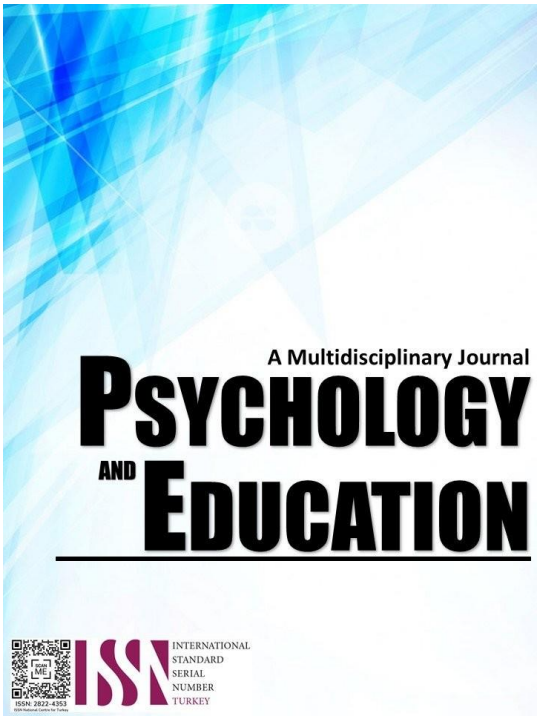
# ENHANCING FOOD SECURITY, INNOVATION, HEALTH AND WELLNESS IN ADAPTING TO CLIMATE CHANGE

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Research Article

# Enhancing Food Security, Innovation, Health and Wellness in Adapting to Climate Change

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## Abstract

Climate change poses major threats to human security, food shortages, and displacement. Extreme weather events and the spread of climate-related pests and diseases significantly impact people's health and well-being. Using hard copy and a Google Forms survey as dependable data collection tools, this study investigated how climate change affects food security, innovation, health, and wellness. The study employed descriptive correlational and causal research designs. A sample was drawn from 112 learning sites for agriculture owners in Northern Mindanao using a proportionate stratified random sampling. Findings show that farmers consistently and generally perceived a very high level of enhancing food security, innovation, health, and wellness in adapting to climate change. In addition, climate change impact is highly correlated with food security, agricultural food innovation, health, and wellness. Moreover, variables that best predict the effect of climate change are enhancing food availability in food security, physical health in health and wellness, and improving food processing and preservation techniques in food innovation, which are both significant predictors of climate change. Finally, an intervention program model is created, like creating an online localized farmer's hub business model named "Food Basket Hub", establishing a food processing training center in SUCs, creating a food innovation center in local municipalities, and developing software that will help smallholder farmers access free medical consultation through an AI-driven multi-platform application named "FarmHealthAI".

**Keywords:** *climate change, food security, innovation, health and wellness, adaptation program*

## Introduction

Human being has a great impact on the environment; their lifestyle choices and ability to manage their surroundings cause different types of changes. The environment and natural resources are vital to our survival and meeting our basic needs. Therefore, the health of a population is the foundation upon which all aspirations and state authority rest. The great majority of the food in the world is produced by farmers. They raise domesticated animals, cultivate crops, and make other food items. Farmers oversee vast areas of land, are regarded as environmental stewards, and their actions have a big influence on the ecosystem. The economy benefits greatly from farming, both in terms of output and employment. It is also a business, and meticulous planning is key to success.

Among other things, climate change is a consequence of human activity. It is evident that natural processes also give rise to it, but statistics and scientific findings make it abundantly evident that these processes are becoming more violent and unnatural in nature, and that the amount of human impact on the climate is significant enough to reach a tipping point that upsets the natural balance (Prandecki et al., 2021). WHO (2023) warns that climate change is a significant threat to human health, affecting health, food systems, social and economic environments, and access to clean air, water, and soil. Drought threatens livelihoods, increases disease risk, and fuels mass migration.

