

## Article

# Coastal Flood Risks and the Business Community: Stakeholders' Perception in Malta

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**Abstract:** Resilience of coastal communities is increasingly required to adjust to the effects of climate change and its coast-related threats. Climate change is a major global threat to the environment, economy, and health of urban coastal lowlands. Flooding risks from both rising sea levels and increases in the frequency and severity of storm surges are considered to be amongst the most threatening consequences associated with climate change. The aim of this study was to assess the levels of socio-economic preparedness of low-lying urbanized towns in Malta for the impacts of coastal flooding through the triangulation of stakeholders' participation from three sectors: the business community, local councils, and specialized experts from the governmental and private sectors. The study also included field collection of elevation data for each locality to capture the businesses' distribution in relation to their height above sea level along the urban waterfront. One-way analysis of variance and NVivo were used to test and compare the business owners' responses and the experts' feedback, respectively. The main findings from the business community suggest that there are no long-term contingency plans or strategies in place to address potential flooding impacts from rising sea levels and storm surges, and that the risks of driving owners out of business is high. From the feedback received by the local councils, it was observed that all of them significantly lack the physical and financial resources to effectively manage long-term coastal flooding within their locality, forcing them to completely rely on central government for any future needs caused by the impact of coastal flooding. From a central government perspective, it seems that all interviewed experts operate within a fragmented governance model, and mainly adhere to the set of responsibilities aligned with their respective roles within such a governance model. This evidence of governance disconnect requires more horizontal and vertical integration of cross-sectoral strategies to address coastal flooding, within the broader framework of integrated coastal zone management as established by the Mediterranean ICZM protocol.



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## 1. Introduction

Climate change is considered to be one of the world's greatest threats to the coast, the evidence of which is supported by decades of scientific studies published by the international community. Human activities have been found to be largely responsible for a spike in greenhouse gas emissions [1]. Global greenhouse gases are expected to peak between 2020 and 2025, in models that limit global warming to 1.5 °C and those that limit warming to 2 °C [2].

It is estimated that by 2040–2050, the minimum sea level rise in the Mediterranean Basin is expected to be within the range of 9.8–25.6 cm [3]. Coastal flooding and erosion are the main hazards affecting coastal areas, especially low-lying areas, which have the highest probability of experiencing damages from flooding [4]. In the last century, global sea levels rose by about 20 cm; however, in the last two decades the rate of sea-level rise has nearly doubled, posing a significant submersion threat to islands and low-lying areas across the

globe [5]. Natural disruptive events such as coastal flooding and storm surges are evidence of the extent to which weather and climate can affect our daily lives [6]. These coastal threats seriously undermine the physical and socio-economic assets of communities who have been surviving due to the functioning of these assets, but which are now becoming vulnerable by virtue of inadequate preparation and/or adaptation strategies [7,8].

Recent studies provide evidence of heavy impacts of flooding on small and medium-sized business operations because of their lack of resources, making them susceptible to a wide range of indirect and direct effects [9–11]. Impacts ranged from indirect effects of event-based flooding episodes to a wider range of long- and short-term direct effects, with only short-term impacts prioritized for immediate intervention [11]. In certain studies, around 40–60% of these small businesses ceased operations following a flooding event due to most small business owners not having a disaster plan in place [10,12]. Cascading impacts also include sanitation and salinization problems that further aggravate the tourism industries present on the coast [13].

Businesses were found to be more vulnerable when they operate in the context of other urban elements, such as road networks and industrial areas, the flooding of which may cut off vital access to the area for transport users and workers [14,15]. The development of a business vulnerability index (BVI) against rising sea levels serves to assess how coastal zones naturally intersect with high-risk areas depending on the risk of other supporting land-use types being flooded as well [14].

Post-flooding costs, recovery and economic support to small coastal businesses are increasingly the subject of scientific attention in the literature. Financial impacts are being observed in post-flooding insurance costs, with a considerable rise in insurance excesses and property insurance costs after an event [16]. Small enterprises were found to be more susceptible to flooding impacts due to lower capacities of economic recovery. Insurance coverage is seen as an important instrument to promote resilient economies to address coastal flooding and erosion, with some countries introducing variable levels of insurance coverage as a financial protection against flooding events or additional exclusion clauses. However, the likelihood of small and medium enterprises (SMEs) being under-insured remains relatively higher [11,16,17].

The effectiveness of governance for flood risk management is critical for developing and maintaining national resilience, sustainable development, and well-being in the face of increasing climate change derived risks [18]. Flood risk mitigation therefore needs to be integrated with sustainable economic development, but questions remain as to how to engage with regional and local businesses within the governance process [19]. Studies show how business owners, even though they receive flood risk information from national agencies, still have relatively little knowledge about the importance of managing flood risks. Stakeholders' engagement is therefore crucial to assess how business owners perceive flood risks and impacts and to secure better participation within a governance process [20,21] to not only achieve sustainable economic development but also meet the Sustainable Development Goal (13) related to climate change [19].

## 2. Study Area

The city-island-state of Malta is the smallest EU nation, consisting of an archipelago of three main islands: Malta, Gozo and Comino situated in the central Mediterranean (Figure 1). Although it is traditionally considered to be a low-hazard country and safe from external physical wounding, recent studies of its public records show the presence of numerous natural hazards events through the ages [22]. In being a small highly urbanized archipelago, dependent on internal and external pressures (both socio-economic and environmental), Malta is faced with multiple internal and external pressures that increase its precariousness and vulnerability to such externalities [23].



**Figure 1.** Location of five selected sites of coastal towns: Gżira, Sliema and St Julian's (Malta) and Marsalforn and Xlendi (Gozo). Marsaskala, Marsaxlokk, Birzebbuga and Msida were selected in a previous study (2019) by the same authors.

The latest national report by the Seventh National Communication of Malta under the United Nations Framework Convention on Climate Change (UNFCCC) identified several impacts related to climate change, including inundation, coastal erosion, loss of beaches and damages derived from high winds, storm surges and waves [24]. The previous UNFCCC national reports identified vulnerabilities pertaining to rising sea levels which affect land-use such as ports, roads, coastal infrastructure and protected areas. The Strategic Plan for the Environment and Development (SPED, 2015) reported that extreme weather events are predicted to increase both in intensity and frequency, leading to increasing risks of flooding [25]. Significant land use pressures exist on the Maltese low-lying coasts ranging from tourism (29% of GDP), maritime activities, traditional services such as fishing, swimming and artisanal salinas to important ecological and geoheritage services such as Natura2000 sites [26,27]. In view of this, knowledge on stakeholders' perception about the effects of climate change-related flooding on the coastal business community is paramount since any change in sea level or coastal dynamics, such as waves, winds, or changes to its landscape due to erosion, would disrupt daily human operations like transport, housing, and work [28]. Malta ratified the Integrated Coastal Zone Management (ICZM) Protocol to the Barcelona Convention in 2019 (signed in 2008) and is still in process of adopting the Protocol principles into local legislation or policy.

This study was conducted in five prime economic localities in the Maltese Islands i.e., Gżira, Sliema, St Julian's, Marsalforn, and Xlendi (Figure 1). Despite their economic importance, all five localities share the same low-lying coastal topography and a ribbon-type business distribution. Each coastal town has a high concentration of retail and recreational services spread along its waterfront and adjacent promenade (Figures 2–6).





**Figure 2.** A Gżira business establishment located close to the water's edge.



**Figure 3.** Businesses operating along the Sliema promenade.



**Figure 4.** Business operating close to sea level at Spinola Bay, St Julian's.



**Figure 5.** Businesses located along the promenade of Xlendi Bay.





**Figure 6.** Marsalforn businesses operating with outdoor seating close to the shore.

However, studies on the impacts of coastal flooding on the Maltese business community remain scarce. Spiteri (2019) assessed the impacts of rising sea levels and storm surge flooding on coastal businesses through stakeholders' consultation with local councils and the business communities in Marsaskala, Marsaxlokk, Birżebbuġa and Msida [28]. None of the business owners or local councils ever had any plans to address such threats, even though the selected localities had experienced coastal flooding, particularly from episodic storm events. Such events have pushed local councils to start evaluating the vulnerability of their locality to coastal flooding, and to begin the process of drawing up plans to protect their towns from future sea level rise and storm-derived flooding [9].

