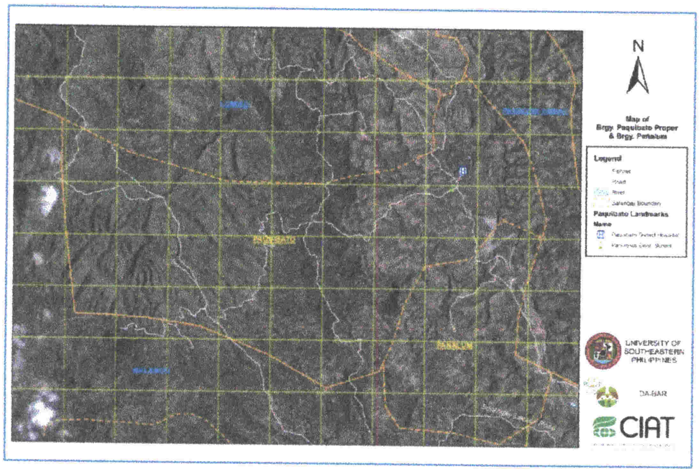
PROGRESS REPORT

(As of April 2017)

Region 11 Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) Phase 2



Proponents: Dr. Larry V. Aceres, Prof. Emelie Pelicano, Dr. Roger C. Montepio, Engr. Apolinar Tabanera, Mr. Noel T. Gloria

Implementing Agency: University of Southeastern Philippines

Department of Agriculture
Bureau of Agricultural Research
RDMIC Bldg., Elliptical Rd. Cor. Visayas Ave., Diliman, Q.C. 1104
Phone Nos.: (632) 928-8624 & 928-8505 • Fax: (632) 927-5691
Email: barrdegrants@bar.gov.ph • Website: http//www.bar.gov.ph

PROGRESS REPORT

A. BASIC INFORMATION

1. Project Title: **Region 11 Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) Phase 2:**

2. Proponent (s)

Name	:	Dr. Larry V. Aceres
Designation	:	Dean, College of Agriculture and Related Sciences
Organization	:	University of Southeastern Philippines
Address	:	Apokon, Tagum City, Davao Del Norte, Region XI
Phone and email	:	(084) 217 9163

3. Implementing Agency

3.1.	Lead Agency	: University of Southeastern Philippines (USeP)
	Head of Agency	: Dr. Lourdes C. Generalao
	Name of Proponent(s):	
	Contact Details	: (084) 218 0998
3.2.	Collaborating Agency	: DA-RFO XI

4. Project Duration

4.1	Approved Duration (Y/M)	: 2016-June – 2017-February
4.2	Actual Duration (Y/M)	: 2016-September – present
4.3	Start Date of Implementation	: 19-September 2017

5. Project Site(s)

5.1	Province	: Davao Del Sur
5.2	City/Municipality	: Municipalities under Davao Del Sur and Davao City
5.3	Barangay	
5.4	Geocode	

6. Project Funding

6.1.	Total Approved Budget	: PHP 1,000,000.00
6.2.	Total Amount Released	: PHP 1,000,000.00
6.3.	Agency Counterpart	
6.4.	Actual Expenses	
6.5.	Unliquidated Balance	

7. RDE Agenda Addressed : Climate change and agriculture

8. Expected Technology or Information : Crop vulnerability and suitability; CRA practices; Cost Benefit analysis of local CRA practices

9. Description of Technology/Information : application of GIS-based mapping modelling: economic analysis of CRA practices

10. Target Beneficiaries/Users : farmers in Region XI; LGU's: DA-XI; Local agriculture offices

11. Tags/Keywords:
AMIA; Climate Resilient Agriculture (CRA); Climate Risk Vulnerability Assessment (CRVA); Cost-benefit Analysis (CBA); Maximum Entropy Model (MaxEnt); Sensitivity; Hazards; Adaptive Capacity; Vulnerability

B. TECHNICAL DESCRIPTION

1. Rationale

The Adaptation and Mitigation Initiative in Agriculture (AMIA) seeks to enable the Department of Agriculture (DA) to plan and implement strategies to support local communities in managing climate risks – from extreme weather events to long-term climatic shifts. Spearheaded by the DA System-wide Climate Change Office (DA SCCO), AMIA Phase 1 in 2015-16implemented activities to strengthen DA's capacity to mainstream climate change adaptation and mitigation strategies in its core functions of R&D, extension, and regulation. It is also designing complementary activities for building appropriate climate responsive DA support services.

With AMIA Phase 2 in 2015-16, the next big challenge is making climate-resilient agri-fisheries (CRA) an operational strategy through field-level action that can directly involve and provide impacts on the livelihood of farming communities. AMIA2 aims to invest in the launching of CRA communities -- as the initial target sites for action learning, supported by an integrated package of climate services and institutions, within a broader food system/value chain setting. The program is launching an integrated and multi-stakeholders effort to operationalize CRA at the community level in 9 target regions.

The AMIA2 program framework shall consist of 9 key clusters of inter-related activities, whose cumulative and combined results will envisioned to help AMIA achieve its goal for 2016 and beyond. For each cluster, a set of projects and activities would be designed towards operationalizing the AMIA framework.

Cluster 1: Enabling environment
Cluster 2: Vulnerability assessment and risk targeting
Cluster 3: Developing knowledge pool of CRA options
Cluster 4: CRA community participatory action research initial phase
Cluster 5: Enhancing services and institutions
Cluster 6: Integrating CRA in food systems and value chains
Cluster 7: Implementing CRA on scale
Cluster 8: Knowledge Management for results

The AMIA2 framework shall provide overall guidance in the planning and design of research and development interventions in 9 target regions:

1. Region I Ilocos
2. Region II Cagayan Valley
3. Region III Central Luzon

4. Region IVA Southern Luzon
5. Region V Bicol
6. Region VI Western Visayas
7. Region X Northern Mindanao
8. Region XI Southern Mindanao
9. Region XVIII Negros Island

Successful implementation of AMIA2 at the regional level shall require the strong collaboration and support of key research and development institutions within the region. This proposed project will enable AMIA2 to establish and mobilize regional teams, each shall be led by a local State University/College (SUC), and in partnership with the corresponding Department of Agriculture - Regional Field Office (DA-RFOs).

1.1. Problem Statement

Climate risks pose a major threat to sustaining the productivity of the agri-fisheries sector in the Philippines. The potential impact of climate change on agricultural crop production varies spatially and depends on crop specific biophysical constraints. Conditions for agricultural production are driven by different climate patterns among other constraints like soil erosion, highly varying soil capacity and land use prevalence's.

1.2. PESTLE or SWOT

2. Narrative Summary
   2.1. Potential Impact or Goal

   2.2. Outcome or General Objective/Purpose

The overall objective is to assess, target and prioritize climate-resilient agri-fisheries (CRA) research and development in Region XI in support of AMIA2.

2.3. Expected Output or Specific Objectives

1. To strengthen capacities for CRA methodologies of key research and development organizations in the region;
2. To assess climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools;
3. To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risk;
4. To document and analyse local CRA practices to support AMIA2 knowledge-sharing and investment planning; and

2.4. Scope and Limitations/Constraints

3. Review of Related Literature

3.1.

Climate Risks in Agri-fisheries Sector of Davao Region

Agriculture is highly sensitive to climate variability and weather extremes, such as droughts, floods and severe storms. It is one of the most vulnerable sectors to a changing climate and as a consequence, food security and rural income. It is highly vulnerable to climatic shocks such as heavy rainfall (and flooding) and drought. Adverse changes in drought conditions with an intensified El Niño, would have severe consequences on this sector (World Bank, 2011). Among the main challenges facing the agriculture sector in the Philippines is its vulnerability to the inherent climate volatility within the region, as well as global climate change.

One of the agriculture-based regions in the Philippines is the Davao Region. It is known as the number one producer of bananas and coconuts in the country, second in coffee and fourth in cacao. It is located in the southeastern part of Mindanao surrounding the Davao Gulf. It is bounded on the north by the provinces of Surigaodel Sur, Agusan del Sur of Caraga Region and Bukidnon of Northern Mindanao Region (DRDP, 2011-2016).

Davao Region is known to be blessed with good climate with rainfall evenly distributed throughout the year. It is outside the typhoon belt. Fair weather is usually experienced during the months of December to June (DRDP 2011-2016). However, strongest typhoon Pablo hit Mindanao especially Davao Region in 2012. The typhoon caused widespread destruction estimated at PhP40 billion, with Davao Region (Region 11) incurring the most damage (UNDP, 2013).

World Bank (2013) reported as featured by Balabo(2013) that the absence of land barriers exposes the country to typhoons, floods, landslides and droughts. Provinces are classified based on their vulnerability to temperature change, rainfall change, El Niño, typhoons and flooding. The province of Davao del Norte belongs to very high risk for temperature change and very high risk for El Niño-induced droughts or abnormal increase in rainfall. Davao Oriental categorized under high risk for El Niño-induced droughts or abnormal increase in rainfall. The province of Davao del Sur is categorized under high risk to flooding.

Research and Development Initiatives for Climate-Resilient Agrifisheries in Davao Region

Climate change will have dramatic consequences for agriculture. The Department of Agriculture Climate Change Program has developed adaptation and mitigation strategies. Adaptation strategies include disaster risk reduction and management including early warning systems, water conservation, water use management and efficient water storage and delivery systems, precision agriculture, climate change adaptive crops, aquaculture species and livestock breeds including early maturing crops and fishes, climate resilient agri-fishery infrastructures and urban agriculture. Mitigation strategies can be achieved through organic farming practices, novel feed formulations, intermittent irrigation for paddy rice, waste management, biotech crops, biological inputs such as bio-pesticides, and energy-efficient and green agri-fishery machineries including transport vehicles. The provision of carbon sinks includes agro-reforestation with long lived fruit and multipurpose trees including coconut, malunggay and seaweed farming (DA, undated).

United Nations Development Program (2012) launched the Project Climate Twin Phoenix (PCTP) as an urgent and more focused intervention prioritizing climate change adaptation and disaster risk reduction actions and initiatives in the country's cities and municipalities. One of the PCTP activities is implemented in the municipalities of New Bataan in Compostela Valley and Baganga in Davao Oriental provinces. It aims in improving the adaptive capacities of communities and enabling them to cope with the impacts of climate change. In addition, to assess the community's disaster vulnerabilities to geological, meteorological, and meteorologically-induced hazards due to climate change and use the results as basis for priority mitigation actions like the setting up of community based and managed early warning systems. The project also conducts massive information, education, and communications activities and campaigns to raise the awareness of communities on climate change and its impacts, as well as, enhance the competencies of local government units in mainstreaming climate and disaster risk reduction into local land use and development planning and regulatory processes.

In Davao Region, the following are priority research areas for climate change: (a)scientific guidelines, benchmarks and indicators for monitoring climate change and assessing associated risks to various crops and livestock, (b)assessment on species-environment interaction, phenology, etiology, and virulence of pathogenic organisms on livestock, (c)changing farming adaptation and coping mechanisms against climate change, (d)vulnerability mapping of threatened species to climate change, (e)coastal and marine protected areas mapping in the advent of climate change (f)best practices on Disaster Risk Management (DRM), (g)identification of flood-prone vulnerable areas and their impact on agriculture, population and investments, (h)identification of drought-prone vulnerable areas and their impact on agriculture, population and investments, (i)identification of earthquake-prone vulnerable areas and their impact on agriculture, population and investments, (j)carbon sequestration and reduction of green house gas (GHG) emission, (k)mainstreaming climate change impacts and vulnerability in policy formulation, (l)early warning systems, and (m)climate change insurance (DRRA,2011-2016).

3.2. References

Balabo, D., 2013. Twenty-three provinces high risk for disaster-World Bank. Posted at Jun 27 2013 12:38 AM Updated as of Jun 27 2013 08:38 AM

Davao Regional Development Plan, 2011-2016

Davao Region:Regional Development Research Agenda, 2011-2016

Habito, C.F., and Briones, R.M. 2005. Philippine Agriculture over the Years: Performance, Policies and Pitfalls.

Hardelin, J.andLankoski, J., 2015. Climate change , water and agriculture: challenges and adaptation strategies, 14(2): 10-15.

Iglesia, A., 2012. Exploring adaptation of agriculture to climate change: policy choices and resiliency, 329-330.

Israel, D.C., and Briones. RM.,2013. Impacts of natural disasters on agriculture, food security, and natural resources and environment in the Philippines Philippine Institute for Development Studies

Jose, A.M., Cruz, N.A., 1999. Climate change impacts and responses in the Philippines: water resources. Climate Research, 12: 77-84.

Nnadi, F.N. et al., 2013. Agriculture insurance:a strategic tool for climate change adaptation in the agriculture sector, 1(1):1-9.

Nwanko, O.C., 2013. Climate variability and its implications on rural household food security in Nigeria, 5(1): 10-18.

