

Climate Change Adaptation On Small Islands: Towards An Effective And Sustainable Fijian Approach

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Abstract

Small islands are referred to as climate change hotspots. Here, the detrimental effects of sea-level rise, rising heat, and fluctuating weather patterns are now being felt, highlighting the urgency of adaptation. While small islands are disproportionately affected by the adverse effects of climate change, they are also disproportionately resilient. Not only are small islands at the epicenter of climate change impacts, but they are also at the epicenter of climate change responses. Island people have an extensive history of resiliency, enduring in resource-constrained, vibrant, and remote settings, if not thriving. Fiji's way of life has included resilience to environmental and climate hazards for centuries. Fiji is one of the most climate-vulnerable nations. Even if global warming is limited to 1.5 °C, Fiji will suffer severe harmful climate change consequences. As the effects of climate change deteriorate, Fiji will see an increase in life-threatening events such as flooding and famines, as well as more powerful cyclones. This chapter will highlight the Fijian response to sustainable climate change adaptation and mitigation. It will highlight the adaptation approaches that have been implemented in response to the impacts of climate change and the extent to which these adaptations have been deemed successful.

Keywords: Climate change action, Adaptation, Barriers, National Action Plan, Ecosystem-based

Introduction

The Republic of Fiji is a growing tiny island nation in the South Pacific archipelago. There are roughly 900,000 inhabitants, most of whom reside on the two major islands of Viti Levu and Vanua Levu. These islands are volcanic and rocky. Nearly 90% of people reside in coastal regions, with more than half in cities and towns. The proportion of people living in urban areas keeps rising (Government of Fiji, 2018). Fiji has a per capita income of \$10,000, making it a middle-income state, but there are significant differences in income between rural and urban

areas. According to projections, per capita income will quadruple by 2036 under annual real GDP growth of 4-5 percent, GDP investment levels of 25%, and inflation of 2-3%. Due to its geographic location, the concentration of its population and belongings in coastal areas, and the importance of natural resources to the country's main economic sectors, Fiji is especially vulnerable to climate change (agriculture and tourism, for example). The country's National Development Plan faces considerable challenges due to natural disasters and climate change. Flooding and tropical

cyclones, which already have a substantial impact on the economy and society, are hazardous in Fiji (Government of Fiji, 2018).

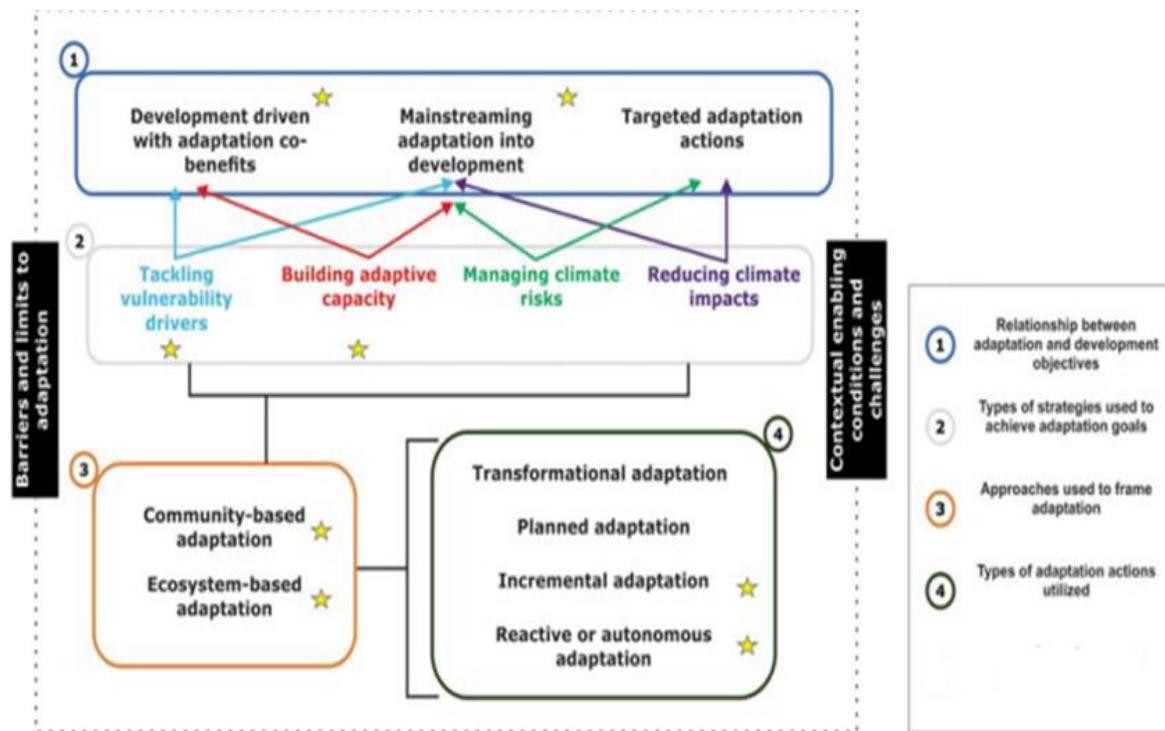
Since the turn of the century, the average air temperature has risen by 0.90°C, in line with the global warming trend (FMS, 2016). Even while ENSO events substantially impact daily rainfall trends, historical rainfall data shows that long-term rainfall is not much affected by ENSO occurrences (CSIRO, 2014). Sea temperatures rise linearly every ten years at a pace of 0.3°C, according to the currently available data. Observations of sea level between 1993 and 2015 show an increase of 4.7mm year, which is consistent with trend measurements in the region (FMS, 2016). Due to the limitations of observational records that are vulnerable to shorter-term ocean changeability (such as El Nino and Pacific decadal alternations), current estimations are still insufficient (FMS, 2016).

