Save the Children

Solomon Islands Knowledge-Action-Sustainability for Resilient Villages (SOLKAS)

Annex 25: Climate Resilient Food Security Analysis and Recommendations

Accredited Entity: Save the Children Australia

Version: B.36

CLIMATE RESILIENT FOOD SECURITY ANALYSIS AND RECOMMENDATIONS FOR SOLOMON ISLANDS KNOWLEDGE-ACTION-SUSTAINABILITY FOR RESILIENT VILLAGES (SOLKAS) PROJECT

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Date: 5th September 2022

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Acronyms

ACIAR	Australian Centre for International Agriculture Research
ADB	Asia Development Bank
CSA	Climate-smart agriculture
DFAT	Department of Foreign Affairs and Trade
FAO	Food and Agriculture Organization of the United Nations
FAO FIRST	The Food and Nutrition Security Impact, Resilience, Sustainability Transformation Programme
FSL	Food Security and Livelihoods
FGD	Focus Group Discussions
GDP	Gross Domestic Product
GHG	Greenhouse gas
IPCC	Inter-government Panel on Climate Change
IPM	Integrated Pest Management
KASA	Knowledge, Attitude, Skills, and Aspiration
KGA	Kastom Garden Association
LDCs	Least Developed Countries
MAL	Ministry of Agriculture and Livestock
MHMS	Ministry of Health and Medical Services
MDPAC	Ministry of Development Planning and Aid Coordination
MPG	Ministry of Provincial Government
NAPA	National Adaptation Programme of Action
NERRDP	National Economic Recovery, Reform and Development Plan
NDMO	National Disaster Management Office
NDS	National Development Strategy
NGOs	Non-government organizations
NPK	Nitrogen Phosphorous Potassium
PO	Production Organization
SBD	Solomon Island Dollar
SCA	Save the Children Australia
SDGs	Sustainable Development Goals

SIG	Solomon Islands Government
SPC	Secretariat of the Pacific Community
SOLKAS	Solomon Islands Knowledge-Action-Sustainability for Resilient Villages
TLB	Taro Leaf Blight
UN	United Nations
UNDP	United Nations Development Programme
WMBGC	Women, men, boys, girls, and children

1. Executive Summary

The purpose of this paper is to support the development of the SOLKAS design components related to food security and livelihoods (FSL) of climate-vulnerable remote and rural communities. It highlights the analysis of the status of remote and rural FSL in Solomon Islands and the implications of projected climate change impacts and effective ways to increase food security and to build resilience of livelihoods – particularly specific activities identified in the project's concept note. The content covers a wide range of discussions including (i) a review of SOLKAS concept note, (ii) FSL analysis, (iii) input of FSL on issues into the project's climate rationale, (iv) input of FSL issues into the project log frame, (v) input of FSL into the national vulnerability assessment, and (vi) support the development of data collection tools and methodologies and provide remote support to data collection towards FSL issues.

The objective of the paper is to provide background information on women, men, boys, girls, and children (WMBGC) knowledge level and understanding about climate change, how it affects FSL, the current level of action on village-centric adaptation and resilience planning and implementation and their knowledge of sustainable interventions integrated into provincial and national programs. This is to assess the gap level of knowledge, action, and sustainable adaptive interventions of climate-smart practices by WMBGC.

The findings identified that the current knowledge of understanding of WMBGC on current and likely future impacts of climate change and their relevance to their communities has gaps and needs to be identified. In the same understanding, there is a lack of current and formalised governance institutions to spearhead village-centre adaptation and resilience planning and implementation. This adds up to a further gap where there is a lack of vertical coordination and integration of priorities of interventions of village and adaptive planning and incorporation in provincial and national adaptation planning processes, where villages have not received any sustainable resources such as climate-smart resilient development trajectories overtime.

The recent ethnic tension and the weak services of agriculture extension in the last 20 years have made setbacks to the adaptation of resilient FSL interventions in remote and rural communities (Kama, 2021). While there was no accurate knowledge and adaptive interventions as responses to climate change, there was also weak progress made by concerned government ministries in supporting communities with climate change effects. This has led to low food production affecting food security and livelihood interventions. While the absence of extension services ran through during and after the ethnic tension, innovative farmers were under the state of urgency (Bevir, 2005), (Long, 1992), and (Long and Ploeg, 1989) and were going through a logic of practice period (Bourdieu,1990: 109), came up with their own innovative and climate-smart agriculture practices. This is seen as a positive response to the uncertainty caused by climate change and the weak extension services. Innovative farmers not only develop adaptive climate-smart practices but were running farmer field schools to train their own. Climate-smart agriculture is a science-based approach which has the following characteristics: increase crop productivity under challenging environmental conditions. It seeks to increase sustainable productivity, strengthen farmer resilience, reduce the greenhouse gas emissions of agriculture, and increase carbon sequestration (Lopez-Ridawa, S., et al. 2018). While innovative farmers have experienced the effects of climate change and have created adaptive interventions and were running farmer field schools in their responses, the training of remote and rural farmers needed to be undertaken. This has led to knowledge and skills gap in understanding climate change and its effects and limited application on adaptive and resilient interventions in remote communities.

2. Background

As climate change escalates, Solomon Islands becomes vulnerable due to its extreme exposure to natural hazards and its limited adaptive capacity (Yeo, 2020 and Save the Children, 2021). Yeo (2020)

stated in his report that climate change has caused biodiversity loss and internal climate induced displacement are major risks for the people of the Solomon Islands. While Kasperson and Kasperson (2016), included food insecure, water scare, delicate marine ecosystem, fish dependent and small island community as vulnerable due to climate change. A greater impact of climate change is seen on lower atolls such as Ontong Java and artificial islands in the Lau lagoon where most inhabitants of these islands are dependent on sea for food sources. With all the adverse effects of climate change, communities in remote and rural communities experienced an existing 'adaptation deficit' – often lacking the capacity to manage current climate variability and extremes. This undermines their resilience to the impacts of climate change. **Solomon Islands Knowledge-Action-Sustainability for Resilient Villages (SOLKAS)** will be a community-based climate change adaptation project focused on building the adaptive capacity of communities across Solomon Islands. SOLKAS is being developed by Save the Children Australia (SCA) with the Solomon Islands Government.

The purpose of this paper is to identify key FSL issues to address in the design. The paper also aims to identify needs and opportunities of Solomon Islands current food security and livelihoods context, with a focus on remote and rural communities. The paper also investigates the implications of projected climate change impacts and effective ways to increase food security and build the resilience of livelihoods including specific activities identified in the project's concept note. The paper highlights the project's rationale on vulnerabilities, risks and opportunities related to FSL. The other areas included in the paper include, (i) supporting project's log frame with particular focus on activities related to FSL, (ii) the development of a national vulnerability assessment to support project targeting key FSL issues and (iii) support for the development and / or improvement of data collection tools and methods to field test the project's approach and provide support to the project design field teams to ensure that community consultations inform FSL activity development.

3. Purpose, Methodology and Findings

The report used the SOLKAS concept note from early 2022 to highlight the key issues of food security and livelihoods in the Solomon Islands, highlighting areas that the design team should address in the funding proposal.

The project plans to achieve a paradigm shift via three interlinked and mutually reinforcing objectives, each operationalized through a corresponding project component:

- Outcome 1 Knowledge – children, youth and communities have increased understanding of climate change implications, improved resilience knowledge, and strengthened adaptation planning capacity
- Outcome 2 Action – Schools and communities are supported with locally-led, scalable adaptation actions, and youth climate resilient entrepreneurship is facilitated
- Outcome 3 Sustainability – Adaptive capacity institutionalised via building adaptive governance systems at all levels, deployment of climate information systems, and facilitation of youth-focused private sector partnerships.

The overarching objective of the paper is to build a strong and context-specific evidence base to guide and inform the development of the (SOLKAS) full funding proposal.

Specifically, the paper will seek to: gather information at Provincial, Ward, Community, and household level through a literature review on climate change and its effects on food security. The focus was on knowledge, action and sustainable interventions and focus group discussion on thematic areas as prescribed by the study design capturing knowledge of climate change, action on targeted communities currently implementing village-centric adaptation and resilience planning and implementation and sustainability of adaptation interventions supported by provincial and national government.

3.1. Methodology

Despite a COVID-19 outbreak in country, data was collected using both primary sources from the MECDM and Save the Children 2022 study and secondary sources through desktop searches and an internet literature review. Primary data was collected through focus group discussions, in-depth interviews, and personal interviews with smallholder farmers, lead and innovative farmers, traders, and producer organizations. In addition, in-depth interviews were used with line ministries such as the Ministry of Environment, Climate Change and Disaster Management (MECCDM) and the Ministry of Agriculture & Livestock (MAL). Journals and research papers were also consulted and reviewed. Other unpublished research papers and reports were also reviewed.

This research was done with the focus on vulnerable remote and rural communities, while consideration was focused on WMBGC participation in knowledge, action, and sustainability of adaptation community projects. Additional, primary data was collected by MECDM through survey, personal interviews, and direct observations.

3.2. Data Analysis

Data collected from primary sources (MECDM and Save the Children 2022) were statistically analysed and interpreted. For secondary sources, data analysis used content analysis and interpreted into themes for final interpretation. Data was divided into three themes according to the objectives of the paper. These are knowledge, actions and sustainability based on food security livelihood in remote and rural communities. All data on climate change impacts and effects were summarized as well as gaps on adaptive and resilience of interventions were also summarized. Gap data on climate change knowledge, adaptive skills and sustainable practices were also compiled involving WMBGC who have limited understanding were under literature review.

3.3. Summary of Findings

The report reviewed the SOLKAS concept note from early 2022 to highlight the key issues of food security and livelihoods in the Solomon Islands which should be addressed in the design stage of the project. The FSL review is only on relevant areas as given below and are in red:

3.3.1. Component 2: Communities and schools have access to locally led climate-resilient livelihoods, food security, nutrition, and infrastructure

Output 2.1. Locally led climate resilient agriculture innovations applied. The first output will provide small-scale investments in resilient agriculture practices to villages and wards where these are priority vulnerabilities. Indicative activities for Output 2.1. include:

- introduction of climate-resilient staple and cash crop varieties or climate-smart agriculture practices.
- establishing ward-level seed centres, field experiment stations, and trial farms for climate-resilient varieties.
- improving/introducing micro-irrigation methods.
- introduction of sustainable and climate resilient agroforestry and non-timber forest product use.
- apiary construction.
- dry litter piggeries; and
- introduction of community level post-harvest processing to add value to agricultural products

3.3.2. Paradigm Shift Potential

Innovation. Most adaptation projects in SI have either worked at the national level on capacity building and policy development or have piloted community-based approaches in relatively small

numbers of communities over short timeframes. No project has taken a comprehensive approach to adaptation across the country that adopts a village-led approach. However, research has shown that innovative farmers have developed several innovative practices in food production under climate change conditions and have shared these with other farmers. Farmer innovation is becoming significant in agriculture innovation due to the weak agriculture extension services in the country since the ethnic tension. Through this farmer innovation process several agriculture innovations have been introduced to communities. This is true in the broader Pacific region and the rest of the global south, where most community-based adaptation initiatives have been small scale, short term, and of limited reach.

The project will also introduce to villages innovations in terms of natural resource management and planning (e.g., climate resilient agriculture and agroforestry; resilient construction techniques). Through peer-to-peer learning and the project's dissemination of successful best practices, it is expected that these innovations will become a 'new normal' supported by stronger institutions at the village, province, and ward level. The use of innovative farmers and lead farmers to share their innovative practices will provide skills and knowledge for the rural people. Where appropriate, adaptation packages will introduce innovative technologies to reduce vulnerability to hazards identified through village planning processes. It is expected that in some cases the introduction of new technologies and climate sensitive livelihood strategies may eventually generate new demand, resulting in new opportunities for MSME entrepreneurs.

Potential for knowledge and learning. During the design stage, a comprehensive learning plan will be developed to support the codification and dissemination of lessons and best practices. This plan will include the production of knowledge products, manuals, case studies, and protocols. The project will be part of SCA's broader multi-country strategy for building national-scale systems to support community-based adaptation in SIDS and LDCs, including a sister project currently in development for Vanuatu. Each project will include activities dedicated to capturing lessons and facilitating cross-country engagement. This will facilitate the development of common approaches to address the specific climate change challenges facing different communities. The project will also partner with the Ministry of Provincial Government, which will facilitate upscaling to other villages in SI. Lessons and best practices from the project will also be disseminated through Save the Children's network of dozens of country programs. The project will also form partnerships with domestic organizations (e.g., women's groups, farmers organizations) to disseminate information through their constituencies. This is when innovative farmers will share their knowledge and skills in innovative agricultural practices (Climate-smart agriculture). Already farmers have both traditional and introduced communication methods for sharing climate change related information.

Overall contribution to climate-resilient development pathways consistent with a country's

climate change adaptation strategies and plans. The adaptation package investments will have a powerful demonstration effect, and we anticipate that climate-sensitive resource management and household skills will diffuse beyond the target villages once communities see the "resilience dividend" that is derived from these activities[1]. The project will establish model disaster management committee structures in villages which can be replicated in additional villages. Since the project is working in all 9 provinces to improve linkages between provincial governments and villages and to improve provincial capacities, expanding to additional villages will have a very low marginal cost, which is likely to be absorbed by the Ministry of Provincial Governments. All knowledge products, school curriculum materials, training materials, climate change information, and other resources developed for the target

villages will be made available to the MPG, which also has a remit for capacity development. As above, the marginal costs for applying these materials to other non-target villages is negligible and can be absorbed into the MPG budget. This will encourage innovative farmers to support the project with trainings and demonstrations on CSA practices when the communities will share CSA practices which provide high yield crops, resilient to climate change, reduce GHG effects and raise sustainable food production in rural Solomon Islands.

3.3.3. Sustainable Development Potential

62. With respect to the Sustainable Development Goals (SDGs), the Solomon Islands does not have a dedicated SDG strategy or framework, but the SDGs are referenced in the National Development Strategy 2016-2035 (NDS). The NDS spells out linkages between SIG's development objectives and the relevant SDGs and targets and includes an indicator for each cited target. As a rural resilience project with a strong focus on enhancing gender equity and youth opportunities, this proposed project connects to all the SDGs elaborated in the NDS. During the detailed design stage, the project's monitoring and evaluation framework will be designed with clear linkages to the SDG targets and indicators described in the NDS. The response to climate change as one of the drivers for farmer experimentation is a significant farmer innovation towards the national food system in Solomon Islands geared to the pathway to achieve Sustainable Development Goals (SDGs) by 2030.

3.3.4. Needs of the Recipient

The urgency of sustainable food production which is affected by long dry periods and heavy rainfall affecting farmers to become uncertain with their planting seasons, planting methods, and experimenting on new innovations to create climate-smart agriculture practices.

4. Description of adaptation packages

Climate Change Process	Hazard	Adaptation Measure
Sea level rise/king tides/storm surges	Coastal Erosion	Mangrove restoration, mangrove nursery, improved cooking stoves, alternative building materials, biogas digesters
	Salinity/Sea water intrusion	Raised beds and shift to higher soil or planting of vetiver grass
	Damage to houses and infrastructure	Elevated houses, model resilient house, improved signage, retrofitting for improved durability and resilience
Changing Precipitation	Drought	Agroforestry, climate-resilient agriculture, village-level post-harvest processing (e.g., coconuts, cacao), bee keeping, rainwater harvesting and storage, weaving/looms, ka*stom garden*, resilient seed varieties, community seed banks, micro-irrigation, solar desalinization
		Alley cropping, heavy mulching, mulching, cover cropping, intercropping,
	Pests and Diseases	Pest and disease control infrastructure, cultural methods, organic pesticides, biological control
	Flooding	Catchment reforestation and protection, water quality testing, buffer zones, sediment control, contour planting, terracing, dry piggeries, improved soil drainage, improved WASH facilities, improved signage, retrofitting for improved durability and resilience. Planting of vetiver grass, building drains and planning trees.