Priya, S.,2010.Vulnerabilities to climate change in the agriculture sector. AIT/USEP Regional Resource Center for Asis and the Pacific

Project Climate Twin Phoenix . 2014 Report

Ramasamy, S., 2014. Managing Climate Risks and adopting to climate change in the agriculture sector in Nepal.22-143.

Selvaraju, R., 2014. Managing Climate Risks and adapting to climate change in the agriculture sector in Nepal, 143.

Shannon, H.D. and Motha, R.P., 2015. Managing weather and climate risks to agriculture in North America, Central America and the Carribean, 10(A): 50-56.

The World Bank, 2011. Vulnerability, Risk Reduction, and Adaptation to Climate Change:Philippines

The World Bank,2013. Getting a grip on climate change in the Philippines: Executive Report.

United Nations Development Programme .2013 Report

Online sources:

http://sdwebx.worldbank.org/climateportalb/doc/GFDRRCountryProfiles/wb_gfdrr_climate_change_country_profile_for_PHL.pdf

www.da.gov.ph

www.ph.undp.org/content/philippines/en/.../projects/.../TwinPhoenix.htm...2012

http://www.catalyst-project.eu/doc/agricultural_education.pdf

4. Methodology per Objective

The project seeks to contribute to the overall AMIA2 program framework, by contributing specific outputs to targeted national-level research projects. It has five key components:

1. Capacity strengthening for CRA research & development
2. Geospatial assessment of climate risks
3. Stakeholders' participation in climate adaptation planning
4. Documenting &analyzing CRA practices
5. AMIA baseline study for monitoring & evaluation

These project components are designed to be directly aligned with the research agenda of three AMIA2 projects: 1) climate-risk vulnerability assessment (CRVA), 2) decision-support platform for CRA, and 3) institutional and policy innovations.

Component 1 - Capacity strengthening for CRA research & development

The regional project team will participate in a series of trainings, workshops and learning events organized by AMIA2 projects. These will focus on three key methodologies: 1) CRVA, 2) CRA prioritization, and 3) CRA M&E.

The project will also provide training support to key research and development stakeholders in the region, by organizing an intra-regional training that covers key learning contents from the national-level trainings.

Component 2 - Geospatial assessment of climate risks

AMIA specified the Agri-fisheries commodity that will assessed to determine its vulnerability for climate change. This include crops like banana, cacao, coconut, corn, eggplant, mango, rice, rubber, squash, tomato and tilapia. Each crops were assessed its vulnerability for the year 2030 and 2050.

Climate-Risk Vulnerability Assessment has three key components. This components are: Sensitivity index (Changes in climatic suitability to grow crops), Hazard index (Biophysical Indicators (climate-related pressures) and Adaptive capacity.

Sensitivity index

For the sensitivity index, suitability for each crop was essential. MaxEnt software was used to generate suitability of each crop. The secondary data that was necessary to run MaxEnt were crop occurrence (Latitude and Longitude) and bio-climatic variables. The bio-climatic variables were provided by CIAT and can also downloaded at the ccafs-climate.org website. This variable includes:

Bio1 = Annual mean temperature
Bio2 = Mean diurnal range
Bio3 = Isothermality
Bio4 = Temperature seasonality
Bio5 = Maximum temperature of warmest month
Bio6 = Minimum temperature of coldest month
Bio7 = Temperature annual range
Bio8 = Mean temperature of wettest quarter

Bio9 = Mean temperature of driest quarter
Bio10 = Mean temperature of warmest quarter
Bio11 = Mean temperature of coldest quarter

Bio12 = Annual precipitation
Bio13 = Precipitation of wettest month
Bio14 = Precipitation of driest month
Bio15 = Precipitation seasonality
Bio16 = Precipitation of wettest quarter
Bio17 = Precipitation of driest quarter
Bio18 = Precipitation of warmest quarter
Bio19 = Precipitation of coldest quarter
Bio 20 = No. of consecutive dry days

To determine the crop occurrence, the project team conducted data gathering from local agricultural offices, which include crop production and distribution. With support of DA-Region 11, a workshop entitled "Participatory Workshop on Data Collection for Crop Occurrence" was conducted. This was participated by the personnel from city and municipal agricultural offices of Davao City and Davao Del Sur. The output of this workshop was a crop location map. In this workshop, the team provide satellite imaged maps of each cities/municipalities with a display of barangay boundary, road networks, and river networks to easily identify the locations. The agricultural technicians and extension workers were tasked to locate the crops in their respective areas.

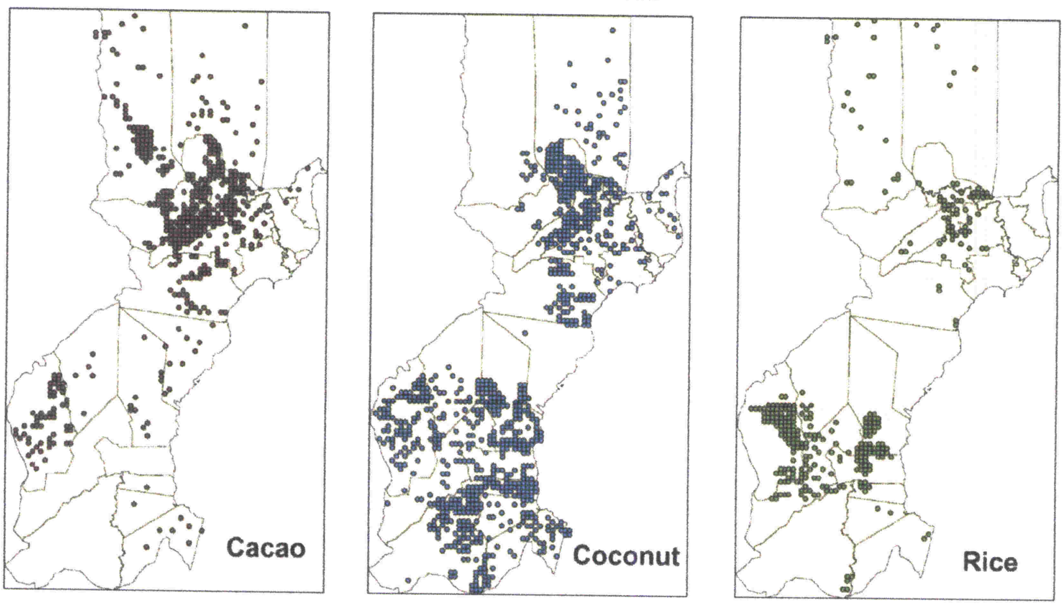
Figure 1. "Participatory Workshop on Data Collection for Crop Occurrence" was conducted last November 29, 2016 at the DA-RFU 11 conference hall.

Some of the Municipal Agriculture Office who was not able to join the workshop were individually visited and the team conducted a brief orientation of the project. Also, short-lived workshop was conducted and maps were given to locate the crops.

Figure 2. The team visited the municipal agriculturist offices who did not able to attend the workshop and orient the DA personnel about the project.

The data that was produced by the workshop was encoded in GIS Software to give a spatial reference. This data was then input to MaxEnt software to generate suitability for each crop for the year 2030 and 2050.

CROP OCCURENCE



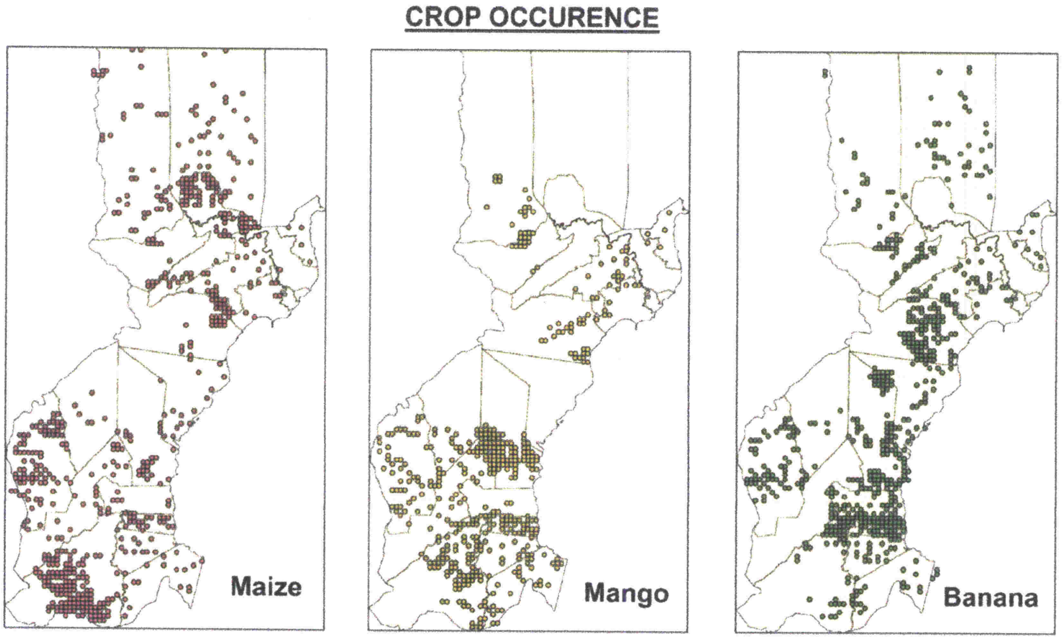


Figure 3. Crop occurrence of different crops

The output of the MaxEnt was a suitability map of each crop for baseline condition and the projected conditions for the year 2030 and 2050. Also, a statistical analysis on the variable contribution that affects the crop-distribution.

Sensitivity was determined by getting the deference between the future conditions and the baseline conditions that will determine which area losses or gained suitability with the future condition. Furthermore, sensitivity index for each municipality was calculate by determining the average sensitivity on each municipality and categorised as of what sensitivity index it will fall. Moreover, the resulted dataset was a shapefile of the cities/municipalities with an attribute table containing its city/municipal name and its corresponding sensitivity index.

	Percent Change (%)	Sensitivity Index
Negative	-50 – -100	1
	-25 – -49	0.5
	-5 – -24	0.25
No Change	-5 – 5	0
Positive	5 – 24	-0.25
	25 – 49	-0.5
	50 – 100	-1

Table 1. List of hazards datasets and its sources

Hazard Index

For the hazard index, hazard datasets are collected in various sources. The following table shows the hazard datasets and the sources of this maps.

Hazard Map	Source	Access
Typhoon	UNEP	CIAT
Flooding	DOST – Lidar	lipad-fmc.dream.upd.edu.ph
Drought		
Erosion	CIAT	CIAT
Landslide	DOST - Project Noah	noah.dost.gov.ph
Storm Surge	DOST - Project Noah	noah.dost.gov.ph
Sea Level Rise	CIAT	CIAT

Table 2. List of hazards datasets and its sources

With the use of GIS Software, this hazard datasets were normalized to generate new hazard datasets with a boolean values of 1 (with hazard) and 0 (no hazard). In addition, the resulting datasets were averaged in associated with its municipal boundary to determine the extent of the effect of this hazards. The resulted dataset was a shapefile with an attribute containing the name of the city/municipality and its corresponding hazard effect.

Furthermore, this hazards were rated based on how disastrous it was in that particular province given a rate of 5 having a more disastrous effect to 1 having almost insignificant effect. The following table shows the weighted effect of this hazards.

Provincial Level (Davao Del Sur)

Criteria	Typhoon	Flooding	Drought	Erosion	Landslide	Storm Surge	Sea Level Rise	Salt Water Intrusion
Probability of Occurrence	1	5	3	5	5	1	3	5
Impact to Local Household Income	3	3	5	2	3	1	1	2
Impact to Key Natural Resources to Sustain Productivity (i.e., water quality & quantity, biodiversity, soil fertility)	2	4	4	3	2	1	2	2
Impact to Food Security of the Country(DC & DS)	3	3	4	3	2	1	1	2
Impact to Nat'l Economy	2	3	4	2	2	1	1	1

Table 3. List of hazards datasets and its sources

Moreover, each datasets containing the averaged hazard effect for each municipality was multiplied by its weighted percentage to generate its hazard index. The resulted datasets was a shapefile with an attribute containing the municipal name and its hazard index.

Adaptive Capacity Index

For the adaptive capacity, CIAT gave the list of indicators that was needed to determine the adaptive capacity index. This set of indicators fall in seven different capital namely: economic, natural, human, physical, social, anticipatory, and institutional. Furthermore, this data were collected within various government agencies like LGU's of each municipality, Provincial Agricultures Office, Provincial Planning, Philippine Statistics Authority XI, DepED XI and DA-RFO XI. The following table shows the list of indicators with its corresponding capitals.