Tropical cyclone frequency varies widely, and there is no apparent difference between El Nino, La Nina, and neutral years. Between 1969 and 2011, an average of 28 cyclones was experienced by Fiji's exclusive economic zone each decade. Seventy-eight tropical cyclones formed between 1981 and 2011, and 32% had severe consequences (CSIRO, 2014). Tropical cyclones have dropped during the past forty years, keeping with climate change predictions, although the fraction of intense tropical cyclones has grown (FMS, 2016). Countries in the Pacific have undertaken a range of Climate Change Adaptation (CCA) strategies over the past 20 years in response to the expanding effects of climate change. These initiatives range from actual on-the-ground projects to incorporating

climate change into national and sectoral policies, plans, and strategies.

Additionally, this area of work includes several other DRM activities and projects that relate to climate and weather but may not have been labeled explicitly as CCA. Around 500 projects totaling US\$1860 million were financed between 1999 and 2009, and many were carried out with the financial and technical help of bilateral or multilateral development partners. (Hay, 2009a). These efforts addressed several challenges, including sectoral adaptation, mainstreaming, and climate risk management. Based on various regional projects funded by AusAID (Australian Agency for International Development), the European Commission, the United Nations Development Programme, the Asian Development Bank, and the World Bank, the majority of regional CCA projects that have been carried out in the Pacific in recent years have emphasized capacity building in some way, including institutional strengthening for better decision-making, policy development, and planning (IUCN, 2011). Existing adaptation strategies, including community-based adaptation (CBA) and ecosystem-based adaptation (EBA), are well-suited to the Pacific Islands, which are primarily rural/peripheral subsistence ecosystems (Clarke et al., 2019; Dumaru, 2010; Farrelly, 2011; Pearson et al., 2020; Remling & Veitayaki, 2016). As the most efficient ways to achieve climate adaptation goals, these strategies are also highlighted in Fiji's national adaptation plans (Government of Fiji, 2018).

Figure 1. A diagram illustrating the key concepts used to define climate adaptation initiatives.



Source: Hidalgo et. al (2020)

The figure illustrates key concepts for comprehending climate adaptation initiatives, their relationship to development goals, and the approaches, strategies, and actions used to accomplish them. Fiji has a range of adaptation strategies available to address at least some of the anticipated impacts of climate change. These strategies are already in various stages of implementation as part of ongoing development activity. Adaptation in Fiji is focused on the four major critical sectors of coastal resources, agriculture, human health, and water resources.

Materials and Methods

This study is descriptive and based primarily on secondary data sources on Fiji's climate change adaptation strategies. Secondary sources include government reports, published books and articles, and unpublished softcopies obtained via the internet and software. Additionally, various government websites have been consulted. The Republic of Fiji's National Action Plan is the primary source of information and data. The data was compiled from multiple sources and

presented in paragraphs, tables, and diagrams. A brief case study of Druadrua island has been presented to highlight the adaptation strategies carried out in one of the island communities in Fiji.

Results and Discussion

Ecosystem-Based Adaptation

Fiji was one of the first developing nations to create a national action plan (NAP). On December 12, 2018, it officially became the twelfth to be communicated to the United Nations Framework Convention on Climate Change (UNFCCC). Since then, Fiji has started implementing the adaptation strategies emphasized in its National Adaptation Plan, a particularly ecosystem-based strategy such as increasing vetiver grass growth. This is mainly because of Fiji's initiatives to elevate ecosystem-based adaptation to a strategic priority and scale it up through its national adaptation planning process (Terton et al., 2021).

Since it is well known, it was crucial to identify and include "ecosystem-based" strategies in the adaptation preparation operations. They accepted that natural capital and the state of ecosystems significantly impact society's exposure and sensitivity to climate variability and change and its capacity to adapt. Ecosystem-based adaptation (EBA), also known as ecosystem-based mitigation (EBM), is a type of climate change adaptation that prioritizes ecosystems, strengthens them, preserves biodiversity, and secures the resources they provide as part of a larger adaptation strategy to assist people in managing the adverse effects of climate change (CBD, 2009; Munroe et al., 2011; Doswald et al., 2014). Ecosystem-based adaptation techniques are crucial on a global scale, according to the UNFCCC. The Paris Agreement emphasizes how important it is to maintain ecosystem stability. Such methods also link the UN Framework Conventions on Climate Change, Biodiversity, and Desertification. Incorporating ecosystem-based adaptation techniques strengthens the government's ability to uphold the Bill of Rights outlined in the Republic of Fiji's 2013 Constitution. Specifically, the mechanisms ensure that all citizens have access to sufficient basic needs, health care, and a hygienic, healthy, and secure environment. Additionally, ecosystem-based adaptation strategies can favor low-income and other underprivileged groups. These groups frequently excessively depend on natural resources, biomes, and their services for survival and are frequently disproportionately impacted by natural environment degradation (Reid, 2015).