Based on the 2014 Climate Change Vulnerability Index (CCVI), regions with a larger number of small farmers are more susceptible to extreme weather events. Philippines is one of the top ten in the lists of highly vulnerable countries (Talukder et. al., 2021). In like manner, Mindanao depends heavily on agriculture, but climate change and its associated risks could seriously harm the industry (Dikitanan et al., 2017). Undoubtedly, climate change will affect food security through its impacts on all components of global, national, and local food systems (Prandecki & Zieliński, 2021). According to the Food and Agriculture Organization (FAO) the world's population is projected to reach 9.3 billion by 2050. In this connection, to feed this greatly increased population, food production must rise by 70%. Improved production is a necessity in ever country to guarantee adequate food access.

It is the policy of the State to afford full protection and the advancement of the right of the people to a healthful ecology in accord with the rhythm and harmony of nature. (Philippine Constitution of 1987, art. II, sec. 16). In this light, the State has adopted the Philippine Agenda 21 framework which espouses sustainable development, to fulfill human needs while maintaining the quality of the natural environment for current and future generations (RA 9729). Evidently, food might be available, but accessibility might not be viable. Similarly, the food availability may not be ensured with proper utilization while it may also be disrupted by a lack of stability caused by climate change.

The researcher aims to enhance food security, agri-food innovation, and health in response to climate change. The study will enlighten food providers and develop programs to mitigate climate change effects, providing evidence for strengthening food system adaptation at local, national, and even global levels.

### Research Objectives

This study aimed to design an appropriate intervention program that would improve food security, innovation, health, and wellness while adapting to climate change in different Learning Sites for Agriculture (LSA) owners and operators to continually upgrade

sufficient and effective training modules in navigating the climate-smart farming system activities in Northern Mindanao provinces. Specifically, the study sought to: 1) evaluate the level of food security in the aspect of: (a) availability; (b) access; (c) utilization; and (d) stability; 2) investigate the level of food innovation in terms of: (a) food processing/preservation techniques; (b) reducing food waste; and (c) packaging and improving shelf life; 3) recognize the level of health and wellness in the components of: (a) mental; (b) physical; and (c) emotional well-being; 4) distinguish the level of climate change adaptability as categorized into: (a) agricultural activity; (b) natural disaster; and (c) weather extreme; 5) analyze the significant relationship between the climate change adaptability and (a) food security;(b) innovation; and (c) health and wellness; 6) identify which variable best predicts climate change; 7) assess what program interventions can be developed to enrich climate change adaptability in terms of enhancing food security, innovating agricultural products and maintaining good health and wellness of the farmers.

## Methodology

### Research Design

The research study utilized the descriptive-correlational and causal research designs which are useful in providing detailed information about the variables under investigation. Descriptive correlational research is a type of research design that tries to explain the relationship between two or more variables without making any claims about cause and effect. It includes collecting and analyzing data on at least two variables to see if there is a link between them (Bhat, 2023). Causal research was used to investigate the cause-and-effect relationships; it talks about how one variable affects the other variables. In particular, this approach was used to describe and analyze the current situation regarding climate change, food security, agri-food innovation, health, and wellness. The descriptive aspect of the method helps to provide a clear picture of the state of these variables, while the correlational approach will be useful in establishing the relationships between them. Overall, the study aims to provide valuable insights into these critical areas of concern and is useful in developing effective strategies and policies for addressing the challenges they present.

### Respondents

The participants of the study were 112 owners and operators of the Learning Sites for Agriculture (LSA) from 5 provinces of Northern Mindanao. LSA is an innovative extension modality conceptualized by the ATI where successful farmers worthy of emulation and willing to share their technologies right in their own farms will be partners in the implementation of training and extension interventions particularly for hands-on training or on-the-job instruction to complement classroom instruction (DA-ATI). The participants are randomly selected and encouraged to voluntarily participate in this study. The sample size was determined using Slovin's formula and stratified random sampling to obtain the study's sample from the LSA owners and operators in 5 provinces in Northern Mindanao as participants where the sample size of each stratum is proportionate to the population size of the stratum considering the formula, n = (n/N)*ns, where n = sample where n = sample size; N = population size, and ns = stratum size. The formula was designed by (Parsons, 2017) and modified by the researcher to simplify the interpretation of each of the symbols appropriate to the study.