Other impact studies are mostly focused on the impacts of projected sea-level rise on infrastructure and transport [29,30]. Rizzo (2019) assessed the reliance of coastal businesses on an accessible and efficient coastal transport network and the vulnerability of the latter to flooding disruptions [15]. Through a multi-criteria analysis, a cascading effect was observed during coastal flooding events in which flooding impacts coastal road networks and severely restricts access to the business areas, including those in Sliema and St Julian's. Rapid urbanization on parts of the Maltese coast (such as St Julian's) since the Second World War has amplified the potential risks of damages derived from coastal flooding events. However, such risks were perceived by the local community as seasonal and too infrequent to be of any national concern [31].

### 3. Materials and Methods

The methods undertaken for this study were based on two types of investigation:

A. Land-use mapping: This exercise aimed to plot the distribution, elevation and types of businesses found along the coast of the five selected localities. The georeferenced coordinates were collected using an embedded GPS app available on iPhone, while simultaneously taking inventory of the number of businesses and classifying them according to the type of business. The coordinates were then plotted into QGIS to transform the coordinates into a set of maps illustrating the spatial distribution of coastal businesses in each locality. Other data could be extracted such as business clusters, sectors, and distribution in relation to the actual geographic distance from one another and the sea. For the creation of these maps, an Excel file was created for each business activity. As for the elevation data, the University of Malta's own digital surface model (DSM) and digital terrain model (DTM)

for each locality were requested and imported into QGIS's business distribution map to illustrate the business community's elevation above sea level. In addition, Cloud Isle, the University of Malta's open-source software hosting the latest Lidar data, was used to extract the elevation data and create a height profile of the areas.

B. Stakeholders' participation: Three sets of mixed methods questionnaires/ interviews were conducted with the business community, local councils, and expert bodies. The local council and business questionnaires were structured to have mixed methods questions using "Likert scales" and "Yes/No" based questions combined with several open-ended questions. Experts were interviewed through open ended questions to encourage experts to share their insights, experiences, and professional opinions.

The targeted business sample size was 50% of the total number of businesses; however, the number of interviewed businesses per locality was influenced by the uneven number of establishments in each locality. The total number of businesses across all five localities stood at 356. With a 50% sample size, the interviewed sample was calculated at 186 businesses with 95% confidence level and a 5% margin of error [32]. The number of questionnaires distributed in each locality was calculated as follows: Gżira: 40, Sliema: 50, St Julian's: 78, Xlendi 7, and Marsalforn: 13. All 5 local councils were interviewed, along with 12 experts from the following private and governmental entities:

- i. The Malta Tourism Authority (hereinafter referred as MTA);
- ii. The Ministry for Transport, Infrastructure and Capital Projects (MTIP);
- iii. The Environmental Resource Authority (ERA);
- iv. The Ministry for the Economy, Investment and Small Businesses (MEISB);
- v. The Malta Chamber of Commerce, Enterprise and Industry (MCCEI);
- vi. The Malta Resource Authority (MRA);
- vii. The Malta Chamber of Small and Medium Enterprises (MCSME);
- viii. The Civil Protection Department (CPD);
- ix. The Ministry for the Environment, Sustainable Development and Climate Change (MESDCC);
- x. The Planning Authority (PA);
- xi. The Transport Malta (TM); and
- xii. The Transport Malta Ports and Yachting Directorate (PYD).

To analyse the experts' feedback, NVivo was used to evaluate and interpret the responses on a thematic level and visually show any differences within the cluster analysis. The closed questions of the local council's responses were analysed through the construction of 'yes' and 'no' matrix. The Likert scale responses in the business questionnaires were tested with analysis of variance (Kruskal Wallis H-Test) through Microsoft Excel (graphs) and IBM SPSS (statistics). The scope of this statistical analysis was to test whether any differences or similarities exist between the replies of owners according to their business category and locality. Before carrying out each Kruskal Wallis H-Test, the Kolmogorov-Smirnov normality test confirmed the use of a non-parametric analysis of variance.