Ecosystem-Based Methods for Adaptation Planning

Ecosystem-based adaptation is one of four "underpinning methods to the NAP process," according to Fiji's National Action Plan Framework, which also highlights the significance of resilient ecosystems (Government of Fiji, 2017b). In the NAP manifesto, efforts to

protect, preserve, and restore natural capital are emphasized, along with the importance of biodiversity and the environment for society and economic development. Regarding giving ecosystems and ecosystem-based adaptation top priority during the NAP planning process, Fiji is a global pioneer. The advice note from the NAP Global Network on maximizing ecosystem-based adaptation through NAP procedures is detailed in the following section to provide an example of Fiji's recent experience (Terton & Greenwalt, 2020).

The first guiding principle highlights the importance of ecosystems in decreasing human vulnerability, sustaining livelihoods, and promoting socioeconomic growth. The Fijian NAP prioritizes socioeconomic development, livelihoods, and people, emphasizing that ecosystem-based adaptation "benefits the Government's long-term ability to implement the Bill of Rights outlined in the Republic of Fiji's 2013 Constitution. Ecosystem-based adaptation "may be especially helpful for low-income and other disadvantaged people" to "secure the right of all citizens to adequate food and water, health, and a clean, healthy, safe environment" (Government of Fiji, 2018). This establishes a crucial mandate for the prioritization of sector-specific ecosystem-based adaptation options. The NAP highlights the critical part that healthy, functional ecosystems play in society and economic development (Terton et al., 2021).

The NAP details how climate change will affect ecosystems and the resources they support. The Government of Fiji's 2017 Climate Vulnerability Assessment (CVA) strongly supported the creation of the NAP (with assistance from the World Bank and financing from the Global Facility for Disaster Reduction and Recovery). In this CVA, which presented the business case for biodiversity and natural resource protection, one of the five intervention areas was highlighted as the need to conserve ecosystems and the local environment to secure significant development

assets (Government of Fiji, 2017a). "Promote the application of both traditional and scientific knowledge as appropriate" was one of the NAP's criteria for judging the significance of adaptation measures (Government of Fiji, 2018).

The third guiding concept adopts a comprehensive strategy for the NAP process that considers ecosystems across all industries. Early in the process, Fiji's NAP incorporated EbA as a guiding principle by including it within the NAP Framework. As more industries joined, this helped with planning and prioritizing adaptation efforts. This entails taking into account the extensive expertise and experience held by many national stakeholders in EbA at every step of development planning and decision-making. The NAP emphasizes the importance of developing a "socioecological system" for planning development that makes it simpler to understand how human activities interact with and affect the entire ecosystem and the opposite (Government of Fiji, 2018). Additionally, it emphasizes prioritizing actions to at least partially adopt EbA over complex (grey) infrastructure options (Terton et al., 2021).

The fourth guiding principle supports global policy alignment by considering how EbA solutions and other pertinent international agreements interact. The EbA practices and their related advantages for people's lives and livelihoods are highlighted in the Fijian NAP. However, it also acknowledges EbA's great potential to support a planned, coordinated strategy for meeting international sustainable development objectives. The NAP is recognized as a complementary tool that can assist in achieving the goals of the National Biodiversity Strategy and Action Plan in addition to carrying out the responsibilities of the Paris Agreement. Fiji made a deliberate effort to include its commitments under the UNFCCC, the Sustainable Development Goals (SDGs), and the Sendai Framework for Disaster Risk Reduction throughout the development of the NAP. For

instance, Fiji emphasizes that any component connected to adaptation is operationalized using the Nationally Determined Contribution (NDC) approach. Another feature of the NAP (2015-2030) discusses the Sendai Framework for Disaster Risk Reduction and the Sustainable Development Goals of the 2030 Agenda (Terton et al., 2021).

The fifth guiding concept is to produce the best EbA solutions through the inclusive and collaborative nature of the NAP process. The NAP for Fiji was developed through a multi-stakeholder participatory process that adhered to the following guidelines. Encourage "ecosystem-based" and "gender and human rights-based" adaptation tactics (Government of Fiji, 2018). The NAP also emphasizes the importance of addressing trade-offs between social, economic, and environmental results by adopting participatory methodologies. By including these concepts in the NAP process, we may raise the possibility that EbA investments will have equitable benefits for people of all genders and social categories, especially the most vulnerable.

Guiding Principle six engages subnational and local governments in designing and implementing regional and local EbA solutions through the NAP process. Fiji's NAP recognizes and appreciates the significance of subnational government engagement and linkages due to the localized nature of adaptation. Vertical integration is also emphasized in Fiji's NAP as a crucial potential for integrating EbA and adaptation. The fair provision of ecosystem services will be aided by linking community-based adaptation to national planning, boosting participation in decision-making and development planning procedures.

The seventh guiding principle adopts a long-term perspective and guarantees adequate funding for implementing EbA solutions. The NAP statement strongly emphasizes long-term capacity building to ensure successful adaptation, particularly EbA.

To promote and contribute to long-term institutional learning and growth, a focus is being made on increasing the capacity for generating, managing, disseminating, and exploiting climate change information. A crucial tenet from Fiji's National Climate Change Plan (NCCP) is also incorporated into the NAP: "Programs and initiatives should have long-term, favorable ecological, economic, and social effects." The NAP for Fiji acknowledges that finance is a significant potential barrier to implementation and that it is necessary to have a comprehensive financing strategy for all possible sources of money (public, private, and international). The Fijian government has created a costing methodology (Government of Fiji 2020a) for this financial strategy incorporating EbA measures. Given how crucial it is to adapt, the Fijian government has made every effort to consider the participation and perspectives of the private sector. This involves educating companies in the private sector that depend on Fiji's ecosystems, such as the tourism industry, the sugar industry, the forestry sector, and companies like Fiji Water, about EbA and the possibilities for natural-based or hybrid solutions.