### Instrument

A four-part questionnaire was used in this study. The first part is suitably adapted from the study of Landicho (2015) and FAO (2016) and modified to suit the precise needs of the population, entitled "Climate change and food security". The second part is a self-made descriptive survey questionnaire. The third and fourth items are adapted from Start Questions and Questions Pro 2023 and ATI program and modified to suit the specific needs of the population "Health and wellness in adapting climate change". Modified adopted descriptive survey questionnaire was used to gather data for the study, this is to check the level of responses on the concept of climate change, enhancing food security, agri-food innovation, health and wellness. A total of 112 items was used with a 5-point Likert Scale which is originated by Likert (1932), with five response options ranging from "Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree" with a score of 5 to "Strongly Agree", and "Strongly Disagree" with a score of 1. Part 1 measured the enhance level of food security. There will be 36 items. Part 2 measured the quality of agri-food innovations, among the respondents. There will be 31 statements. Part 3 measured the health and wellness. There will be 22 items. Part 4 measured the level of responses on climate change. There will be 23 items that will seek to gather responses.

### Procedure

The data collection for the study followed meticulously the standard research protocol from the Liceo de Cagayan University, Cagayan de Oro City Graduate Studies, and the School of Business Management and Accountancy. The investigator obtained a letter of recommendation from the office of the Dean of the Graduate School at Liceo de Cagayan University. The investigator made a request letter to ask permission from the office of ATI (Agricultural Training Institute) to secure the updated list of certified of learning site farms throughout Northern Mindanao. The permission was granted; the investigator proceeded to the different locations to meet with the thirty respondents for pilot testing at a pre-arranged date, time, and venue to discuss their participation in the study. Structured questionnaire was administered in-person to the identified respondents. Tabulated pilot testing result was submitted for reliability testing to the LDCU. Final data collection was done after the ethical clearance released from the Research Ethics Board through blended platform .

In addition, the LSA owner, operator, administrator, manager, and direct supervisor of the farm who holds a degree in the relevant

field were among the respondents included in the study. However, other groups of respondents was not included in the study like farm workers without formal training or a degree in a related field, and LSAs who did not renew their ATI certification after five years. The participant's involvement in this study is purely voluntary and they have the right to withdraw or decline to answer any or all questions given in the survey questionnaire. It is up to them whether they participate in this study or not. Participants had fifteen to twenty minutes to complete the survey, after which they must return it to the investigator in person or in Google form. Further queries and clarifications were entertained while answering the survey, or if there is an indicator that needs to be clarified. The session adjourned and terminated. The results of the study will only be used for scholarly and instructional purposes, and all information collected were treated with the utmost confidentiality. Sufficient security measures were implemented to preserve the privacy and confidentiality of the participants' responses. Regarding the research, writing, and/or publication of this research study, the investigator disclosed no potential conflicts of interest. Also, there is no monetary compensation associated with participating in the study, and participants were chosen voluntarily and with free will. Rest assured that there are no known risks associated with taking part in this study. It won't have any bearing whatsoever on how well they perform at work. The research is helpful in bridging the knowledge gap in the literature about investigating these factors, especially with regard to agriculture and climate conditions. Closing the gap could lead to farmers adjusting to the climate more positively and increase food security in the community. The research study's findings are to be shared with participants, faculty, the university administration, and government climate concern agencies. They may also be presented at conferences and in academic journal.