Indicators	Attribute Capital
Poverty	Economic
Inflation Rate	
Min. Wage (Agriculture)	
Financial Institutions and Cooperatives	
% of area irrigated	Natural
% of mangrove and forest	
Health	Human
Education	
Infrastructure Investment	Physical
Access to services	
Infrastructure Network	
Number of Public Transport	
Telephone Companies and Mobile Services	
Number of DA Officers	Institutional
Buffer Stocks	
Presence of DRRMP	

Table 4. Adaptive capacity indicators and its attribute capital

Experts from DA (from different agencies), NEDA, FAO, NGOs, and Academe were invited to the workshop. They were grouped into 2 clusters and ask to rank each of the indicators according to importance. Each group should discuss and decide for a common value/rate for each indicator. They were provided with 1-5 score/rates, where 5 is the highest/most important. Only those indicators that got rate/score of 4 and 5 were considered. Some of the variables were lumped into a single variable and was given a high score as suggested by experts. The values of the 16 indicators were integrated in the shapefile municipal boundaries. Each of the indicators were normalized and was treated with equal weights. The sum of the 16 indicators provided the adaptive capacity index.

Overall Vulnerability

The values of the sensitivity index, hazard index, and adaptive capacity were integrated in the shapefile municipal boundaries. The weights that were used to determine vulnerability were "Sensitivity (15%)", "Hazards (15%)", and "Adaptive Capacity (70%)". In addition, five equal breaks was arbitrarily used to rate the vulnerability. Specifically, 0-0.20 (Very Low), 0.20-0.40 (Low), 0.40-0.60 (Moderate), 0.60-0.80 (High), and 0.80-1.00 (Very High).

Component 3 - Stakeholders' participation in climate adaptation planning

The regional project team organized a series of stakeholders' meetings and focus group discussions to collect supplementary data and validate preliminary results of CRVA, as well to undertake CRA prioritization and planning.

These activities were guided by process facilitation and data collection tools developed by the AMIA2 projects on CRVA and CRA decision-support platform.

Component 4 - Documenting & analyzing CRA practices

The regional project team conducted a semi-structured survey with local stakeholders to identify and document CRA practices, as well as collected existing CRA-relevant statistical and other secondary data.

These data was systematized and analysed, using cost-benefit and trade-off analyses tools as input to AMIA2 CRA prioritization and investment planning. These will likewise contribute to developing knowledge products, such as searchable online portal, under the AMIA2 project on CRVA decision-support platform. A national working team, consisting of representatives from regional teams, will undertake this joint tasks.

5. Results and Discussion per Objective

The approved project duration is June 2016 to February 2017 (9months). However, the fund was released only last October 21, 2016. Thus, activities are still in the data gathering stage and the data and results are preliminary. The following are the outputs.

1. To strengthen capacities for CRA methodologies of key research and development organizations in the region;

Project team participated in project orientation to level-off objective, project site, methodologies and activities. Team members participated trainings–workshops hosted by CIAT–AMIA 2 counterparts, namely, Climate-Risks Vulnerability Assessment and Cost-Benefits Analysis

At the local levels, project team formally presented the project to the DA-Region 11. Discussions were also made with LGUs such as the Municipal Agricultural Office of Marilog District (the target pilot site for CRA assessment and prioritization).

2. To assess climate risks in the region's agri-fisheries sector through geospatial & climate modelling tools;

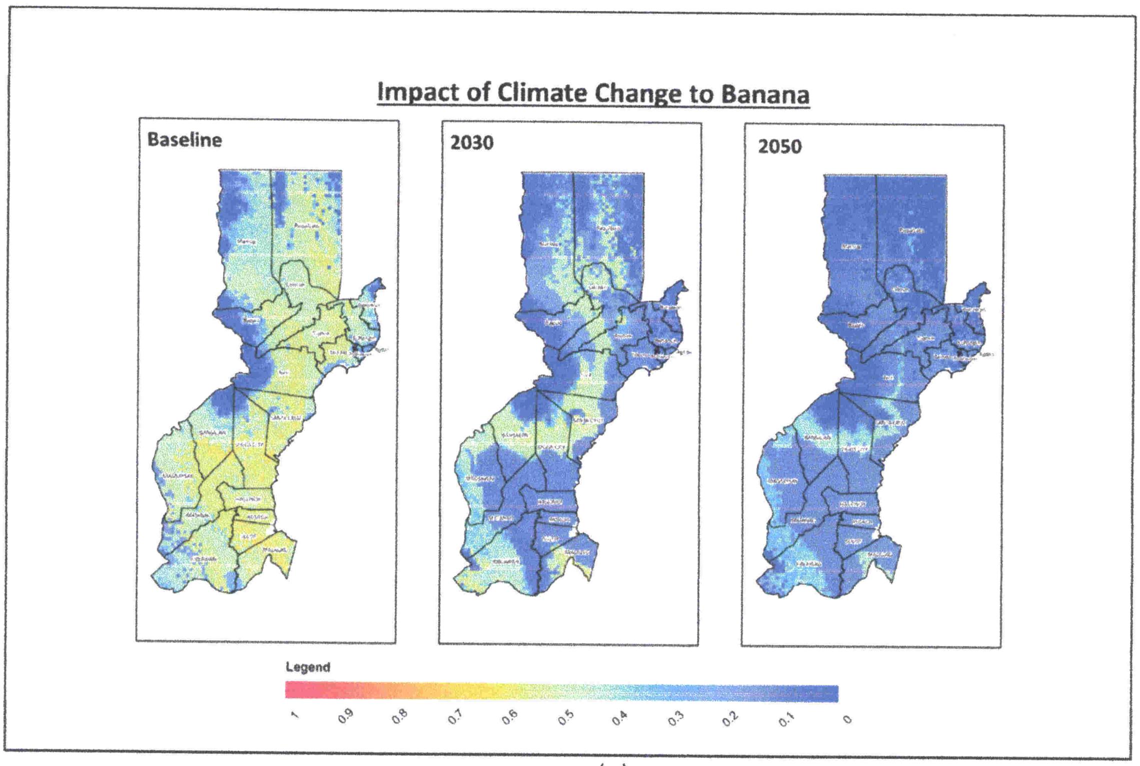
Suitability and Sensitivity

For suitability, species distribution modelling techniques produce maps of the potential distribution of species. MaxEnt is a predictive biogeography programme that uses a maximum entropy algorithm to match known locality points for a species to potential localities, based on their environmental characteristics.

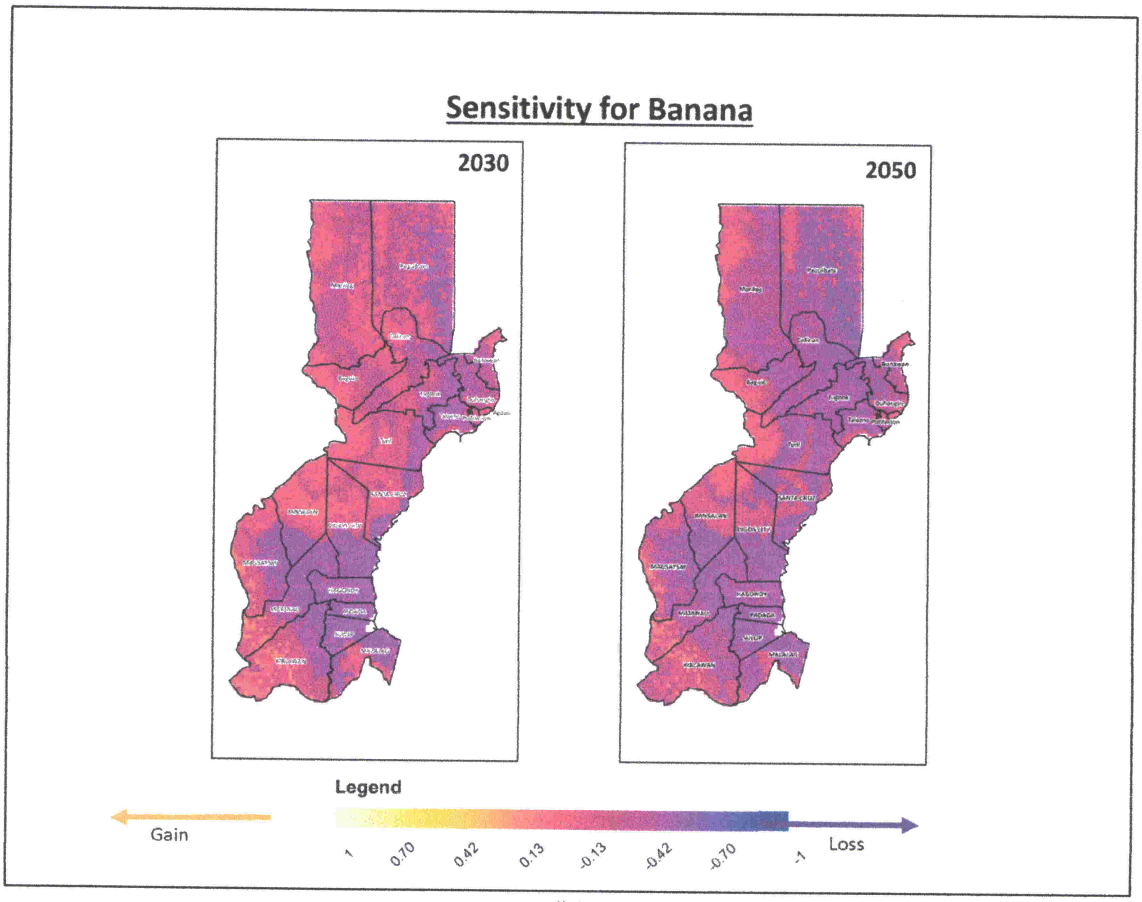
- Banana

Changes in temperature and rainfall patterns will cause a general decrease of areas suitable for banana and reduce areas which currently possess high suitability for banana production as showed in Figure 4. Additionally, Suitability is predicted to climb up altitudinal gradients to currently cooler climates. Models predict that banana will greatly lose suitability in lower altitudes and a minor loss of suitability in higher areas.

Changing climatic conditions in Davao Del Sur could lower the quality and yields of current banana producing areas and this is likely to be most prevalent in lower-altitude zones. Furthermore, economic losses in the future could ensue if adaptation efforts are not implemented. However, there are many opportunities to adapt to such changes and for those banana farms whose suitability will drop but not decrease drastically, adaptation is a crucial strategy. These strategies include improved agronomic management, drought- and heat-resistant varieties, irrigation and shade cover.



(a)



(b)

Figure 4. (a) Impact of climate change for banana (Warmer colours in the map indicate the better predicted conditions for banana). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

Environmental factors that drive suitability

Figure 5 shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is bio_2 (Mean diurnal range), bio_3 (Isothermality) and bio_4 (Temperature seasonality), which therefore appears to have the most useful information by itself. Furthermore, this variables were correlated with each other as they were all interconnected on variability of temperature

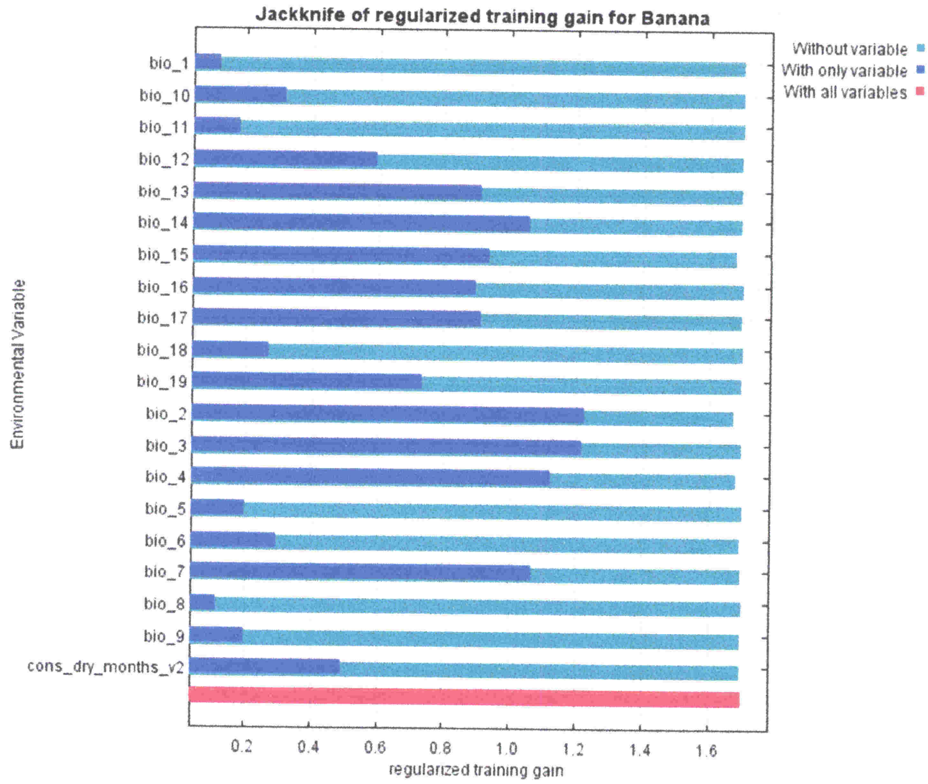
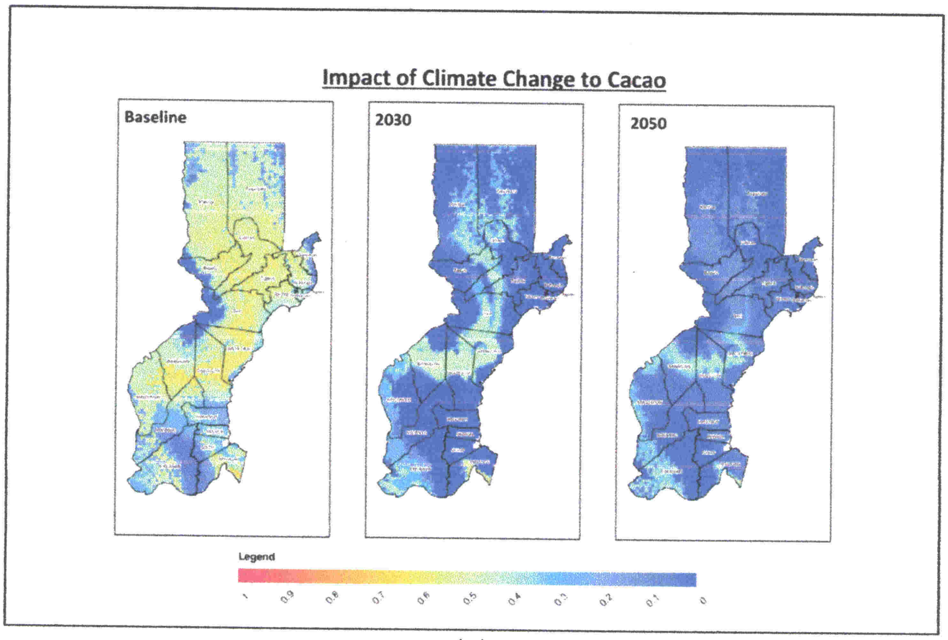