Guiding Principle eight develops a solid evidence base for EbA solutions to ensure accountability and performance as part of a more extensive NAP monitoring and evaluation (M&E) system. The NAP lists activities to "create strong multi-criteria monitoring and evaluation systems" to evaluate the effectiveness of national, sectoral, and local adaptation strategies (Government of Fiji, 2018). It specifically highlights how crucial it is to establish and improve the monitoring and evaluation of ecosystems and natural resources, especially national water resources. In Fiji, work is now being done on the NAP's monitoring and assessment system. It acknowledges the potential connections between the NAP and SDGs 13, 14, and 15, the latter ecosystem-focused, and EbA as a criterion for prioritizing actions in the NAP.

Adaptation in the Interest of Gender and Civil rights

Gender and civil rights issues and approaches are critical to identifying and integrating into adaptation design. Experience, sensitivity to climate change, and adaptability vary greatly among social and economic categories, as is well-established and widely acknowledged. Due to prevailing inequality and non-climatic variables, it is also generally accepted and entrenched. As a result, without addressing these underlying vulnerabilities, climate change susceptibility cannot be fully addressed (McGray et al., 2007). The NAP procedure has become a crucial opportunity to acknowledge the multiple intersectional truths, intervene on behalf of vulnerable groups, and assist efforts to eliminate persistent forms of injustice and perception (Dazé and Dekens, 2017). Universally, the UNFCCC and many other international accords and organizations prioritize human freedoms and gender equality. To maximize the potential of women as dynamic agents of change and drivers of climate-resilient progress, gender integration is given special attention. In particular, it is necessary to improve the well-being of the female population by ensuring their whole, fair, and significant contribution to and access to opportunities and assets. It is crucial to include gender and human rights issues nationally. Climate change hinders the government's ability to execute the Republic of Fiji's 2013 Constitution's Bill of Rights in the long run, eroding its current efforts. Irrespective of their actual or perceived individual characteristics or settings, all people are given several privileges under this law and a right to a hygienic, healthy, and secure environment. These advantages include fairness and the absence of discrimination, access to evidence and education, adequate basic needs, good well-being, comfortable lodging, sanitary conditions, and transportation.

Approaching Adaptation Planning with a Gender and Human Rights-Based Perspective

It is crucial to recognize the distinctive consequences and levels of vulnerability that different social groups experience to put a "gender and human rights-based" approach to adaptation planning into practice. Low-income and marginalized clusters must also be seen as "active agents of change" instead of a "susceptible group," which might restrain agency. The NAP Framework lists the LGBTQ community among low-income and other underprivileged clusters, with the aged, teenagers, and women. Marginalized groups must embrace development planning strategies to proclaim their human rights and obtain equitable access to management roles, policymaking processes, opportunities, and resources. Consequently, it is acknowledged that the NAP is a crucial tool for executing the state gender rule (MoWCPA, 2014).

To fully include low-income and other disadvantaged groups in the development decision-making processes at all levels and throughout the formulation, implementation, and monitoring of policies and plans, this NAP aims to assist efforts to remove all hurdles that stand in their way. Numerous rights enshrined in the Republic of Fiji's 2013 Constitution were used as the benchmark for evaluating the rationality of prioritized actions and identifying individual components that comprise the NAP's structure. The NAP document, on the other hand, was developed as a high-level strategic plan. As a result, the degree to which outcomes equitably benefit underrepresented groups will depend on how successfully prioritized activities are carried out. However, as a policy document, the NAP sets standards for incorporating gender and human rights considerations within NAP processes and (multi) sectoral institutional arrangements. They are urged to be included in all sections of this and future NAP papers and associated procedures. The organizations in charge of its execution,

monitoring, and assessment are required under this NAP document to demonstrate that they have embraced or surpassed best practices. When operationalized to take into account the context-specific needs of low-income and other disadvantaged groups, maximize their potential, and ensure equitable access to opportunities and mobilized resources at all stages of project design, implementation, monitoring, and evaluation, each of the prioritized strategic actions in the document is anticipated to include pertinent gender and human rights perspectives. Results that fairly benefit vulnerable groups are unlikely to occur without it. The operationalization of a gender and human rights-based strategy will require the involvement of gender specialists and focal points. The following equipment and procedures are essential: 1) Institutional capacity assessments; 2) official engagements receptive to the desires of low-income and underprivileged groups (such as gender-sensitive standard operating procedures); and 3) sex- and age-disaggregated data.

Realizing that human rights and gender-based perspectives impact many businesses. is critical for instance, this approach raises the level of inclusivity and participation quality. Additionally, it aligns with community-based adaptation strategies, with numerous connections to ecosystem-based adaptation strategies. Additionally, broadening women's participation will likely result in significant indirect benefits. For example, because females are the key caregivers, any increase in their awareness of sustainable resource use and administration will probably be handed down to their children (Ram-Bidesi, 2015). All shareholders, both universal and domestic, as well as through all stakeholder groups, will need to work together to mobilize the necessary resources to gather appropriate proof and share experiences to constantly develop the amalgamation of gender and human rights into development design procedures and acknowledge

this as a constant learning-by-doing procedure (Government of Fiji, 2018).