	Soil erosion	Mulching, heavy mulching, cover crop, contour farming, planting of vetiver grass, agroforestry, alley cropping, and intercropping
Increasing sea surface temperature	Altered fish migration/declining recruitment	Mariculture/aquaculture infrastructure and demonstration, fish aggregation devices, post-catch processing and preservation
	Bleaching	Community marine protected area infrastructure
Extreme events (cyclones)	Wind and debris	Model resilient house, retrofitting for durability/resilience, food preservation, signage for evacuation, early warning systems

5. Potential output-level implementation partners

Component 1	Knowledge	
Outcome 1	Targeted communities (women, men, girls, and boys) incorporate climate change knowledge to shift to resilient livelihoods	
	Description	Potential Implementing entities
Output 1.1	Climate change information availability and delivery channels established/improved	• Department of Meteorology • Department of Climate Change • Provincial Disaster offices • NGOs
Output 1.2	Village Disaster Risk Committees formulate social inclusion and resilience plans	• Save the Children • Department of climate change • Provincial Disaster offices • NGOs • Innovative farmers/Lead farmers
Output 1.3	Communities equipped with resilient livelihood skills	• Provincial governments and Wards • Provincial disaster offices • Department of Climate Change • Save the Children • NGOs • Innovative farmers/Lead farmers
Output 1.4	School and youth adaptation and resilience outreach established	• Ministry of Education • Provincial Education authorities • Save the Children • NGOs • Innovative farmers/Lead farmers
Output 1.5	Village and ward DRC human and institutional administrative capacities improved	• Ministry of Provincial Government • Provincial Planning and Wards • Provincial Disaster offices • Department of Climate Change • Save the children • NGOs • Innovative farmers/Lead farmers
Component 2	Action	
Outcome 2	Ward and village governance mechanisms lead community-driven adaptation and resilience planning and implementation	
	Description	Potential Implementing entities

Output 2.1	Locally led climate resilient agricultural innovations applied	• Ministry of Provincial Government • Provincial Disaster offices • Provincial Planning and Wards • Department of Climate Change • Provincial government and Ward systems • Save the children • NGOs • Innovative farmers/Lead farmers
Output 2.2	Community-wide measures to enhance resilience to climate-driven disasters applied	• Ministry of Provincial Government • Provincial disaster offices • Provincial government and Ward system • Department of Climate Change • Provincial agriculture extension services • Save the children • NGOs • Innovative farmers/Lead farmers
Output 2.3	Village climate resilient water resource management techniques and technologies applied	• Ministry of Provincial Government • Department of Climate Change • Provincial disaster offices • Province and Ward Committees • Agriculture extension services • Save the children • NGOs • Innovative farmers/Lead farmers
Output 2.4	Village-led climate resilient fisheries for food security and enhanced livelihoods	• Ministry of Provincial Government • Provincial planning and Wards • Department of Climate Change • Save the children • NGOs • Innovative farmers/Lead farmers
Output 2.5	Monitoring, evaluation, operations, and maintenance established at village and ward levels	• Ministry of Provincial Government • Provincial Planning and Wards • Provincial Disaster offices • Department of Climate Change • Save the children • NGOs • Innovative farmers/Lead farmers
Component 3	Sustainability	
Outcome 3.1	Provincial and national governments support resilience building at national and ward levels	
	Description	Potential Implementing entities
Output 3.1	Village and ward disaster risk committees established/strengthened	• Ministry of Provincial Government • Provincial disaster offices • Provincial Planning and Wards • Department of Climate Change • Save the children
Output 3.2	Vertical institutional arrangements to implement NDMP and support local resilience building established	• Ministry of Provincial Government • Provincial disaster offices • Provincial Planning and Wards • Department of Climate Change

		• Save the children • NGOs • Innovative farmers/Lead farmers
Output 3.3	Financing arrangements to support village resilience building established	• Ministry of Provincial Government • Provincial Planning and Wards • Provincial Finance Unit
Output 3.4	Provincial capacity for NDMP implementation strengthened	• NDMO • Provincial Disaster offices • Provincial planning and wards

6. Detailed FSL Analysis

6.1. FSL Analysis

Solomon Islands has a small rural economy relying on rich natural resources in land, forests, marine resources, biodiversity and subsistence and semi-subsistence agriculture (Houma, 1988; MDPAC, 2007; DFAT, 2004, Kama, 2021). About 82 percent of the total population live in the rural areas and depend solely on agricultural activities for their livelihood, survival, and daily living, (FAO, 2020, Kama, 2021, and Georgeou, et al. 2018) and 89 percent of households participate in gardening activities. As the country's largest rural employer and source of income and responsible for a large portion of exports, the agriculture sector is a key contributor to the economy, livelihoods, food, and nutrition security (FAO, 2020). Approximately 12 percent of its land is classified as agricultural, and 80 percent is forest (MDPAC, 2007). The resilient semi-subsistence agriculture sector is seen as a strong asset for rural development (MDPAC, 2007). MAL (2021), in its Agriculture Sector Growth Strategy and Investment Plan 2021 – 2030, indicated that 80 per cent of Solomon Islanders living in rural areas are with limited access to infrastructure and services. Agriculture (including crops, livestock, fishing, and forestry) is the foundation of livelihoods in the country. Subsistence agriculture provides a large proportion of the income of most of the population and represents over a third (16 percent) of gross domestic product (GDP), but only receives a small proportion (max 1.5 per cent) of the total national Government budget – the lowest level of agriculture funding in the region (MAL, 2011 and FAO, 2020).

Food systems production in Solomon Islands including source of protein, is produced, and gathered by subsistence farmers, semi-commercial farmers, producer organisations and other small holder producers using different production systems (Kama, 2021, FAO FIRST, 2016). This supports the fact that 82% of the population dwell in rural areas to support the 669,823 people of Solomon Islands with food (World Bank, 2019). With much of the agriculture and fisheries sectors linked to smallholder production, the food production systems are significant to both livelihoods and the economy of Solomon Islands (FAO FIRST, 2016 and SIG, 2019). These production systems and other livelihood cultivation systems are influenced by several factors including technology, infrastructure, government policies, economic governance, and government services (Bammann, 2007 and Kama, 2021). The absence of such factors affects the food systems in production, processing, distribution, and storage.

Subsistence agriculture production in the Solomon Islands is dominated by traditional food adapted to local environments and tend to be nutrient rich (FAO, 2020 and FAO, 2019). Part of the FAO stocktake of agriculture sector activities addressing National Development Strategy (NDS) is to align policy and resources to enhance farm production through improved farming systems to increase economic growth through enhancing sustainable subsistence-based farming system, including organic farming and indigenous crops. Solomon Islands National Food Systems is currently expanding without proper directions and abiding policies to guide its roles and to fulfill its purposes. When the current system is measured against the United Nation Food System (UN FS), we see the gaps and challenges that exists in the Solomon Islands food systems.

Currently, there is hunger and poverty existing in Solomon Islands. About 1 in every 10 people are undernourished, 12.7 percent of people live below the national poverty line and one person out of four lives on less than USD$1.9 per day (FAO & SPC, 2012). This is often denied by many but, hunger occurs as it is related to poverty. The two are inseparable. In reference to the Solomon Islands National Development Strategy 2016 – 2035, the government has already implemented plans for achieving the Sustainable Development Goals (SDGs) and improving the social and economic livelihoods of Solomon Islanders. In response to aligning food policy MAL has begun boosting Food and Nutritional Security (FNS) and sustainable agriculture in the Solomon through its food and security strategy as a priority action of the Solomon Islands Government (Solomon Islands Government, 2016 and FAO, 2012). Emerging development trends also contribute to the status of food security in Solomon Islands. These include the (i) countries' inadequate economic performance, aggravated by political instability and ethnic tension; (ii) slower growth in agricultural production than in population, urbanization, and rural-to-urban migration; and (iii) increasing threats of climate change and adverse effects on key production sectors. While reducing seasonal food shortages, the increasing dependence on imported food, especially rice and wheat flour, has introduced a new kind of food insecurity and exposed Solomon Islands to the uncertainties of global food production, supply, and cost.

More recently, the agriculture extension system has refocused its purpose and strategy to deliver its services on supporting cash crop production and processing and increasing food production by means of food security. Extension staff's interventions are now focused on (i) Sustainable economic development and National Strengthen; (ii) Agriculture livelihood and export expansion and (iii) National food security program. Efforts are on training farmers**,** how to increase cash crop production, improve added value of cash crop products and improve quality of products and at the same time extension interventions are also focused on improving food production. In addition, these focuses are delivered using pluralistic approach and extension officers are expected to deliver all three interventions. However, there are setbacks to this extension dream. Logistics, infrastructures, and availability of funds are major roadblocks to extension services throughout the country. These are further discussed in a later section. The setback only indicates that the sector needs a greater support and investment by the government to boost not only food security but value adding for export crops as well. The MAL's Solomon Islands Agriculture Growth Strategy and Investment Plan 2021 – 2030 will focus in getting food security and marketing of cash crops to the next level, thus support to transform the food systems in the count.

Food security and livelihoods in remote and rural areas in Solomon Islands is influenced so much by available markets, transportation to move farm produce from farm to neighbouring markets, the demand for farm produce and the quality of farm produce (MECDM & Save the Children, 2022). Value adding products are not seen in both remote and rural areas except for traditional food processing for ngali nuts, cassava, taro, and fish. The input costs depend much on variable and fixed costs. These factors influence farmers decision to enter value adding or not. Farmers in remote and rural areas indicated the benefits of storage and food processing along the traditional post-harvest processes. Other cash crop value adding are on-going including cocoa, copra, coconut oil, honey, ginger, noni, peanuts, and kava.

The main staple food crops grown are sweet potato (*Ipomoea batatas)*, cassava (*Manihot esculenta)*, taro (*Colocasia esculenta)*, pana (*Dioscorea esculaenta), yam (Dioscorea alatas)*, banana *(Musa acuminata)* and vegetables which include leaf, fruits, leguminous and root crops. Crops such as cassava, cabbage, banana, pawpaw, sweet potato, or long beans are grown in over 80 percent of rural and urban household gardens. Livestock including poultry, pigs, honey, and cattle are kept by 64 percent of rural and 15 percent by urban household, but predominantly within Guadalcanal and Malaita (FAO FIRST, 2016 and MECDM & Save the Children, 2022). Crops which are newly

introduced include Chinese cabbage, peanuts, watermelon, and cucumber, okra, lettuce, corn are produced to meet local markets.

The knowledge and understanding of the type of farming practices used in food security is important so that any food security issues can be looked at according to the food production system. Three food production systems are briefly discussed. The traditional practices, innovative practices, and the introduced practices.

6.2. Traditional Practices

Traditional methods are those that were developed over time and years by farmers. Such approaches may include bush fallow cropping, mixed cropping, agroforestry cropping and slope cropping. One special features of traditional method are spontaneous planting without planning. Based on the continuous spontaneous planting farmers have developed the best planting timing and the planting methods used for each crop.

6.3. Innovative Farmer Practices

Next is the innovative farmers' methods. The methods have been developed over time by innovative farmers through informal farmer experimentations. Farmers innovative practices are the result of creating climate-smart agriculture practices (CSA) (Kama, 2021). Farmer innovations on which farmers do informal experimentations initially driven by several drivers. Such drivers may include climate change, pests and diseases, soil infertility, shortage of arable land, cultural bride price, swampy land, population increase, low crop yield and lack of planting materials. Innovative practices including climate-smart practices include heavy mulching, contour farming, slash and plant, use of vetiver on swamp cultivation, parallel planting of pumpkin and Pueraria (legume cover crop), planting of water cress on fishing nets, and application of seaweed compost.

6.4. Introduced Practices

Introduced practices are those practices which were introduced into the communities. These were introduced by the Ministry of Agriculture and Livestock, non-government organizations, church missions and private innovators. Examples of introduced practices may include mulching, intercropping, alley cropping and crop rotation (Kama, 2021).

7. Food Security and Livelihoods Situation in Remote and Rural Solomon Islands

Production systems at the subsistence and semi-commercial levels cover those practices involving food cultivation methods. Solomon Islands agriculture is characterised by three types of farming methods, namely (i) smallholder subsistence farming with occasional sales of surplus, (ii) smallholder semi-commercial farming with deliberate market production including cash crops, and (iii) commercial farming including plantations (FAO, 2020). Most rural households are classified smallholder farmers either subsistence or semi-commercial, selling occasional surplus food crops as well as small amounts of cocoa and coconut products, predominantly copra. Per-capita production of food crops has diminished, and the subsistence sub-sector is no longer fulfilling its traditional food security function. Speciality crops targeting niche markets include coffee, kava, vanilla, spices, and indigenous nuts but volumes are low and erratic. Artisanal fishing in the lagoons and reefs provide the needed proteins, but due to declining yields, livestock (mainly pigs and poultry) are gaining importance as an additional source of relatively cheap protein. There is a large ocean tuna fishery which exports most of the catch and generates royalties for the Government. Private investment in the sector is scarce, with most agribusiness companies engaged in aggregating and exporting commodities with limited value addition.

7.1. The MECDM & Save the Children Study 2022

Food production in Solomon Islands (Malaita, Makira, Western, Isabel, Choiseul, and other islands) is produced by several community household members (Kama, 2021, MECDM & Save the Children, 2022). These include women, men, boys, girls, and children as well as lead and innovative farmers. The MECDM & Save the Children study indicated that women and girls performed a wide range of tasks as mothers of families. The tasks range from housekeeping to gardening including gardening, feeding pigs, marketing garden produce, feeding chicken, harvesting crops, weeding, brushing, planting crops, and watering crops. In the same study men and boys performed a range of tasks including fishing, building houses, brushing, gardening, making canoe, chopping firewood, cutting trees, digging, and making potato mounds and hunting pigs. These tasks between male and female have been changed much from the previous years. There are several tasks that are commonly shared between women and girls with men and boys. This is due to the need and changing role between men and women as well as boys and girls including children.

7.2. Size of farm

The size of farm and production ranges from 50 plants (1/2 acre) to 8,000 plant or more (10 acres). The size of farmland varies depending on the size of tribal land which is customary land and the allocated clan land. Those who planted betel nuts grow as much as 5,000 to 8,000 plants. Kava production varies as well but most farmers grow at least 100 plants while average number of coconuts grown is 300. Where the topography of land is steep and valleys, land used by farmers are limited. In addition, where land is limited by sea water intrusion, flooding, erosion or landslide, and other land degradation. The MECDM & Save the Children study indicated that 60% of farms are in between half and one and half acres. Where land is limited due to densely populated, farmer have a quarter to half acre or less to work on.

7.3. Production and Crop yield

The production of farm produce ranges from farm to farm depending on the farming system used and sustainability of soil fertility. Potato for example, a half-acre can produce 5 to 15 bags of potato. Taro, cassava, and yam will produce similar yield. Vegetables such as slippery cabbage, Chinese cabbage, corn, bean, tomatoes, and others can be bundled before being sold. Soil fertility, improved planting methods and improved planting materials increased crop yield. Some of the improved planting methods are discussed in the section on climate-smart agriculture practices. The MECDM & Save the Children study indicated that crop yield and production increase from time to time. The reason behind this is not very clear but lead farmers and innovative farmers indicated increase in yield due to crop demand, increase in crop cultivation, better planting techniques and improved planting materials.

7.4. Decrease of Crop Production

On the other hand, farmers indicated that the decrease in production and crop yield is caused by several factors. These include (i) Market related factors such as less demand, inadequate access to market, transportation, low price, and poor-quality farm produce. (ii) Cultivation related factors including no proper tools for harvesting e.g., Cocoa and kava. Others include less labour, lack of cultivation tools, lack of nursery, lack of seeds, mono cropping, and lack of planting plan due to change of weather pattern. (iii) Pests and Diseases cause reduction of crop production. Pests and diseases cause decrease in production due to continuous rain, no intercropping, no mix cropping, lack of weeding, and lack of mulching. (iv) Infertility of soil. This includes issues of overcultivation, use of mono-cropping, soil erosion, flooding, and reduction of fallowing period. (v) Lack of post-harvest management and issues include no proper storage facilities, delay of transportation, poor value adding process, and lack of proper tools and equipment. (vi) Poor planting materials is one reason for the decrease of crop yield. When farmers use low yield and infected planting materials, yield of crops reduce, (vii) Inappropriate planting methods can also reduce crop yield. When cuttings, seeds and

root stocks are not planted well to produce roots they will not produce high yield, and (viii) Infertile soil does not provide the required nutrients for the crop to grow and yield (MECDM & Save the Children, 2022).