Figure 5. Result of Jackknife test performed on banana

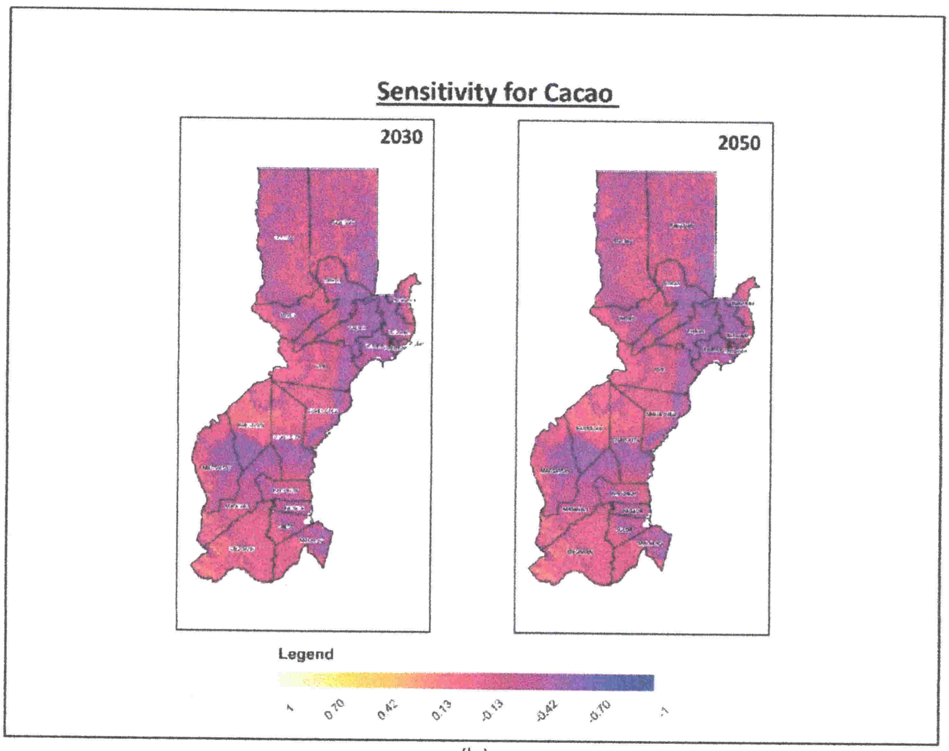
- Cacao

A general decrease of areas suitable for cacao was observed from areas which currently have high suitability for cacao production which may cause changes in temperature and rainfall patterns as showed in Figure 4. Moreover, a small increase in suitability is predicted to climb up altitudinal gradients to currently cooler climates. Models predict that cacao will lose suitability in lower altitudes and gain with small amount of suitability in higher areas.

Changing climatic conditions in Davao Del Sur could lower the quality and yields of current cacao producing areas and this is likely to be most prevalent in lower-altitude zones. Furthermore, economic losses in the future could ensue if adaptation efforts are not implemented. However, there are many opportunities to adapt to such changes and for those cacao farms whose suitability will drop but not decrease drastically, adaptation is a crucial strategy. These strategies include improved agronomic management, drought- and heat-resistant varieties, irrigation and shade cover.



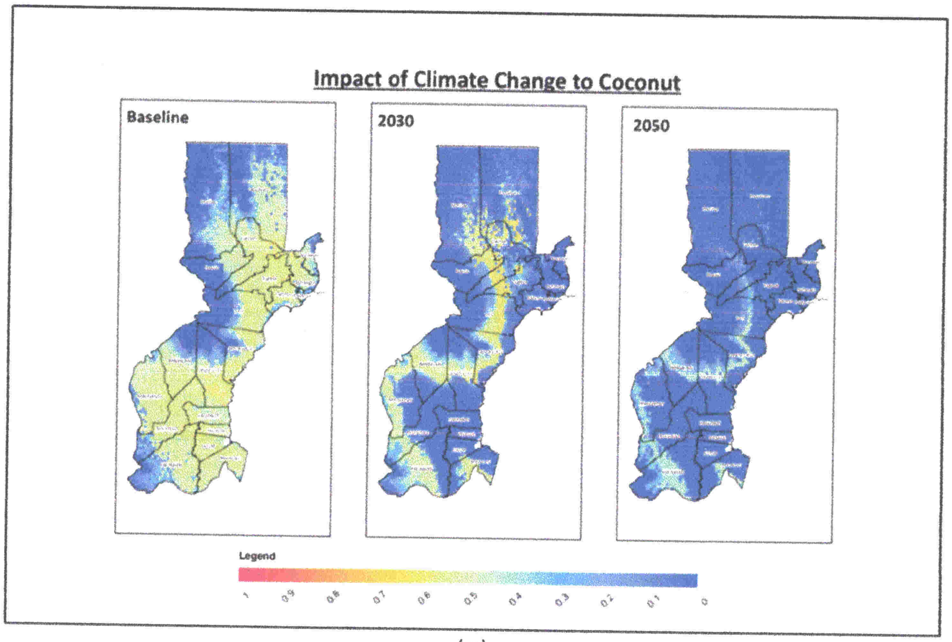
(a)



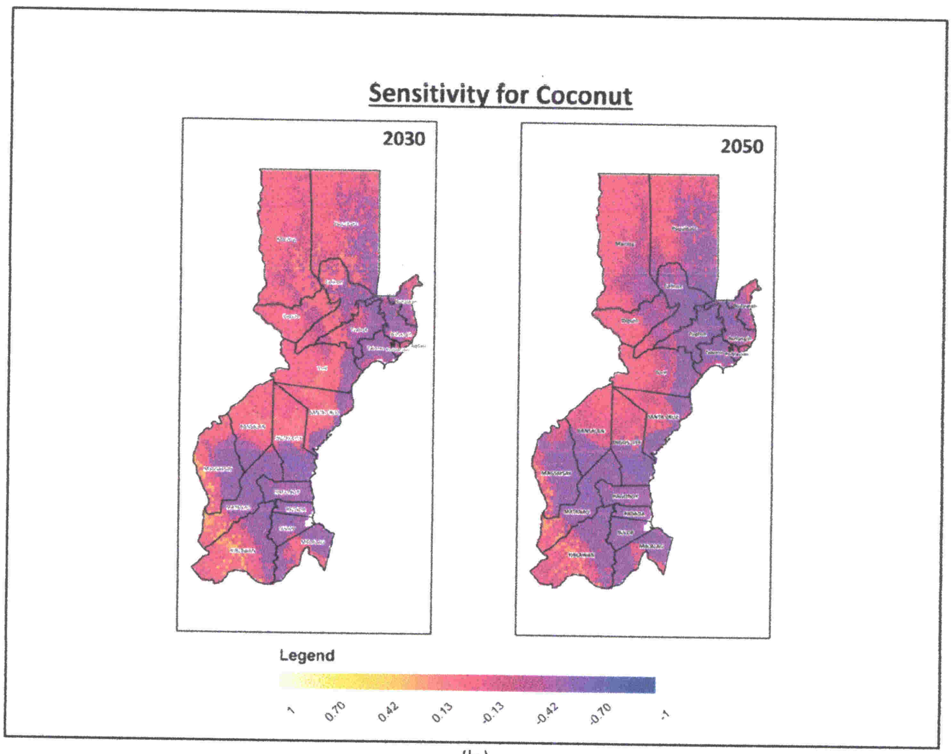
(b)

Figure 6. (a) Impact of climate change for Cacao (Warmer colours in the map indicate the better predicted conditions for Cacao). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

- Coconut



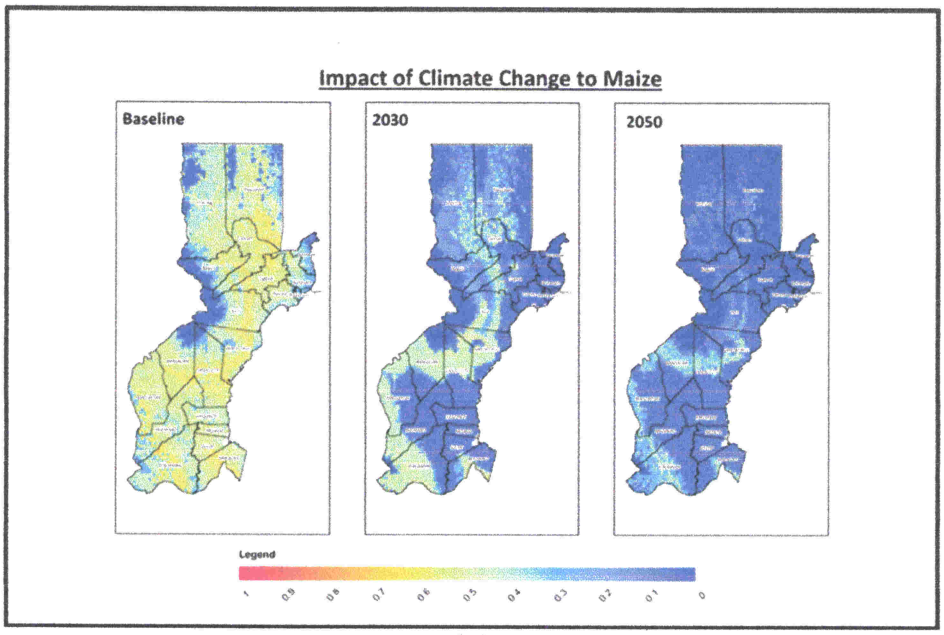
(a)



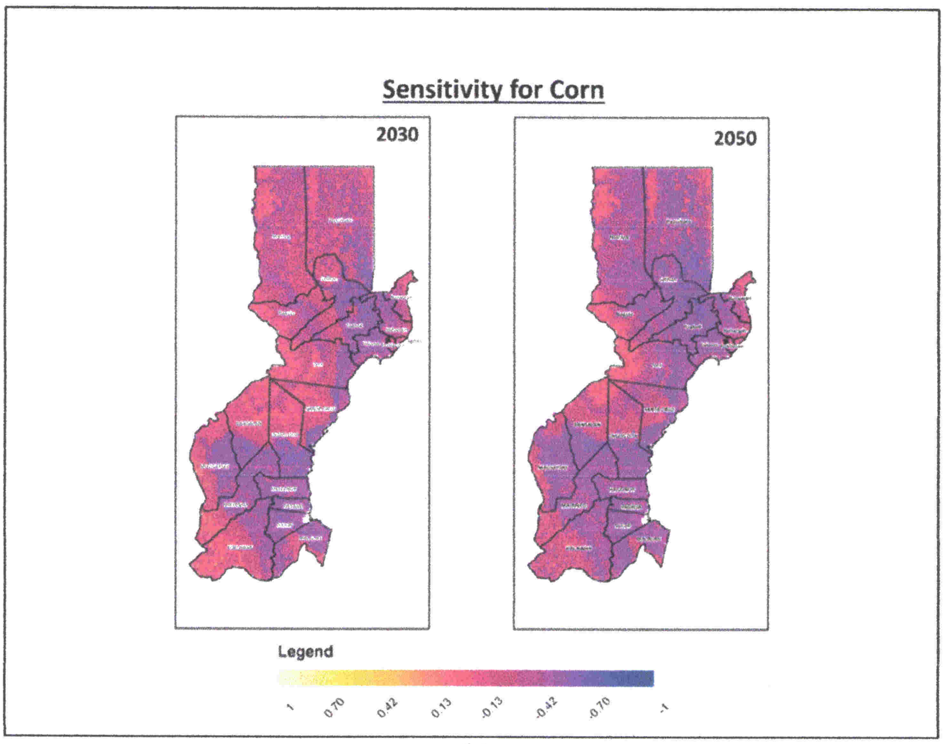
(b)