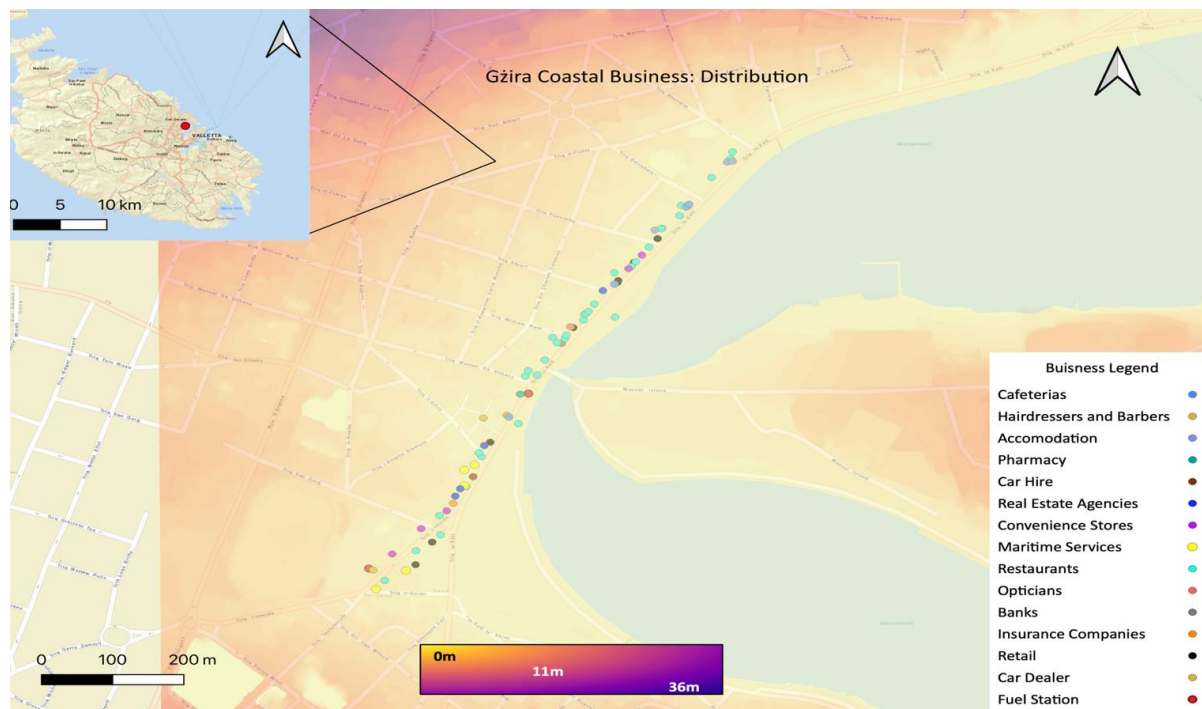
## 4. Results

### 4.1. Businesses

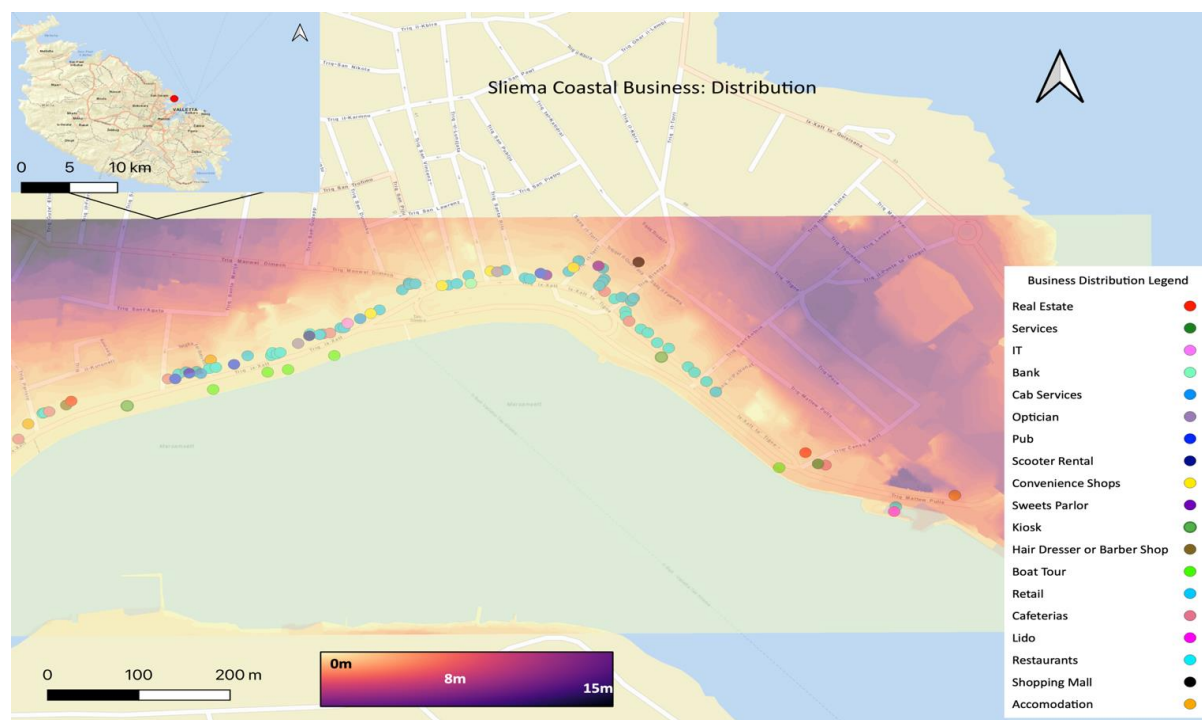
#### 4.1.1. Mapping of Locations and Types of Coastal Businesses

Figures 7–12 illustrate the coastal business distribution for each locality. The various coloured dots along the coastline represent the various sectors operating in each locality. In addition, the shaded areas superimposed on the business distribution, portrays the elevation of the area above sea level, with the lighter shade representing a low elevation while the darker shades exhibit a progressively higher elevation. Each map depicts various business sectors with catering, accommodation, and retail being the three most dominant sectors and primarily serving the tourism industry. The key finding from these maps is that, in each locality, a heavy concentration of businesses is situated in a low-lying area between 0–3 m above sea level, except for the backshore of St George's Bay (Figure 10) where elevation increases rapidly due to an uphill topography. The land-use maps confirm

the high degree of concentration of a wide variety of businesses present along the lowest coastal elevations in the selected localities and how their exposure risks to coastal flooding is related both to their close proximity to the shoreline, but also to their orientation to frequent north-westerly and north-easterly winter storms.