7.5. Where does farmer sell their farm produce to?

Farmers sold their farm produce to several buyers. The MECDM and Save the Children 2022 study indicated that farm produce is sold to the following people: (i) Local market. Local markets are those located in a village e.g., the Ugele market at Ugele village. Ugele market is a well-known market for anyone travelling through Western Province would stop and buy local food. Other local markets may include Munda market, Afio market, Bunikalo market or Qasini market. (ii) Provincial market. Provincial market includes Gizo market, Auki market, Kirakira market, Taro market, Buala market or Lata market. (iii) Community markets including house markets, village markets, sold directly to customers, neighbours in the village, teachers at local schools. Logging companies, kava buyers, relatives, farm gate markets or local agents and (iv) Honiara based markets including the main market in Honiara as well as exporters including Varivao, Kavanitu and others.

7.6. What prevents Farmers from Selling more farm produce?

There are reasons why farmers are not selling enough at the markets. These include (i) Crop damage by Pest and diseases. Crops such as cabbage, beans, taro, and slippery cabbage are often damaged by insect pests and diseases. Examples of pests are caterpillars, fruit flies and taro beetles. Diseases like taro leaf blight damage taro leaves while fungus damage Chinese cabbage rough rotting the stalk. (ii) High competition at the market. When most farmers grow the same crop for market, there is often he supply for the same crop thus create a competition on the price. (iii) The Lack of Roads and Transport. One of the biggest setbacks in marketing is the accessibility to markets. This includes lack of roads and transportation to the markets. This prevents farmers to increase their farm sales. (iv) Low Demand of farm produce. In some remote areas in Solomon Islands like Baniata in Rendova Island, there is low demand for farm produce, and this has affected some farmers day to day market sales. (v) Family Consumption of Farm Produce. When the soil is infertile and when arable land is limited, less food crops are grown for both families and for sales. When this does happen, there is less farm produce to support both for family consumption and to have extra for sale. In a real situation, farm produce is consumed by family. (vi) Change of weather (Continuous rainfall). In many remote places such as the Eastern part of Malaita, continuous rainfall disrupts the movement of people including taking farm produce to the nearest market. (vii) Decrease in Market Prices. In the case of cash crops, many farmers are responsive to price fluctuations. When price for commodity such as cocoa goes down, farmers sell less cocoa. In the case of vegetables and root crops, the higher the supply is the lower the price will be. This is one factor preventing farmers to sell more of their farm produce and (viii) The Lack of Storage. The lack of storage causes the farmer not to sell all his crops and other farm produce. Without proper storage, it is impossible to sell all his farm produce continuously.

7.7. Value Adding Farm Products

One of the concern areas in food security and livelihoods is value adding. According to the study, there is small number of farmers engaged in value adding process with their farm produce. About 75% of farmers did not involve in value adding while only 24% said yes. However, it is critical what types of value adding activities are done. According to the study the following activities are done (i) separating kava roots and chips from plants, washing roots, peeling of chips, and drying. (ii) fermenting and drying cocoa beans using hot air drier. (iii) drying local tobacco leaves and packing them. (iv) drying copra in a hot air drier. (v) storing bananas in empty drums for ripening and (vi) drying peanuts for future markets. There are several reasons why some farmers are not getting into value

adding include (i) customers only prefer organic farm products, (ii) there is no value adding processing equipment, resources, and facilities. (iii) too expensive to buy chemicals need by the value adding process. (iv) About 20% of farmers do not need value adding process. This means their farm products do not need any value adding processes, which may be due to not having equipment or facilities in their farms.

According to the MECDM & Save the Children 2022 study, farm sales range from ten dollar to five thousand dollars a month. Little value adding is done across all islands except for copra, kava, noni, and cassava. Farm produce including cash crops are sold to local markets, provincial markets, at the village level and other commercial markets like Varivao. The biggest challenge to marketing farm produce is transportation, access to markets and the low demand for farm produce. The biggest challenges for farm production are climate change, infertile soil, pests and diseases, land shortage, bride price, and low production (Kama, 2021 and MECDM & Save the Children, 2022). These factors have caused food production and crop yield to reduce causing farmers to be discouraged.

7.8. Challenges in Agribusiness

There are several challenges in running a farm as a business. The MECDM ad Save the Children 2022 study revealed the following challenges. About 40% indicated the accessibility to market due to transportation; 4% need more training on learning new methods with tools and equipment; 15% indicated that there is less demand for farm produce; 15% indicated no proper tools and equipment for cocoa plantation maintenance and management. 33% indicated climate change due to bad weather such as long period of rainfall preventing kava drying process. 6% indicated no storage facilities. 4% indicated pests and diseases affecting farm produce. 22% indicated lack of labour and the costs involved. 2% indicated here is soil erosion and home consumption. 8% indicated that there is inadequate land for the farm. 2% of farmers indicated that there is no proper poultry house, stealing, lack of feeders, pesticides are expensive, soil salination, lack of livestock feed and there is competition on farm produce. 6% indicated flooding and landslides are hindering factors. 8% indicated the lack of proper fencing is needed for livestock and 6% indicated pests and diseases including birds as challenges.

7.9. Innovative Methods and Products to Increase Crop Yields

The use of innovative methods or products in growing crops is not commonly practised by farmers in remote areas in Solomon Islands. The MECDM and Save the Children 2022 study indicated that very few farmers rarely use or innovate new practices of growing crops. 2% of farmers indicated that they use traditional digging stick, raised beds for planting vegetables, prune cocoa branches, use nursery boxes for planting shallot, use mangrove mud for growing crops use 5 to 6 stamps of kava during planting. About 13% indicated that they add compost to improve soil fertility and 4% of farmers indicated that they have no new innovative methods to increase yield. The study also indicated that about 26% of farmers still use the same innovative methods at their farms. About 42% of farmer indicated that they learn the new innovative methods and products from neighbours, friends, and family members, 4% learn from local farmers, awareness training and from own knowledge. About 2% indicated from radio, books, SIBC, SINU, and MAL.

7.10. Sources of Information about Demand and Prices of Farm Produce

The MECDM and Save the Children 2022 study indicated that the sources of information about the demand and prices of farm products are shared through the following. About 49% is shared by friends, 48% is shared by family members, 44% is shared by neighbours, 13% is shared by SIBC, 11% is shared by traders, 9% is shared by people's own knowledge, 4% is shared through local farmers, and 2% is shared by agriculture farming in community, local buyers, and through internet.

7.11. Use of Agriculture Inputs

The study indicated that 88% of farmers did not use any agriculture inputs in farms while only 11% use agriculture inputs. The inputs include the use of seeds, feed stuff and animal manure improve soil nutrients. Apart from these there was no other inputs that were used by the farmers in the study. Seeds and fertilizers are purchased from agriculture stores and animal feeds are bought from feed companies. About 80% did not use any agriculture inputs for the following reasons: no insect pests around the farm, the soil is still fertile, agriculture inputs are very expensive, there was no training to use agriculture inputs, there are no facilities for agriculture inputs, fertilizers are not used in kava cultivation as it contaminates the kava taste, and many buyers prefer organic products. Remote farmers have also made some changes in their farm management to increase farm sales. Some ways farmers have engaged in increasing farm sales include (i) increase planting; (ii) training on methods, techniques of cultivation, management; and value adding processes. (iii) use of improved cultivars; (iv) provision of good storage facilities, (v) use awareness and promotion of farm products; (vi) introduction of new planting methods; (vi) provision of agriculture inputs to increase production; (vii) production of quality products such as kava; (viii) improve management of poultry management and housing; (ix) increase labour to complete farm tasks; (x) invest resources such as cash to increase production; and (xi) improve soil fertility to sustain crop production.

7.12. Changes in Village/Ward that will Change farm Sales

The MECDM and Save the Children 2022 study revealed that village sales can increase if (i) roads are available to access markets; (ii) storage facilities are available at the village level; (iii) transportation should be provided to access to markets; (iv) provide awareness and training program in the village level for farmers are aware of the developments; and (v) provide sources of agriculture information and resources.

7.13. Change in Supply Chain

Farmers in remote areas suggested management change in farm is needed in supply chain, have storage processing facilities, creating high demand from buyers, and increase prices of farm produce. Farm products are sold in different locations including village markets, in front of houses, at centre's market or at farm gates.

7.14. The Benefits of storage facilities

The most important reason for storage is to store farm produce for some time while waiting for transport or when the price is high for a better sale. This would store several farm and sea products including kava, vegetables, copra, cocoa, betel nuts, fish, and root crops. Another reason is to cut cost of transportation or waiting for a good weather to come.

7.15. Experience of Shocks and Stresses on Changing Environmental changes

About 90% of farmers indicated that they have shocks and stresses due to the changing environmental conditions. About 10% indicated they have not received any shock or stresses due to environmental conditions. The reasons for shock and stresses are (i) the change of weather. The weather conditions include high rainfall, high temperatures, and cool nights. (ii) the sea effects including high tides, sea water intrusion, and soil salinity. (iii) Flooding, landslides. and earthquakes and (v) Economic factors such as small demand for farm produce. These shocks and stresses have caused several issues. One is the existence of low demand from buyers and processors. The shocks and stresses have impacted the farm production in some ways. Some of these impacts are pest and diseases development after rain, low production both in crops and processed products, crop damages

and reducing quality of produce, and uprooting crops. In response to the shocks and stresses, farmers do the following: extend planting of crops, use compost to improve soil, use different methods of planting, use mulching, use shifting cultivation, plant kava on slopes, and dig drains to get rid of excess water. About 6% of farmers do not know how to respond to the shocks and stresses and so did nothing about it. Other ways of addressing the impacts of shock and stresses include receiving advice from MAL and other line Ministries; provide post-harvest facilities, use agriculture inputs, and use managerial methods and techniques for increasing crop yield.

7.16. Other products that can be sold

Apart from the mainstream farm products, a few products can be sold as well. Ginger, coconut oil, spring onion, carrot, chilli, rice, tobacco, and peanuts are products which can be sold. However, there are other products which the farm business cannot easily buy or access in the Ward. Some examples are honey production, transport services, agriculture equipment and tools, electrical supplies, seed supply, proper fencing, and banking services.

7.17. Lead Farmers

7.17.1. Percentage of Community engage in Agriculture/ Understanding of Climate Change and Definition

According to the MECDM and Save the Children (2022) study. About 85% of community engage in agriculture. This engagement involves 75% of farmers who have been familiar with climate change. When asked to define climate change, farmers gave some of these definitions:

“Changes of climate pattern and warming temperature and unstoppable bad weather”

“Sea level rise, very hot weather, abnormal weather e.g., frequent rainfall, low food production from root crops and long dry season”

“Changing of weather from old patterns to new patterns”

“Changing environment from time to time in weather patterns with sea level rise”

“Climate change affected environment and people”

7.17.2. Changing climate Conditions Affect Agriculture and How People Respond to the Effects

About 93% of lead farmers indicated a change in environment (climate change) affecting agriculture while 7% are unsure agriculture is affected by change of environment. Lead farmers also indicated that the change of environment affected food production. About 71% indicated that the climate change has also affected fishing and other food resources from the sea. The effects of climate change have dramatically subdued agriculture and lead farmers and the effects are many including Loss of biodiversity, extreme heat affecting soil, coral habitats, reduce soil water, induce pests and diseases breakout, low crop yield in potato, pana, yam and banana, change of planting season, reduction of fish harvested, cause flooding and landslides, and crop damage.

7.17.3. Responses of People to Climate Change

The effects of climate change have caused lead farmers to respond with various ways. In response to agriculture practices, farmers are doing mix cropping, shifting cultivation, planting legume crops, crop diversity, using new crop varieties and increase planting areas. In terms of inputs, farmers increase farm labour to increase production. Training was also for farmers on adaptive measures and on new fishing techniques. Farmers also did awareness programs to the community regarding best options for addressing the effects of climate change.

7.17.4. Adaptation Responses by Lead Farmers

Lead farmers have responded according to their adaptation response by practising the following: (i) shifting to crops that grow well in wet weather; (ii expand garden areas; (iii) doing crop rotations; (iv) doing mulching; (v) addition of animal manure to soil; (vi) composting; using new methods of fishing; and (vii) relocation of village.

Farmers did several adaptation responses using several methods and techniques. Lead farmers do shift cultivation, increase planting areas, use crop rotation, mulching, addition of animal manure to soil, composting, using new methods for fishing and in some cases relocation of villages to avoid flooding and landslides.

7.17.5. Use of Climate-smart Agriculture Practices (CSA)

The study indicated that 25% of farmers agreed that they have used CSA as part of their farming. About 50% indicated they have not used CSA. Climate-smart Agriculture is not practised, understood, and known in many parts of Solomon Islands. This is due to the nature and characteristics and how it is exposed to rural famers. Farmers opinion about CSA are as follows: (i) they are developed through village farming system; (ii) they are developed through previous training from responsible authorities like MAL staff covering crop selection, good soil and for food security and (iii) responding to a change of planting season to achieve high product ion and sustain family needs for food security (MECDM and Save the Children (2022). CSA is innovative related practices developed by lead or innovative farmers in response to uncertainties which resulted in farmer experimentations. When farmers are uncertain about their farm production, they do plant trials until they arrive in a successful planting method (Kama, 2021). According to Kama 2022, CSA practices are end results of what farmers gone through in terms of drivers such climate change, infertile soil, low crop yield or pests and diseases. These drivers cause uncertainties to farmers which finally cause them to innovate CSA practices.

7.17.6. Type of Assistance Needed by Communities

The study identified several assistances needed by communities. These include engaging youth in climate change adaptive programs, the need to learn about how to manage climate change adaptive programs and activities. The communities also need proper tools for farming. There is a need to engage people in communities to learn about the effects of climate change and how to develop adaptive programs to address them. The community also need learning on how vulnerability and how to address it (MECDM and Save the Children, 2022). Kama (2021) indicated that 70% of people in the communities are not sure how to identify what effects are climate change related and know how to address them.

7.17.7. Factors that Determine Adoption of Approaches, Methodology and Technology

The study indicated several factors including participation in the new approaches, methods, and technologies in agriculture practices. The introduction of training in climate-smart agriculture practices and applying these practices enhances adoption of new practices and CSA practices. The use of agriculture tools, MAL support, farm inputs, and gaining better agriculture sites provide better chances for adoption of CSA practices.

The best ways of supporting farmers adoption of new practices include proper farmer consultation and awareness, training of farmers about new practices and CSA practices; conduct farmer field school; running a village workshop; use farmer-extension and create a village committee to support new approaches and practices.

According to the study, there is no adaptation programs been developed and implemented so far. However, there are few NGOs and faith-based organisations that have contributed to change

programs at the community level. These include NGOs such as Kastom Garden, SIDT, and SDA 10,000 Toes awareness program on lifestyle diseases.

7.17.8. Climate-smart Agriculture (CSA) Practices Shared in Communities

Though few farmers have aware of CSA, many farmers do not understand and have good knowledge about CSA. Throughout Solomon Islands only a few innovative farmers have knowledge and skills in practising CSA. The study by Kama (2022) have shown that CSA innovative farmers are taking the lead in developing CSA practices and are sharing them with other farmers. The MECDM and Save the Children 2022 study indicated that farmers share some unproven CSA information and skills (practices) through local network, local church, tribal meetings, church meetings, social network, hiring of labourers, training, and through central marketplaces. Due to unproven CSA practices indicated in the study, not much of the practices have become resilient to climate change. Only a few practices which went through farmer innovation by experimentation have shown resilient to climate change. See section on Kama's study (2021) on Climate-smart Agriculture practices.

7.17.9. The Need for Additional Information by Farmers

Information is powerful and farmers needed it so much to empower them to effectively do their farm work. The study indicated that farmers needed additional information to have access to markets, information on training and awareness about climate change and adaptation programs, MECDM and extension staff (MAL) for community visits, transportation for taking farm produce to markets and information on farming.

