton)

One of the main impacts due to flooding that affects livelihoods is access being cut off between communities in South, North, and Central Rupununi, as shown in Table 2.

Table 2. Impacts of flooding on the village (Source: survey data).

Affected	Impacts
Transportation routes were cut off.	Routes to farms, other villages, hunting grounds, and the roads to Lethem are normally impassable. Water levels vary between 1 and 8 feet in depth on the nearby lands surrounding the waterways. In the lowest areas on land, they may cover up to 8 feet and at least 1 foot in other, higher areas.
Movement of goods and services	Prices of goods and services increase.
Physical infrastructure	Damage to roads, culverts, and bridges.
Income of farmers	No source of income; had to look for alternatives.

In multiple years, farms were destroyed in the North and South Rupununi. Participants in the FGDs noted that transportation routes, goods movement, infrastructure, and farmers' incomes are all affected. A severe flooding event in 2011, for instance, damaged critical infrastructure within the region, leading to longer recovery periods from these impacts. Periods of extreme flooding also lead people to seek additional jobs. Secondary derived effects included an increase in the price of services in villages of the South Rupununi. The destruction of bridges, roads, and culverts in the South Rupununi during a number of years was also recorded as an impact of multiple flooding events. Notably, agriculture is a primary activity that is negatively affected by flooding events and, in turn, adversely affects the local economy and food prices.

Flood impacts in the South Rupununi include access being cut off between villages, livelihoods being affected, environmental disruption, and disruption to the local economy. These findings indicate that severity of flooding events in the South Rupununi is increasing and can threaten regional development.

3.2. Flood Impact on Crops

Figure 3 indicates that village-level agriculture is particularly affected by floods. Results from the focus groups discuss some of these impacts that floods have on crops:

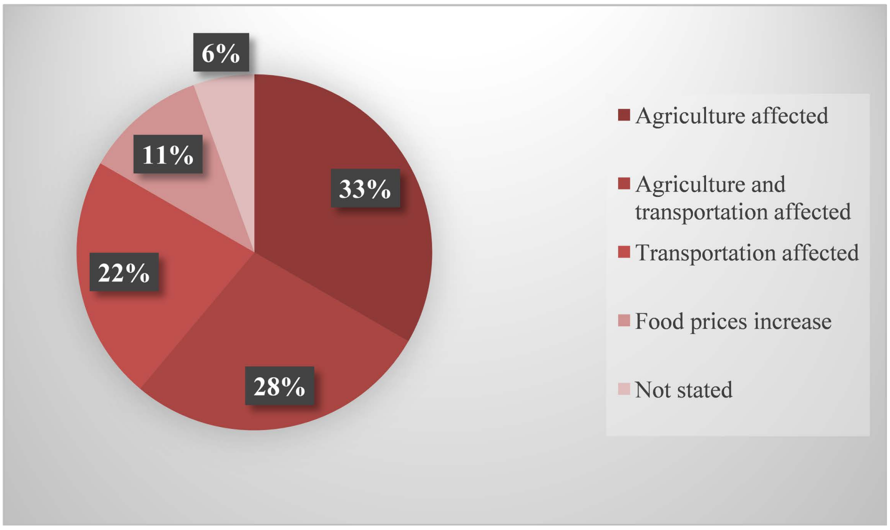


Figure 3. Flood impacts on village (Source: Survey data).

One response revealed that severe intermittent rains lasting over a two-month period resulted in the flooding of farms, affecting crops such as cassava, pumpkin, bananas, and plantains, as shown in Table 3.

As a result of the floods, the soil becomes waterlogged after two days, damaging cassava tubers the most and causing rot. After floods, cassava products are produced in excess, leading to shortages after a few months. Poor planning leads to planting in risky, flood-prone areas. Farmers must replant fields at the end of the rainy season, affecting planting and harvesting patterns. This indicates that indigenous populations highly dependent on agriculture are vulnerable to flooding.

Table 3. Crops that are normally grown on farms. In bold, main crops (Source: Survey data).