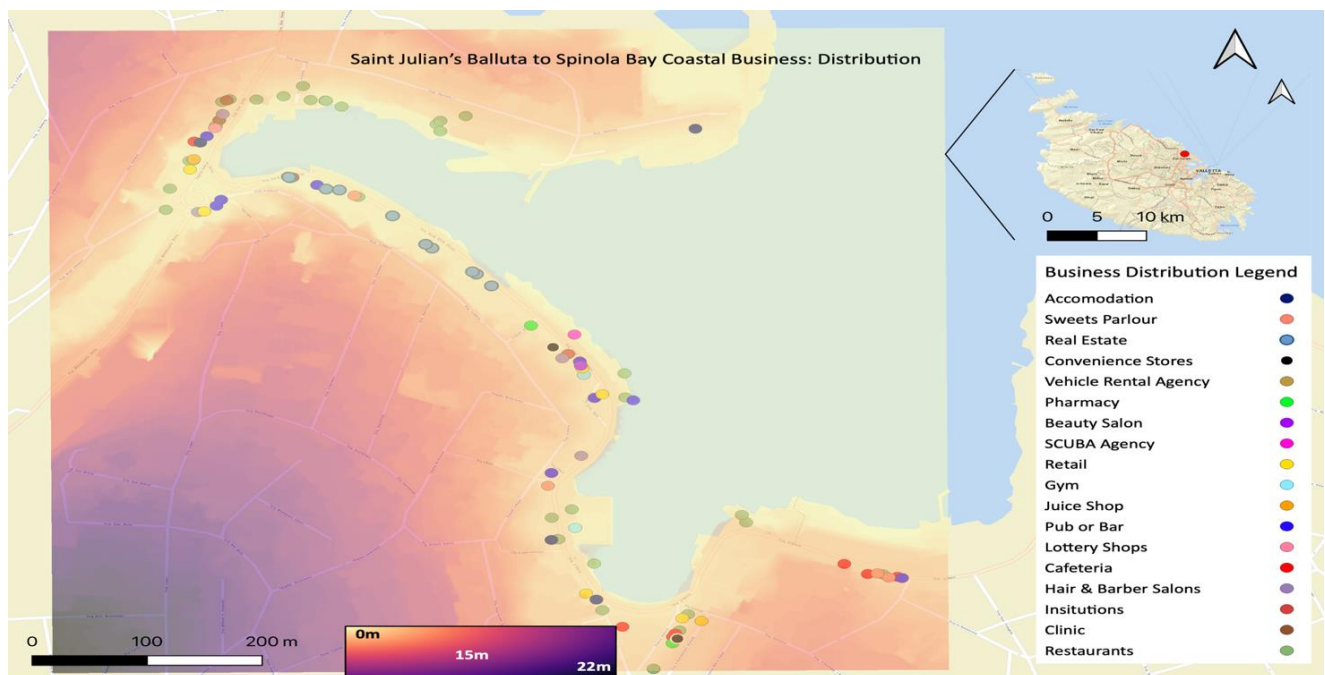


**Figure 7.** Gżira's coastal businesses' distribution.

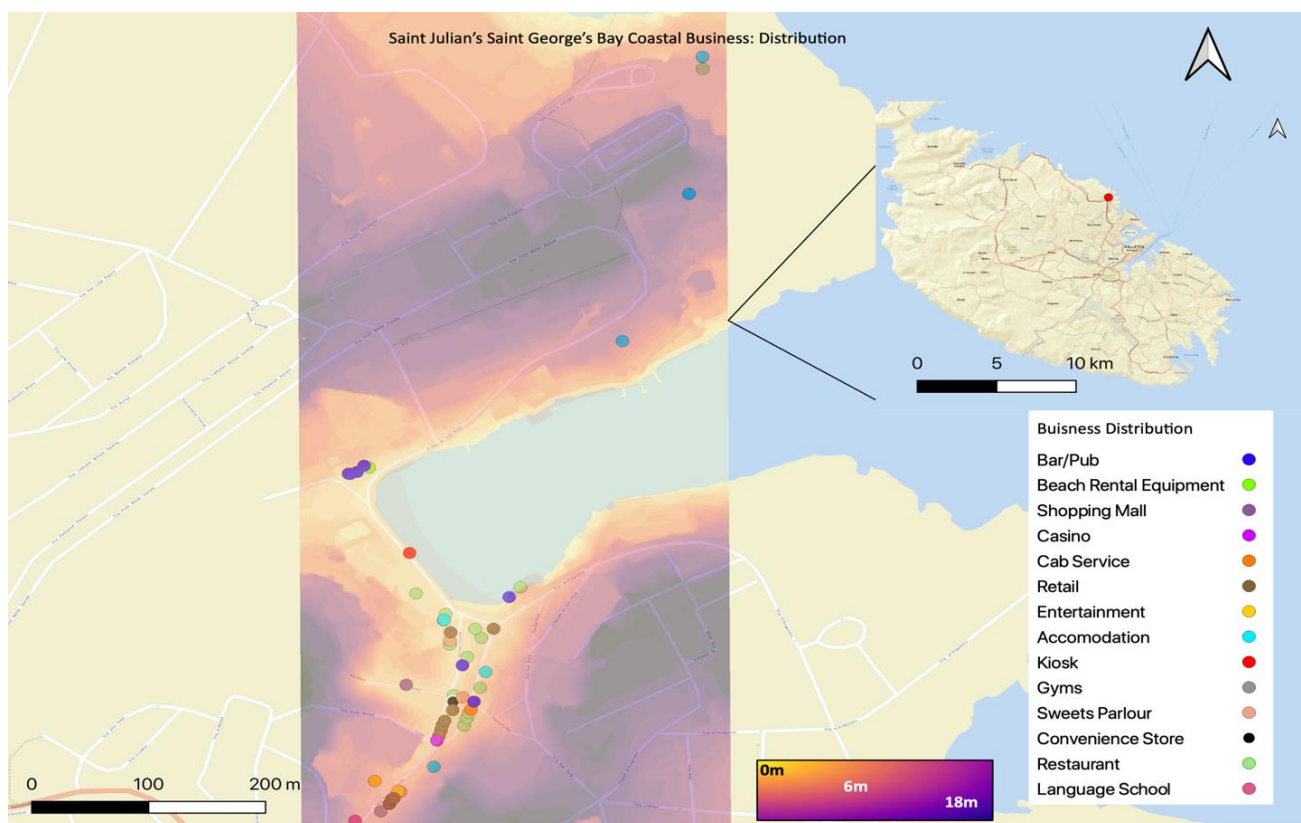


**Figure 8.** Sliema's coastal businesses' distribution.

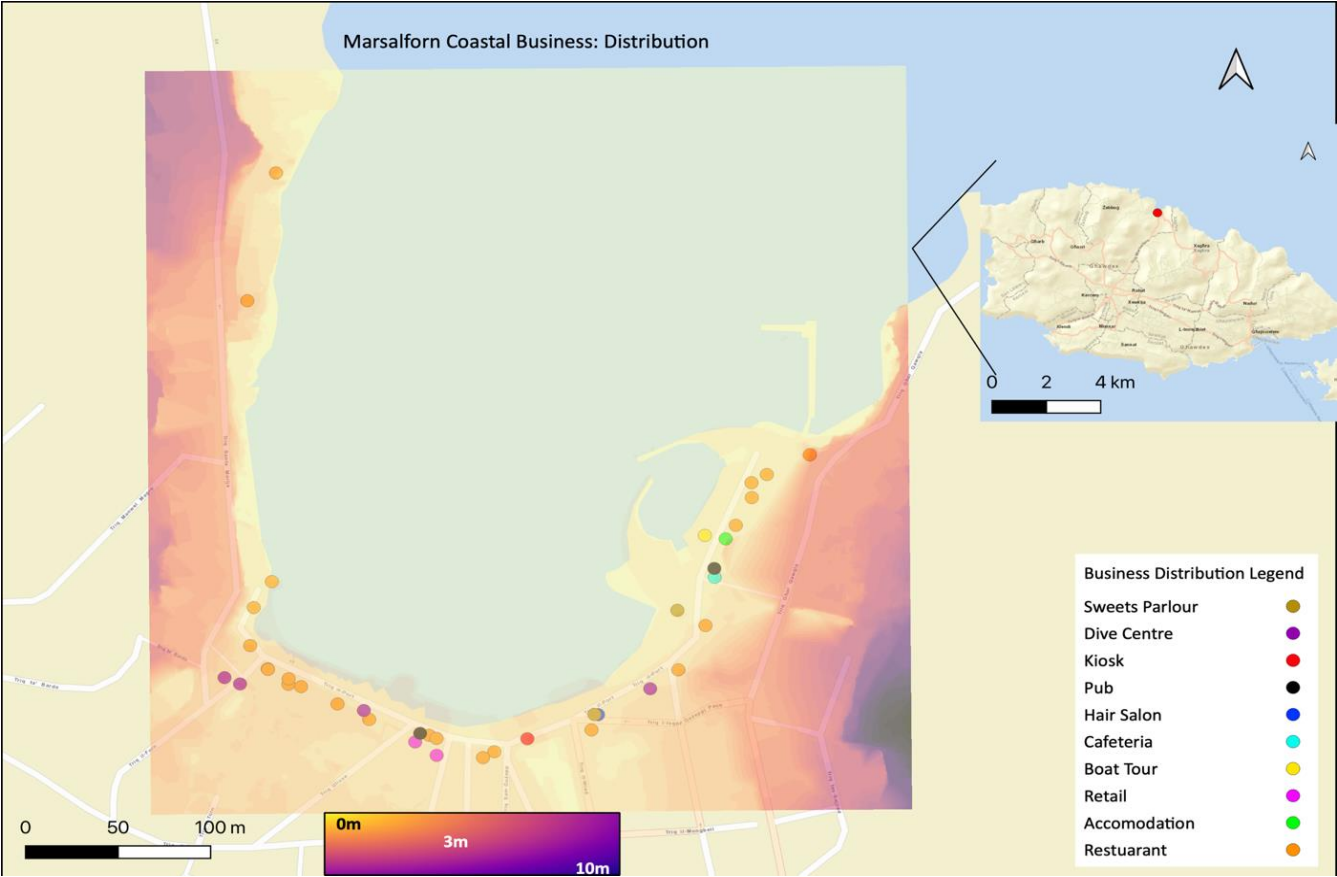




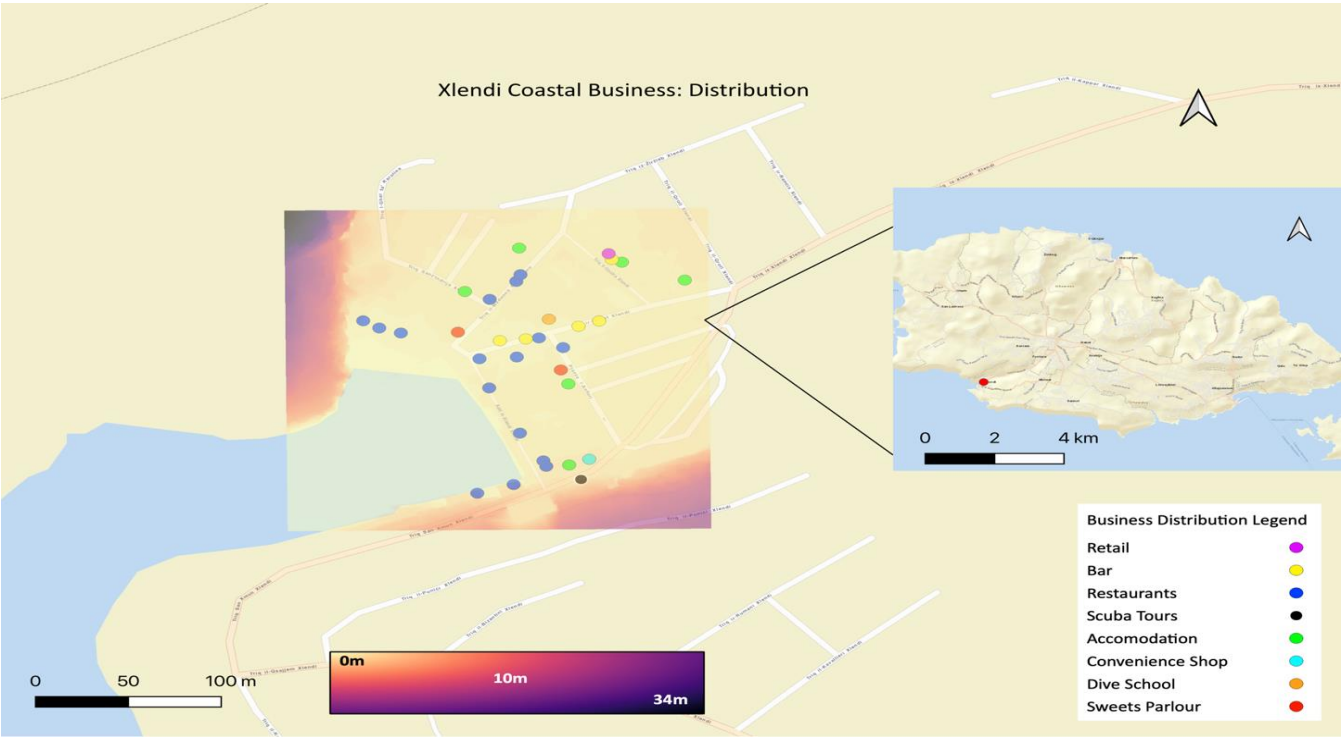
**Figure 9.** Coastal businesses' distribution in St Julian's: Balluta to Spinola Bay (Part 1 of St Julian's).