7.18. Heads of Producer Organizations

The study indicated that there are several producer organizations which manages produce from farms. These include Blackbird Cocoa Enterprise, TM2, M.N, MAVONA Enterprise, SIKU, PQK and JQI. Blackbird enterprise manages wet bean cocoa, TM2, M.N, MAVONA Enterprise and SIKU manage copra. Blackbird Enterprise meets every 3 weeks and has about 15 farms from which they buy wet beans from. It uses at least 15 to 30 bags of wet bean per month. M.N meets every 2 weeks and has 2 sheds to get its copra from. It buys copra from the villages at $2.50 per kg. MAVONA which is consist of 4 members, has 3 villages to buy its copra from at $2.50 per kg. PQK has 2 members and meets only during shipments of copra. Its buys copra from 40 to 100 kg.

The heads of producer organizations do some (50%) do value adding while 50% did not do value adding. Some value-adding activities. The reasons for processing are the simple required value adding such as drying wet beans, drying copra, and drying seaweed.

Producer organizations sold their produce to (i) provincial buyers; (ii) Indian buyer, (iii) village shed; (iv) Honiara buyers; and (v) farm gates. Most of these buyers are traders, SINCA and an Indian trader. Producer organizations use Face Book to advertise their products.

The biggest challenges for running a business are as follows: managing accounts, managing finances, cash availability, market price, lack of market, transportation, late harvest, input costs, lack of storage facilities and late shipment. Similarly, the lack of storage, cash problems, price competition and transportation sometimes prevent the producer to sell produce.

7.18.1. Innovation Methods and Uses of Changes for Higher Sales

About 60% of producers knew innovative methods. Only a few producers heard or seen any form of innovative methods. Producers learn about innovative methods through several media include SIBC, neighbours, friends, family members, traders, phone calls, and own knowledge. Producers receive their sources of information from buyers, radio broadcasts, phone calls, traders' relatives, and friends. Most producers do not use agriculture inputs because resources are not available.

Producers have increased their sales due to improved storage facilities, prices for commodity, relationship building between customers and producers, and the availability of piggery, kava, and teak trees. At the village level, sales have slightly increased due to availability of copra buying point. Sales have also increased due to availability of farm tools and equipment. The availability of storage facility at the village enables the famers to store farm produce, avoid costs of transportation to markets, having easy access to load copra. Producers have continuously gone to the village and buy farm produce. About 60% of village produce seaweed for sale. In terms of honey, only 90% sell honey while another 90% sell noni. About 90% of ngali nuts, noni, coconut syrup.

7.18.2. Shocks and Stresses Caused by Environmental Changes

About 60% of producer organizations felt the shocks and stresses caused by environmental changes. Their experience includes witnessing flooding, landslides, and sea-level rise. Such shocks and stresses have reduced cocoa production, the flow of goods supply, and low copra price. Not much is done to avoid such natural shocks and stresses. For example, coconut seedlings are now planted near river.

7.19. Local Traders

In the study 5 local traders were also part of the survey. The study indicated that the traders were trading copra, cocoa, consumer goods and all other items demanded by the local communities. The traders normally buy goods from Honiara and sell them to the local communities. The demand of goods is based on the nature of what communities prefer to consume. The nature of trading has been limited due to the high cost of transportation, weather conditions and cashflow. Oher factors include the type of customers they have, and the demand from local communities. The biggest challenge is management, freight, space for more rooms, and credit (Cash). The traders indicated that rejecting any credit and working on pricing and increasing stock would result in high sales. The study indicated that traders that there is an absent of local value adding farm produce in their trading business at the communities. There was a doubt on having value adding units at the community level except for a storage shed.

Like farmers, traders are experiencing shocks and stresses due to environmental changes in the communities. This has an indirect impact to the traders because their customers would be affected as well in terms of low crop yields due to pests and diseases, soil erosion, heavy and prolonged rainfall, bleaching of coral and killing of other marine habitats and other resources. With such shocks and stresses, traders have not taken any actions to address some of the environmental issues.

8. The Effects of Climate Change in Subsistence and Semi-Commercial Food Production

Climate change presents Solomon Islands with unique challenges including rising temperatures, sea-level rise, contamination of freshwater resources with saltwater, coastal erosion, an increase in extreme weather events, coral reef bleaching, and ocean acidification (MECDM & Save the Children, 2022, Yeo, 2020, Kama, 2021, Albert, et al, 2012). Projections for the rest of this century suggest continued increases in air and ocean surface temperatures in Solomon Islands, increased frequency of extreme weather events, and increased rainfall during wet months and a decrease in rainfall during dry months.

The studies of Chand et al. (2013) in Fiji, Kiribati, and Samoa, and Tambo and Wunscher (2014), Rogers and Josefa (2000), Rogers and Josefa (1996), Garnett, (2013), UNDP (2008), FAO (2019), and SPC (2007) in Solomon Islands and the Pacific, have identified climate change as another driver (cause) for strengthening subsistence agricultural production. The negative impact of climate change

has resulted in the more frequent and severe occurrence of weather events, thus putting greater stress on economically impoverished communities in Solomon Islands as well as other developing countries. While the agricultural extension system has been unable to provide services to smallholder farmers, the country has also been experiencing prolonged dry seasons and erratic seasonal rainfall patterns caused by climate change. Many of the Solomon Islands environmental problems including shocks and stresses have resulted from exploitative and extractive or destructive industries activities (Talo, 2008, UNDP, 2010). These activities include logging, land clearing, urban development and construction, waste disposal, and over harvesting of natural resources (Talo, 2008, Barbier, 2004). The result of such activities has caused increased soil erosion and declining soil fertility, pest infestations, destruction of ecosystems, loss of biodiversity and habitat loss, loss of water quality and quantity, coastal erosion and degradation, sedimentation, and saltwater intrusion; all of which have impacted heavily on agricultural production (MECDM & Save the Children, 2022, Talo, 2008; World Bank, 2015; ACIAR, 2006; KGA, 2006; UNDP, 2019). In addition, over the past decade several natural disasters have struck the country, including cyclones, floods, king tides, earthquakes, and tsunamis, resulting in the destruction of property, livelihoods, and the loss of life (Talo, 2008; UNDP, 2011). Furthermore, the consequences of climate change – changing seasonal weather patterns, rising sea-levels, and associated saltwater intrusion into crops and planting fields, and the contamination of freshwater aquifers are rapidly changing the landscape and environment for these communities and affecting food security (Talo, 2008; KGA, 2007; UNDP, 2011).

Many farmers including women, men, boys, girls, and children (WMBGC) have no further understanding of the changing weather patterns and the reasons for it except for innovative and lead farmers (MECDM & Save the Children, 2022). These observations were observed in five provinces, Choiseul, Western, Malaita, Isabel and Makira, Kama, (2021). In the MECDM and Save the Children (2022) study, many farmers (80%) including WMBGC have little knowledge about climate change and a lack of strategies to address its effects. Farmers in the five provinces indicated the presence of climate change through the change of weather, low crop production, pests and diseases, high temperatures, high rainfall, dry season, unpredictable, high tide, slow down farm harvest, flooding, landslide, sea-level rise, and drought. Some of these are discussed in the following paragraphs. Their limited knowledge is adaptive strategy for to cope with the changing environmental conditions.

8.1. Change of weather pattern

Farmers were aware that the climate has changed (Kama, 2021, & MECDM & Save the Children, 2022). The MECDM & Save the Children (2022) study indicated that the weather pattern has changed in remote and rural areas in Choiseul, Western, Makira, Isabel, Malaita provinces as well as in other provinces, making it difficult for farmers to plant crops in the normal weather. This has also changed the planting and harvesting times. The changes they observed are changes in average temperatures, rainfall, weather patterns and variations which have affected both subsistence and semi-commercial agriculture in the Solomon Islands. Climate change has been the reason many farmers sought solutions through innovation.

According to Kama, (2021) A farmer in Kolombangara stated.

> *When I saw my produce were damaged or affected by weather and other means, I felt very discouraged. At the market, I sell the produce while my husband and children do the planting. When I sat down, I already know how much I will collect one day. But when I saw the produce reduced, I told my husband that we will not go against mother nature. Even though we face such challenges, God has given us a time for everything. A time for grow, a time for harvest and so on. So, we just continue with farming. Even*

> *though we face the uncertainties in a farming life, we knew that life is not straight forward but full of challenges. So, we just continue with our planning and actions in farming. No matter insects, weeds, or weather that comes, we try use another method.*

Farmers from Kolombangara Guadalcanal and Malaita indicated that climate change has several effects, one of which is: changes to weather patterns (wet and dry seasons) (Kama, 2020). This creates uncertainty for farmers in relation to what crops they should grow under an unpredictable weather pattern. In all three cases, the unreliable weather pattern has stimulated many farmers to come up with their own planting seasons and they have developed new reasoning on what to grow and when to grow their crops. A farmer in a focus group discussion in North Malaita (Kama, 2021) shared his experience about the weather variations affecting his farming activities:

> *Climate change is hard to predict, especially the weather. Before it was easy to know the weather but these days weather has changed. Before we can be sure what to plant in rainy and on dry seasons. Today you may want to plant a rainy season crop, but it will be ended up that the weather has changed to dry season.*

In the in-depth interview in Kolombangara (Case Study 1) indicated a farmer stated this.

> *This climate has changed today, and we hardly ever predict it. During sunny weeks or months, we suffer due to the lack of irrigation. And if the water source is far away, we faced tough times trying to irrigate our nursery. So, climate change is a big problem affecting our farm production because we can hardly predict when the best time is to plant our crops. It will take a bit of time to identify the true weather pattern so that we can establish a more accurate growing season.*

Moreover, farmers agreed that their knowledge and skills in planting different crops with the natural weather cycle has changed, leaving them with a sense of uncertainty and confusion about the weather. This has had an impact on their growing season. A farmer in Case Study 1 stated,

> *We cannot predict weather now, it has changed. Before we can predict what crops to grow in rainy or dry seasons, not now. Not sure when should I plant my crops because weather has changed planting time. Not sure how to manage weather variations and Climate change is hard to predict.*

Another farmer in Case Study 1 stated, “I am uncertain about my gardening cycle. I am not sure and how will I understand it.”

Albert, (2016) identified in his assessment of climate change impact in Roviana Lagoon, Solomon Islands that the changing climate, among other changes, is affecting the productivity of local agroforestry. In this case, unpredictable seasons are causing staple food crops to rot during very wet periods or die during very dry periods. Pests and plant diseases are more prevalent.

8.2. Sea level rise and increases the water level in waterlogged areas.

Most of atoll islands in Solomon Islands including Ontong Java, Sikaiana including the Lau lagoon islands have experienced the sea level rise affecting limited agriculture land and fishing grounds for farmers livelihoods. The increase of waterlogging situation in swampy areas is the result of long periods of rainfall. In an in-depth interview in Kolombangara, a farmer indicated that in the case where the swamp land is closer to the sea, saltwater intrusion occurs, causing the soil to become saline and difficult to cultivate. When asked about the problem about waterlogging he said:

> *Biggest one is swamp or waterlogged land because of the lack of land. During extended periods of rainfall, water rises, and it makes it difficult to cultivate the soil. At the same time sea water comes in making my soil salty and it is not good for my crops. It will take some time for the water to go down again. I think climate change has cause all these. The sea level has risen, and I am uncertain about farming on this land in the future.*

The swampy (waterlogged) farming land has caused an uncertainty in relation to future cultivation on swampy land. This uncertainty only occurs in Kolombangara Island (Case Study 1) and not at the Guadalcanal and North Malaita study sites. In response to the uncertainty of future cultivation on swampy land, a farmer has developed a practice to address the waterlogging problem (Kama, 2021). The MECDM & Save the Children (2022) study also indicated that sea-level rise is a changing environmental issue identified in five or more provinces in Solomon Islands.

In a universal view, melting of grounded ice and thermal expansion of the oceans are expected to continue for many hundreds of years with a predicted rise of two to three feet this century (IPCC, 2007). Low-lying coastal areas will be periodically or permanently inundated by seawater, and saltwater intrusion will permanently alter low coastal wetlands and low-lying freshwater resources (Fetcher, 2009). Sea level rise also is directly implicated in increasing frequency and severity of high wave inundation and accelerate beach erosion (Fetcher, 2009), which will impact coastal habitats (e.g., nesting areas), ports, and coastal infrastructure (e.g., roads, sewers, communities)

8.3. Causes crop damage.

In-depth interviews according to Kama (2021) with farmers in North Malaita and the MECDM & Save the Children (2022) study indicated that hot and wet climatic conditions caused damage to crop and increased pest and disease infestations especially after long periods of rainfall. The results indicated that the most common insect pests in North Malaita are those related to the types of crops they grow, for example, sweet potato, taro, watermelon, and yam.

A focus group in Kolombangara (Case Study 1) and in-depth interviews in Guadalcanal and North Malaita (Case Studies 2 and 3), indicated that sweet potato yield decreases during rainy periods. This was also indicated by MECDM and Save the Children 2022 study. A farmer in Guadalcanal stated that *"sweet potato grows more vigorous and vegetatively during rainy period but do not have any yield".* This effect is a concern to farmers as this will impact on how much they will get back from their crops under weather variations. Such effect has caused farmers to be uncertain about quality and quantity of farm produce if the climate is changing continuously pests and diseases, uncertainty).

The MECDM & Save the Children 2022 study in five or more provinces (Choiseul, Western, Isabel, Makira, Malaita, and others) indicated that crops are damaged by heavy rain, flooding, landslides and pests and diseases. This did not only affect the quality of farm produce available for market but the

value of the produce. Crop damage can be prevented at both harvesting stage and post harvesting stage.

8.4. Causes soil erosion.

Flooding, landslides, and heavy rain cause soil to erode and washed into the sea. When excessive water runs over the soil surface it causes soil erosion and consequently reduces soil nutrients (Kama, 2021 and MECDM & Save the Children, 2022). The reduction of soil nutrients has become a major concern for farmers in all three sites and therefore presents significant uncertainty in relation to their capacity to continue to be productive. In response, farmers in all three sites use practices to conserve soil fertility including covering the ground with heavy mulch, slash and mulch, alley cropping, non-tillage planting, use cover cropping, diversity planting, and the planting of vetiver (Chrysopogon zizanioides) grass (Kama, 2022). See soil infertility, uncertainty and details of farmers responses covered in this chapter.

8.5. Intrusion of sea water into arable land

Since the sea level has risen, sea water intrusion into agriculture land has become a threat to food security. Sea water intrusion has reduced available land for growing staple crops as well as cash crops in some rural areas in Kolombangara, Choiseul, Malaita, Makira, Guadalcanal, and the atoll islands (Kama, 2021 and MECDM and Save the Children, 2022). Soil has become salinized changing the pH of soil which is unfavourable to growing crops. Rising sea levels and higher tides are increasing the amount of salt that is entering coastal gardens either directly from the high tides or carried by the wind (Albert, 2012).

8.6. Causes flooding and landslides of arable land

Climate change has caused long periods of rain causing floods and landslides in some Islands in Solomon Islands. This was indicated by the MECDM & Save the Children, 2022 study in five provinces. In Guadalcanal flooding is one natural cause of reducing land use in subsistence agriculture. Crops are wiped out by flooding or are buried: There is total disaster and farmers are worried and become uncertain about their future gardens. Soil is destroyed in landslides and is normally the topsoil is totally covered by soil from landslide, burying every crop. Flooding is another natural disaster. For example, in Guadalcanal, flooding of the Tina River sweeps crops and soil away from their gardens: Sometimes floods carry away crops and soil as well down the river into the sea.

Heavy rain also cause surface water accumulates which gradually cause flooding. Farmers in North and South Choiseul, Kolombangara, South Malaita and Makira indicated flooding as an environmental problem to subsistence agriculture. A study by Kama (2021) and MECDM & Save the Children (2022) indicated flooding and landslides are common deterrent to arable land particularly those situated by riverbanks e.g., the Tina River.