Figure 7. (a) Impact of climate change for Coconut (Warmer colours in the map indicate the better predicted conditions for Coconut). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

- Corn



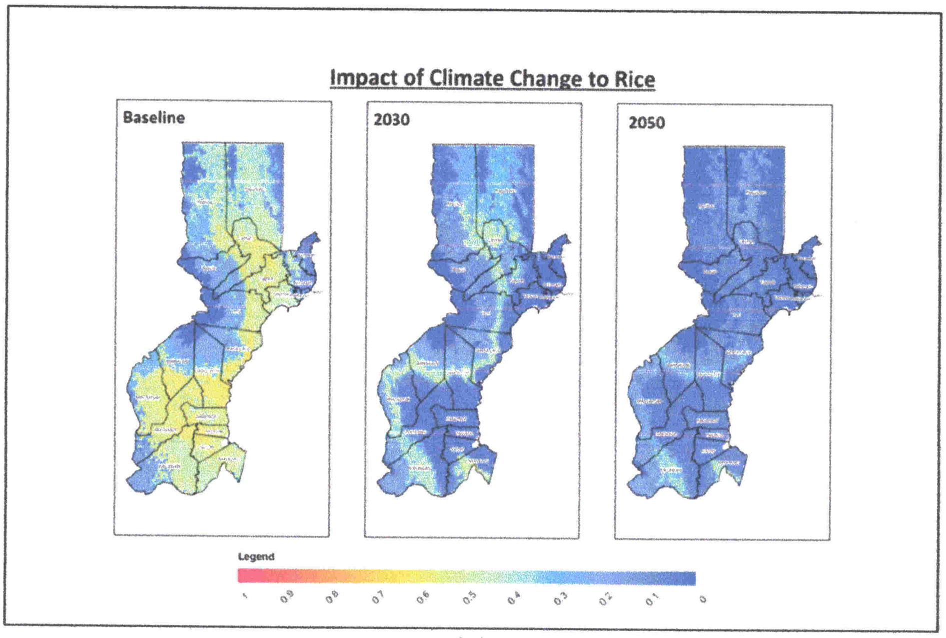
(a)



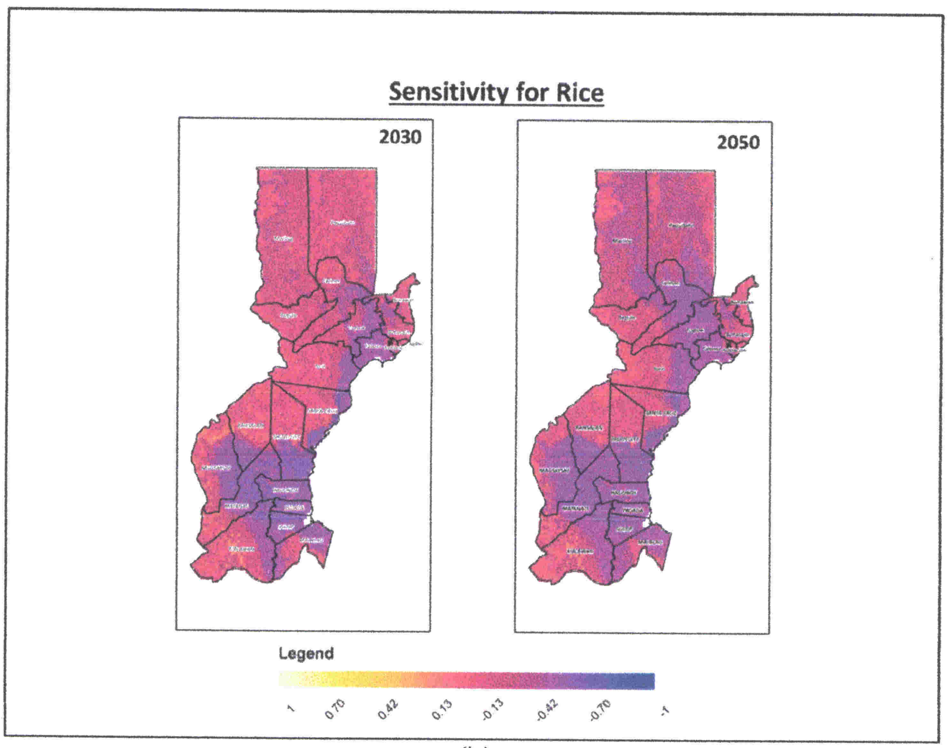
(b)

Figure 9. (a) Impact of climate change for Corn (Warmer colours in the map indicate the better predicted conditions for Corn). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

- Rice



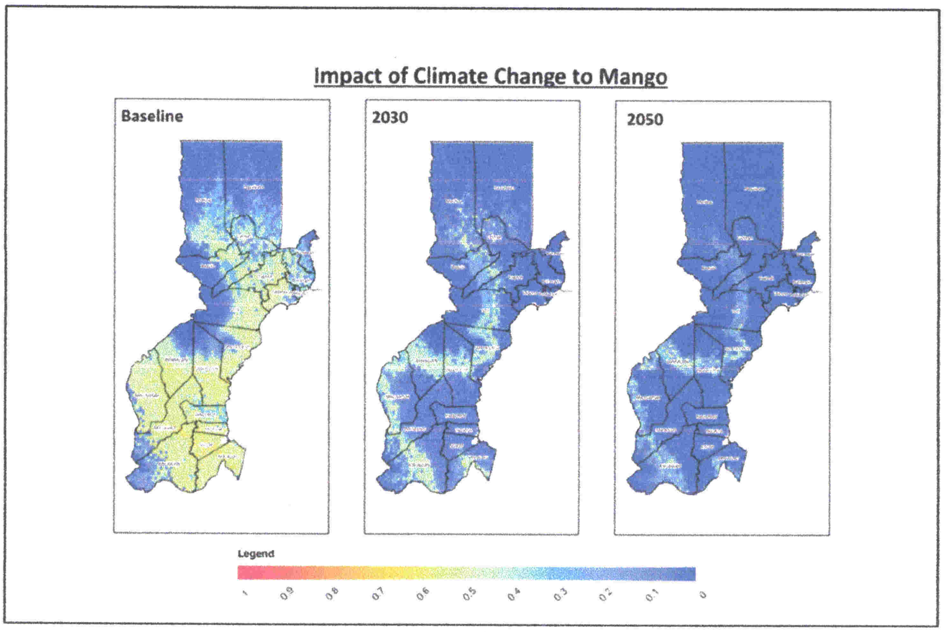
(a)



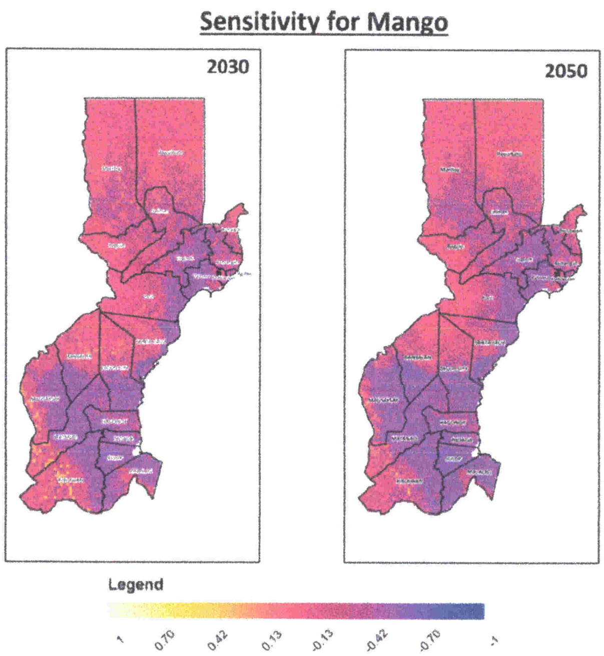
(b)

Figure 10. (a) Impact of climate change for Rice (Warmer colours in the map indicate the better predicted conditions for Rice). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

- Mango



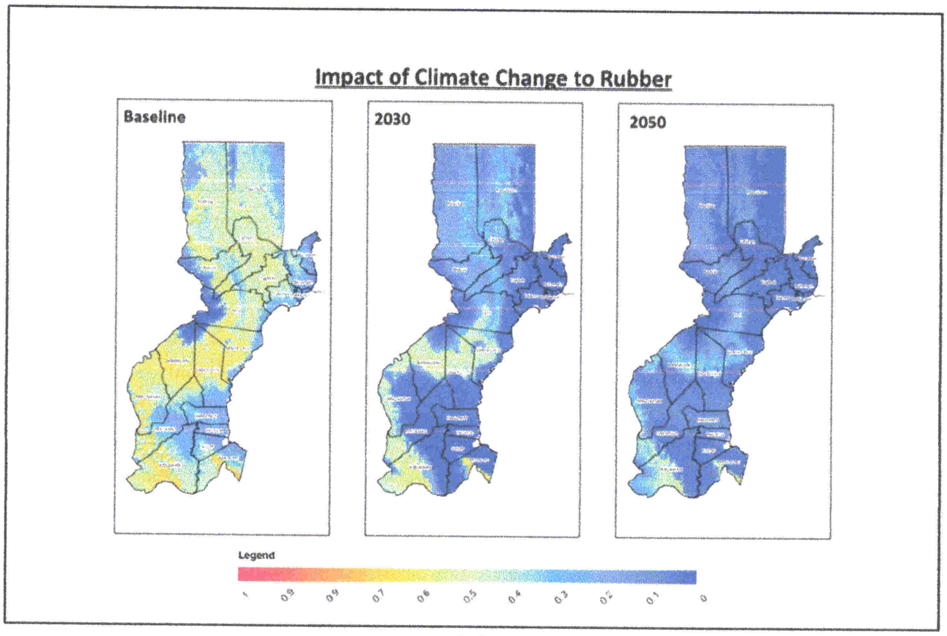
(a)



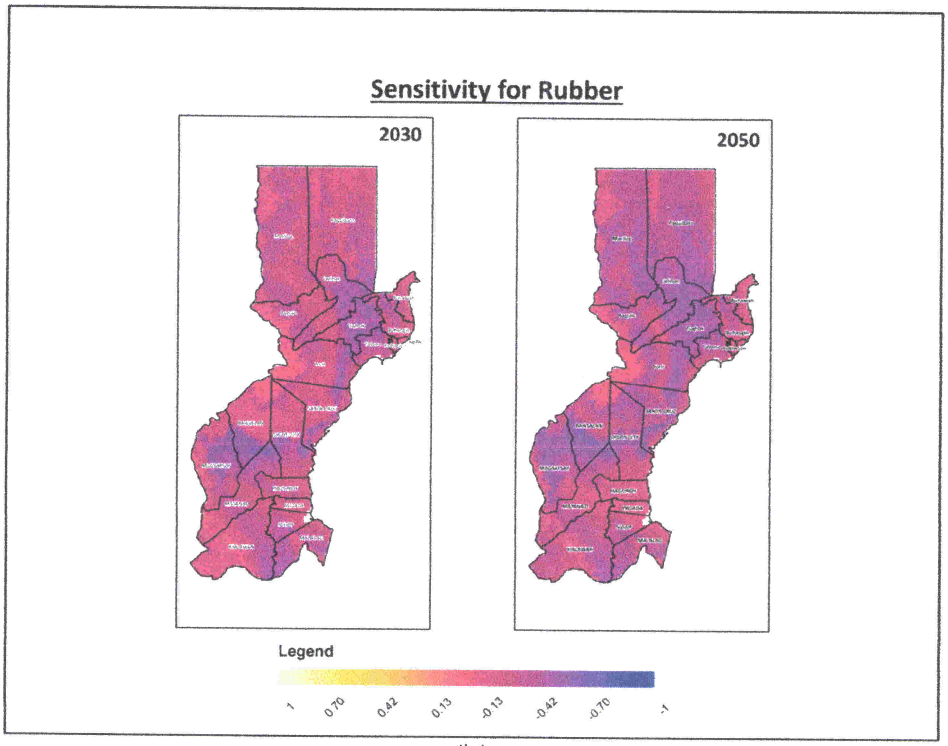
(b)

Figure 11. (a) Impact of climate change for Mango (Warmer colours in the map indicate the better predicted conditions for Mango). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