**Figure 10.** Coastal businesses' distribution in St Julian's: St George's Bay (Part 2 of St Julian's).



**Figure 11.** Marsalforn’s coastal businesses’ distribution.



**Figure 12.** Xlendi’s coastal businesses’ distribution.

#### 4.1.2. Feedback from Business Owners

Table 1 lists all the main responses provided by the business community. For some questions, similar responses were collected in each locality, while for others, there were some differences, mainly when comparing the Maltese against their Gozitan counterparts. Similar feedback was observed for matters related to relocation, contingency plans, coastal flooding, and planning and management. In each locality, business owners do not have any contingency plans for the possibility of having to close down due to rising sea-levels or flooding. This decision appears to be based on the seasonal experience of past flooding events i.e., of suffering coastal flooding in one-off events during winter, and how the owners always managed to recover and resume operations in the shortest possible time.

**Table 1.** Feedback from interviews held with business communities of five selected towns.

Question Feedback	Key Findings				
	Gżira	Sliema	St Julian's	Marsalforn	Xlendi
Number of owners who were knowledgeable about coastal flooding on the Likert Scale	57%	66%	56%	46%	42%
Number of owners who were not aware of the risk of rising sea levels and storm surge flooding before they established their business	53%	56%	60%	31%	14%
Number of owners who did not envisage that rising sea levels and storm surge flooding could pose a threat to their business	73%	70%	68%	31%	43%
Number of owners who thought that rising sea levels and storm surge flooding would affect their operations.	77%	82%	78%	92%	72%
Number of owners who had contingency plans to avoid bankruptcy	None	None	None	None	None
Owners' decision-making regarding location if they knew of the possible impacts of coastal flooding before opening their establishment	92%	92%	84%	85%	72%
Number of owners refusing relocation	88%	82%	86%	100%	71%
Owners' opinion on who they think should be addressing coastal flooding	The government by building and managing infrastructure.	The government by building and managing infrastructure however, a few owners reported that it is impossible to solve.	The government by building and managing infrastructure however, a few owners reported that it is impossible to solve.	The government by building and managing infrastructure however, a few owners reported that it is impossible to solve.	The government by building and managing infrastructure however, a few owners reported that it is impossible to solve.



As for relocation, most business owners believe that they will not relocate to inland locations, as they think that their type of business will only thrive and prosper in a coastal location which are the most visited areas by tourists. As shown in the land-use maps most of the catering, accommodation, and retail industries were found to be the dominant sectors on the selected waterfronts (Figures 7–12). In all localities, more than 50% of business communities were not aware of the risk of rising sea levels and storm surge flooding before they established their business. They rarely or never envisaged that rising sea levels and storm surge flooding could pose a threat to their operations. However, they agreed that rising sea levels and storm surge flooding would affect their operations in future as they have already experienced operational difficulties from coastal flooding in the past.

When addressing the planning and management of coastal flooding within their respective localities, similar mitigation and adaptation responses were noticed across the five localities. Most owners believe that to effectively address coastal flooding, proper planning and management are fundamental, along with the required upgrades to the current infrastructure and, where necessary, new infrastructure to be developed along with regular maintenance. Some of the infrastructure proposed included breakwaters, reservoirs, road redesign, upgrading the drainage systems/gutters, early warning systems, and small dams (Xlendi).

One major difference was observed between the Maltese and Gozitan business communities in terms of how knowledgeable they were on coastal flooding in general and more specifically in their respective localities. When comparing the Gozitan communities (i.e., Marsalforn and Xlendi), the Gozitans were found to be more aware about coastal flooding than their Maltese counterparts (Table 1).

A series of business disruptions and damages caused by past flooding events were mentioned by the owners during the interviews (Table 2). This inventory ranges from economic, infrastructural, and health and safety issues, to long-term maintenance and extremes, such as closing of business. Some of these damages and disruptions are manageable and short term e.g., loss of sales, which was only temporary during a flooding episode. However, some are more long term and of a more serious nature, which may require a temporary shutdown until fixed, e.g., internal and external piping damages.

**Table 2.** An inventory of damages and disruptions sustained by the business communities during past coastal flooding events.

Damages	Disruptions
Broken glass	Loss of sales
Shorted appliances	Loss of revenue
Repainting	Reduction in operational capacity
Products discarded	Accessibility
Overflowing of internal and external drainage systems	Closure
Internal and external piping damages	Foul smells derived from overflowing drainage
Broken doors	Overflowing of drains resulting in drainage release of bugs and insects
Broken windows	Maintenance
Ruined furniture	Cleaning
Plumbing	

Table 3 lists all the reasons provided by the owners for their answers to each qualitative question categorized by locality. In most questions, the responses were observed to be quite similar as these phenomena were found to affect each locality in a similar manner. Nevertheless, in certain questions, feedback was distinctly different, e.g., in question 7B the owners were asked how they think rising sea level will affect their business and to provide reasons for their answer. For this question, Xlendi business owners were the only ones who identified bankruptcy as an answer and how they would not be able to cope with the constant disruptions along with the daily overheads' costs and limited revenue.

**Table 3.** Reasons provided by the business owners in the qualitative section.

Question Feedback	Reasons				
	Gzira	Sliema	St Julian's	Marsalforn	Xlendi
Coastal flooding experience	Flooding, business disruptions, preventive measures	Flooding, business disruptions, preventive measures	Flooding, business disruptions, safety precautions	Flooding, business disruptions	Flooding, business disruptions
Coastal flooding disruptions	Flooding, business disruptions	Flooding, business disruptions	Flooding, business disruptions, elevation.	Flooding, business disruptions	Flooding, bankruptcy
Opting for coastal location	Location, tourism, demand, challenges, relocation	Location, tourism, seasonality, lack of knowledge, relocation, minor impacts	Location, tourism, demand, flooding, seasonality, risk	Location, tourism, challenges	Location, tourism, challenges
Business recovery	Preventive measures, insurance, conditional damages	Insurance, preventive measures, conditional damages	Insurance, recovery confidence due to never/rarely flooding, conditional damages, recovery period.	Insurance, preparation, minor damages, recovery difficulties.	Insurance, finance, damages
Lack of contingency plans	Preventive measures, lack of knowledge, operational continuity, retirement, minor effects, and rare flooding events	Preventive measures, seasonality, operational continuity, retirement, relocation, lack of knowledge, no major incidents	Mitigation/adaptation measures, operational continuity, lack of knowledge, seasonality, business disruptions, no risk, never sustained any extensive or permanent damages	Lack of knowledge, seasonality, operational continuity, hope	Lack of knowledge, hope
Authorities talks with the business communities	Mitigation and adaptation measures	Mitigation and adaptation measures	Climate change and coastal flooding mitigation and adaptation	Climate change mitigation and adaptation measures, background information on climate change and, its consequences, and impacts	Climate change impacts
Owners' opinions to mitigate coastal flooding	Management and planning, implementation of climate change mitigation and adaptation measures, infrastructure maintenance, ceasing coastal development, lack of knowledge	Infrastructure, lack of knowledge, management, and planning, ceasing coastal development, environmental protection.	Infrastructure, lack of knowledge, management and planning, government, reducing and managing climate change, ceasing coastal development, scientific studies, financial and scientific priority	Infrastructure, lack of knowledge, preventive measures	Infrastructure, lack of knowledge, management, and planning, cease coastal development

Table 3. Cont.

Question Feedback	Reasons				
	Gżira	Sliema	St Julian's	Marsalforn	Xlendi
Owners' opinions on what the local and central government should do to mitigate coastal flooding	Management and planning, infrastructure maintenance, climate change mitigation and adaptation measures, government, lack of knowledge, ceasing coastal development	Infrastructure, lack of knowledge, management, and planning, ceasing coastal development, environmental protection, mitigation, and support	Infrastructure, lack of knowledge, management and planning, government, reducing and managing climate change, ceasing coastal development, scientific studies, financial and scientific priority, local council	Infrastructure, management and planning, local council, investment (educational and financial), lack of knowledge, land reclamation, cease development	Infrastructure, lack of knowledge, management, and planning,
Relocation to those owners who said they might consider relocation	Relocation within the same area	Relocation within the same area but further inland	Depends on trade, relocation within the same area but at higher elevation	N/A	Relocation within the same area but at higher elevation

In question 15, owners were asked whether they think about the possibility of business diversification as a solution to future impacts of coastal flooding, and what alternate business operations they would engage in. The catering businesses in St Julian's claimed that, if possible, they would keep their current operations but switch their services as a delivery/take away restaurant. St Julian's was once again the outlier as a few owners claimed that they would still opt for the same area but locate at a higher elevation above sea level. Others claimed that they would study the market forces at that time and would base their decision on relocation accordingly.