8.7. Increase Crop Pests and Diseases

Damage crop: Crop can be damaged by pests and diseases by eating, cutting, and chewing any parts of the plant. Diseases can damage the plant through invading through fruits, leaves, roots, or the trunk. Reduce crop growth: Pests and diseases reduce crop growth when they attack the roots, fruits, leaves, or the stem. Reduce quality of market produce: When the crop is attacked by pests and diseases, it reduces the quality of the produce for market. Defoliate crops: The defoliation of crops is caused by pests chewing the leaves or a fungal disease such as taro leaf blight (TLB). Reduce leaf surface area: When pests chew the leaves or disease like TLB attack the plant leaves, it reduces the leaf area. Damage to the leaf, fruit, roots, stems: Most pests and diseases attack leaves, fruits. Stems and roots. When these important parts are damaged, food is reduced, and market produce decrease

in quality (Kama, 2021). The study from MECDM and Save the Children also indicated pests and diseases are major setbacks for food production in remote and rural areas in Solomon Islands. Pests and diseases normally in peak occurrences after long period of rainfall.

8.8. Infertile Soil and Soil Erosion

Farmers in all three sites (provinces) indicated that infertile soil was the result from continuous gardening where it is no longer possible to practice swidden agriculture or fallow the soil. The MECDM & Save the Children, 2022 indicated that infertile soil and soil erosion are due to climate change. Both focus groups and in-depth interviews in all three sites indicated infertile soil is a major driver of farmer uncertainty. There are many causes of infertile soil and in all three case studies, the causes of infertile soil were similar. Over cultivation was the main reason why soil becomes infertile as farmers have practiced fixed farming (continuous farming). According to participation observations, the reasons for the soil infertility are quite different. In Case Study 1(Kolombangara), the reason is due to shortage of arable land to expand or shift cultivation. Much of the land that were customary in previous decades are now alienated land, currently owned by the Solomon Islands Government. The land has been for the past fifty (50) years leased to the Kolombangara Forestry Plantation Limited or KFPL which replants and harvests plantation trees. This left indigenous farmers with very little choice but to apply fixed farming methods which have resulted in the reduced fertility of the land.

However, this does not limit the reasons for soil infertility because soil erosion or leaching of soil nutrients are important reasons as well. When soil is overused, farmers are uncertain of the future of fixed farming which is dependent on soil fertility. A farmer in Case Study 2 stated, *"how to improve soil fertility is our problem and there is no manure available, so we are in trouble".*

The effects of infertile soil vary from site to site, but common issues include low crop production, reduced crop growth, and delays in flowering and maturity of the crop. When soil is infertile, soil characteristics are also destroyed. Farmers in all three Case Studies (Kolombangara, Guadalcanal, and North Malaita), through in-depth interviews indicated that when soil is overused, it loses its fertility. Farmers agreed that several soil characteristics are affected by infertility. These are:

(i) Soil becomes free and loose and soil particles no longer bind to each other due to a lack of organic matter,

(ii) The soil structure is destroyed,

(iii) Soil moisture decreases dramatically leaving only hydroscopic water in the soil, and

(iv) The soil becomes compacted.

A farmer in Case study 2 (Guadalcanal) stated "*The effects of infertile soil are (i) crops reduced in yield, (ii) lack of soil nutrients especially the major elements. (iii) lack of soil water and (iv) soil becomes compact*."

A farmer in Kolombangara stated this in the focus group.

> *For me, my biggest problem is the declining of soil nutrients. Because we here are living on Government land. And we cannot increase our planting area, so we must repeat planting on the same piece of land for several years. So that is the biggest problem, the decline of soil nutrients in the soil.*

In response to the uncertainty, farmers in all three sites responded with the following practices:

- Application of heavy mulch to increase yields and soil fertility,
- Slashing bush to use for mulching to maintain soil fertility and moisture,
- Broadcasting seeds on non-tillage soil to maintain soil fertility and moisture,
- The application of chicken manure to improve soil fertility,
- Intercropping for maintaining soil fertility,
- Non-tillage to maintain soil fertility and soil moisture,
- Mulching to control weeds, maintain soil fertility and control soil erosion,
- Mixed cropping to maintain soil fertility and pest and disease management,
- Alley cropping to maintain soil fertility and increase crop yields,
- Bush fallow to maintain soil fertility and maintain soil organic matter, and
- The use of cover cropping to maintain soil fertility and increase crop yield (See, Soil Infertility, uncertainty, and farmers response to uncertainty).

8.9. High Sea Temperatures Affect Marine Resource and Irreversible Losses to Marine Ecosystem

The study done by MECDM & Save the Children 2022, indicated the seriousness of high sea temperatures in Solomon Islands. Rising sea levels and high sea temperatures are affected marine resources such as fish. Fish are important source of protein. In Roviana sea level rise has affect mangrove areas more than others. However, the major threat to mangroves in Roviana is cutting to make room for villages and plantations. Mangroves help stabilise coastlines and reduce erosion and are a haven where fish and shellfish live and breed (Albert, et al, 2012, ADB, 2011). In Lau lagoon, Yeo (2020) indicated that climate change has risen sea level which directly affect communities fishing grounds and threatens local people for displacement. Commercial logging in the lagoon catchment area is increasing soil erosion and subsequent sedimentation of the water – which affects fish stocks. In addition, coral bleaching and diseases is also already impacting Roviana and will worsen with climate change (Albert, et al, 2012).

Food security is a key concern, with irreversible losses to our marine ecosystem now inevitable. Studies have warned that even if the Solomon Islands governments successfully keep global warming below 1.5°C, 70-90% of reef-building corals will be lost – and 99% with 2°C of warming. These reefs provide crucial ecosystems for life underwater and support thousands of marine species, notably our national treasure the hawksbill turtle. The people of the Solomon Islands and particularly those in low-lying atoll communities such as Ontong Java rely heavily on the protein the coral reefs provide, including fish, seaweed, and crayfish. The reefs also support their economic livelihoods with sea cucumber as their main export commodity. The impacts of climate change are many and some are described in this report (Albert, et al, 2012, Kama, 2021).

8.10. Information Gap on Climate Change

The Solomon Islands, like all small island states, faces a unique set of challenges in dealing with climate variability and change. While several climate change and adaptation activities are ongoing, significant research, data, and information gaps that will need to be addressed considering projected changes in climate. Detailed assessments of climate change impacts and risks focusing on food security, water resources, and coastal resources are required (MECDM & Save the Children, 2022). Water supply and demand studies need to be conducted by the Water Resources Department in Honiara, and this needs to be expanded to other critical urban areas to appropriately address issues and problems with water resources management and the development of an integrated coastal management plan.

Most climate change effects are easily observable by innovative and lead farmers through their farming experience and have accumulated experience which women, youth and children do not have and see. However, the evidence of sea level rise is observable by all community members including youth and children. Thus, there is climate change knowledge gap existing with women, youth, and children.

The MECDM & Save the Children, 2022 study and Kama, 2021 indicated the evidence that WMBGC in the five (Choiseul, Western, Isabel, Makira, and Malaita) provinces in the remote and rural communities of Solomon Islands that there is a lack of knowledge in climate change, its effects, and strategies for adaptation. Farmers (WMBGC) gap in knowledge on climate change, its effects, and strategies for adaptation is clear in the MECDM & Save the Children 2022 study. This indicates that climate change can be seen in their remote and rural environment but the there is a lack of knowledge on how one should address the effects. This becomes the underlying training climate change need in the remote and rural communities in Solomon Islands.

9. The Weakening Role of Agriculture Extension Services in Rural and Remote Communities

Conventional government-run agricultural extension services have notably failed to deliver improved agricultural productivity in rural Solomon Islands. In 1998, the single agricultural research station for the Ministry of Agriculture and Livestock was destroyed in an intercultural conflict. Therefore, the centralized agricultural research activities and the extension system associated with it, collapsed. Since then, conventional extension strategy was weakening with limited extension delivery in limited locations around the country.

Though several approaches have been introduced to improve agricultural production, the Ministry of Agriculture and Livestock (MAL) is claimed to be a weak department. This is measured by the unavailability of funds, infrastructure, qualified personnel, transportation (Kama, 2021). It thus has low capacity to make drastic changes in the rural regions of the Solomon Islands and subsequently it has struggled to achieve its extension mission (Ho'ota, 2014 and Kama, 2021). In recent years, there has been growing dissatisfaction with the poor adoption rate of agricultural technologies in resource poor farming systems in the rural areas of Solomon Islands (Ho'ota, 2014; SPC, 2015; World Bank, 2015). The poor rate of adoption occurs partly because when agricultural technologies are developed, there is little input from farmers which created the lack of ownership by the farmers (Stur, Horne, Hacker & Kerridge, 1999; Hazelman, 1988; ADB, 2005). In addition, the weak extension services and the lack of an agricultural research station and laboratory infrastructure is one of the major causes of the stagnation and collapse of extension services and research activities into innovative crops, crop production, and the increase in export of many commodities (ACIAR, 2006; Powles, 2013; Waetara et al, 2007; Crescent, 2015). Since 1999, there has been a remarkable reduction in research activities, especially in the development of new agricultural technologies tailored to rural farmers. The effectiveness of agriculture extension is affected by the following factors and challenges including:

- ***Distance and isolation:*** The geographical structure of many parts of the country is difficult with many scattered islands, steep slopes, and storm-prone coasts making it difficult to reach rural communities (Ho'ota, 2014). Transport limitations also make it difficult to reach and deliver extension services to remote islands and those communities living in the interior of bigger islands (Ho'ota, 2014; MAL, 2011). The distances from central markets (MAL, 2011; Ho'ota, 2014) has also caused difficulties for farmers. In addition, there are poor communication linkages between MAL headquarters and the provinces (MAL, 2011; Ho'ota, 2014). This tends to lead to a lack of coordination and reduces the effectiveness of the network, which can be coupled with a reduced sense of teamwork and issues with the flow of command and information dissemination. All these factors distort and hamper the effective delivery of extension services.

- ***Poor infrastructure, facilities, and equipment:*** There is a lack of proper office space, staff accommodation and equipment in the provinces and other major centres. Strategies and plans to build much-needed infrastructure are often deferred due to the delays in government funding (MAL, 2011; Ho'ota, 2014). This is due to lack of prioritisation of these areas within the department's infrastructure needs and, in the Ministry's strategic plans and reviews. It is also for this same reason that the research station was never rebuilt (ADB, 2005), together with a lack of adequate land to house the research station and relevant infrastructure. Most provinces have limited infrastructure, and this limits visitations and dissemination of agriculture innovations (MAL,2008; Ho'ota, 2014). The Fote Training Centre in Malaita Province for instance, has been taken back by landowners, leaving no land for MAL to run its research activities. However, the recent move by MAL to build its research station at Tenaru is yet to be finalised and implemented.

- ***Lack of extension information:*** There are two key reasons for the lack of extension information (MAL, 2011; Ho'ota, 2014). Firstly, there has been little research to help create farming innovations since the destruction of the research station near Honiara in 1999 (Kama, 2021). Secondly, for reasons previously stated MAL, the department responsible for extension information, is impaired in its capacity to perform these services (Kama, 2021).

- ***Administrative:*** There are several administrative challenges in relation to extension services. Importantly, there is a lack of operational guidelines for the conducting of field activities (MAL, 2011; Ho'ota, 2014), due to a lack of proper planning, implementation, and allocation of yearly work plans. The lack of funds also contributes to the situation. Another challenge is the frequent delays in the release of funds from the government, which also affects work efficiency (MAL, 2011; Ho'ota, 2014). The current rate of the disbursal of funds to the government ministries is slow and by the time funds are available the operational period allocated to use these funds has passed. This is a critical challenge and one that the ministry has no control over.

- ***Personnel:*** The department also lacks staff qualified to conduct scientific research on crops and livestock as well as specific operations in certain crops. These have caused setbacks for research programmes and extension services (Crescent, 2015, & Kama, 2021). This discussion highlights the challenges facing the successful conversion of agricultural extension programs within the Solomon Islands context.

In 2020, in Kama (2021) study confirmed that these factors and challenges are still exist in all provinces and extraordinarily little development has been done to alleviate them. Such factors and challenges are crucial drivers for effective extension service and sustainable mechanism for supporting food security and livelihoods. MAL has recently refocused its extension services on participatory agricultural extension with a focus on areas including (i) National food security; (ii) Agriculture livelihood and export-based expansion and (iii) Sustainable economic development export strengthening. All these strategies are in response to the need of food security, agriculture livelihood and sustainable economic development and export challenges and market extension delivery (Ho'ota, 2014).

10. Farmer Innovations in Response to Climate Change (Adaptive Interventions)

It is important to note that innovative farmers are not compliance to the effects of climate change. These group of farmers are the fore front of farmer innovation in Solomon Islands who have become innovative in their farming practices. The study by MECDM & Save the Children 2022 was not able to properly identify this group of farmers for some reasons. One is the fact that the study of MECDM & Save the Children was more focused on remote and rural communities and could have missed the innovative farmers who are normally located close to some community centre. Secondly, they normally have previous training from a vocational or agriculture college and would have applied their knowledge and skills through running a farmer field schools. Thirdly, they are very innovative based

on their responses on urgency, the fact that MAL extension services are not visiting farmers due to ongoing issues. Their innovativeness is a response to driver such as climate change and many others such as infertile soil, pests, and diseases, limited arable land, and lack of planting materials. Their initiative to innovate is driven by urgency, due to the absence of government extension services after the ethnic tension in 2000. They were responding to the drivers including climate change by using their climatic ecological knowledge to plant and harvest their crops. The presence of innovative farmers is in all provinces in the country. This was evidenced in the FAO Live & Learn Sustainable Land Management (SLM) training carried out by Kama and Pauku in 2021 and 2022 in five provinces, Choiseul, Western, Makira, Guadalcanal, and Malaita. The climate-smart agriculture practices shared during the FAO Live & Learn were developed by innovative farmers. About 200 farmers in the five provinces were trained in sustainable land management practices involving climate-smart agriculture practices. The study by MECDM & Save the Children 2022, have identified that most farmers in the remote and rural Solomon Islands have no deeper knowledge and understanding about CSA practices.

Currently, the government's capacity to produce high yield crops and resistant varieties to pests, climate change and other drivers such as infertile soil is very limited due to the lack of research field grounds. To exacerbate the situation, the current extension delivery system continues to be weakened. In 2002 after the ethnic tension up to the present, smallholder, subsistence farmers have been compensating for the lack of extension services by introducing their own innovations and have continued with their own food production using traditional adaptive and resilient methods (Kama, 2021 and MAL, 2011). This farmer response was based on the theory of urgency, in this case farmer urgency which took place by unlocking farmer led innovation and were compensating by introducing their own innovations without technical or extension support. Farmers have conducted on-farm experiments including the testing of different varieties to increase yields, using biodiversity to select the best varieties, applying different methods of farming to monitor crop growth and performance, improving soil fertility using differing techniques, and breeding crop varieties to identify varieties which were climate change resilience (Kama, 2021 and Kastom Garden, 2007). As this had been the case in the past, farmers tolerated the absence of extension services and the lack of availability to improved agricultural technologies (National Economic Recovery, Reform and Development Plan (NERRDP, 2003). After the ethnic tension, the fact that farmers were able to cope with their farm problems including the effects of climate change on their crops, poses a question in relation to their dependency on the Ministry of Agriculture and Livestock (MAL) for agricultural innovations. Already several climate-smart agriculture practices have been developed by innovative farmers and shared between farmers (Kama, 2021). These practices have increased food production however, they would need government investment and support to produce more nutritious food, nature-positive and sustainable production.

In response to the effects of climate change and the uncertainties of unpredictable weather pattern and other effects, farmers have developed farming practices which they have created through farmer innovation (experimentations) which have proven resilient and have increased in yield in many subsistence crops. These practices have certainly address drivers and uncertainties of climate related issues in agriculture production (Kama, 2021). Some of the innovative or climate-smart agriculture practices are described in this report. These climate-smart agriculture practices are the result of Kama's research work in Kolombangara, Malaita and Guadalcanal provinces in 2017 to 2019. In addition, in 2021 and 2022, similar climate-smart practices were observed during Kama and Pauku's farmers training on sustainable land management practices which were shared amongst farmers in Choiseul, Western, Malaita, Guadalcanal and Makira provinces. This indicates that such practices have been transferred or developed by other innovative farmers in almost all provinces. The work of Live and Learn on sustainable land management has used some of these practices in its delivery of knowledge and skills to empower farmers in managing their protected areas, a FAO project on Integrated Forestry Management. According to Kama's findings, climate-smart agriculture practices

are found to be climate change resilient, increase in crop yields, resistance to pests and diseases, sustainable under climate change and reduce Green House Gas effects. Each practice is described and the concept behind each of them. To be able to widely use these practices in other provinces, practices need to be properly documented, stored, and used by innovative farmers, extension staff and NGOs to deliver them to farmers.