- Rubber



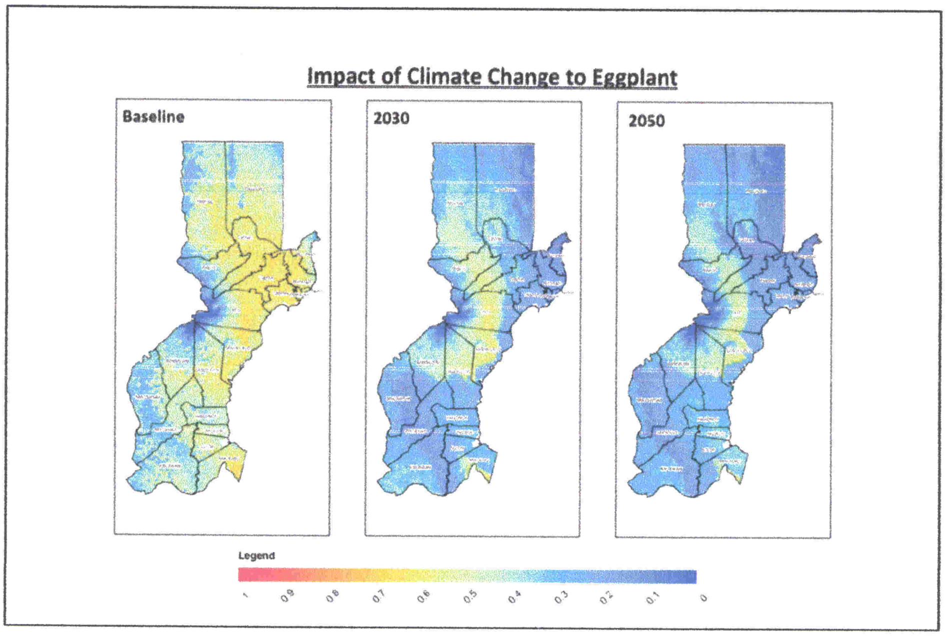
(a)



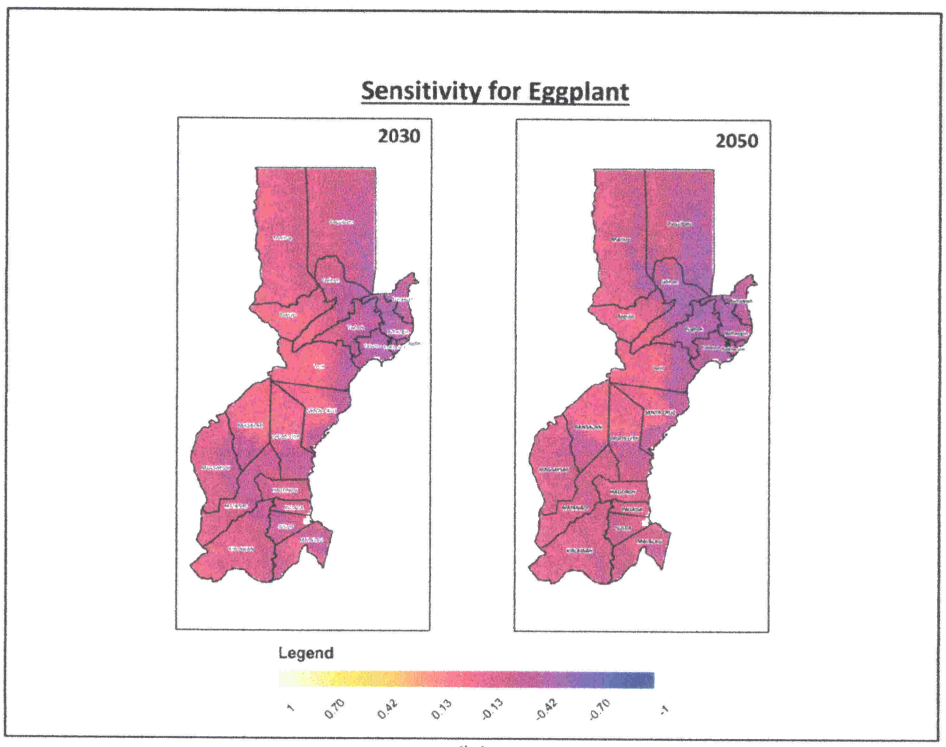
(b)

Figure 12. (a) Impact of climate change for Rubber (Warmer colours in the map indicate the better predicted conditions for Rubber). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

- Eggplant



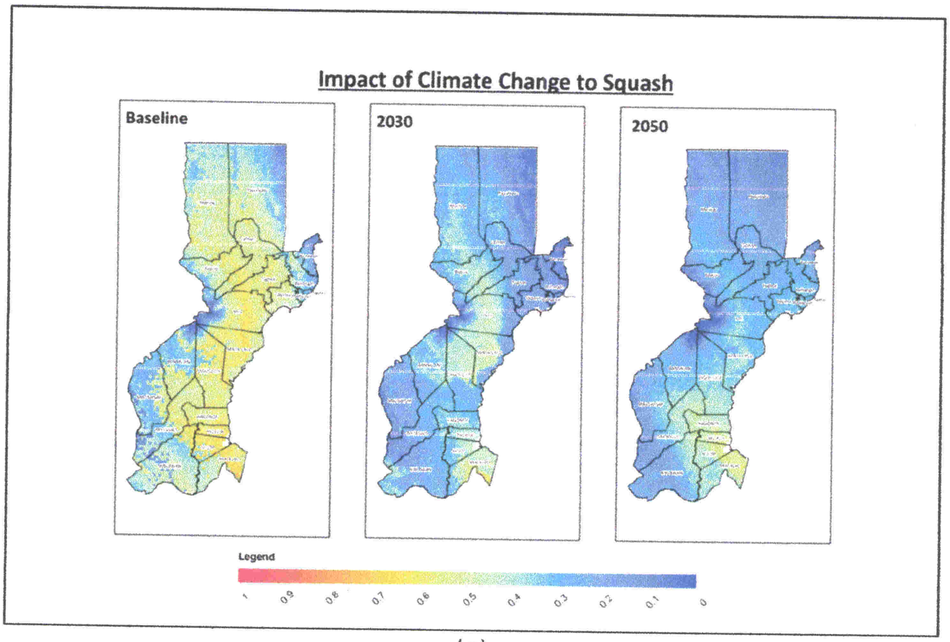
(a)



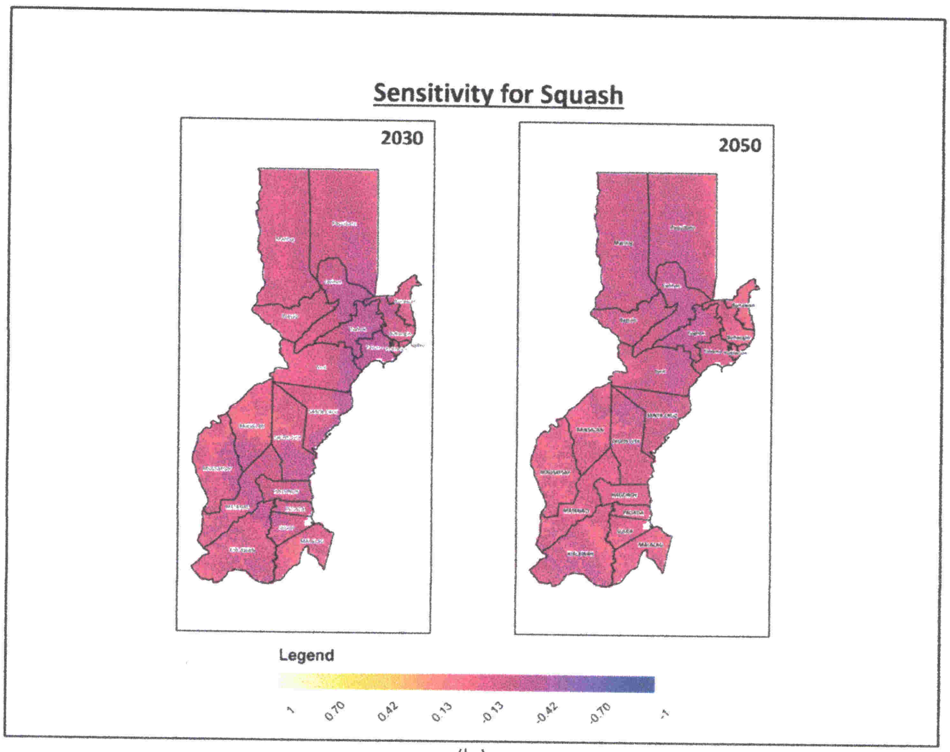
(b)

Figure 13. (a) Impact of climate change for Eggplant (Warmer colours in the map indicate the better predicted conditions for Eggplant). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

- Squash



(a)



(b)

Figure 14. (a) Impact of climate change for Squash (Warmer colours in the map indicate the better predicted conditions for Squasht). (b) Change in suitability (Lighter color gain suitability, while darker colour loss suitability).

Hazards

For the overall hazards, Figure 10 shows that Poblacion district and Agdao District in Davao City had a very high hazards. This may due to hazards like flooding, storm surge, and sea level rise.

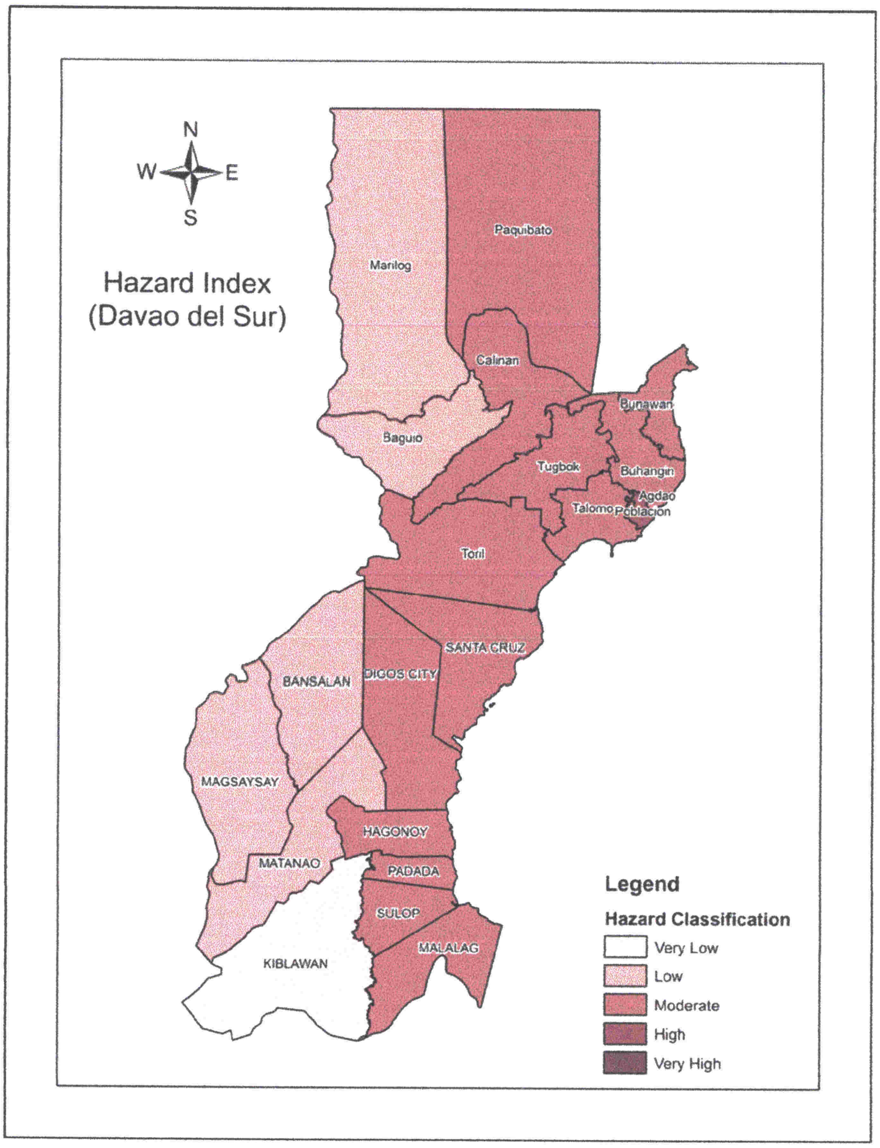


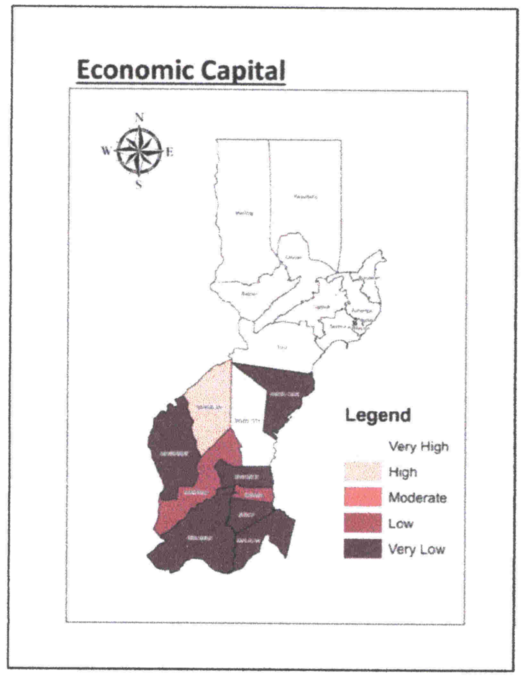
Figure 15. Hazard index for Davao del Sur.

