Chapter 9
Climate Adaptation by Farmers in Three Communities in the Maldives

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Key Messages

- Farmers need a valid source of information at the island level on climate change and its impacts in order to adapt to the changing conditions and to be more resilient in the future.
- Women farmers who tend to the home gardens and the homestead plots with assistance from their families and those who have participated in agricultural workshops conducted in the island are more likely to contribute to the social capital of farming.
- Farmer cooperatives are an important institution for farmers to build trust and reciprocity which has been identified as one of weakest links among the surveyed communities.

> With climate change, the growth of subsistence root crops and vegetables is likely to be affected. Moreover, sea-level rise and its consequent saline intrusion will have major impacts on crop production, especially in low islands and atolls in the Pacific, where all the crop agriculture is found on or near the cost (UNFCCC, 2005, p. 19).

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9.1 Introduction

The impacts of climate change are more evident in Small Island Developing States (SIDS) like the Maldives Islands (Baldacchino & Kelman, 2014). SIDS are vulnerable to coastal inundation and erratic rainfall. These events are further aggravated by El Ninõ, tropical cyclones, and hurricanes (Metz et al., 2007; Khushal, 2016). Sea-level rise has been identified as a major threat to the low-lying island nations in the SIDS and especially to island nation states such as the Maldives where critical infrastructure, housing, and settlement areas are near the coastline. Ideally, the farms near these areas could be moved inland to combat such coastal erosions. However, in the case of the Maldives due to the small size of the islands, there is no inland area away from the coast for such relocation. This threat is exacerbated by storms, tidal waves, and beach erosion (MEE, 2016); increase in the minimum and maximum temperatures; and decreasing quantity and increasing intensity of rainfall.

Since 80% of the land is one meter above sea level (MEE, 2016), the risks of an increase in sea level are immense and could change the soil and fresh groundwater resources making it unfit for human use even before total inundation of these areas occur. Sea-level records for the past 20 years show a rise of 3.753 and 2.933 mm per year in Malé and Gan, respectively (MEE, 2016).

Schleussner and Hare (2015) state that the effects of climate change on the agriculture sector in the SIDS will impact negatively on the national income. In the past, most Maldivians have practiced subsistence farming and used very few tools. Khushal (2016) states that: "Small farmers in SIDS are among the most powerless victims of climate change and the most immediately affected, but their voices and concerns are not adequately understood and supported in international negotiations."

There have been a series of policies published by the Ministry of Environment and Energy, the Disaster Management Authority, and other stakeholders that address the impacts of climate change on the Maldives (MEE, 2016, 2017). However, impact assessments have not been undertaken at the national and island level in an organized manner and need to be studied further in order to formulate effective mitigation and adaptation strategies at the local and national level. A crucial part of this process is to develop a better understanding of the impact of climate change on communities at the local level. In this study, we ask two questions: (1) what are the current adaptation practices of Maldivian farmers? and (2) what is the role of social capital in influencing these practices?

9.2 Adaptation and Climate Change

Dodman and Mitlin (2015) stress the importance of considering the local knowledge and community experience in the development of climate change policies and adaptation strategies. Local perceptions are critical in determining why communities are not taking appropriate adaptive action when faced with disasters (Tshotsho,

2022, Chap. 6 this volume). Lopez-Marrero and Yarnal (2010) have studied two communities in Puerto Rico and found that the communities were more interested in attending to their health, family well-being, and other economic factors even while these communities were facing floods and hurricanes. This shows that it is very critical to address adaptation within the context and situation of the communities and their well-being (Smit, 2000; Smit & Wandel, 2006). The authors have discussed that there are differences between autonomous (automatic, spontaneous, or passive adaptations) and planned (strategic or active) adaptation. Smit et al. (2000) have also added that adaptations may occur as an inadvertent outcome of other activities. They have stated the importance of contextualizing the adaptive capacity and actions of the respective communities and individuals.

Kelman (2007) has identified some advantages in SIDS to tackle these issues which include tight kinship networks, unique heritage, a strong sense of identity and community, sustainable livelihoods, remittances from islander diasporas supporting life on SIDS and local knowledge and experience of dealing with environmental and social changes throughout history (Kelman, 2007). Social capital is one of the major assets of small islands and has been discussed by many authors.