Apart from Kama's study, there were several adaptive community interventions that were implemented throughout remote and rural Solomon Islands. These interventions were incorporated into the national government and provincial governments (Albert, et al, 2012 and McNaught, et al, 2011). However, a number of these adaptive interventions were not sustainable. In addition, there was a lack of strong participation of WMBGC in the programs. A strong and sustainable support from the government was also missing to sustain the projects. Kastom Garden Association: has developed several climate-smart agriculture practices. Examples are composting, alley cropping, mulching, intercropping, agroforestry, and crop rotation. Complementing these practices are similar practices carried out by Zai and Tina Organic farm in Honiara. Zai and Tina Organic farm is an organic farm which produces organic produce from its farm. Several organic practices are used including composting, mulching, addition of organic matter to soil and the use of organic pesticides.

Burua Garden Association is a home grown and locally owned non-profitable organization established to help local farmers cope with the ever-increasing effects and impacts of climate change and the challenge of food security. The Burua Gardening is a locally designed climate smart gardening system and approach to improve food quality and increase food productivity. The Burua gardening approach focus more on family food security and family cash economy. Burua in the Lau dialect is referred to a small box erected using logs and sticks for litter and compost. Burua garden in its totality is a litter garden or compost garden. It is a climate smart gardening concept designed to increase production and improve quality of local food stability (security).

10.1. Case Study 1: Kolombangara Experience (Kama, 2020)

The results presented in this section highlights six new agricultural practices adopted in the study locations in Kolombangara (Kama, 2021). The new practices are closely related to the effects of geography, environment, ecology, beliefs, farmers' needs, economics, and environment of Kolombangara island. The Ostrich fern (*Matteuccia struthiopteris)* for example, is associated with infertile soil and climate change drivers. The five new practices in Kolombangara were developed to address drivers such as climate change, low crop yields, infertile soil, and pests and diseases.

10.1.1. The use of coconut fronds as mulch for tomatoes without staking

One innovative farmer decided to use coconut (*Cocos nucifera*) fronds to mulch his tomato (*Solanum lycopersicum*) crop after seeing that staking tomato without mulching encourages a fungus to attack the tomato fruits. This had eventually reduced his crop yield and income. After making several observations, the farmer experimented on the use of coconut fronds to mulch his tomato crops. He collected dried coconut fronds from nearby plantations and carefully placed them under tomato plants. Rather than staking the tomatoes, he allowed them to drape over the two-inch-thick mulch. After observation, the farmer found that his new practice worked very well and has increased both his production and the quality of the tomato fruits.

The fungal disease reduced dramatically, and crop yield improved significantly, because the use of the coconut fronds prevents fungal spores from the soil splashing up to the crop during the heavy rainfall. A farmer stated:

> *I started off by staking my tomatoes, but I realised that fungus was attacking them. This reduced the number of fruits as well as the quality that I was expecting to market. After*

some time, I decided to use coconut fronds to mulch the ground under the tomato plants. I removed the stakes as well to see if that was the problem. I collected coconut fronds and applied them as mulch. I observed the new practice and identified that it has significantly improved not only the production but the quality of the fruits as well. After several trials, I confirmed that it was the best way to grow my tomatoes

According to the farmers, this is a responsive technology to improve quality and quantity of tomato produce due to fungal diseases. shows the coconut mulching.

Figure 1. Cocos nucifera fronds used for mulching tomato plants (Solanum lycopersicum) in response to fungal attack

When other farmers learnt about the use of coconut fronds as mulch for tomato crops, they also experimented and eventually adopted the new practice.

10.1.2. Parallel planting of pumpkin (Cucurbita pepo) and Pueraria (Pueraria phaseoloides)

Legume plants live in a symbiotic relationship with the nitrogen fixing bacteria - the Rhizobia which live in nodules in the plant's roots. In this way the plant can look after its own nitrogen needs and fertiliser is not required.

The same farmer experimented with parallel planting of legume plants with pumpkin, after seeing that the conventional cropping system was not achieving the crop production and extra income required for his growing family.

He planted rows of pumpkin on non-tillage soil. After 4 weeks he planted *Pueraria*, a legume plant (cover crop) between the rows of pumpkins. The *Pueraria* supports the pumpkin by supplying nitrogen to the soil. The farmer discovered the cover crop not only improved soil fertility but maintains soil moisture, prevents weeds, and to some degree control's pests and diseases. He found that organic

materials under the *Pueraria* decompose and provide an adequate source of potassium (k) to the pumpkin to induce flowering.

Parallel planting has resulted in high yield pumpkin crops and improved both quality and quantity of the crop yield. Figure 2 shows parallel planting at a later stage of the practice.

Figure 2. Parallel planting of pumpkin (Cucurbita pepo) and Pueraria (Pueraria phaseoloides)

10.1.3. Use of ostrich fern (Matteuccia struthiopteris) land for non-tillage planting of vegetables

Ostrich fern grows wild on Kolombangara, especially on previously cultivated land and was regarded as a weed. A farmer in Kolombangara discovered from pulling out ostrich fern that the soil where it grew had broken down and created a good soil structure. He also found that the good soil structure encourages microbial activity and so with the organic materials from dead leaves and roots, the soil provides suitable conditions for the growing of vegetable crops. Farmer in Kolombangara stated:

> *I was weeding out the ostrich ferns when I realised that the soil on which it was growing was well structured, soft and was easy to dig. I tried out my digging stick to see what the soil was like and found that it was good for planting. When I planted my pepper and corn, I noticed that they were growing very well. Ostrich ferns soils are good for gardening*

Since the farmer's discovery, the use of ostrich fern land for non-tillage planting of vegetables has been adopted by other farmers. When opening a new plot, farmers slash the fern very low before using the land for planting vegetable crops such as capsicum *(Capsicum annuum),* egg plant *(Solanum melongena),* and corn *(Zea mays).* Figure x shows pictures of ostrich fern area.

Figure 3. Ostrich fern (Matteuccia struthiopteris) growing wild in Kolombangara

10.1.4. Planting of Vetiver grass (Chrysopogon zizanioides) on swampy land

After gardening on swampy land for several years, an innovative farmer in Kolombangara decided to plant vetiver grass (*Chrysopogon zizanioides)* where water accumulates between raised beds. His only previous knowledge about the grass was that it could control erosion. His purpose was to control extreme waterlogging in his garden. With this scrap of knowledge, he planted the vetiver grass to see what might happen. He found the vetiver grass achieved two things, control water level and control over the water temperature. A farmer stated:

> *The only thing I knew about vetiver grass is it is good for controlling soil erosion. However, I tried to plant it on the swampy land I was farming. I planted them between the planting beds because I want to protect the beds from eroding into the water. I noticed that when the vetiver grass was fully grown, I realised that it was sucking out the water in between the beds. At the same time, I noticed that it was making the water cool during hot sunny days as well as keeping it warm during rainy days. After several attempts and observations, I confirmed that vetiver was removing the swamp water as well as regulating water temperature.*

This farmer showed that vetiver grass can be used to rehabilitate swampy waste land for the cultivation of vegetables. Planting vetiver grass on swampy land has become an alternative cropping system for growing food on wasteland that could not be previously cultivated. Fig 4 shows the use of *Chrysopogon zizanioides* to reduce swamp water levels and to regulate water temperatures in response to high temperatures and long periods of rainfall.

Figure 4. Chrysopogon zizanioides planted between beds to reduce swamp water levels and to regulate water temperature to optimum levels for crop growth.

10.1.5. Growing watercress (Nasturtium officinale) on fishing nets

Watercress (*Nasturtium officinale)* is normally planted on riverbeds or naturally grows on stream beds. However, due to the damage caused by flooding, and a low yield, an innovative farmer in Kolombangara decided to experiment using fishing nets to grow his watercress on streams.

To carry out this experiment, the farmer obtained fishing nets from two large fishing companies in Noro township in New Georgia. Next, a frame structure was built on strong wooden posts and frames above the stream water level. The fishing net was then spread over the frame and fixed with nails or tied firmly onto the frame. Watercress was then planted onto the nets and secured by strings. After two weeks of observations, the watercress grew to cover the fishing net. After repeated experiments, the practice has been refined to give the farmer positive results. The practice was very successful. According to the farmer, crop yields have significantly increased and regrowth after each harvest has recovered faster than the original planting on riverbeds. Farmers adopting the new practice have doubled their harvest and income at the Gizo market. A farmer stated:

> *I decided to use the fishing net when I saw the limitation of watercress not growing further into the deep part of the stream. I thought the net should provide support for watercress to maximise production. I went to Noro, bought my fishing nets, and built the net across the stream. I planted the watercress onto the nets and after a while I noticed that it was growing vigorously. The new cropping method has increased both quality and quantity.*

Fig 5: shows *Nasturtium officinale* growing on fishing nets.

Figure 5. Watercress (Nasturtium officinale) growing on fishing nets.

10.2. Case Study 2: Guadalcanal Experience (Kama, 2020)

Guadalcanal, like Kolombangara, is mountainous, steep, and rugged with deep valleys and rivers in the interior. Within the Tina area, where the study was conducted there is limited arable land due to this topography. The soil type in the area is loam, sandy loam, and alluvial soil and is subject to soil erosion, leaving the soil infertile. The culture is different from Kolombangara, and Malaita and the cultural norms, values, and beliefs are expressed in their gardening practices. Socially, they are more relaxed, the community socialises more and spends much of their money on social events. Honiara is their main market, and the main means of transport is by road.

The study identified three new agricultural practices developed by farmers in this region. For example, what farmers grow in their gardens is influenced by their values, beliefs, and needs in terms of local market demand. The new practices are specifically developed to address drivers related to pests and diseases and ease of harvesting.

10.2.1. Building drains to control giant African snails (Achatina fulica)

Within the Tina region, the giant African snail *(Achatina fulica)* is a serious pest to all crops in Central Guadalcanal and has caused serious losses to farmers' crops. The pest was introduced to the area by logging trucks and bulldozers. As a result, it has spread throughout Central Guadalcanal. Although several farmers had used snail baits, they could not eradicate the pest from the area. The practice of building drains around a garden to control the giant African snail *(Achatina fulica)* was developed in response to uncertainties related to future crop quality and quantity and that garden produce would decline. According to the farmer in Guadalcanal, he stated:

> *I dug a drain around my garden at about knee deep. When I had finished the drain, I made few observations to see if this method would work. During rainy days, I collected snails inside the drain and destroy them. During hot days, snails fell into the drains and because of the heat from the sun, the snails die. I also noticed that the alluvial soil found on the tongues of the snails prevented them from moving any further. When the sun*

came up, the snails could not escape the heat and that killed them. I found that the method I discovered was working very well.

In some cases, farmers see snails laying eggs inside the drain. This makes it easy for farmers to destroy both eggs and adult snails. This effective control measure proved better than the cost of buying snail baits which were sometimes not available in agricultural stores. Fig. 6: shows a giant African snail (*Achatina fulica).*

Figure 6. Giant African snail (Achatina fulica)

10.2.2. Application of coconut (Cocos nucifera) charcoal on taro to control of taro beetle (Papuana buebneri)

The Taro beetle is a serious pest to taro *(Colocasia esculenta)* and reduces the quality and quantity of taro corms. The pest bores into taro corms causing yield loss and making taro susceptible to fungus attack. When taro corms are damaged, farmers do not get a good price for their taro. In response to the pest, an innovative farmer in Guadalcanal conducted an experiment by applying coconut charcoal around the taro plant. Coconut charcoal was made by burning coconut shells in empty 44-gallon drums. When the charcoal was ready, they were crushed to a smaller size to make application much easier. The coconut charcoal is applied around each taro plant, known as a ring dressing. After several observations, the farmer confirmed that there was no further attack by the taro beetle and confirmed that the new practice was controlling the pest.

Other farmers who applied the new control method confirmed that there were no further attacks by taro beetle on the taro corms. Fig 7. shows ready-made coconut charcoal. Fig 8 shows the taro beetle and the damage it can cause to taro.

Figure 7. Coconut (Cocos nucifera) charcoal used for controlling the taro beetle (Papuana huebneri)

Figure 8. Taro beetle (Papuana huebneri) and the damage it causes to taro (Colocasia esculenta)

10.2.3. Planting of banana (Musa acuminata) for easy harvesting

Cleaning or harvesting banana is a tiring task when farmers must go through a banana plantation to look for banana fruits as well as removing dead banana leaves. An innovative farmer experimented with a new way of planting bananas. The suckers are cut away and are planted out in holes so that all the cuts face the same way. His intention was to find out how the crop would respond to the planting method. As a result, the farmer noticed that all flowers and fruits were produced on the same side of the plant. The planting method has made harvesting a lot easier and more importantly requires less labour cost to manage the plantation. Figure 9 shows suckers which had been cut out from the parent plant. Figure 10 indicates the bananas bunches all hanging on the same side.

Figure 9. Banana suckers cut from the parent plant. Arrows indicate the cuts or scars on suckers

Figure 10. Bunches of bananas hanging on the same side of each trunk

10.3. Case Study 3: Malaita Experience (Kama, 2020)

Malaita is a volcanic island and is dominated by steep mountains and deep valleys in the interior of the island. The Malaita site, unlike Guadalcanal and Kolombangara, is situated on low, undulating land with relatively small streams. The island has volcanic soil. However, soil in the Northern region area is clay loam, with low soil fertility on cultivated plots (in the past farmers preferred swidden farming) due to continuous cultivation. The lower land area is covered with secondary rainforest which has become the main gardening area for farmers.

Malaita has a very strong culture, and the norms, values, beliefs, and daily practices deeply influence subsistence agriculture. In most cases, women do the gardening but since innovative farmers had introduced new agricultural practices both men and women now garden. Farmers are conservative and have a very strong work ethic. As in the other case studies, the ecology, environment, beliefs, farmer's needs, and economics influence agricultural practice. The cultivation methods and practices are related to the type of soil, topography, and soil water. Moreover, traditional beliefs on growing crops and market prices are also key factors in existing agricultural practices. Farmers have a local

market but most garden produce goes to the Auki market, the provincial capital of Malaita, and some goes to Honiara market. Farmers in Malaita have developed six new agricultural practices identified by this study. The new practices were specifically developed to address the drivers and uncertainties related to soil infertility and low crop yield.

10.3.1. Heavy mulching on sweet potato (Ipomoea batatas) and taro (Colocasia esculenta)

Heavy mulch materials are applied along rows of both sweet potato and taro. An innovative farmer in Malaita tried this to see if there was yield differences to the normal way of growing such crops without mulching. Mulch materials used include organic materials found on soil surface, dead leaves, dead roots, small branches, and parts of rotten log. Thick mulch was applied between sweet potato mounds and next to the rows of taro plants at a thickness of about 15 to 20cm. After several observations, the farmer observed positive results and confirmed the successful use of heavy mulching.

The result showed heavy mulching had the following positive impacts:

(v) The mulch improved soil fertility by supplying organic nutrients into the soil,

(vi) The mulch when converted into organic materials significantly increased crop yields was evidenced in the harvest,

(vii) The mulch maintains soil temperature and moisture, and encouraged microbial activity in the soil,

(viii) The mulch prevented soil erosion, and

(ix) The mulch allowed a second harvest of sweet potato.