Adaptive Capacity

Economic Capital

Figure () shows the adaptive capacity of Davao del Sur in terms of its economic capital. The municipality of Hagonoy, Kiblawan, Magsaysay, Malalag, Padada, Sta. Cruz and Sulop have a very low adaptive capacity. This was because they have a low income level that range from 2nd to 3rd municipal class.

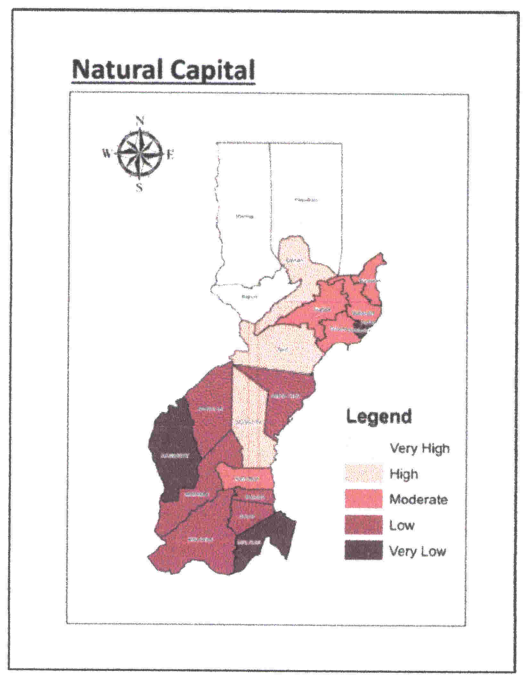
Moreover, all districts of Davao City and Digos City have a very high adaptive capacity because this is a 1st class city and having several financial institution under its boundary.



Natural Capital

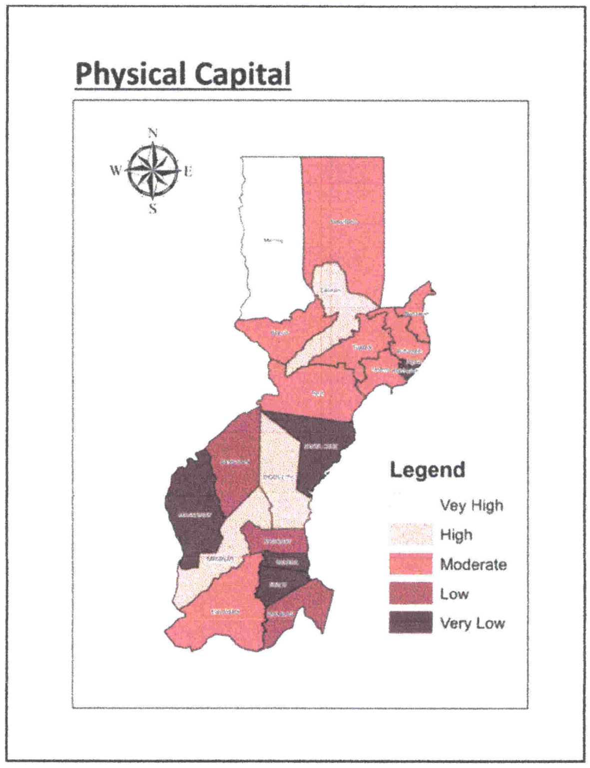
For natural capital, Districst like Paquibato, Marilog, and Baguio have a high adaptive capacity in terms of natural capital. In that district, supporting ecosystem are still available.

In contrast, Municipality of Magsaysay and Malalag have a very low adaptive capacity.



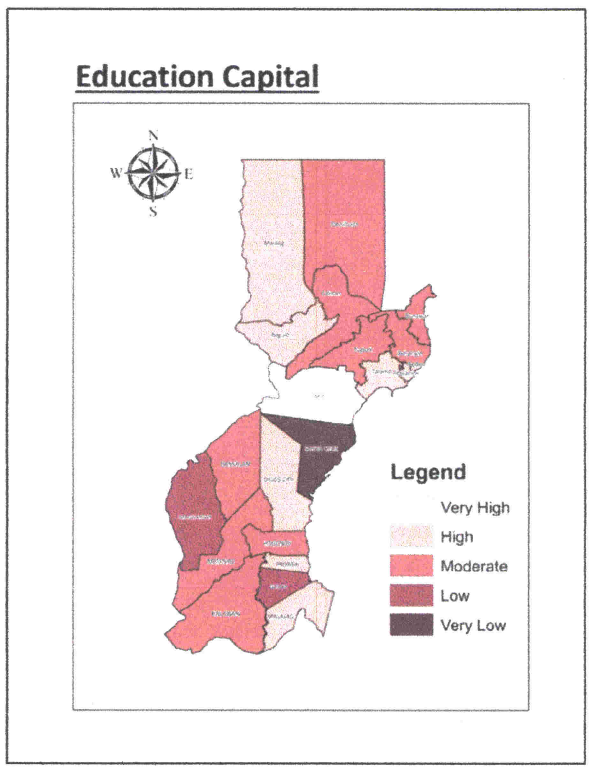
Physical Capital

Marilog district in Davao City have a very high adaptive capacity due to a various postharvest facilities and number of agricultural machineries.



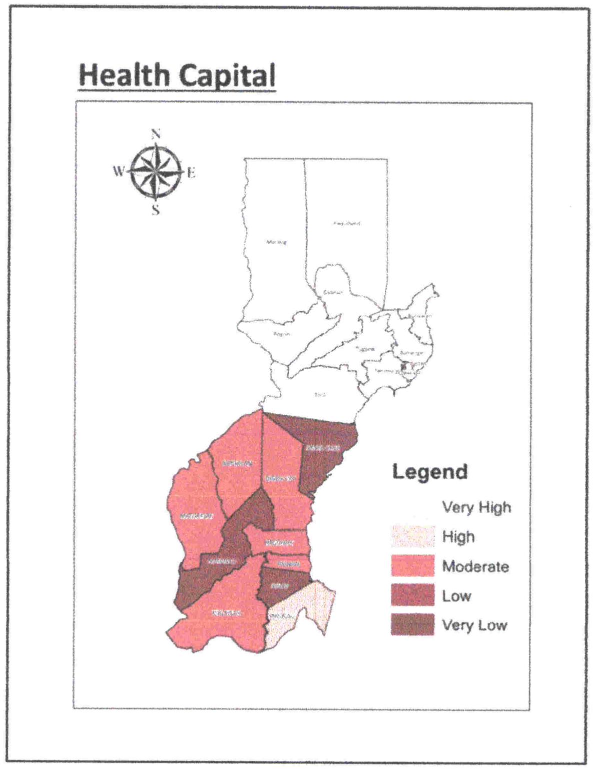
Education

For education capital, municipality of Sta. Cruz have the lowest adaptive capacity in terms of education, while, Toril district have the highest AC.



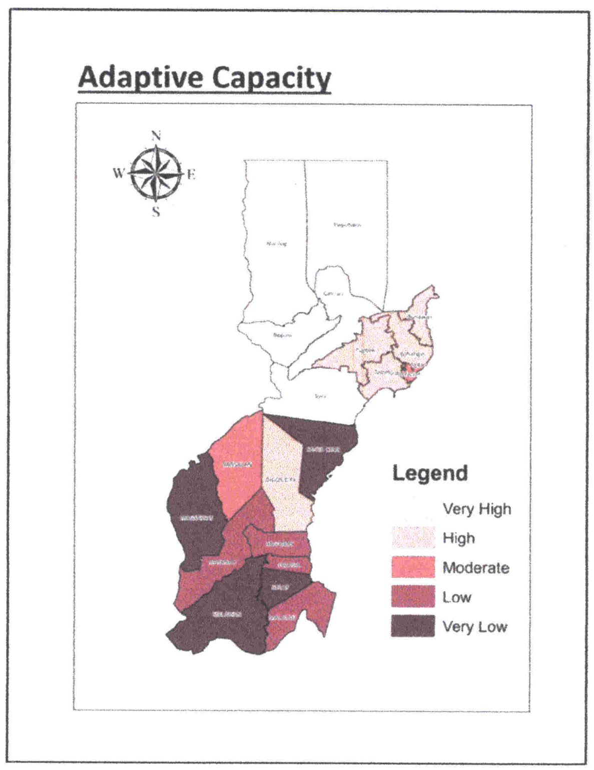
Health Capital

Davao City have thhe highest AC in terms of Health Capital.



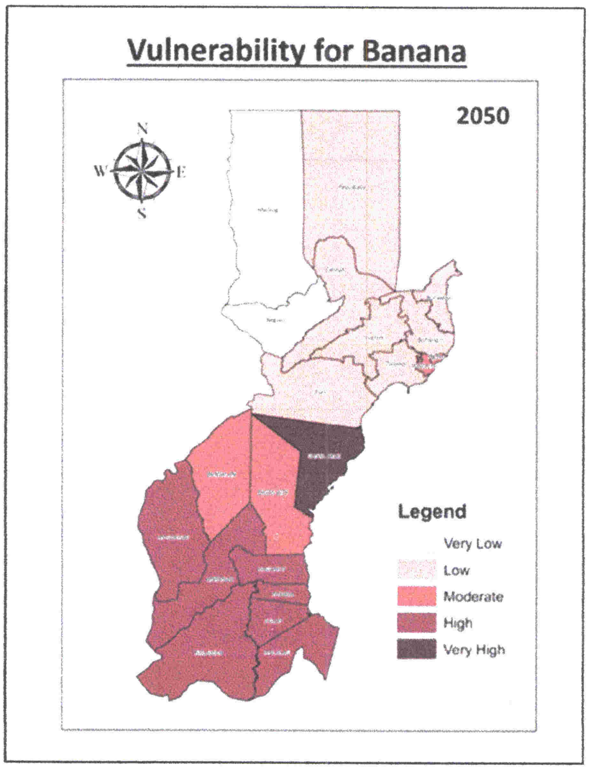
Overall Adaptive Capacity

For the overall adaptive capacity, districts in Davao City namely; Paquibato, Calinan, Marilog, Baguio, and Toril have a very high Adaptive Capacity while, municipalities of Sta. Cruz, Magsaysay, Kiblawan and Sulop obtain a very low adaptive capacity.