The Fiji Climate Change Action Project

Two of the most vulnerable groups listed in Fiji's Climate Change Policy Framework, water supply, and coastal ecosystems, were the focus of the Fiji CCA Project, which was established to test a unified approach to CCA in six rural Fijian villages. The project's objectives included increasing public awareness of climate change, incorporating its adaptation into local governance processes, and selecting and implementing workable adaptation options. The study, which AusAID funded, was carried out by the Pacific Centre for Environment and Sustainable Development (PACE-SD) and the University of the South Pacific's Institute of Applied Science (IAS) (USP). Representatives from several government agencies, academic institutions, conservation organizations, non-governmental organizations (NGOs), regional development organizations, extra contributors, and private water and coastline industrial experts made up the advisory council for the project (Dumar, 2010).

Implementation and Outcomes of the Fiji CCA Project On Druadrua Island

The creation of the country's initial Community Adaptation Plan (CAP), as illustrated in Table 1, was a notable result of the Fiji CCA Project in Druadrua. The recommendations from a technical report by water engineers that had been condensed and translated into Fijian were included in the plan, which was created in partnership with the community. The CAP was developed to comprehend that in reaction to new information and lessons learned. The community might change it to consider new adaptation objectives, like food security and health. After the CAP was developed, the island's first water committee was formed, and it has since helped the inhabitants coordinate with outside parties to carry out the plan. As a result, the CAP has been modified to consider unmet opportunities and facts (Dumar, 2010).

Table 1 Adaptation Plan, Druadrua community, October 2007

Source: Dumar, 2010

| Activity | Responsible stakeholders | Implementation date |
|--|---|---|
| Ascertain that the prohibition on bush burning on Druadrua Island is adhered to | Druadrua community | Ongoing |
| Control the island's tree chopping | Druadrua community | Ongoing |
| Ascertain that the island's ban on pine planting is adhered to | Druadrua community | Ongoing |
| The workshop on community water management will focus on the maintenance and operation of the community water system and water conservation. | USP, MRD, Department of Energy, SOPAC, Rural Water Authority (Labasa) | Nov 2007 to April 2008 |
| Ascertain that the community is consulted and that its perspectives are incorporated into the design and implementation of future water and other development projects. | Relevant government departments, development agencies, and Druadrua community | Ongoing |
| Evaluate the dam's water system, which is currently inactive due to technical difficulties. | MRD, Rural Water Authority, Druadrua community | October–December 2007 |
| Ascertain that the prohibition on goat rearing is adhered to | Druadrua community | Ongoing |
| Assure that the springs are kept clean. | Druadrua community | October |
| Compile a 'Program for Sustainable Island Development | USP | 2010 |
| Create household rainwater collection systems | Druadrua community | 2009 |
| Borehole drilling in the school and Delaivadra | MRD | October–November 2007 |
| Three solar pumps were installed to supply water to three newly drilled boreholes (at the school, Delaivadra village, and Salevukoso village) and two bore-hole water tanks for the two villages. | USP, Druadrua community, and Department of Energy | November 2007 to April 2008 |
| For the village, test a compost toilet. | Druadrua community | In progress (community and local Peace Corps) |

Three stand out among the numerous benefits of the Druadrua CCA project, including upgrades to

water supply systems. They are institutionalizing an adaptive approach to water resource

management, raising local understanding of the risks posed by climate change, and creating networks that make it easier for people to access information and resources. The following factors explain these findings: (1) The survey's results show that the Fiji CCA Project helped the Druadrua community understand the need for adaptation, climate change causes, and its likely future implications. The project implementers presented scientific explanations of climate change to supplement the community members' observations of changes in their local surroundings. Community leaders and decision-makers, who were especially appreciative of this increased awareness of climate change, encouraged and supported the community's involvement in the project and the acceptance and recognition of the new water management plan and committee as an integral part of the community governance system. These results show a greater local capacity to adapt to climate change, even though they directly benefit community-based water management (Dumaru, 2010).

Priorities for Adaptation by Sector

Agriculture

The National Growth Plan for Fiji identifies agriculture as a transformative focus for the country's development (NDP). It is crucial to the Fijian economy and directly and indirectly impacts the quality of life of 118,801 families (FBS, 2017). Agriculture has produced an average annual export revenue of FJD 194.2 million during the past five years. Fish, forest products, sugar, mineral water, and alcoholic beverages are not included in this. The NDP wants to boost production and export self-sufficiency in areas with a competitive edge. The Fijian government has been concerned about how climate change may affect the country's agriculture industry. According to various projections, Fiji could lose between 2% and 3% of its gross domestic product due to climate change-related losses in agricultural production.

The CVA highlights the severe danger that climate change poses to the agricultural industry and the NDP's goals. It suggests investing FJD 14 million in climate-proofing techniques to maintain these goals.

The suggested activities considerably improve resilience by boosting capabilities for anticipating, reducing, and managing environmental and climate threats. Climate-smart agriculture adjusts and reorients agricultural systems to offer food security when faced with shifting climate scenarios. This is accomplished by developing the most cutting-edge agricultural inventions and methods. The use of traditional and scientific knowledge, institutional improvements, and an improvement in the coherence of agricultural and climate policies and funding are all supported by cooperative stakeholder participation for the generation of evidence (Lipper et al., 2014). By incorporating the administration of natural resources pertinent to agriculture and land use so that societal demands are addressed without endangering the long-term viability of ecosystems, sustainable land management contributes to the decrease of vulnerability.