Vegetables	Fruits	Grains, beans, and nuts	Staples	Others
Corn, pumpkin, plantain, bora, calalu, ochro, boulanger, corilla, eschallot, tomato, sweet potato, pepper.	Fruit, papaw, lemons, tangerine, oranges, watermelon, bananas, peanuts, pineapple, fruit, sugarcane.	Paddy, peas, beans, peanuts.	Cassava, yams, eddo	Cotton

3.3. Flood Exposure

To determine flood exposure at Aishalton, maps of flood severity and flood frequency were created based on input from the focus group discussions and participatory mapping exercises. The maps show past flooding events during wet seasons. **Figure 4** displays flood severity in Aishalton, indicating areas most affected by flooding, with the main access routes being severely impacted. The Rupununi Savannah has undulating hills and valleys, with floodwaters primarily affecting lower areas. Residential areas remain unaffected due to their elevated location. Floods at the village level can lead to isolation when connecting roads are submerged. Flood severity can cause inconvenience and damage, but in this case does not result in loss of life. Regarding flood frequency, to answer, has flooding been increasing? Of the respondents, 45% indicated that the frequency of flooding in Aishalton has not been increasing, 33% indicated that flooding frequency has been increasing, while 22% remain unsure. Presently, no comparison data exist to indicate a similarity or difference in flooding frequency of the period of study. Velasco (2014) reported more floods in Guyana since 2005. Recent South Rupununi floods occurred in 7 of 10 years between 2008 and 2018, but the available data indicate that present flood patterns are irregular. More intense rainfall is expected during La Niña years, as some argue climate change intensifies floods. Aishalton flood frequency map (**Figure 5**) shows most affected areas near main creeks, areas where most farms are located. Villagers mainly farm in forested areas closer to waterways, e.g., in riparian forests, due to savannah infertility.

Coping practices for agricultural security.

In most hinterland and remote communities, agriculture provides the mainstay of the diet (**Table 3**), which is based above all on bitter cassava, a root crop used to make cassava bread, cassareep and beverages such as paiwari and parakari: indigenous farmers also plant a range of other crops including sweet potatoes, eddoes, bananas, plantains, maize, and sometimes sugar cane or peanuts (Renshaw, 2007). David et al. (2006) explained that the Wapichan peoples of the South Rupununi customarily use the land for farming and plant a variety of crops, following a traditional farming calendar which is guided by customary practices and law.

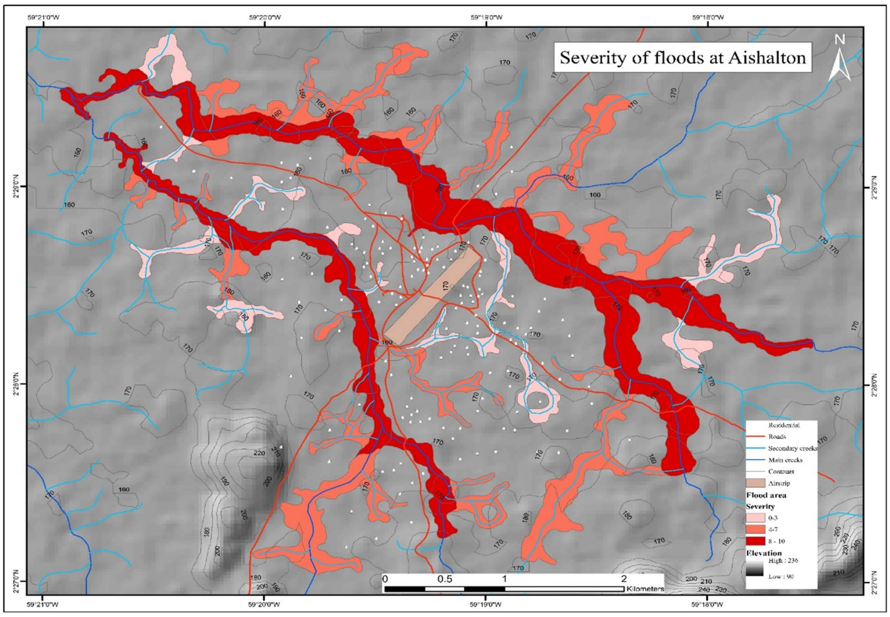


Figure 4. Flood severity map of Aishalton.