With regards to physical preventive/adaptation measures (Table 4), business owners mentioned only short-term measures.

Table 4. Inventory of preventive/adaptation measures.

Gżira	Sliema	St. Julian's	Xlendi
Placing high enough slabs against the entrance	Higher topographic elevation	Higher topographic elevation	Waterproofing
Entrance elevation	Entrance elevation	Entrance elevation	Placing high enough slabs against the entrance
Waterproofing	Waterproofing	Waterproofing Placing high enough slabs against the entrance Work from home policy	

#### 4.1.3. Analysis of Variance: Businesses' Responses

Most of the analysis of variance tests showed no difference in responses across the types of businesses in the five tested localities (Table 5). Out of 50 tests, only 5 results showed that there were differences. This means that the type of business category did not have any influence on the type of response received from the owners. Table 5 shows how St Julian's is a strong outlier when compared with the other localities in having correlation between the various business categories and each tested question. This is key



to understanding how to better profile the business community as stakeholders, and to determine what level and types of engagement should be exercised for each category of businesses.

**Table 5.** Results from Kruskal Wallis H-Tests for selected businesses owners' responses.

Question	Gżira	Sliema	St. Julian's	Marsalforn	Xlendi
Question 1: How familiar are you with the issues of climate change and its implications?	0.430	0.765	0.005	0.520	0.269
Question 2: How informed are you about coastal flooding (in your locality)?	0.665	0.464	0.013	0.559	0.346
Question 4: Were you aware about the risk of sea-level rise and possible coastal flooding when you opened your current business?	0.716	0.687	0.015	0.643	1.000
Question 5: In recent years, have you experienced coastal flooding?	0.463	0.520	0.694	0.875	0.189
Question 6: Have you ever envisaged that future sea-level rise and coastal flooding could threaten your business?	0.752	0.665	0.035	0.668	0.978
Question 7: Do you think that sea-level rise and flooding will affect your business?	0.199	0.607	0.505	0.801	0.978
Question 8: If you knew the risks that coastal flooding (due to sea-level rise and storm surges) could have on your business, would you still have chosen a location along the coast?	0.273	0.162	0.943	0.052	0.153
Question 9: If such an event does happen in future, do you think that your business can recover from such a setback?	0.532	0.431	0.514	0.264	0.153
Question 15: Would it be possible to diversify your business operations, should current business operations not be possible anymore due to future impacts of coastal flooding?	0.171	0.027	0.559	0.760	0.444
Question 16: How likely would you consider relocating your business?	0.789	0.916	0.214	0.616	0.053

#### 4.2. Local Councils' Feedback

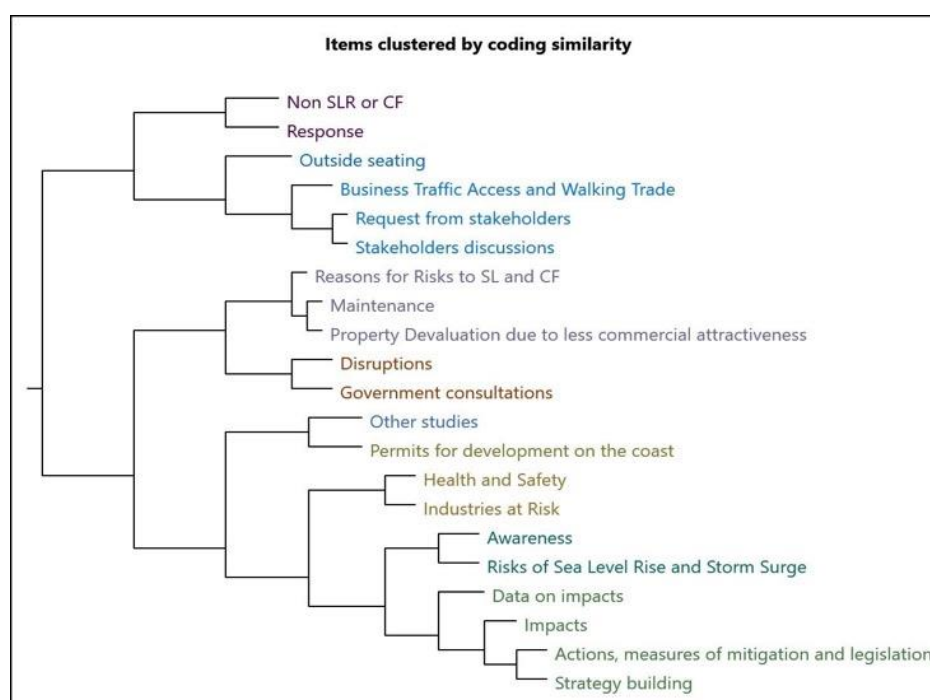
The five local councils provided mixed feedback on how coastal flood risks are perceived. In terms of general sea level rise and storm surge flooding risk assessments, all councils—except for Xlendi—identified sea level rise hotspots within their locality. Xlendi's local council could not provide feedback on which areas are more susceptible to coastal flooding. In addition, the local councils of Sliema, Marsalforn, and Xlendi's do not think that the current local sea level rise projections of around 3.5 mm per year, are a threat to their town's economy and local population. Conversely, the local councils of Gżira and St Julian's believe that coastal flooding is a concern for their community.

With regard to the dissemination of information between the central and local governments, residents, and the business community, all councils except Marsalforn reported that to date, they have not received any information. However, the councils of Gżira, St Julian's, and Xlendi reported that they had organized meetings with their business communities and residents to discuss the effects of coastal flooding on their towns, while Sliema and Marsalforn reported that, to date, no such meetings had been held. It is rather incongruent to note how the only informed councils did not organize any meetings with the residents and business community, whereas three uniformed councils did reach out and organize such public meetings.

For infrastructure and planning, Gżira and St Julian's reported that they do not have any infrastructure at risk to rising sea levels while the remaining councils reported that they do. This finding is contradicted by real life events - often reported in the media [33]—showing how coastal flooding impacts the town's main infrastructure (mainly roads). Regarding mitigation planning, only the local councils of Gżira, Sliema, and Marsalforn reported that in recent years the council did implement mitigation measures to reduce the effects of rising sea levels within their towns. In addition, Gżira, St Julian's, and Xlendi reported that they do have plans to protect their towns against rising sea levels.

#### 4.3. Government Experts' Feedback

The experts' analysis is illustrated in Figure 13 which shows a dendrogram analysis of all of the main points mentioned by the experts grouped into codes and subcodes to illustrate the degree of similarity between them. Two main groups can be identified; the first has codes between "Non SLR or CF to stakeholders' discussion", while the second group includes the rest (i.e., "Reasons for risk to SL and CF to Strategy Building").



**Figure 13.** NVivo's dendrogram illustrating similarity clustering based on experts' feedback.

In terms of awareness to coastal flood risks, the responses from the key experts were varied. On one hand, the Malta Chamber of Small and Medium Enterprises (MCSME) answered to not be sufficiently aware of the risks related to the effects of rising sea levels, and storm surge flooding on the coastal business communities. The Malta Resources Authority's (MRA) only role pertaining to climate change is to serve as the GHG Inventory Agency; hence, they shared no insights. However, other experts showed a higher level of

awareness in their response. The Malta Chamber of Commerce, Enterprise, and Industry (MCCEI) classified rising sea levels and storm surge flooding as a medium risk to Malta's commercial activity. Malta Tourism Authority (MTA) was relatively more aware of the risks, especially with regard to beaches and how the loss of sand and bathing areas will have a direct effect on tourism. In terms of business disruptions, the MCCEI predicts disruptions related to health and safety issues, reductions in business traffic, cleanliness, and reductions in the prime value of real estate. The expected business disruptions mentioned included decline in walking trade, accessibility issues, and outside seating issues.