9.3 Social Capital and Adaptive Capacity

First defined in the early twentieth century, social capital is defined by Moser et al., (2010, p. 7): "Social capital is an intangible asset, defined as the rules, norms, obligations, reciprocity and trust embedded in social relations, social structures, and societies' institutional arrangements. It is embedded at the micro-institutional level (communities and households) as well as in the rules and regulations governing formalized institutions in the marketplace, political system and civil society." Any community or group that can self-organize to work together for a common challenge can be considered as having social capital (Moser et al., 2010). Although there are many explanations and interpretations of social capital, the main components highlighted in the above literature are trust, reciprocity, and interpersonal relationships (Pelling & High, 2005).

In the Maldives, small-holder farmers who rely on their own families to work in the homestead plots share information largely by word of mouth informally while sitting and relaxing in the community seating areas (*joalis* or *holhuashi* near the beach area) or while going to the homestead plots or working in the homestead plots. Although all the farmers use smart phones and text messaging, these are not used to communicate agricultural practices in a more practical and systematic way.

9.4 Study Area and Methodology

For data collection, three island communities were selected based on their agricultural production. The three sites selected for this study include the islands of Gan and Fonadhoo in Laamu atoll and Fuamulaku in Gnaviyani atoll. These sites lie in the southern end of the archipelago and is the one of biggest three islands of the Maldives in terms of land area. In Gan and Fonadhoo islands, 80% of the island is marshy and in the rainy season the entire area is flooded. In Fuamulaku, about 70% is marshy land.[1] The largest natural island of Maldives is Gan. The census of 2014 enumerates the total population of Gan as 2809, Fonadhoo as 1400 people while Fuamulaku's total population is 8095. Figure 9.1 shows the populated areas and the areas utilized for agriculture in each of the sites.

The study uses a qualitative approach using field data collection. Primary data was collected using in-depth interviews with a random sample of farmers in each of the three sites. The list of farmers registered in the council office was sought from the councillors in each community. First the sampling started by selecting an element from the list at random and then every kth element in the frame is selected, where k is the sampling interval and n is the sample size, and N is the farmer population size. After selecting the list, an exclusion criterion of active farmers who work on their homestead plots, who managed homestead plots and home gardens plus the availability of the selected famers was listed with the assistance of the councillors. The secondary data sources used were published and unpublished documents from the relevant agencies.

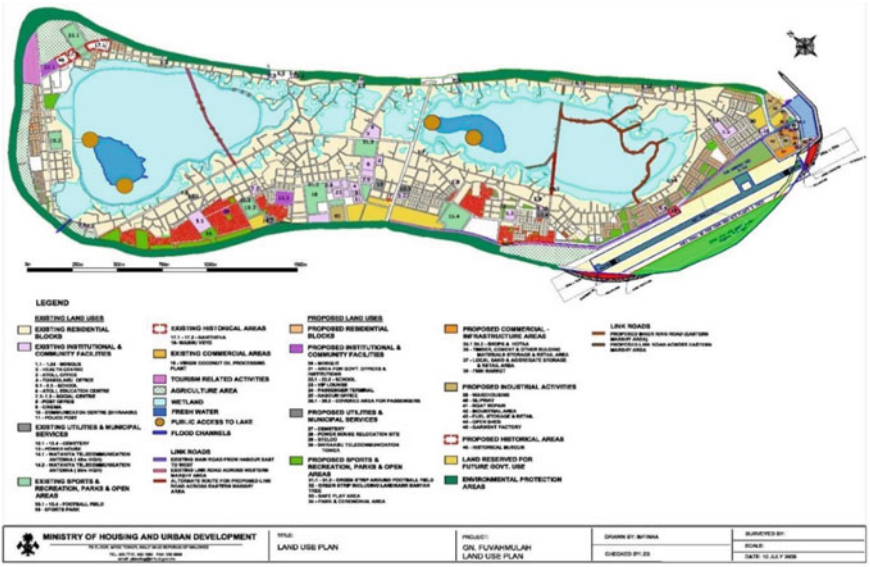
9.5 Case Studies

Selected narratives extracted from the in-depth interviews are used here to present the adaptation methods used by the farmers from Fonadhoo, Gan, and Fuamulaku. The social adaptive capacity and its role in complementing the identified agricultural adaptation practices in the three studied communities are examined and presented in these narratives. The kinds of adaptation practice the farmers employ are discussed below.