Health

As a result of geographical and socioeconomic issues, susceptibility to fluctuating weather patterns, and a restricted capability to regulate and adjust to linked health hazards, Fiji is exposed to the adverse health effects of climate change. The expected impacts of climate change on Fiji's health will manifest themselves in three ways. The first direct victims of weather and climate extremes will be the populace. Second, adverse ecological system alterations will influence where and how much communicable illnesses conveyed by vectors are present. Thirdly, destroying traditional homes and towns will severely impact mental health, including stress and trauma. Dengue, typhoid, leptospirosis, and diarrheal disease are the four main climate-

related illnesses, and their unpredictable and widespread consequences on human health are of utmost concern (McIver et al., 2012). Following floods or cyclones, several disorders are regularly reported in Fiji (GoF, 2017). It is imperative to address these detrimental repercussions to reduce the harmful effects of climate change and increase adaptive capacity. Developing other types of human capital depends on maintaining good health, a crucial component of human capital. As a result, emphasizing health as a part of increasing resilience makes logic. Health would significantly impact adaptation ability even if climate change had no adverse effects on human health. In other words, investing in health is a no-brainer because it benefits irrespective of climate change.

Human Settlements

Both rural and urban areas are vulnerable to various environmental and climatic risks, which is a severe concern. Vulnerability results in planning and administrative efforts that fall short of appropriately supplying serviced land in safe regions for home construction due to littoralization, a lack of public sector resources, and vulnerability (GoF, 2017). Middle- and low-income earners have been disproportionately affected by this due to the expense of safe housing being driven way outside the reach of the majority population. This has led to an increase in squatter settlements, which the CVA refers to as "vulnerability hot areas," along with an increase in urbanization (GoF, 2017). Additionally, due in part to poor building regulations, one in five households lost their whole home and personal goods to Cyclone Winston, leaving them without insurance (GoF, 2016; Lucas, 2015). It will be essential to address these negative repercussions to reduce the adverse effects of climate change and increase adaptive ability. Increased efforts to make urban regions more resilient help the country's ability to adapt because they play a prominent role in economic activity at the national level. More significant benefits from

better land use, management, and development include lowered costs for public services, less urban sprawl, increased security for natural resources, and a decline in collective prejudice (UN-Habitat, 2015). The well-being of the household depends on resilient housing, a substantial domestic strength to which families devote extensive resources. Future resource savings can come from investing in resilience-boosting measures now. For instance, a recent analysis of Lami Town's adaptation options revealed that, despite the potential for FJD 232 million in damages, implementing adaptation actions to lessen or avert these expenditures would merely cost FJD 24 million over two decades (Rao et al., 2013).

The Natural Environment and Biodiversity

It is becoming increasingly clear how crucial the environment and biodiversity are to supplying Fiji with essential ecosystem products and services. The nation's aquatic ecosystem services are estimated to be worth FJD 2.5 billion annually (Gonzalez and Ram-Bidesi, 2015). A significant fraction of economic activities, especially those that are crucial to the national economy, is supported by these products and services on a biophysical level (fisheries, forestry, agriculture, and tourism). Due to its importance as the primary driver of the economy, tourism is particularly significant. Nearly 40% of Fiji's GDP and employment come from tourism. It supports and creates jobs while also being essential to keeping the country's balance of payments.

Additionally, by charging tourists' admission fees, the tourism sector has an excellent opportunity to contribute considerably to maintaining protected areas (Sykes et al., 2018b). But the CVA's findings show that a large portion of Fiji's biodiversity and natural surroundings is susceptible to climate change in the medium and long term (GoF, 2017). For instance, coral reef ecosystems are highly vulnerable to climate change, and the Pacific region's coral reefs have

a grim future. National ecosystems are rapidly deteriorating due to inadequate security from development-related undertakings like unsustainable logging, clearing for infrastructure, agriculture, commercial development, and overfishing. The advantages of climate resilience are diminished by society's reduced capacity to adjust to climate change's effects. Intact ecosystems have significant financial benefits for the tourism industry, which is Fiji's primary source of income (Government of Fiji, 2028).

Adaptation Barriers

The term "adaptation obstacles" refers to solvable problems that either 1) hinder the growth and mobilization of adaptable capacity, 2) limit the variety of readily available adaptation choices, or 3) lessen the efficacy of approved adaptation options (Biesbroek et al., 2013). They are not susceptible to these restrictions, in contrast to adaptation limits, which are described as thresholds that, if exceeded, have irreparable consequences (Klein et al., 2014b). The planning process must take adaptation hurdles into account since they control the implementation of government policy. Barriers are essential because they prevent adaptation even when communities, businesses, and the government have high adaptability levels.

Barriers to information, knowledge, and technology

By disguising the necessity of adaptation, the extent to which adaptation is required, what must be modified, how adaptation occurs, and the related results and impacts, information, knowledge, and technology barriers hinder adaptation. Increasing resilience at all levels will depend on addressing adaptation knowledge gaps and communication problems (Williams et al., 2015). In Fiji, the availability of information, knowledge, and technology is frequently inadequate, contributing to its high prevalence. For instance, the GGF stressed the significance of comprehending climate change's effects to

prepare for long-term climate-resilient development (MoE, 2014). It is necessary to have access to flood maps similar to those in Nadi for all major population centers (GoF, 2017). Enhancing information exchange agreements, compatibility, and administration would considerably improve monitoring and evaluation efforts (Zenos, 2016; BRCC, 2012). To support initiatives to aid low-income and other disadvantaged groups and make it easier to monitor and evaluate progress at the national and sub-national levels, it would be highly beneficial to establish a registry of "near-poor and vulnerable" individuals who have been identified through the application of a forceful and collective vulnerability agenda (GoF, 2017).