**Data Analysis**

The survey instrument was used to gather data for the study, the Statistical Package for the Social Sciences (SPSS) was used for analysis. The research problems 1,2,3, and 4 were analyzed by using Descriptive Statistics such as Mean and Standard Deviation. The standard deviation or SD theoretically tells us how far from the mean the average the data result is. This indicates that if the SD is large, the values are widely distributed around the mean . In contrast, if the SD is small, the scatter is also small. Thus, mean tells us what the average value is and the SD tells us what the average scatter of values is, around the mean. Taken together, particularly along with the range, these statistics give us a good conceptual picture of the sample. Standard Deviation is a summary statistic of how much scores vary from the mean (Andrade, 2020).For problem 5, the researcher was used Pearson Product-Moment Correlation to definitively correlate the climate change and food security, innovation, health, and wellness. This approach provides a clear understanding of the correlations between these key areas and climate change, enabling us to gain valuable insights and draw accurate conclusions. The Pearson correlation coefficient is a descriptive statistic, meaning that it summarizes the characteristics of a dataset. Specifically, it describes the strength and direction of the linear relationship between two quantitative variables. It is important to remember that r is a measure of any linear trend between two variables (Puth et al., 2014).In problem 6, Multiple Regression was used to determine which variables, either alone or in combination, are the best predictors of climate change as impact of food security, innovation, and health and wellness. The goal is to identify which factors contribute to improving climate change adaptation. It is a least square general linear model technique appropriate for the analysis of data sets containing a single dependent (criterion) variable and multiple categorical or continuous and orthogonal or non-orthogonal independent (predictor) variables (Knight, 2018).

Validity and Reliability of the Instruments

Survey face validity was established by three experts for the improvement of the questionnaire, which was requested by the researcher. In the view of the respondents, face validity implies that the questions measure what they are intended to measure (Bobbitt, 2021). Reliability refers to the degree to which scale produces consistent results when repeated measures are being used (Surbhi, 2017). The research instrument was pilot tested on a subset of 30 LSA owners and operators who were not be part of the study, pilot testing was done to Lanao del Norte and Misamis Oriental in Northern Mindanao in person, after pilot testing the result was tallied and submitted for reliability testing. An individual reliability coefficient of items on the instruments was observed in the acceptable range of 0.7 to 0.99. Items with coefficients below 0.30 in the item total correlation were discarded. The total items were valid and reliable, and all 112 items were included in the instrument for the actual survey. The researcher also submitted the approved manuscript after the proposal defense to the Office of the Ethics Review Board for review and evaluation of the ethical considerations that were observed and implemented in the conduct of the study.

## Results and Discussion

This study developed an intervention program on the factors of enhancing food security, innovation, health and wellness in adapting to climate change of the farmers.

In terms of enhancing the four pillars of food security in adapting to climate challenges, farmers shown a high level of improving food availability (M=4.67, SD=.259); followed by food access (M=4.64, SD=.298), stability (M=4.63, SD=.316); and utilization though slightly lower, still scored high (M=4.62, SD .329), contributing to the overall mean score of M= 4.64 (SD=.251) indicating a very high level of enhancing food security to escalate environmental resilience.

Enhancing agricultural food innovation was also rated very high, particularly on the aspect of reducing food waste (M=4.81, SD=.216). Packaging and improving shelf life were also commendable (M=4.72, SD=.3230) as well as the food processing and preservation techniques (M=4.71, SD=.299), prompting to an overall mean score of M=4.75 (SD=.257), reflecting a very high level of innovating

the agricultural food product.

In terms of farmers coping strategies in confronting climate-related risks and vulnerabilities found exceptionally high in improving physical health and wellness (M=4.63, SD=.379); mental health and wellness also got very high score (M=4.59, SD=.398) while emotional health and wellness got high score (M=4.49, SD=.452) lower than physical and mental health and wellness. Contributing to the general mean of 4.57 (SD=.372) which is interpreted as very high. In consequence, farmers respond positively by enhancing coping strategies to adjust environmental stressors to maintain health and wellness.

The study also identified strong positive relationships between climate change adaptation and food security, innovation, health, and wellness. The correlation coefficient between climate change and food security is 0.692, ($p<.01$). Additionally, climate change is highly correlated with agricultural innovation with a value of 0.800, ($p<.01$). Also, health and wellness has a value of 0.821, ($p<.01$) indicating a high significant relationship. Suggesting climate change is a major driver of progress in these aspects.