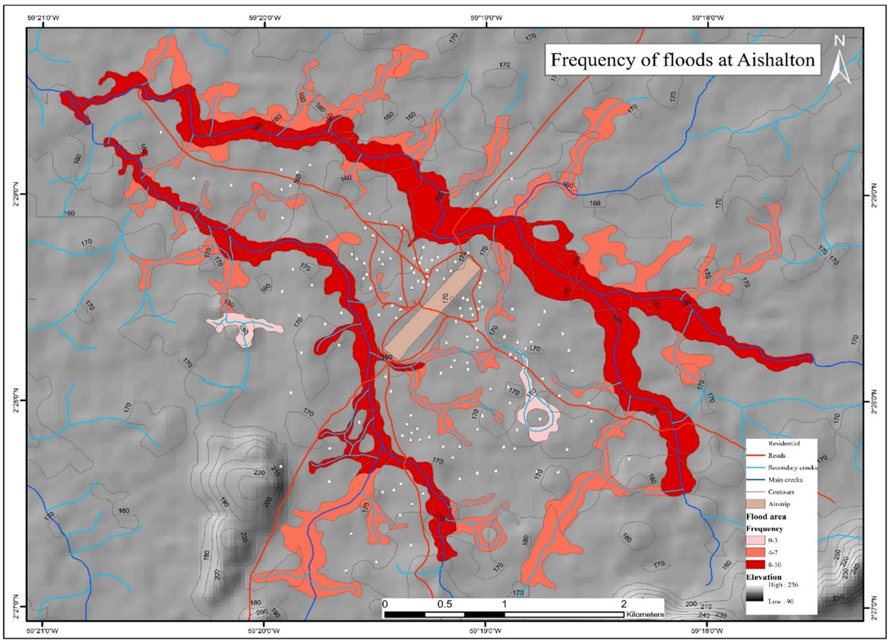


Figure 5. Flood frequency map of Aishalton.

According to David et al. (2006), farms produce over one hundred different foods, fibers, dyes, and medicine, of which a few are listed in bold in **Table 3** as the most affected. From some of the plant species listed in the table, participants identified planting times based on a traditional farming calendar. Cassava is planted at the beginning of the wet season, corn and paddy during the wet season, and yam from September to November. The Wapichan practice year-round subsistence farming. Farmers prepare farms in dry seasons and plant before the onset of the wet season. Normally, cassava, which, when planted before the May/June rains, is processed after 9 months, was once unaffected by flooding. Presently, farmers increasingly plant throughout the year due to unpredictable weather. Table 4 shows planting times according to the farming calendar based on respondents' information. Unfavourable weather in recent years has affected planting, leading to poor or no production. Rain during the normal season was short-lived, with no floods despite rising water levels. Some crops planted at the mid-year rains can give good production. Crops planted year-round, especially before the mid-year rainy season, are most affected by floods.

Table 4. The farming calendar.

The time of the year crops are planted			
January - March	April - July	August - October	December
Dry weather	Rains	Dry weather	Rains
Cassava, peanuts	Corn, paddy, eddoes	Yams, bananas	

Table 5 summarizes the results of findings gathered directly from elders through interviews and from villagers through the focus group discussions. Respondents had lived in the study area for at least 61 years, mostly from the village of Aishalton. Most respondents were elders who provided critical information. Ninety-four percent of respondents identified flooding as an issue; they noted that flooding has affected the region since 2000, with respondents having 40 years of experience before that. Respondents listed a variety of crops grown on their farms, including vegetables, fruits, grains, beans, nuts, and staples. The main crops grown were staples, vegetables, and fruits, with cassava being a key crop used for various purposes. Cassava production was noted as being crucial for food security in the area. Other crops, including pumpkin, banana, plantain, tomatoes, pepper, and watermelon, supplemented the main diets. Farmers also sold their products in the local market.

Table 5. Agricultural coping strategies for the seasonal floods (Source: Survey data).

Threat	Coping/management strategy
Flooding of susceptible crops	Emergency reaping.
Destruction of seedlings and tubers	Store in a controlled environment.
Destruction of all main crops	Utilize alternative crops that thrive within the rainy season.

Findings from the interviews and focus group discussions identified strategies that have been used to cope with flooding events in Aishalton (Table 6). The reviewed literature identified coping strategies of various populations and classified them based on common characteristics—classifications that were adopted in this research. Hakim (2012) classified coping strategies based on preventive and adaptive features. Comparatively, Smaaraweera (2018) indicated that different coping strategies exist both in the reactive and recovery phases. Other authors, such as Sultana & Rayhan (2012), classified coping strategies into economic, environmental (Parker, 1995) and social strategies (Rayhan & Grote, 2007).

Table 6. Agricultural adaptations to climate change (answers from the community).

Plant according to weather patterns.	Plant according to the farming calendar, use slash-and-burn, and utilize maiden forest where the soil is fertile.	Use traditional knowledge of natural indicators when planting and preparing for the flood season.	Plant both 'wet' and 'dry' season crops.	Diversify crops: cash crops, all-weather crops.	Introduce savannah farming	Not stated
4	4	3	3	2	1	1

Based on the findings of this research, the agricultural coping methods were classified as preventative and adaptive, as done by Hakim (2012), and are shown in **Table 7**. Preventative coping refers to the actions taken by the villagers of Aishalton in anticipation of floodwaters, which reduces the risk of being impacted by the floodwaters, while adaptive coping refers to the actions taken to adjust to the seasonal flooding, with the aim of minimizing risks of floodwaters. On the other hand, coping strategies derived from this research are adaptations to floods that enhance the indigenous community's resilience (**Table 7**).