If local investors were more knowledgeable about climate change, it would be simpler to increase community understanding of the implications and potential adaptation measures related to the phenomenon (Lata and Nunn, 2012; Nunn et al., 2014; Dumar, 2010; Nunn et al., 2016). It would be better if there were more climate information services, knowledge brokers, and mediators to make sure that pertinent information is available when it's needed and presented in a way that end users can comprehend and act on (Lata and Nunn, 2012; Nunn et al., 2016; Janif et al., 2016). The ability of communities, the private sector, and sub-national development planners to obtain locally pertinent information would increase their comprehension of hazards in the context of their proper geographic location. Hazard mapping, socioeconomic statistics, seasonal and climatic estimates, and other data may be included in this material. This knowledge should be incorporated into the planning processes for subnational development to promote resilience. Urban regions, where most people and essential infrastructure are concentrated, particularly need it (UN-Habitat, 2012). Incorporating ecosystem-based approaches into program design would be easier if commercial sector organizations, non-governmental organizations, and community-

based organizations were more aware of ecosystem-based adaptation. The potential for green, natural, or hybrid infrastructure solutions to reduce environmental and climate risks should be given special consideration (WCS, 2016). The advantages of raising awareness of gender and human rights-based initiatives are equivalent.

Barriers to governance and institutionalization

Governmental and formal restrictions limit adaptive capacity by amplifying vulnerability causes and obstructing resource movement and action where needed (Klein et al., 2014a). These are the difficulties that are most typically cited when using Fiji as an example (e.g., BRCC, 2012). This is most likely a result of national development processes not paying enough attention to the issues that climate change causes, exacerbates, and introduces. Establishing climate change focal points or units with the capacity and authority to manage cross-sector mainstreaming within government and inside projects will considerably aid in incorporating environmental and climate risk. Government ministries can cooperate and coordinate by identifying cross-sectoral connections and dismantling silos (MoE, 2014; ADB, 2016; SPC, 2015). The integration procedure would benefit from more widespread usage of development planning tools. Assessments of the desired environment, multi-criteria analysis, combined vulnerability assessments, gender analysis, and action plans will ensure fair outcomes, sound decision-making, and trade-off management for low-income and disadvantaged groups. Planning for adaptation and disaster management would greatly enhance budgeting and planning procedures for development (MoE, 2014). This is crucial because, as the saying goes, "the weakest link primarily determines vulnerability," and strengthening one area without addressing the others is unlikely to be successful (GoF, 2017).

If budgetary procedures were changed to consider environmental and adaptation-related activities through official lines at national and subnational levels, tracking adaptation measures would be substantially facilitated (MoE, 2014). In general, attempts to build resilience will be helped by increasing resources and support for enforcing pertinent laws, notably those that promote and control the use and management of natural resources (MoE, 2014; GoF, 2017). As a result, there needs to be more monitoring, assessment, and comprehension of climate change adaptation. For instance, the NCCP did not mandate project reporting or the advancement of climate change-related activities within or outside the government (Zenos, 2016). Improvements can be made to local government and subnational development planning procedures to ensure that evolving environmental and climatic concerns are adequately considered by subnational organizations, management systems, and financial operations (MoE, 2014).

It is also possible to upgrade the procedures and equipment that guide decision-making and control trade-offs among numerous potential courses of action and development. To prevent councils from unintentionally underrepresenting certain groups, such as women and adolescents, adequate care must be taken (UN-Habitat, 2012). A comprehensive, regularly scheduled platform and forum for managing knowledge and information about adaptation would support adaptation initiatives (MoE, 2014). Many great efforts have been or are currently being undertaken, but there is insufficient knowledge exchange. There are worries that this might lead to redundant efforts and a diminished impact of limited resources. Institutional learning is hindered because it prevents the integration of lessons learned into current and future practices.

Additionally, it makes coordinating efforts harder, making attempts less effective. Whether during planning, implementation, monitoring, or assessment, there is room for improvement

concerning the inclusion of low-income and other disadvantaged people in adaptation planning. These people have a lot of experience with the flexibility (BRCC, 2012).

Financial Obstacles

Financial knowledge, capital, and services are essential elements of adaptive capacity, and financial constraints hinder adaptation. Wide adaptation measures, such as more inclusive decision-making procedures, call for significant financial capital. It is necessary to take a comprehensive approach to resource mobilization that 1) boosts adaptation financing, 2) aligns financial flows to support a climate-resilient path, 3) encourages private sector, household, and community autonomy in adaptation, and 4) coordinates financial inclusion efforts with other development and adaptation efforts. The amount of money available for crucial infrastructure investment and conservation needed to mitigate the additional risks associated with climate change would grow with more adaptation funds (GoF, 2017; GoF, 2016; MoE, 2014). We can lessen the pressure on the limited resources at the national and household level that is currently being directed toward disaster recovery efforts rather than prevention and risk reduction by incorporating risk transfer mechanisms and contingency finance into the development planning processes (GoF, 2017). For example, recovery operations from the severe tropical hurricane Winston continue to get only a little cash from national budgets. According to climate simulations, future storm intensification will likely result in comparable financial effects.