The farmer noticed the soil under the decomposed mulch provided a rich organic source of soil nutrients causing potato roots to produce additional potato tubers. When the crops are harvested, the organic matter that remained was turned back into the soil. The same farmer also carried out heavy mulching on taro and had received similar results as the sweet potato. The yield increased however, unlike sweet potato there was no second harvest. A farmer stated:

> *I knew mulching is good for the soil, but I want to try out by putting more mulching materials on both sweet potato and taro. When I did, I realised that it has significantly increased my potato and taro production. For both crops, quality and quantity dramatically increased in yields. Fig 11: shows heavy mulching in Ipomoea batatas and Fig 12: shows heavy mulching on Colocasia esculenta*

Figure 11. Heavy mulching on Ipomoea batatas. Heavy mulch was applied between mounds.

Figure 12. Heavy mulching is applied beside the rows of taro

10.3.2. Horizontal planting of sweet potato (Ipomoea batatas) and cassava (Manihot esculenta)

An innovative farmer from Malaita conducted two experiments. Two horizontal plantings were carried out with one planting of sweet potato and the second of cassava. Ridges were prepared and sweet potato were prepared at 50cm in length including the tip of the vines. Leaves were removed on the vine except at the tip of the vine. Next, he placed the cutting in a horizontal position on top of the ridge three inches deep with the vine tip at the surface of the ridge, see Fig 13. The cutting was then buried with soil. Cassava cuttings were prepared in the same way.

The experiment showed that horizontal planting of both sweet potato and cassava had significantly increased yields. According to the farmer's observations, the yield in both crops increased by a significant 50%. Horizontal planting is normally done when temperatures are high, and soil becomes drier. Horizontal planting allows several nodes and internodes to produce roots which later developed into tubers. The higher the number of internodes, more roots developed into tubers. This increased the yield in a unit area. A farmer stated:

> *I noticed that both sweet potato and cassava production depend on the number of nodes and internodes. I therefore decided to plant these two crops the horizontal way instead of vertical. I also decided to use ridges because the length of the planting materials was longer than the mounds I previously used. I made the ridges and first I tried out the sweet potato. I cut the sweet potato vines to the tip at 50 cm in length and planted it horizontally on top the ridge. The depth of planting was three inches. In the same manner, I cut a cassava stem at 60 cm in length and planted it in a horizontal method and with three inches deep. When I harvested both crops, yield was significantly increased. I realised through my observations that the more nodes and internodes were planted under soil, the more roots and tubers were developed.*

Figure 13. Horizontal planting of Ipomoea batatas on ridges

10.3.3. Seaweed (a kelp species) compost application to watermelon (Citrullus lanatus)

An innovative farmer in Malaita decided to experiment with seaweed (a *Kelp species*) composting after seeing huge piles of seaweed on beaches and in mangroves. Seaweed is harvested from the seashores and mangroves and piled to make a compost heap. According to the farmer's observations the compost was ready to be used after three months. The seaweed compost was applied into the planting hole at the time of transplanting watermelon seedlings to the field. This provided the main

source of multiple nutrients needed by the seedling to sustain its growth up to the production stage. After several trials, the farmer confirmed that the new practice provided adequate nutrients to support the watermelon plant from transplanting to harvesting. Fig 14 shows some of the different seaweed species used in composting.

Figure 14. Types of seaweeds used for seaweed composting

10.3.4. Pruning of watermelon (Citrullus lanatus)

In Malaita, the same innovative farmer who discovered the seaweed compost and the pruning of the watermelon vine. According to the farmer, the process of pruning requires careful observation and some basic knowledge and understanding of the relationship between nutrients and crop production. The pruning process of watermelon started in week three after planting. The first pruning involved removing the first 13 young shoots of watermelon. These shoots are normally found on the main vines. The second pruning took place in week five after transplanting watermelon. This pruning, like the first one, was undertaken to increase the vigorous growth of the crop, as well as increase the number of vines from the main vine and the number of flowers and fruits. The pruning technique was developed to respond to several uncertainties including low crop yields, the demand for cash for tithes and offerings, and low food production for a growing population. The new practice showed that watermelon yield increased significantly when pruning took place. It confirmed that pruning induces vigorous growth, increases the number of vines, and increases the number of flowers and fruits shows growth of watermelon after second pruning

Figure 15. Watermelon (Citrullus lanatus) after the second pruning.

10.3.5. Organic yam (Dioscorea alata) nursery box

According to another innovative farmer, yam setts were planted in nursery boxes that contained organic materials and left to sprout before transplanting them into the field. The purpose of an organic yam nursery box was to produce stronger, more vigorous yam setts before transplanting into the field. There have been some problems with direct sett plantings in the past with only 70% to 80% sprouting and surviving. Based on the new practice, the organic yam nursery box method proved successful, produced a more robust and vigorous yam crop and is the way forward for maximising production.

The process of preparing organic yam boxes was critical in terms of supplying the relevant nutrients to yam setts to induce quality sprouting. An important step in the operation was to make sure the organic component of the materials were good sources of plant nutrients. Moreover, the mixture of organic materials with topsoil was equally important to the nurturing of the yam setts. Yam setts were placed in the box to allow sprouting. Management practices such as watering was done when necessary to keep the organic material moist. After three weeks in the organic material the yam setts sprouted. The time taken from sprouting to the transplanting of the yam setts into the field normally took at least four weeks.

The result of this practice showed that yam sprouting, and yield increased by 95% of the total number of yam setts (see Fig). The practice was developed to respond to the uncertainty of low crop yields.

Figure 16. Yam (Dioscorea alata) setts

10.3.6. Blocking sweet potato plots for weeding. A Practice developed by two case studies, Kolombangara and Malaita

Weeding in subsistence gardens becomes a difficult task if not maintained at the early stage of weeds. When weeds grow some farmers hire labourers to do weeding, but this costs money. Blocking a sweet potato *(Ipomoea batatas)* plot or garden is a new practice developed by both Kolombangara and Malaita farmers. Blocking occurs by dividing the garden into several smaller plots with sticks, logs, and in some cases in Malaita, stones. Farmers weed a block each day and by doing so they avoid overworking themselves by trying to weed the whole garden.

Farmers in Case Studies 1 and 3 in Kama (2020) identified that blocking their sweet potato garden was a response to the heavy demands of weeding and high labour costs, while the time taken is another factor to overcome. A farmer in Kolombangara stated:

> *I do my own observations and sometimes get help from other farmers. One of 1my ways of identifying solution is through observations, discussions with my husband and making decision on blocking my garden. Sometimes you see, weeds grow big and comes laziness to remove them. I think after marketing my products I set aside some money for weeding by hiring labour to weed.*

Though innovative farmers have created several climate-smart agriculture practices as well as the training carried out by FAO and Live and Learn on climate-smart practices in five provinces (Choiseul, Western, Malaita, Makira, and Guadalcanal), the study by MECDM & Save the Children (2022) suggests that about 80% of WMBGC in remote and rural areas in Solomon Islands have no in-depth knowledge about climate change and how to address its effects. In addition, WMBGC in remote and rural communities need technical consultations on climate change and demonstrations on how to address climate change effects.

11. Rationale for FSL Adaptive and Building Resilient Farming Population in Remote and Rural Solomon Islands

The 82 percent of the total population who live in the rural areas depend solely on agricultural activities for their livelihood, survival, and daily living and that 89 percent of households participate in gardening activities (FAO, 2020, Kama, 2021, and Georgeou, et al. 2018). Food production is traditionally produced by subsistence farmers, innovative farmers, lead farmers, commercial farmers, production organizations and backyard farmers (MECDM & Save the Children, 2022). In terms of agriculture land, approximately 12 percent of Solomon Islands land is classified as agricultural, while 80 percent is forest (MDPAC, 2007). Subsistence agriculture provides a large proportion of the income of most of the population and represents over a third (16 percent) of gross domestic product (GDP). The small rural economy depends on rich natural resources in land, forests, marine resources, biodiversity and subsistence and semi-subsistence agriculture (Houma, 1988; MDPAC, 2007; DFAT, 2004, Kama, 2021). Subsistence agriculture production in the Solomon Islands is dominated by traditional food adapted to local environments and tend to be nutrient rich (FAO, 2020 and FAO, 2019). The production system is a mixture of tradition and innovative cropping methods created by innovative farmers (Kama, 2021 and MECDM & Save the Children, 2022). Part of the FAO stocktake of agriculture sector activities addressing National Development Strategy (NDS) is to align policy and resources to enhance farm production through improved farming systems to increase economic growth through enhancing sustainable subsistence-based farming system, including organic farming and indigenous crops. The resilient semi-subsistence agriculture sector is also seen as a strong asset for rural development (MDPAC, 2007). MAL (2021), in its Agriculture Sector Growth Strategy and Investment Plan 2021 – 2030, indicated that 80 per cent of Solomon Islanders living in rural areas have limited access to infrastructure and services, agriculture (including crops, livestock, fishing and forestry) is the foundation of livelihoods in the country.

However, food security and livelihoods are affected by many drivers (Kama, 2021). According to Kama, 2020, climate change is one of the drivers' causing uncertainties to farmers resulting in low yield, soil erosion, and increase pests and diseases. Kama (2021) noted that heavy and long period of rain reduces the yield of potato, causes soil erosion, flooding, landslides, waterlog, intrusion of seawater in arable land, increases pests and diseases and the change of cropping season. This was confirmed by the MECDM & Save the Children 2022 study. These effects are felt in most remote and rural areas of Solomon Islands

While such effects on food security and livelihoods have been seen, there have been some responses by farmers as well as some strategic response from government ministries as well as no-government organizations. Most responses from farmers are those from innovative farmers who have developed sustainable practices which are high yielding, resilience to climate change, sustainable production, reduce GHG effects and resistance to pests and diseases. These practices have been adapted and adopted by many farmers in Solomon Islands through the FAO & Live and Learn training. On the other hand, adaptation programs through strategic plan and implementation by government ministries are also implemented. However, such strategy plans and delivery have not fully achieved their objectives and goals. Thus, widening the gap for better adaptation strategy for building relevant resilience to climate change. One strategic program was the NAPA project implemented by the Ministry of Environment, Climate Change and Disaster and Meteorological Services. According to Maetala and Smith (2021) and Kama (2021), there is a lack of participation from women, boys, girls, and young children in adaptation and building resilience in the remote and rural communities. It is confirmed from Maetala, et al, (2021) and Kama, (2021) studies that women, boys, and girls do not have adequate knowledge understanding about the current and future impacts of climate change, what and how adaptation programs would have been done to address these environmental changes and how these are relevant to their communities. This is confirmed in a recent study by MECDM & Save the Children 2022, that many farmers including WMBGC have no further understanding of the

changing weather patterns and the reasons for behind. These observations were observed in five provinces, Choiseul, Western, Malaita, Isabel and Makira, Kama, (2021) and MECDM & Save the Children (2022). In the MECDM and Save the Children (2022) study, many farmers (80%) have little knowledge about climate change and a lack of strategies to address its effects. Farmers in the five provinces indicated their awareness and presence of climate change through the change of weather, low crop production, pests and diseases, high temperatures, high rainfall, dry season, unpredictable, high tide, slow down farm harvest, flooding, and landslide The gap in climate change knowledge is seen in women, men, boys, girls and young people such as children and their lack of action (responses) is due to lack of knowledge and skills in addressing climate change effects. Their knowledge of and engagement on sustainable and resilience programs to the impacts of climate change is also a gap.

It is the objective of the project to build a strong and context specific evidence base to guide and inform the development of the Solomon Islands Knowledge-Action-Sustainability for Resilient Villages (SOLKAS) project will be a community-based climate change adaptation project focused on building the adaptive capacity of communities across Solomon Islands. SOLKAS is being developed by Save the Children Australia (SCA) with Solomon Islands Government (Save the Children, 2021). The project will partner with targeted communities to catalyse sustained processes of community-driven adaptation and resilience building in villages across the Solomon Islands.

The Solomon Islands Knowledge-Action-Sustainability for resilient villages (SOLKAS) is an initiative by joint venture between the Solomon Islands government and Save the Children aiming at making changes and develop sustain community-driven adaptation and resilience building in villages across the Solomon Islands. This working statement is a strategic response by the government and Save the Children to implement in remote and rural communities of most vulnerable settings where food security and livelihoods are practiced. The strategy for implementation is based on the gap identified in this research where alternative adaptation and resilient practices for food security and livelihoods are to be carried out throughout Solomon Islands.

The focus target clients and areas in the project are women, men, boys, girls, and children in the remote and rural areas of Solomon Islands. It is evidenced that previous adaptation strategic programs and interventions have not fully achieved a total transformation of adaptive practices and building resilience food security and livelihoods in the remote and rural areas. The inputs of resources and strategic planning and implementation of the project will provide enhancement of desired outcomes and change of Knowledge, Skills, Attitude and Aspirations (KASA CHANGE) in the people of Solomon Islands. By the end of this project, remote and rural communities including women, men, boys, girls, and children will increase understanding, acquire skills in best practices and apply best climate-smart-agriculture practices in sustainable food security and livelihoods in remote and rural areas of Solomon Islands.

While such effects on food security and livelihoods have been seen, there have been some responses by farmers as well as some strategic response from government ministries as well as no-government organizations. Most responses from farmers are those from innovative farmers who have developed sustainable practices which are high yielding, resilience to climate change, sustainable production, reduce GHG effects and resistance to pests and diseases. These practices have been adapted and adopted by many farmers in Solomon Islands. On the other hand, adaptation programs through strategic plan and implementation by government ministries are also implemented. However, such strategy plans and delivery have not fully achieved their objectives and goals. Thus, widening the gap for better adaptation strategy for building relevant resilience to climate change. One strategic program was the NAPA project implemented by the Ministry of Environment, Climate Change and Disaster and Meteorological Services. According to Maetala and Smith (2021) and Kama (2021), there is a lack of participation from women, boys, girls, and young children in adaptation and building resilience

in the remote and rural communities. It is confirmed from Maetala, et al, (2021) and Kama, (2021) studies that women, boys, and girls do not have adequate knowledge understanding about the current and future impacts of climate change and how these are relevant to their communities. The gap in climate change knowledge is seen in the young people by their lack of action (responses) and their knowledge of engagement on sustainable and resilience programs to the impacts of climate change.

Solomon Islands has a small rural economy relying on rich natural resources in land, forests, marine resources, biodiversity and subsistence and semi-subsistence agriculture (Houma, 1988; MDPAC, 2007; DFAT, 2004, Kama, 2021. As the country's largest rural employer and source of income and responsible for a large portion of exports, the agriculture sector is a key contributor to the economy, livelihoods, food, and nutrition security (FAO, 2020). The resilient semi-subsistence agriculture sector is seen as a strong asset for rural development (MDPAC, 2007). MAL (2021), in its Agriculture Sector Growth Strategy and Investment Plan 2021 – 2030, indicated that 80 per cent of Solomon Islanders living in rural areas with limited access to infrastructure and services, agriculture (including crops, livestock, fishing and forestry) is the foundation of livelihoods in the country. Subsistence agriculture provides a large proportion of the income of most of the population and represents over a third (16 percent) of gross domestic product (GDP (MAL, 2011 and FAO, 2020).

12. FSL Issues in the National Vulnerability Assessment

The National Vulnerability Assessment and Adaptation Assessment of Solomon Islands is an important benchmark to estimate the vulnerability of food security and livelihoods in remote and rural areas of Solomon Islands. The assessment will provide strategic planning for adaptation interventions in addressing the impacts of climate change that can be designed and implemented. Previous work on integrated vulnerability and adaption assessment was done in Sikaiana island in Malaita Province in 2020 by the Ministry of Environment, Climate Change, Disaster Management and Meteorology. However, the work revealed that both effects of climate change on sea and land were assessed. In general, the national vulnerability assessment for food security and livelihoods in remote and rural areas should fall on the following FSL:

9.1 Prolonged rainfall period which cause low yield in potato. An assessment of rainfall season is necessary to identify the pattern of rainfall so that farmers can plan their cropping season. Without an assessment, farmers will not be able to identify and develop a cropping calendar.

9.2 Prolonged rainfall which cause soil erosion. An assessment on soil erosion and its impact on topsoil will provide a better understanding for farmers and to select the most appropriate methods of soil erosion control.

9.3 Occurrence of Pests and Diseases on Crops after prolonged rainfall. Assessment on vulnerability to assess the stages of pests and diseases occurrence during and after prolonged rainfall is needed. This will provide information on peak stage when pests and diseases are hosting crops.