Table 7. Coping strategies for floods.

PREVENTIVE	ADAPTIVE
Utilize higher ground in the forest.	Utilize both higher ground and lower ground in the forest.
Predicted Weather Based on Natural Indicators	Depended on game
Emergency reaping	Diversify crops during rainy seasons. Plant both wet and dry crops.
	Store new plants in a controlled environment

4. Discussion

The classification of flood impacts was based on OQCS (2018) and Guerreiro et al. (2007). Findings reveal that general flood impacts can be physical, economic, and social. Physical impacts include affected farming areas and infrastructure destruction, while economic impacts include a price increase and loss of income, and social impacts include service disruption. In their study on the socioeconomic impacts of flooding and its coping strategies in Nigeria along the Gwagwalada area, Badamosi et al. (2023) also discovered that flooding had a wide range of socio-economic impacts on the community, including income, education, agriculture, sanitation, infrastructure, and properties. This research revealed that villagers' residences are not exposed to flooding, and that loss of life is absent. Flood impacts were classified into direct and indirect impacts. Aishalton was found to be largely exposed to flooding events, with flooding affecting the study area 9 out of 18 years, causing physical, social, and economic impacts. There has been a general decreasing trend in annual rainfall patterns; however, severe rainy seasons continue to threaten local food security. Severe flooding events can have devastating impacts on communities, affecting a wide range of sectors within the dynamics of the village. For instance, the village's farmers' vulnerability to floods is exacerbated by a lack of infrastructure and technology. However, strategies developed over time by farmers help them cope with flood events.

Daniel (2001) stated that Region IX (the Rupununi) is located in elevated parts of the country, with a maximum elevation of 235 ft above sea level. Aishalton has low vulnerability to flooding due to its relative elevation and distance from the major river, the Rupununi River. Villages near main rivers, such as St. Ignatius and Sand Creek, are most vulnerable to seasonal flooding, as noted by CDC (2017), which compared vulnerability levels of Rupununi villages to natural hazards. Studying flooding at the village level provides crucial information for disaster response in Aishalton. Flood maps can aid decision-making by village councils and regional governing bodies. This research emphasizes the importance of local community input in disaster response.

Bynoe (2009) found strategies used by farmers in Surama in the North Rupununi to cope with flooding, similar to Parker (1995). Sultana & Rayhan (2012) noted economic coping in rural Bangladesh. Rayhan & Grote (2007) discussed crop diversification as a physical coping method. Parker & Thompson (2000) mentioned African communities adapting to floods, using their established means and methods. In a similar situation, Mendy et al. (2024), noted that local flood-prone populations in the Gambia were able to stay in their communities despite the possibility of additional climatic disasters and severe floods because to their coping mechanisms.

Extreme measures like total relocation are not needed in Aishalton, as the village is less vulnerable, as documented by CDC (2017). The study noted that the farmers of Aishalton use coping strategies that include farming on elevated, less flood-prone areas (**Figure 6**), diversifying crops (**Figure 7**), and dependence on wild meat (**Figure 7**), similar to Parker & Thompson (2000). Okonya, Syndikus, & Kroschel (2013) also found that rural farmers used coping strategies like food storage, designing special drainage systems, and income diversification as part of their flood resilience strategy.

This study classified the coping strategies as economic, social, and environmental. From the findings, indigenous knowledge is shown to be crucial for flood resilience, knowledge which is based on customary practices and adaptation to past experiences—local knowledge drives community-based adaptation. Globally, floods threaten vulnerable populations, affecting food security, which is further compounded by the effects of climate change. This study contributes to climate change and natural hazard aims in the Caribbean and aligns with the UNFCCC, Sustainable Development Goals, and the Sendai Framework. Further, the findings strengthen resilience to climate-related hazards in rural areas, and the integration of these findings can improve climate change planning in developing countries like Guyana.