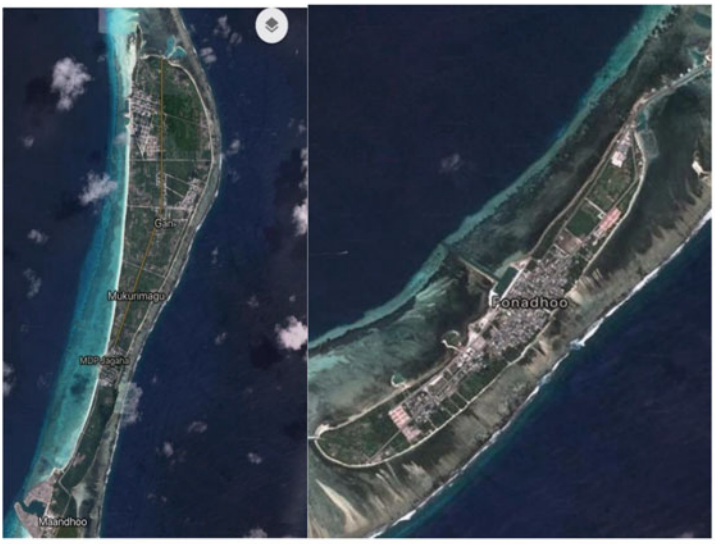
9.5.1 Adaptation Methods Used During the Dry Season

During the dry season, there is less rain and the temperature is hot. Daily temperature ranges from around 31 to 33 °C (Maldives Meteorological Service, 2020). All participants in the study use shade nets to cover the crops, especially the scotch bonnet

[1] Information provided by the respective island councils.



(a) Source: The map has been provided by Fuamulaku city council.



(b) Source: Google maps **(c)** Source: Google maps

Fig. 9.1 **a** Map of Fuamulaku island; **b** Map of Gan island; and **c** Map of Fonadhoo island

chillies. In the dry season, cucumbers and pumpkins are planted on the surface as well. This season is utilized by the farmers to grow watermelon.

Narrative 1 (Respondent F-007)

I use a shade net to cover my plants during the dry season because the heat is too much for the plants. I cover the whole plot with a shade net to provide protection for my scotch bonnet chillies. I have invested a lot of money on the shade nets and the structure to hold the shade nets in place because it has to be sturdy and strong during the rainy season as well. The winds can be strong and it can damage the shade nets. Even during the rainy season there are days that are very sunny and the plants wilt, so it is better to have the shade net all the year round. The idea of shade nets has been shared by my friends who have participated in the trainings.

The adaptation method used by the farmers in the dry season as narrated by most farmers and as specified in narration 1 is using shade nets to minimize the harsh sun from the plants (Fig. 9.2). Some farmers have been using the shade nets since it was introduced about 5 years back. This practice has been introduced by the older farmers who participated in the trainings organized by the agriculture ministry in these study sites. These trainings were conducted by the agriculture extension officers based in the region. This information has been shared among the farmers, and those who participated mainly in the trainings share this knowledge with their family and friends. The shade nets are used to cover mainly the scotch bonnet chillies, a chilli popular to the Maldivians as an ingredient in local dishes, which fetches a good price in the market.

9.5.2 Adaptation Methods Used During the Wet Season

During the wet season, there is a lot of rain and the homestead plots get flooded. All the participants used containers to plant short crops like chillies and use improvised fences to grow creepers during this season (Fig. 9.3). Some farmers raised the bed to plant creepers on the surface as well.