In relation to government consultations with stakeholders, the MCCEI did organize discussions with potential stakeholders about the threats that may impact the coastal business communities through rising sea levels and storm surge flooding. The MSCME has never organized any seminars/talks and to date, this is still not on the chamber's agenda.

With regards to data on coastal flooding risks, many of the interviewed institutions do not have longitudinal or national data. The MCCEI does not have any data showing the expected losses to revenue, jobs, labour force, and coastal business establishments, and stated that such data still needs to be modelled. The Ministry of the Economy, Investment, and Small Businesses (MEISB) has never collected economic data related to rising sea levels and storm surge flooding. Both MTA and ERA have not conducted any studies on the risks of sea level rise and storm surge flooding on coastal towns across the Maltese Islands as they claimed that this aspect is not within their remit.

When new coastal infrastructural developments are proposed, Transport Malta (TM) is usually involved and assesses the likely impacts of rising sea levels and violent storms on these new developments. The MTA assesses every development proposal and submits recommendations to the Planning Authority (PA), highlighting both the impacts and benefits from such a project. However, with regard to management, planning, and regulations, the Ministry for Sustainable Development, Environment and Climate Change (MSDECC) does foresee future regulations pertaining to coastal development in low-lying areas that are highly susceptible to rising sea levels and storm surge flooding. Currently, the MSDECC is in the process of updating the national Adaptation Strategy, which will inform policy makers and other authorities about measures and regulatory measures to better strengthen resilience to climate change.

Coastal management actions as a response to coastal flooding are also delivered specifically within institutional remits. Presently, there is no nationwide assessment of the risks associated with coastal flooding and its impact on coastal communities and businesses in Malta. The Ministry for Transport Infrastructure and Capital Projects (MTIP) addresses impacts on the basis of local community's needs, with specific projects instigated mostly in the aftermath of storm events. Actions and works are carried out depending on the budget allocated on an annual basis. In addition, the PA does not foresee the introduction of future regulations pertaining to coastal development in low-lying areas that are highly susceptible to rising sea levels and storm surge flooding, as the authority does not have any clear evidence on which to base such regulations. For the tourism sector, the MTA has not yet aligned its future policies and marketing strategies to reflect the impacts of climate change on coastal tourism, especially in relation to rising sea levels and storm surge flooding. The reason provided is that marketing serves to attract high quality and environmental tourists in a positive manner, and not by highlighting issues whose risks and impacts are not yet assessed. TM does have yet plans to protect coastal infrastructure and other investments that are deemed to be at risk of being partially or fully submerged and mostly limits itself to repair works, such as repairing the original flood valves at Sliema Ferries.

Preventive measures are critically important to effectively manage coastal flooding; however, more than one entity must be involved in order achieve maximum protection from these measures. The MSDECC reported that in the current Adaptation Strategy, measures are being proposed to protect the coastline, roads, and infrastructures from rising sea levels and storm surge flooding, including flash floods; however, the implementation of such measures does not fall under this ministry. The Civil Protection Department (CPD)



does receive calls for support during storm flood events, but it does not have preventive measures to mitigate the onset of these requests for support during storm flood events.

Apart from the preventive measures, newly constructed and/or future planned infrastructure must be designed in such a way that it can withstand rising sea levels and storm surge flooding. TM reported that newly constructed and future planned roads are designed to cater for rising sea levels. Whenever possible, roads and waterfront infrastructure are constructed at higher levels; however most low-lying areas are densely built-up, with urban land-use closely situated to the water's edge. TM also reported that during the recent coastal road upgrades, measures were implemented to protect these investments from rising sea levels and storm surge flooding. To date, the Ports and Yachting Directorate (PYD) did not consider any mitigation measures to protect coastal infrastructure and towns from rising sea levels and storm surge flooding as this is not the directorate's area of responsibility. Their responsibility is to ensure the safe navigation and operation of vessels in Maltese territorial waters. Finally, in terms of transport, the ERA, MTIP, MSDECC, and TM identified road networks and public structures that are at risk from rising sea levels and storm surge flooding.

## 5. Discussion

In terms of the vulnerability of these businesses to coastal flooding, the land use mapping task (Figures 7–12) shows how each establishment's elevation (i.e., height above sea level) clearly indicates that most of the coastal businesses in the five selected localities are clustered around 0–3 m above sea level. This makes these businesses highly sensitive to coastal flooding, and this was confirmed by the interviewed business owners who reported that they have experienced coastal flooding in the past. In fact, the Kruskal Wallis H-tests results for Question 5 (Table 5) established that there is no statistically significant relationship between coastal flooding and the type of business sector, in view of how the various business sectors operate adjacent to one another along the coast and therefore are equally exposed to the same level of risks from coastal flooding (Figures 7–12).

These findings build on those from Spiteri (2019) and others [10,14] who found that the coastal businesses operating in low lying areas are more susceptible to rising sea level and extreme storms. The land-use maps also confirm that these coastal areas should be considered high risk areas not only by virtue of their elevation above sea level, but also because of the dense concentration of business services within a very small stretch of the coastal zones, which are also exposed to some of the most prevalent storms coming from the northwest and northeast sextants. This confirms how the zones deemed to be at the highest risk of flooding do not necessarily intersect with high-risk areas, as other factors apart from flooding, such as land use, road networks and infrastructural quality increase the coastal area's vulnerability [14].

The feedback responses provide evidence that the Maltese business communities are not sufficiently informed by any government entity about the potential risks associated with rising sea levels and storm surge flooding. Receiving information on floods and risk management may help to improve stakeholder involvement but the former should not be considered as the only strategy to increase knowledge about the importance of flood risks management. In fact, studies have shown that business operators who had received flood risk information had lesser knowledge on the importance of managing flood risks than those who had not [19].

Those owners and local councillors who reported having experienced coastal flooding agreed that future flooding caused by rising sea level and storm surges, may produce more deleterious business disruptions, particularly in terms of their operations. This feedback echoes that of Spiteri (2019) for other coastal localities in Malta. However, as with other studies, these disruptions were considered by the business owners to be seasonal and not substantially impactful during the high summer season [9]. The long-term notion of rising sea level impacts remains widely underestimated.

Other disruptions such as reduced accessibility and the reduction in business traffic, were documented by the local councils and business owners as factors of major concern during flooding events. A substantial number of business owners in this study complained about inaccessibility issues due to road flooding since customers are not able to access the establishment when the roads are completely flooded. These issues, which included lack of sales due to inaccessibility, were also reported by the experts from the MCCEI and MCSME and documented by Rizzo (2019). These findings continue to confirm the views of how the vulnerability of the business community to coastal flooding is compounded by other impacted land uses such as flooded road networks [14,15].

Another crucial issue was relocation prospects, given that most owners expressed a strong refusal to relocate in the likely event of coastal flooding. In addition, owners working in the catering industry also reported that a coastal location is a must for their establishment to succeed for two main reasons: walk-in trade and the fact that people prefer coastal locations for leisure and dining. This significantly elevates the establishments' susceptibility to the risks of coastal flooding. This refusal was tested by Kruskal Wallis H-Test for Q6 and Q18 of each locality (see Table 5) in which relocation refusal was voiced by the majority of the owners and did not vary according to the business category. NVivo coding of experts' interviews also confirmed that walk-in trade is an important source of revenue, which would therefore explain the refusal to relocate. This issue was reported by Stafford and Renaud (2019), who investigated a high percentage of businesses that were at risk of relocation after episodic storm events, and how the communities nevertheless refused to relocate, due to the economic turnover generated by the coast as a touristic service area [10].

Amongst the business disruptions listed in Table 1, the one most experienced by local stakeholders was reduction in sales. However, during the analysis, three specific sales disruptions were identified. The first was related to the outdoor seating areas (Figure 14) as the physical indoor dimensions of most establishments in the five studied localities were observed to be quite small and tended to have a larger outdoor seating capacity. Such an outdoor setup is the main factor responsible for sales reduction when impacted by road flooding. Road flooding significantly reduces the businesses' seating capacity and operations, and sales go down drastically as they cannot use the outside area. One study mentioned that flooding or inundation of roads can cause devastation to coastal businesses and their sales [14]; likewise, the Maltese and Gozitan businesses (especially the catering industry) suffer similar decreases in sales.