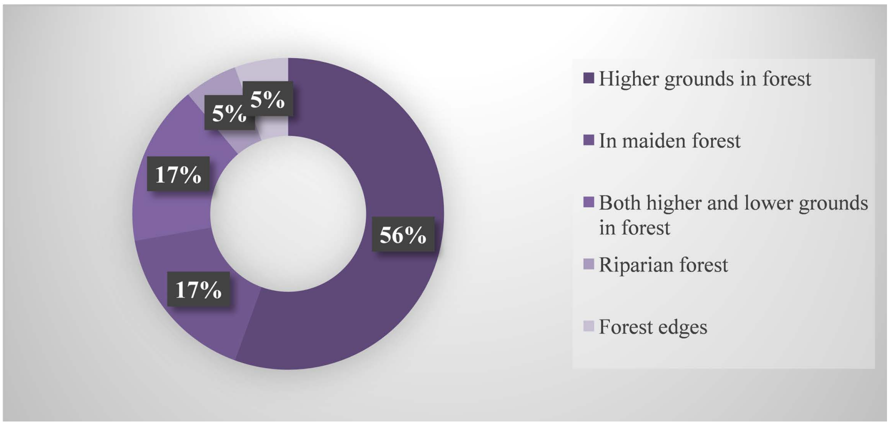


Figure 6. Traditional location of farms (Source: Survey data).

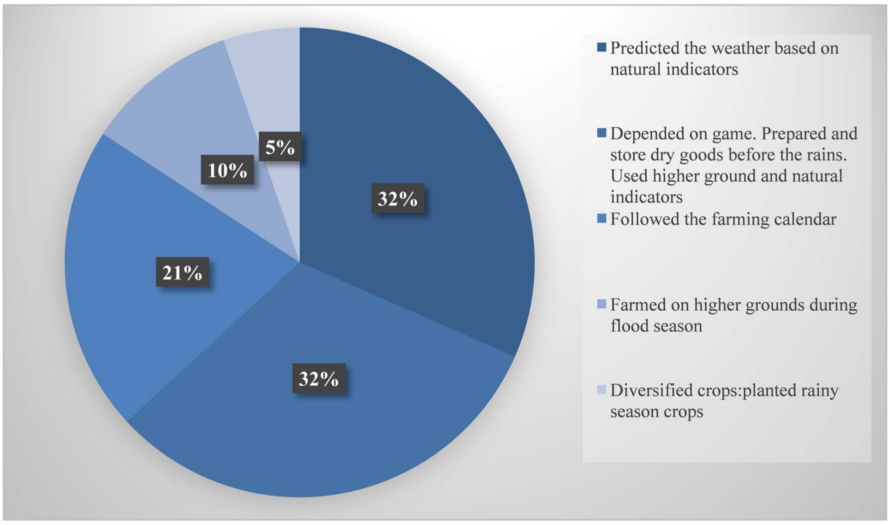


Figure 7. Ways of coping with seasonal flooding (Source: Survey data).

5. Conclusion

As a preliminary community assessment, this study has pursued a qualitative approach towards flood hazard assessment. This preliminary assessment proved useful by highlighting the environmental effects of seasonal floods on Aishalton, indicating that the village is vulnerable to seasonal floods, which are particularly influenced by its geography. Aligning with the study's objectives, the findings of this research highlighted the impacts of extreme flooding felt by Aishalton, produced village-scale frequency and flood maps to spatially represent flood exposure, and identified coping strategies adopted for agricultural security during extreme seasonal flooding events. It should be noted that further studies can develop research based on the social and economic impacts of seasonal floods at the village level, and, even more so, they can build on the findings of this research to develop further cross-sectional understanding of the characteristics of seasonal floods at the broader regional scale.

In this case, the research highlights the importance of collaboration with local communities. It aligns with the mandate of the Regional Disaster Risk Management (under National Disaster Risk Management), and, more specifically, the CDC's Community-Based Disaster Risk Management (CBDRM) at the community level, in an effort to highlight disaster vulnerability and to provide information that can be used to enhance disaster response. Therefore, the findings of this study can help to inform CBDRM operations, which is important given the unavailability of vital flood information for the community, a pattern throughout the Southern Rupununi.

Importantly, it informs about the effects of climate change at the location and its influence on flooding, a key agenda item that the Green State Development Strategy and Low Carbon Development Strategy (LCDS) both aim to address in the country by using appropriate information (such as this research) to develop appropriate disaster preparedness and responses. Community level disaster risk management will enhance the resilience of villages like Aishalton to climate change impacts. On the larger scale, Guyana may effectively prepare for and respond to climate-related catastrophes, safeguard vulnerable populations, and ensure sustainable development by including community disaster risk management into policies such as the LCDS.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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