Narrative 2 (Respondent G-004)

My homestead plots have suffered from the rains and flooding. 800 plants fell from my homestead plot early this year (2018) due to rain. All the chillies are planted in the homestead plots are in containers, because it is easily available, and in the home gardens chilli and local cabbage are planted in containers. I raise the beds to plant other crops because if there is a heavy shower the

Fig. 9.2 Using shade nets during the dry season. *Source* Waheedha @ Fuamulaku

Fig. 9.3 Container gardening. *Source* Waheedha @ Fuamulaku

surface gets flooded. The lady's finger and tomatoes are planted in wooden boxes. Container gardening is used in home gardens and homestead plots for local cabbage and other varieties because when planted on the surface ground the pests attack the plants. Container gardening is also good because I have to use less water. We mainly use five-liter water bottles, because we have been informed that yellow containers attract pests and diseases and some people paint the containers black. We have to use less fertilizers in containers. During the Hulhangu monsoon, the creepers such as cucumbers are not planted on the surface. Rather, I built improvised fences and support the creepers, to prevent the plants from getting destroyed by flooding. This information has been shared by my family and friends after they have tried it out to avoid damaging the crops due to flooding.

Container gardening used by farmers since the 90s in some home gardens because they have limited space and this is used as a flood adaptation strategy in the three sites. The container method has proven to be useful because it reduces the need for fertilizers and water and saves space in a country like the Maldives which has very little arable land. This method is practised now in homestead plots as well as home gardens for multiple purposes such as avoiding the wet season and this information has been shared among the farmers in this site. Figure 9.3 shows local cabbages grown in containers.

9.5.3 Changing of Crops to Rain-Fed Agricultural Crops as an Adaptation Technique

One of the participants stated that due to pests and diseases it was very difficult to grow the short crops he used to grow in the homestead plots and he changed to rain-fed crops, planting only coconuts in his homestead plots. In this community no land rent has to be paid to the council. It is easy to manage and not labor-intensive.

Narrative 3 (FN-004)

I own two homestead plots each of 100,000 ft^2. In Fonadhoo island, we do not have to pay any land rent on the homestead plots. In one homestead plot, I have planted 600 coconut palm trees which is mainly rain fed and does not require much input. I hired helpers during the planting of the coconut trees to dig the pits required for planting of the coconut trees when they were small. The coconuts are sold to the local markets and the boats and fetch a very good price. I sell the young coconuts and also the coconuts used in everyday cooking in the Maldivian homes to both the local market as well as to the boats that

carry the goods to the Male' markets. I do not need to water the plantation since the coconut plantations are rain fed and I check the plantation on and off for any pests and diseases and cleaning of the coconut palms for a good harvest. I understand the impacts of climate change very much and I used to grow a variety of crops like pumpkin and scotch bonnet chillies I have now given up to concentrate only on the coconut plantation which is more beneficial.

Changing of the crops to rain-fed agriculture with more hardy and resilient crops have been practiced by some of the farmers as an adaptation strategy, because the changing climate and prolonged periods without rain have introduced many pests and diseases, and the chemical pesticides necessary are costly and difficult to manage. Organic farming in home gardens is an adaptation technique. All the home gardens which are inside the boundary walls of the homes and some homestead plots have changed to organic farming as an adaptation technique.

Organic farming is used as an adaptation strategy by farmers for multiple reasons. Due to the changing climatic conditions farmers in the three sites, many face problems such as unpredictable rains, soil degradation, and new or different pests and diseases. The farmers in the three sites have said that organic farming helps to maintain high soil organic matter content and soil cover which in turn helps to prevent nutrient and water loss. This makes soils more resilient to floods, droughts, and land degradation processes. Since organic farming does not use the imported fertilizers, it reduces energy consumption by eliminating the energy required to manufacture the imported fertilizers, and by using internal farm inputs, thus reducing fuel used for transportation. Similar studies have shown that organic farming is a low-risk farming method which reduces the cost of the required inputs, lowers the risk of crop failure in extreme weather events, and changes climatic conditions (Eyhorn, 2007).

9.6 Discussion

9.6.1 What Do the Local Farmers Know About Climate Change?

The finding from this study shows that farmers are aware of climate change in the study area and are trying to adapt. Most of the respondents understood that the impacts of climate change as causing increase in temperatures, lengthening of the dry periods, rainfall variations, storm surges and flooding due to rain**,** unpredictability of the weather and pests and diseases. The communities can no longer rely on observing the weather and climate by the traditional *Nakaiy* system—which is part of the formal calendar in the Maldives that depicts the weather.