9.4 Prolonged rainfall which cause flooding. Assessment on flooding and its effects will provide better understanding on the characteristics of how floods develop and flow along rivers and soil surface.

9.5 Waterlog of arable land. Assessment on sea level rise and land gradient will provide information for farmers to avoid cultivating on waterlog land. The method of site selection for gardening will also provide information for farmers to make proper site selection.

9.6 Prolonged drought causing soil infertility. Assessment on prolonged drought will provide information on relationship between soil moisture and length of drought. Information the soil moisture and drought period relationship will provide guidelines for mulch application.

9.7 Sea water intrusion. Assessment of coastal lines and seashores will provide information to farmers to avoid sae water intrusion into arable land. In addition, the assessment of sea level rise will also provide information on likely sea water intrusion.

9.8 Long drought period or high temperatures. These cause soil to dry, and degradation occurs. Assessment of soil type, drainage, soil moisture and soil organic content is needed for providing logistical and accurate adaptive measures.

9.9 Long drought period. This normally affects crop growth and determine the pattern of growth. Assessment should be done on several areas. These would include soil type, soil drainage, organic content of soil, soil moisture practices and planting season of the crop.

9.10 Several climate change impacts affect available arable land. These include site selection for growing crops, long period of rainfall and drought, waterlog and intrusion of seawater. Assessment should be done on proper site selection, the rate of sea level rise, study suitable planting dates and topography.

The Ministry of Agriculture and Livestock has in its policy, areas of assessment on food security and livelihoods and to identify areas of concern affected by climate change. In implementing such policy, MAL is currently being challenged by the fact that its research arm is underdeveloped resulting on unavailable information on deliverable interventions on food security and livelihoods. Its ongoing assessment on food security and livelihoods is important to identify areas climate change has been the main cause of food security and livelihoods vulnerability. In this regard, MAL ongoing effort on conducting vulnerability assessment on FSL is fundamental to addressing an accurate position of how climate change is affecting food production and livelihoods of the rural and remote farmers in Solomon Islands.

FSL Issues for National Vulnerability Assessment

Table 1. FSL Issues for National Vulnerable Assessment

Impacts of Climate Change	Vulnerability Area	Severity Level	Adoption Options & Implementation
Prolonged rainfall	Low yield in most root crops	High	Change planting season and use climate-smart agriculture (CSA) practices
Prolonged rainfall	Soil erosion	Moderate to High	Do mulching, build drainage and use CSA
Prolonged rainfall	Pests & diseases outbreak	High	Integrated pest management (IPM)
Prolonged rainfall	Flooding and landslides	Moderate to high	Proper site selection
Prolonged drought	Infertile soil	Moderate to High	Do heavy mulching and use CSA
Prolonged rainfall	Waterlog arable land	High	Proper site selection and use CSA
Sea water intrusion	High salinity soil	High	Proper site selection
High temperatures/ Prolonged drought	Dry soil	Moderate to high	Do mulching, cover cropping or add organic matter to soil and CSA
High temperatures	Slow crop growth	Moderate to high	Do mulching, cover cropping or add organic matter to soil
Sea level rise/waterlog	Limited arable land	High	Proper site selection/planting date

According to the Solomon Islands National Climate Change Vulnerability Assessment some indicators and criteria were used to categorised vulnerability.

Table 2. Vulnerability indicators and criteria used for Solomon Islands Wards assessment.

Solomon Islands community-based climate resilience site selection criteria: Wards					Data type	Data source
	Indicators	SCORING CRITERIA				
		Low = 1	Medium = 2	High = 3		
Exposure	Historic major climate hazards	rarely or once every 20+ years	once every 10–20 years	once every <5 years	TC, severe storm, drought, flood, heatwave (land or marine), storm surge/coastal inundation	Major hazards/ disaster record for past 20 years - MECDM
	Non-climate major hazards	rarely or once every 20+ years	once every 10–20 years	once every <5 years	Volcanic eruption, tsunami, earthquake, saltwater intrusion in groundwater	Major hazards/ disaster record for past 20 years - NDMO
	Shoreline geomorphology	steep or rocky	low-lying and mangrove/tree dominated	low-lying beach, limited vegetation	shoreline topography influences exposure to hazards	Topographic maps, satellite imagery
	Topography/elevation	inland or upland, far from rivers, extreme slopes	moderate elevation, no steep slopes, >5km to rivers	low-lying, atolls, near coast or rivers, steep slopes	topography/elevation to risks from flooding, sea level rise, seawater intrusion, and erosion/ landslides (7 sub-indicators),	Topographic maps, satellite imagery (*Google Earth*)

Sensitivity	Dependence on agriculture/fishing for income (% primary jobs)	<40%	40-60%	>60%	80% primary jobs involved in fishing (marine or freshwater) or agriculture for income	Solomon Islands census 2009; Household income surveys
	Dependence on agriculture for subsistence (% crops grown by households for food)	<40%	40-60%	>60%	80% households growing crops primarily for own consumption	Solomon Islands census 2009; Household income surveys
	Condition of vegetation (e.g., mangroves, upland forests, coastal mosaic)	75-100% natural vegetation intact	25-75% natural vegetation cover	Cleared landscape with <25% vegetation cover	Cover of coastal vegetation and intact habitats; land-use change/clearing over last 10 years	Satellite imagery (*Google Earth*)
	Remoteness/accessibility	peri-urban or near Provincial capital (< 50 km) with good road/boat access	medium distance from provincial capital (50-100 km) with good road/boat access	far from provincial capital (> 100 km) and no/poor road/boat access	Location, condition of roads/bridges, distance from nearest Provincial capital	Ward maps, local knowledge
		Low = 1	Medium = 2	High = 3		
Adaptive Capacity	Education (literacy rate)	<80%	80 to 85% (national average)	>85%	Literacy rate - % adults 15+ literate in English and/or local language	National census 2009
	Education (primary school education)	<85%	85-90% (national average)	>90%	Education level (% students enrolled in primary school). Nationally 48%	National census 2009; HEIS

					enrolled in ECE; 88-89% in primary school (2013 data)	
	Health & equity (disability)	>5%	2-5% (national average)	<2%	% Adults report a disability (national data 2011 3.5% average: range 0-20%)	Disability Nationwide Survey 2005
	Community level actions targeting climate change	none or limited actions at community level	some initiatives/actions started but not well progressed or inclusive	many established initiatives/actions being well implemented	Awareness and action of community without the risk of duplicating other project activities, noting that focus is on COMMUNITY-LEVEL actions	Other project data/reports, national project database & local knowledge

13. Development of Data Collection Tools and Methodologies

A qualitative approach is recommended for the collection of data on FSL issues from remote and rural communities in six provinces in Solomon Islands. The study key clients are subsistence farmers, production organizations (PO), innovative farmers and smallholder farmers but should be classified as women, men, boys, girls, and children category in remote and rural communities in the country. There are four approaches which can be used to conduct the study. The alternative data collection methods can be undertaken by following three methodologies including (i) personal in-depth interview, (ii) focus group discussion, (iii) direct observations and (iv) a survey. For in-depth interview and focus group discussion, guiding questions are important to be provided. In Solomon Islands, three vibrant associations currently practising food security and livelihoods are Kastom Garden Association, Zai & Tina Organic farm, and Burua Gardening Association.

13.1. Personal in-depth interview

Personal in-depth interview can be used under case study or as focus group discussions to collect in-depth information from women, men, boys, girls, and children's farmers. The interview may be audio recorded. Producers Organizations such as Farmers Associations/Groups, livestock farmers, innovative farmers, and smallholder farmers can be interacted in the villages at both remote and rural level. An in-depth interview can last from 40 to 60 minutes. Ethical issues should be carefully addressed before the interview starts. In all provinces proper protocols should be followed before entering a village. Chiefs and elders should be contacted and be informed about the interview and its purpose. To assist with the interview, a set of guiding questions should be prepared to undertake the in-depth interview.

13.2. Focus group discussion

Focus Group Discussions (FGD) can be conducted with women, men, boys, girls, and children's farmers. Other members of producer organizations of farmers associations or group of innovative farmers or commercial farmers. A focus group should have 6 to 8 participants and questions should be asked before everyone so that they speak on the topic and express their views. Protocols should be followed to respect the participants. For example, greetings to all the participants and thank them all after the end of the discussion. A set of guiding questions can be prepared before the FGD. If one is in a school, 6 to 8 students can be called to a classroom to conduct FGD. Likewise, if one is in a community, a meeting house can be used to meet youth and young couples.

13.3. Direct observations

Direct observation means to observe farmers including women, men, boys, girls, children, and farmers as participants. While interacting with the participants, it is always advised to observe the surroundings and ask questions related to that. During various meetings and field visits, observations can also be conducted. These observations should be recorded and can be used to verify other data collected using other methods.

13.4. Survey

A survey is another method of gathering primary data from a school and community. It involves the use of questionnaires which requires time to prepare. The questionnaire can be pre-tested to see how the responses were given based on the questions and if the responses are

relevant. Surveys are relevant when one intends to get some data from a sample of a population.

13.5. Data Analysis

Qualitative data analysis for this research can be a choice. Others may want to use content analysis on several documents, research papers and other articles to identify themes which represented the content of information. The content analysis can identify key information taken from available readings and these can be interpreted to provide useable information for use in the synthesis report. To identify and verify key information from data, thorough reading is done during literature review and reading available from several secondary sources and other reliable information sources. The main activity in the analysis is sorting out themes and sources to verify information.

The other method of analysing qualitative data is the use of software such as NVIVO and other software Data collected from field is transcribed, coded, and translated into themes which are finally interpreted. Data collected through a survey can also be analysed using software such as SPSS, Stata. SAS, MATLAB or excel. However, the most common way of analysing quantitative data are descriptive statistics and inferential statistics.

14. Conclusions

Climate change has affected food security and livelihoods in remote and rural Solomon Islands in many ways. Most of the effects have impacted on crop yields, soil fertility, soil erosions, soil water, crop pests and diseases, reduction of fish on fishing grounds, reduction of mangrove shells, salinity of arable land, changing of cropping calendar and planting season and many more. Many of such impacts have been sighted by many village women, men, boys, girls, and children (WMBGC) as indicated by the MECDM & Save the Children 2022 study.

14.1. Knowledge

The study revealed that 80% of WMBGC **(Smallholder Farmers)** have no further knowledge about climate change and have no experience in adaptive and building resilient village interventions for incorporation into province and national plans and programs.

There is strong evidence through literatures and studies such that of MECDM & Save the Children (2022), Kama (2021) and FAO & Live & Learn (2022) that WMBGC have lacking knowledge, skills and understanding on climate change and its effects. In addition, there is lacking experience by WMBGC especially in rural and remote areas on interventions such as applying adaptive and developing intervention programs for integrated activities for provincial and national adaptive strategy programs. This revealed that there is an 80% of gap in knowledge about climate change, its effects and adaptation of resilient interventions in the Solomon Islands.

In the case of **Lead Farmers/Innovative Farmers**, the following areas were revealed by the study. About 85% of lead farmers are engaged in agriculture of which 75% have been aware of climate change and 93% understood that there has been an environmental change. About 7% of farmers are unsured of climate change. This has revealed that majority of lead and innovative farmers (20% of total population engaged in both subsistence and cash farming) are aware of climate change and have responded to uncertainties and have developed climate-smart agriculture practices.

The MECDM and Save the Children 2022 study revealed that climate change has affected both smallholders and innovative farmers in the following ways:

a. Crop yield has been reduced due to several factors such as pests and diseases, lack of innovative farming methods, use limited agriculture inputs, infertile soil due to soil erosions, flooding, landslides, and small size farms.
b. Farm sales could have been better but due to the following factors such as Climate change, lack of agribusiness skills, lack of roads and transportation, lack of markets, lack of information sources, lack of storage, drying, and fermenting facilities, the need for management change and the availability of markets.

Farmers who had previous learning on climate change including innovative farmers have responded to use adaptable practices. Some of the adaptation practices include mix cropping, shifting cultivation, planting legumes, diversification of crops, mulching, composting, adding animal manure, and intercropping.

It can also be concluded that there is a 90% knowledge gap on value adding knowledge and skills and other livelihoods businesses amongst WMBGC, smallholder farmers as well as lead and innovative farmers.

14.2. Action

In the same analogy as with **Knowledge**, about 90% of WMBGC have not engaged in planning and execution of climate resilient adaptation farming in response the effects of climate change, leaving a training need gap (MECDM and Save the Children, 2022 and Kama, 2021). This is due to the lack of accessing information to climate change (MECDM and Save the Children 2022).

On the other hand, about 25% of lead or innovative farmers are currently using climate-smart agriculture (CSA) practices. The study by Kama (2021) confirms that innovative farmers from Western, Guadalcanal and Malaita provinces develop CSA practices. Because of their innovativeness, they participated well in the adaptation interventions using new adaptive methods.

Though lead and innovative farmers have made some very positive responses to climate change, the number of climate-smart agriculture practices they created have not passed down to WMBGC at large. The work of FAO through Live and Learn Solomon Islands on sustainable land management in the five provinces (Choiseul, Western, Guadalcanal, Malaita, and Makira) have started training 200 farmers on climate-smart agriculture practices, which are classified as sustainable land management (SLM). Such training is needed much for WMBGC to further their understanding about climate change, its nature, its effects on food security and livelihoods interventions and how to implement adaptive village climate interventions and build resilient climate-smart agriculture practices.

There is a lack of skills application on both practical climate-smart agriculture practices and livelihoods interventions which exists all over Solomon Islands. As this is a high priority in this project, there is a need to visibly identify the training need.

14.3. Sustainability

The MECDM and Save the Children 2022 study revealed a lack of vertical coordination and integration to ensure village priorities are incorporated into provincial and national adaptation

planning processes, and that villages lack necessary resources to support their climate-smart agriculture and value adding development. All parties, youth, young couples, smallholder farmers and lead or innovative farmers have not connected well to the provincial and national resilient adaptation interventions-based policy. It can be concluded that there is a need for vertical coordination and integration between communities and ward, provincial and national adaptation planning process, and implementation.

The results prompted an emerging need to identify training gaps (need) on knowledge and understanding climate change and its effects, the training gaps on applying ward, provincial and national government adaptive interventions. Such interventions as using CSA practices to address the effects of climate change and identify collaborative efforts from farmers and government ministries in designing and implementing adaptation strategies in addressing climate change is a much-needed training gap in WMBGC group. Identifying the importance of training gaps is important in the delivery of climate-smart agriculture practices and livelihoods interventions in a sustainable manner. This will allow on the job training on vertical and integration of adaptive interventions on climate change for provincial and national level programs. These need assessments can be carried out in baseline trips.

15. Recommendations

Based on the data available and results from this report, the following recommendations are given:

1. That a baseline study should be conducted in all targeted provinces to identify:
- the type of impact, the effects it causes to the food security and livelihoods and compile photos of both impacts and effects for designing purposes.
- training areas in knowledge, actions, and sustainable integration of local on climate change and its effects from remote and rural women, men, boys, girls, and children (WMBGC). Use data gathering equipment to collect information on WMBGC knowledge about climate change and identify knowledge gaps.
- action knowledge gap on climate change, adaptive interventions and building resilient interventions on FSL in remote and rural communities is a priority The data should describe adaptive and building resilient climate-smart agriculture practices gaps and livelihoods business interventions which are much needed by WMBGC, smallholders' farmers, business traders and agriculture producers to learn and practice.

2. sustainable vertical coordination and integrated interventions as village priorities to be incorporated into provincial and national adaptation interventions needed by WMBGC to learn and implemented adaptive interventions with the government.
3. training on identifying effects of climate change on FSL should be conducted for WMBGC so that they can identify climate change related effects and be able to analyse and prepare to address the effects.
4. training on CSA practices should be conducted for WMBGC (See Kama 2021 on CSA) so that they will adopt methods of increasing food production, sustainable food production, resilient to climate change and reduce GHG effects, and
5. training should be conducted for WMBGC to start and sustain CSA practices to sustain food production and livelihoods under climate change environment.

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