Finance's capacity to drift to this level to support adaptation processes would be considerably improved by expanding the structures, modalities, and fiduciary management at the local level. Additionally, by streamlining budgeting and resource mobilization processes, projects can be supported quickly and adaptably while

meeting local needs. Further, they could be developed to encourage the utilization of green infrastructure and recover natural resources that support adaptability (WCS, 2016). There is a huge opportunity to improve financial inclusion in rural areas and farther-flung islands, which would considerably aid measures to reduce vulnerability. Additionally, it might act as a catalyst for the growth of the job market, the abolition of poverty, and long-term economic progress. Modernizing financial services to incorporate environmental and climatic hazards could support private sector efforts to reduce susceptibility, and DE encourages riskier investing behaviors.

Economic Obstacles

The frequent occurrence of low returns, Fiji's distance from critical economic hubs, and relatively low investment are all significant barriers to adaptation that restrain economic progress (GoF, 2017). Climate-sensitive industries that strongly rely on biodiversity and other natural capital dominate the country's economy (Gonzalez and Ram-Bidesi, 2015). Although there are adaptive measures to lessen these sectors' risk, there will always be a residual vulnerability. If the demands of the private sector were considered while designing the adaptation, some of the issues caused by economic barriers would be significantly minimized. This assistance should provide private sector entities with the tools and capability to identify and mitigate climate risks in their supply chains and business portfolios, so they can participate in subnational development planning procedures and strengthen ties with private sector entities and representative bodies like the Fiji Business Disaster Resilience Council. Economic obstacles also occur due to urbanization and littoralization, which have led to a concentration of people, property, and essential infrastructure around coastal areas and rivers. These regions are prone to several environmental and climatic dangers by nature. Although there are alternatives for

adaptation to lessen the risk of these towns and infrastructure, the remaining susceptibility will endure. Littoralization can be slowed by adequately factoring in the worth of all coastal ecosystems and resources when making decisions.

Barriers and Limits to Natural and Biological Adaptation

Due to its geographic position and topography, Fiji is susceptible to various environmental and climatic dangers. Hazards are frequently impossible to avert because of widespread processes like ENSO and climate change. Land structure, which makes urbanization and infrastructure development challenging in hilly interiors, is the leading cause of littoralization. Littoralization prevents wetlands from moving inland as a result. The same land topography restrictions restrict agricultural, and water supply adaptation alternatives on smaller islands, where freshwater is scarce, and groundwater is at risk of salinization due to sea-level rise and higher tidal waves. These challenges can be addressed by definition, but doing so would cost a lot of money.

Vital natural resources have biological adaptation constraints. Even at 1.5°C and 2°C global temperature increases, the biological limit to adaptation connected to the dangers of impacts on the coral reef ecosystem remains a crucial issue for Fiji (Wong et al., 2014). Deteriorating coral reef health will affect livelihoods, food security, and economic growth. Particularly vulnerable industries include fishing and tourism. Ocean acidification and rising sea surface temperatures have been linked to reported coral bleaching occurrences. It is uncertain how many coral reefs are eroding. Thus, measures to stop this are crucial.

Additionally, mangrove forests have biological constraints. Mangrove decline will affect coastline management, disaster management, and food security. Sea level rise and other hazards

threaten to erode mangrove forests' long-term viability. The capacity to address these constraints is minimal, as global climate change drives sea-level rise, warming, and acidification. Because they are correlated with global greenhouse gas emissions, Fiji cannot address the limits of natural and biological adaptability. They can only be reduced with global mitigation ambition, which Fiji lacks.

Conclusion

Adaptation can significantly mitigate the negative consequences of climate change. A key element of humanity's response to climate change is adaptation. With the effects and dangers of climate change, anticipatory adaptation has the potential to reduce susceptibility and take advantage of possibilities. The hazards and opportunities associated with climate change are well-represented by several examples of effective responses. Particularly in the most vulnerable areas, the prompt implementation of adaptation measures can significantly reduce climate change impacts.

Without purposeful adaptation, communities will independently adapt to changing climatic conditions, but at a cost and with long-term damage. Societies and economies have long been making adjustments to cope with climate change. Even though some sectors suffer considerable and escalating losses due to climate-related catastrophes, this illustrates how development patterns are subject to temporal variations in climatic conditions and climate change. Relying on reactive, independent adaptation to the cumulative effects of climate change has significant adverse ecological, social, and economic impacts that can be avoided mainly through anticipatory, planned adaptation.

Not just changing average conditions but also traits linked to unpredictability and extremes are crucial for adaptation to climate change. The rate at which event frequency fluctuates is also essential. Unless the changes are extraordinarily

rapid or abruptly discontinuous, most communities, sectors, and regions can adjust to changes in average conditions. On the other hand, these communities are more prone to variations in the frequency and severity of non-average conditions, particularly extremes, and are less adaptable. Adaptation efforts to these risks are crucial because variations in the frequency and severity of extremes support changes in mean conditions and are thus intrinsic to climate change.

Adopting adaptation policies, programs, and actions often offers short-term and long-term advantages. Adjustments to the existing climate and dangers associated with it (repeated storms, floods, and other extremes) are compatible with changing and changing climatic circumstances. If climate-related adaptations are consistent with or integrated into non-climatic decisions or activities, they are more likely to be implemented. Vulnerabilities to climate change are rarely felt in isolation from non-climatic circumstances. Climate-related stressors cause economic and social strains, and people, communities, and governments evaluate and practice climate adaptations in light of these circumstances. Compared to other management or development costs, adaptation costs are often minimal. To be successful, adaptation to climate change must take non-climatic pressures into account and be consistent with current policy standards, development goals, and management frameworks.

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