9.6.2 What Do the Farmers not Know About Climate Change?

The findings of this study suggest that although there is some understanding of climate and its impacts among the local farmers there is still a dearth of knowledge on the causes of climate change consistent with a similar study undertaken in the Maldives. The Rapid Assessment of Perceptions (RAP) , undertaken in the communities by Live & Learn Environmental Education with regard to community-level adaptation of fishery and agricultural sectors, found there to be limited knowledge, awareness (and action) on climate variability, future climatic changes and their likely impact on agriculture, fisheries, and food security systems at large. All communities lack strong plans and communication systems for climate change and food security—highlighting the need for stronger links between the National Adaptation Program of Action (NAPA) and community-level planning (Shafeeqa, 2011).

This has been observed when some participants have changed the crops they were growing and experimented with new crops which were not based on any valid source of information. Thus, farmers need a valid source of information at the island level on climate change and its impacts in order to adapt to the changing conditions and to be more resilient in the future. A similar study undertaken by Foran (2014) suggests that there is a need to introduce new approaches to agriculture research which are more climate smart and the building up of decentralized knowledge networks that can address these complex issues at the community level to reach out to the small-holder farmers are very important.

9.6.3 How Do Farmers Adapt to Climate Change with the Knowledge They Have?

Participants had limited information on climate change and its impacts on the crops. Some of the participants learnt from his/her own experience and the other respondents received information from different sources including workshops, radio, visiting personnel from the agriculture ministry officials, field officers, and from other farmers. The respondents have expressed the reasoning and understanding based on their everyday experience with growing their crops which is very much tied to their livelihoods. In Gan and Fonadhoo, a lot of awareness programs on climate change and its impacts have been a part of the training given under programs for the United Nations Development Programme (UNDP) and other non-governmental organizations based in this atoll. The findings of this study show that the respondents are making efforts to adapt to the changing conditions and adapt based on their experiences. However, lack of technical know-how and information is a hindrance to make the farmer community more resilient.

9.6.4 What Are the Strengths and Weaknesses of Their Current Adaptation Practices?

The current adaptation practices that have been documented give the readers an overview of how farmers in the three sites are trying to cope with the changing climate by using local knowledge and experiences and other information gained from various sources. All current adaptation practices that have been captured in this study may not be considered as the best adaptation options. Some of the reasons are lack of technical know-how and information. However, these strategies will not suffice in the future in changing climatic and environmental conditions. The findings of this study show autonomous and experimental adaptation strategies being implemented by farmers.

9.6.5 What is the Role of Social Capital in Adaptation?

This study has shown that women farmers who tend to the home gardens and the homestead plots with the assistance from their families and those who have participated in the agricultural workshops undertaken in the island are more likely to contribute to the farming social capital. With regard to demographic features, the women farmers who are younger show a more positive relationship in contributing to social capital. The three studied communities are adapting to the climate change impacts at an individual and household level and not at the societal level, because agricultural plots and home gardens are owned by individual farmers and there are no informal or formal institutions formulated to deal with the challenges regarding climatic variations. Information is shared among some of the farmers especially the younger women farmers and critical resources accessed by sharing this valuable information with each other. Farmer organizations or non-governmental organizations working for the benefit of farmers were not visible in the three study sites. However, this study has shown that among individual farmers a lot of interactions and critical information are shared among the individual farmers and within families who work in the home garden and homestead plots and thus can be called social capital at the family and individual level. The trust factor was very low among and between the farmers working in the same communities.

9.7 Conclusion

Farmer cooperatives are an important institution for farmers to build trust and reciprocity which has been identified as one of weakest links among the surveyed communities. The adaptation policies need to take into account the building of social capital and such policies are critical for the farmers so that in the future the social capital

can be harnessed to its full potential in the island communities. The farmers lack the technical knowledge and information on best adaptation practices and on this basis this study suggests designing of effective agriculture-related adaptation policies considering all the characteristics of the farmers in the island communities. These findings are important when designing agricultural policies in contributing to sustainable agriculture in the islands of the Maldives.

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