Among the variables that best predict the climate change adaptation, food availability and physical health as indicated by the standardized beta coefficient of 0.478 and a p-value of 0.000, both are highly significant predictors of adapting to climate change. This suggests that enhancing physical health and food availability can substantially influence climate change impacts. Furthermore, food processing preservation techniques with a standardized beta coefficient of 0.304 and a p-value of 0.000, are also a significant predictor of climate change. This highlights the importance of investing in innovative food processing and preservation methods to mitigate climate change effects.

An intervention program was developed to enhance the resilience and adaptive capacity of the farmers to reduce vulnerability to climate-induced impacts and foster community-based adaptation planning. The proposed program is localized farmers hub, an online platform to help farmers to facilitate their farm to market activities. Another is food innovation/processing center, to process and adding value of the agricultural products and FarmHealth AI-driven tele consultation platform to accommodate the farmers' health-related concerns impacted by atmospheric disturbances.

In conclusion, this study featured the critical role of professional development, farmer competencies, and innovative agricultural production in enhancing farmers' climate change adaptation to have food security, offering valuable insights for local government units (LGUs) and policymakers aiming to improve the food system in the community.

## Conclusions

Based on four factors—food availability, access, stability, and utilization—the food security for farmers adjusting to climate change in Northern Mindanao is statistically interpreted as "very high." It suggests that improving food security is necessary in order to adapt to climate change.

The degree of agricultural food innovation is also regarded as "very high" in all three areas, such as food processing and preservation methods, packaging and extending shelf life, and minimizing food waste. It indicates that in order to increase food value and shelf life and reduce post-harvest losses and food waste, agricultural production must be processed and preserved.

Farmers' health and wellness regarding climate change at various agricultural learning sites in Northern Mindanao are generally interpreted as "very high." Of all the components, the emotional health is statistically interpreted as "high," while mental and physical health are "very high". It proposes that health and wellness against the impact of climate-driven diseases should be treated accordingly.

The climate change and its adapting strategies are at a "very high" level. The results for all three aspects, such as weather extremes, agricultural activity, and natural disasters, fall within the "very high" level. Immensely enhance the resilience and adaptive capacity of the farmers is suggested.

Consequently, there is a significant relationship between adapting climate change and food security, agri-food innovation, health, and wellness. The correlation coefficient between climate change and food security is 0.692, indicating a significant relationship. Also, climate change is highly correlated with agricultural innovation and health and wellness with a value of 0.748 and 0.743 respectively. This implies that climate change is a major driver of progress in these aspects. Also, food availability, food processing and preservation techniques and physical wellness are all significant predictors of climate change. Finally, intervention program are to be established to help the farmers augment their food security, innovation and well-being in mitigating the impact of climate threats.

The research findings and conclusions previously discussed are directly addressed by the following recommendations:

These suggestions are envisioned to provide direction and provision to the farmers, barangay/llocal leaders, food innovators/entrepreneurs, health professionals, Department of Agriculture, Department of Environment and Natural Resources, and other researchers in developing wide-ranging programs that specifically address the farmer's capabilities in adapting to the impact of climate change threats.

Farmers. The farmers are encouraged to embrace and implement the on line localized farmer's hub business model to enhance their financial and marketing challenges, invest in training program, and adopting climate-resilient farm and agri-innovation practices.

Barangay/local leaders. The barangay and local leaders are emboldened to have reliable and just implementation of the plans and programs, projects, and activities in the community, particularly on the farmers advancement.

Food Innovators and Entrepreneur. The food innovators and entrepreneurs may consider the food innovation center as a good venue to add value to their produce by processing fresh agricultural materials into wholesome goods using the technology in the hub.

Health professionals. Health workers are motivate to improve health and wellness program by promoting the Tele-Kosulta Multi-platform App, a software that will help small holder farmers to access free medical consultation through an AI- driven multi-platform application to mitigate climate- related health risks, and improving health care access.

Department of Agriculture. DA is stimulated to provide policy framework for the smallholder farmers, support services needed for local agricultural business enterprise.

Department of Environment and Natural Resources. DENR are encouraged to implement a sustainable and dependable policy on safeguarding the forest, agricultural and wetland domains.

Future Researchers. The future researchers are motivated to conduct more robust interdisciplinary research on climate emergency and justice investigation.

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