The second factor was that these five areas are well known for coastal flooding events. Therefore, visitors avoid these areas during storms (regardless of whether they are flooded or not) which in turn leads to a reduction in revenue. This is a very common pattern that was also observed by Craig et al. (2019) who found that businesses also experienced a drastic reduction in their daily sales during rainy days. The last factor, not mentioned in any of the literature, was the localized incidence of foul smell after a flooding event. Several businesses in the catering industry reported that they suffer a reduction in sales, when powerful storms damage the sewage systems, resulting in the presence of a pungent smell while repairs are being carried out. These three factors in the reduction in sales were also noted by the MCCEI and MCSME experts.

Despite both SME's and the coast are considered as important economic engines, a research gap in business flooding disruptions still exists, and which requires a multi-disciplinary approach to the assessment and implementation of mitigation measures. In addition, none of the interviewed businesses had any contingency plans in place in case coastal flooding puts them out of business. This trend was also observed by Craig et al. (2019) who found that most small business owners do not have a disaster plan in place and that around 40–60% ceased operations after they endured a natural disaster [12]. The reason given by Maltese and Gozitan business owners for not having any contingency plans was that all interviewees have managed to recover from episodic coastal flooding.



**Figure 14.** Coastal restaurants in Marsalforn, with their outdoor seating area densely occupying large parts of the coastal promenade.

When all council members and experts were asked about their risk awareness in relation to rising sea levels and storm surges, all interviewed councillors agreed that they were extremely aware of these phenomena. Nevertheless, except for Xlendi, they reported that they rely on central government in terms of concrete actions and mitigation measures. This same concern was voiced by another four local councils in the study of Spiteri (2019) [9]. Good governance is central to any successful management of hazards and threats driven by climate change. However, given the multi-sectorial nature of flooding phenomenon, challenges remain as to how to engage with other stakeholders in this effort. It was observed that such leading initiatives in mitigating flood risk and informing the local business community about the risks, were sporadic and have not yet been concretely addressed [19]. Only one of the five councils reported that a government entity had informed them about the impacts imposed on their locality due to rising sea levels and storm surge flooding. Nonetheless, it is important to mention that Gżira, St Julian's, and Xlendi reported that they have organized meetings with their business communities and residents to discuss these phenomena.

When government experts were asked about concrete action in addressing these two phenomena, only those responsible for the environment gave detailed and specific answers while the rest all reported that they rely on other environmental ministries and departments. Due to limited resources and human capacity, both the MCSME and MCCEI are forced to prioritize the needs of the wider agenda of the business community and hence, have never addressed the specific nature of the risks posed by coastal flooding to coastal businesses.

St Julian's and Gżira were the only two localities whose councillors reported that they do believe that rising sea levels are a threat to the town's economy. When asked whether the councils had identified hotspots for sea level rise and storm surge flooding, only Xlendi's council responded in the negative. Similar questions were asked to some experts who reported that Sliema does have infrastructure and road networks that are susceptible to coastal flooding; this was corroborated by Sliema's local council. However, even though neighbouring localities (i.e., Gżira and St Julian's) share similar geographic and topographic characteristics, none of the experts mentioned them. The NVivo analysis identified a strategy building code within the Ministry for Transport, Infrastructure and Capital Projects which plays a key role in vulnerability/risk assessments. This code was also



identified in a UK study, where the authors identified that strategy building through spatial planning is key for effective governance for flood and coastal erosion risk management [18].

Roads have a strong connection with the success of coastal businesses and the overall potential post-flooding recovery of coastal territories. Although local councils and experts did not specify any high-risks roads, Sliema has one major road that is highly susceptible to coastal flooding; this is Triq ix-Xatt which constitutes Sliema's study area as all of the businesses interviewed operate along this road. Meanwhile in St Julian's, there are multiple coastal roads, but like Sliema, the roads that are most susceptible to coastal flooding are the roads located along the coast which host a high concentration of different businesses [15]. Prioritizing investment and planning climate change adaptation measures during the planning and construction of coastal roads remains paramount [28]. Another study confirmed the dire need for such actions, as it was discovered that in both studies findings are corroborated by the author's own study [26].

Coastal flooding is often perceived as a seasonal phenomenon with minimal effects on the bay and urban environment, due to its seasonal (winter) frequency [31]. Although in this study, the business communities shared a similar perception, the local councillors, and experts considered it to be a more tangible, long-term phenomenon [28]. Such a distinction in perception shows the need for better communication and wider consultation between the different stakeholders to create a more common public knowledge base about the science of coastal flooding.

From an adaptation and mitigation measures perspective Busuttil (2011) recommended the implementation of soft and hard engineering methods to continuously safeguard the bay. The PA and ERA reported that they no longer advocate for the use of hard engineering methods but have instead transitioned to soft engineering methods coupled with green and blue infrastructure. However, both authorities reported that in certain scenarios, the implementation of green and blue infrastructure is not possible, and therefore other engineering methods may need to be considered.

NVivo thematic analysis revealed how some responsibilities tend to overlap between authorities/entities (Figure 13). Similar to other studies, such as that carried out by UK's Environment Agency [18], this finding suggests that there is some form of inter cooperation between the identified entities, irrespective of the distinct differences in their remits.

## 6. Conclusions

The main key findings with respect to the business communities were as follows: (i) none of the interviewed businesses have any contingency plans to safeguard themselves against bankruptcy caused by coastal flooding; (ii) most interviewed owners consider their business areas to be a prime locations, and confirm that they would still opt for a coastal location for their business regardless of the risks linked to coastal flooding; (iii) for the same reason expressed in (ii), they also refuse to consider relocation; (iv) owners explicitly stated that to resolve the recurring issues caused by coastal flooding, the central government needs to heavily invest and plan in building adequate infrastructure along with the required maintenance of such infrastructure to help in mitigating the effects of coastal flooding. The key findings with respect to the local councils were as follows: (i) Gżira and St Julian's claimed that they do not have any infrastructure at risk of coastal flooding, while the other councils reported that they do; (ii) only Xlendi identified sea level rise hotspots within their locality; (iii) Gżira, Sliema, and Marsalforn reported that they had implemented measures to mitigate the impacts of coastal flooding while St Julian's and Xlendi did not; (iv) finally, Gżira, St Julian's and Xlendi reported that they do possess plans to protect their towns from coastal flooding, while Sliema and Marsalforn reported that to date, no such plans exist. The main finding from the experts' interview was that all interviewed government and private organizations, entities, departments, and ministries operate within their legal framework and act within their own jurisdiction and there is limited horizontal and vertical cooperation in the risk management of coastal flooding and its long-term hazard implications.

A long-term and strategic form of governance between the three different stakeholders for coastal protection from coastal flooding is vital to maintain economic and social resilience, in the wake of increasing risks posed by climate change to city-island-states such as Malta [22,23,27,29,30]. Recommendations for coastal protection were expressed by the business communities such as the implementation of early warning systems as a highly effective mitigation tool, so that owners will have sufficient time to protect their establishments from the upcoming events. As key stakeholders and intermediaries between the central government and the citizens, local councils may have an important role to play in future risk assessments of coastal flooding in their respective locality, especially to assess hotspots of vulnerability.

The multi-faceted threats driven by climate change, require an equally multi-faceted and multi-sectoral management strategy to address them. Each threat, such as rising sea levels and storm surges, imposes cascading impacts that amplify the vulnerability and precariousness of low-lying coasts and their communities. Within this context, central government institutions need to ensure that there are no vacuums of climate change related policies and strategies in their governance structure. The process of collecting data about the economic costs of coastal flooding (among other factors) is an important start to fill gaps in knowledge. A long-term assessment and vision of resource allocation and infrastructure modifications is also required to increase the level of coastal protection of these towns. In conclusion, more national research is required on the risks of coastal flooding, not only to define and quantify the socio-economic risks, but also to collect more perception data from stakeholders, which will ultimately secure a stronger participatory role from the Maltese community.

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