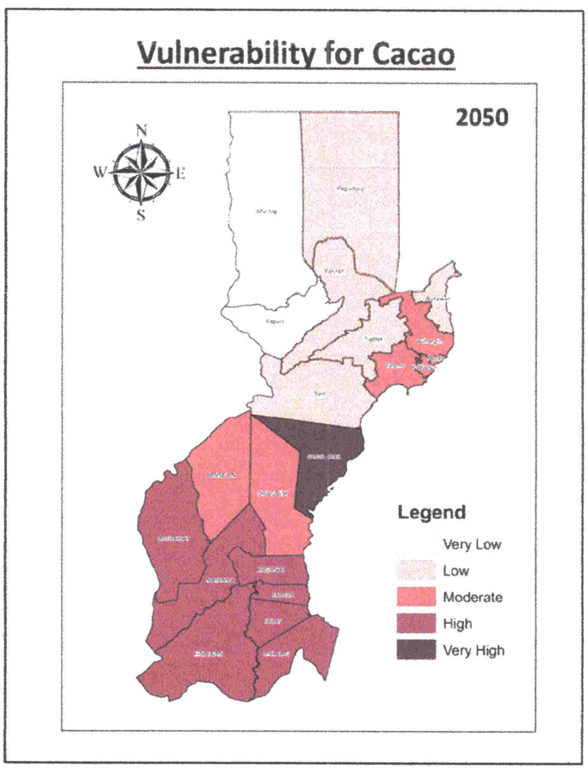


Vulnerability

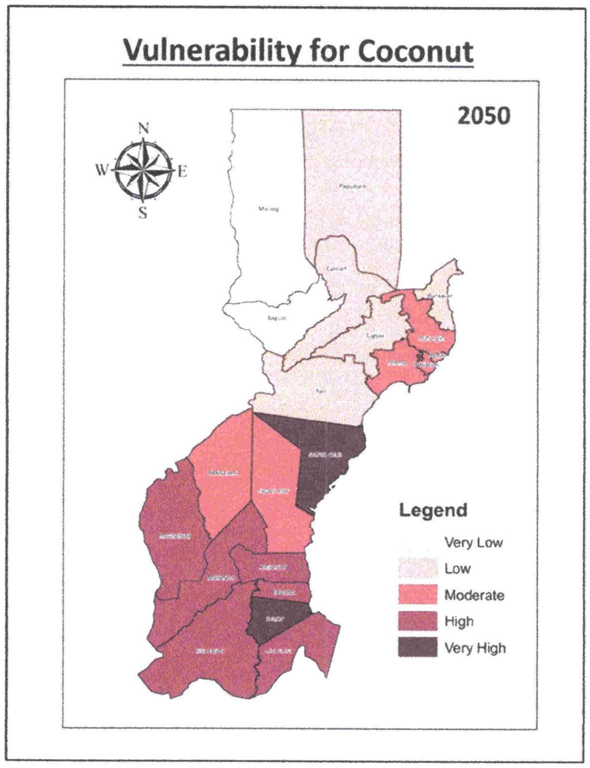
Vulnerability for Banana



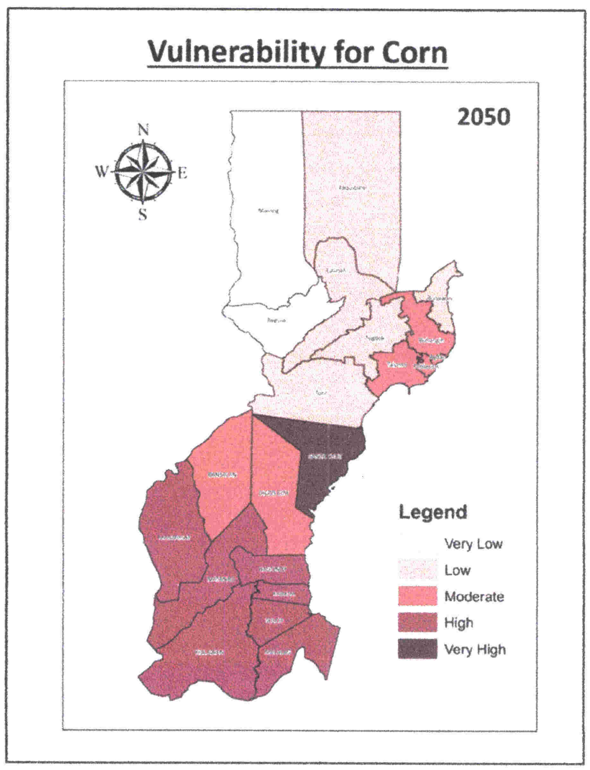
Vulnerability for Cacao



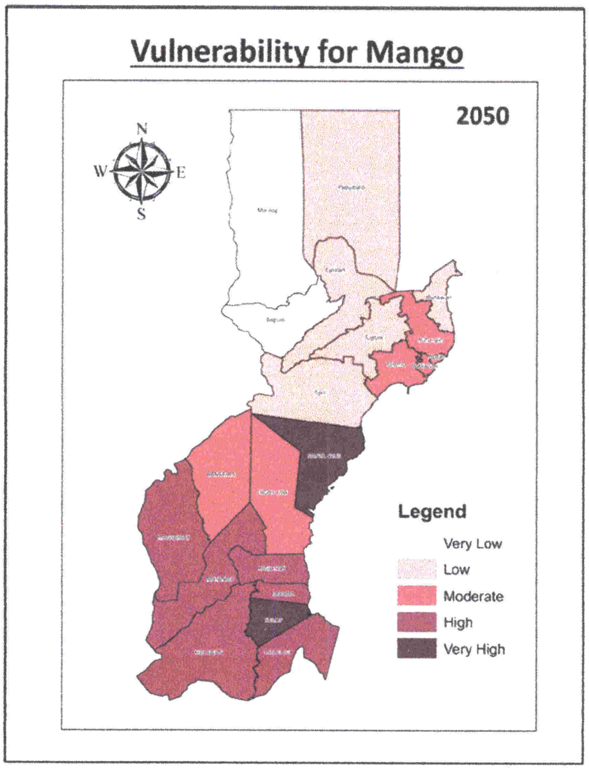
Vulnerability for Coconut



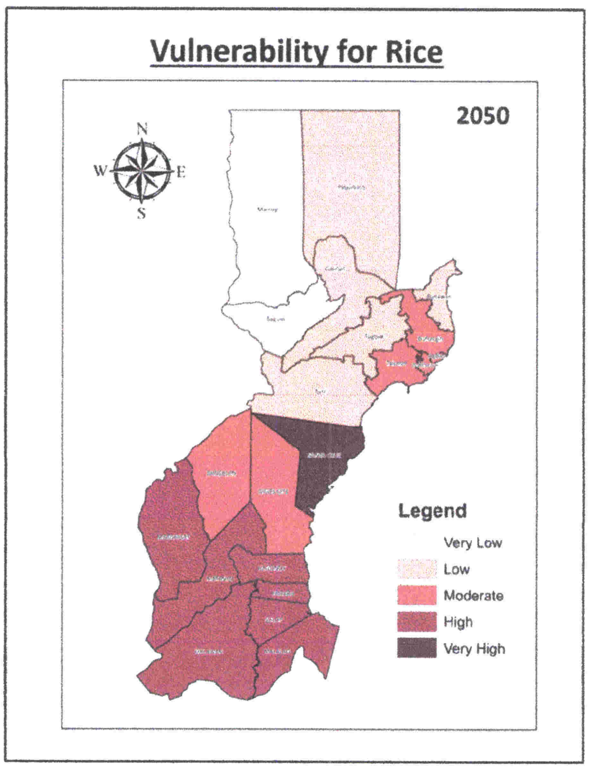
Vulnerability for Corn



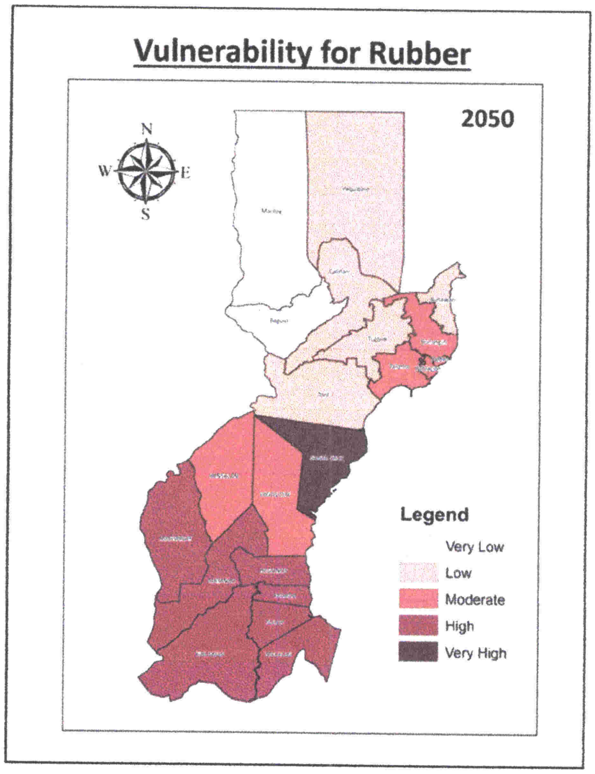
Vulnerability for Mango



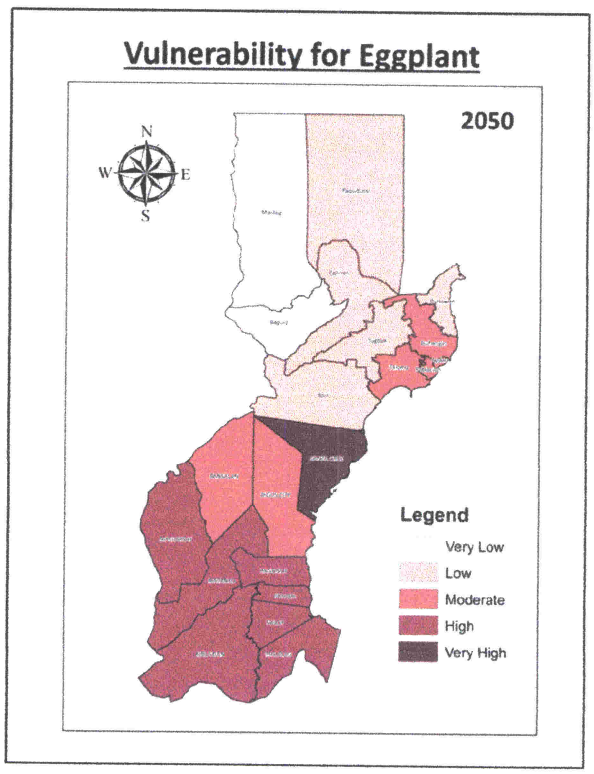
Vulnerability for Rice



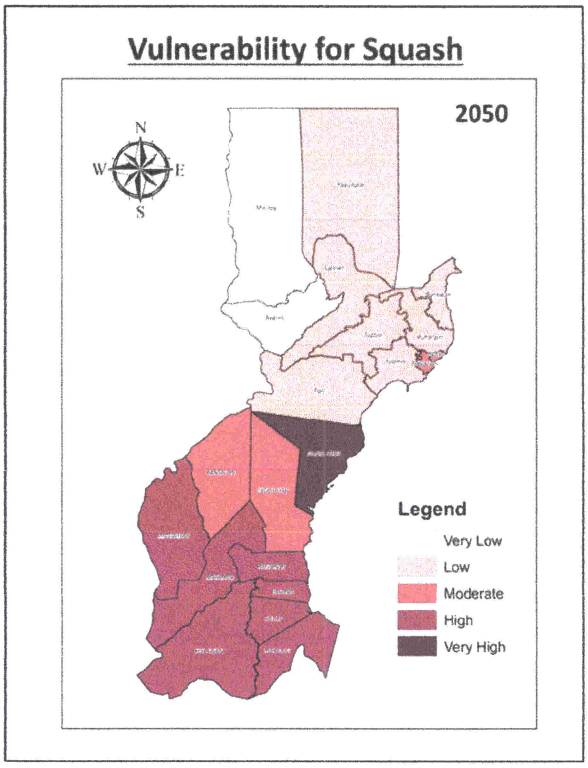
Vulnerability for Rubber



Vulnerability for Eggplant



Vulnerability for Squash



3. **To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risk.**
   The team had conducted several meetings and Focus Group Discussions (FGD) and Key Informant Interviews (KII) to the target clientele in the target site within the province on their perceptions, knowledge and strategies for adapting climate change using the prepared questionnaire provided by CIAT. This questionnaire was pre tested before the actual interview was conducted.

Farmers' Interview Documentation

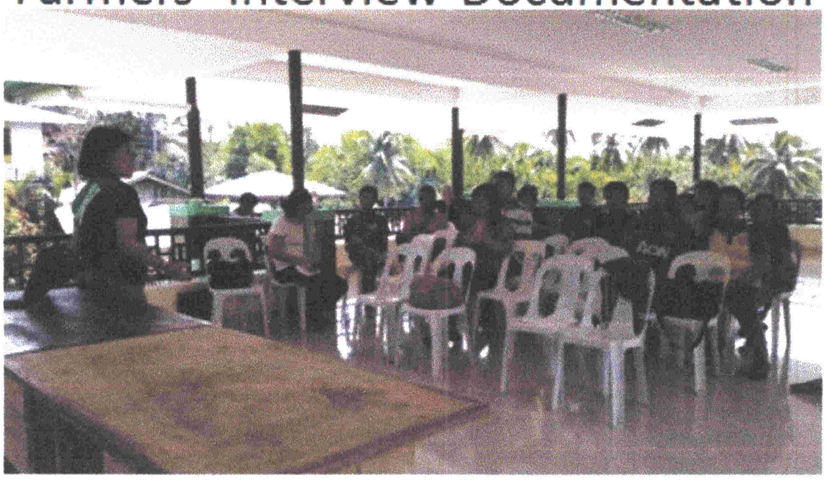


Fig.4. Mrs. Jovita , DA-RFO XI collaborator, discussed the rationale of the project to the local farmers of Brgy Suawan.

Fig.6. Mrs. Sargado,Agricultural Technologists , introduced the Team to the farmers during the meeting.

4. **To document and analyse local CRA practices to support AMIA2 knowledge-sharing and investment planning; and**

Two CRA practices were identified and analysed using the Cost Benefit Analysis (CBA). These were intercropping (coconut and cacao) and crop change with integrated nutrient management. Based from CBA, it was found out that these practices are privately and socially feasible and viable. Initial investment can be recovered in a span of 5 years. Hence, these 2 CRA practices are recommended for the region for the farmers to be able to cope up to climate change.

Some farmers who were interviewed for their intercropping practices.

Some farmers who were interviewed for their crop rotation with integrated nutrient practices.

Below are the sample investment plan and the result of CBA for intercropping (cacao-coconut):

Investment Prioritization for Region XI: Intercropping

Climate-Smart Agriculture Practices Investment Prioritization

Overview

Davao Region is located in the Southeastern portion of the island of Mindanao surrounding the Davao Gulf. The region is blessed with good climate as it experiences Types II and IV climate and lies outside the typhoon belt. Rainfall ranges from 1,673.3 mm to 1,941.8mm while average temperature ranges from 28°to 29°C.

However, like any other regions, it is vulnerable to flooding, droughts, temperature rise, and abnormal increase in rainfall. Davao del Norte and Compostela Valley are very high risk for temperature change and high risk to flooding. Davao Oriental is high risk for El Niño-induced droughts or abnormal increase in rainfall. Davao del Sur and Davao Occidental are very high risk for El Niño-induced droughts or abnormal increase in rainfall.

Apparently, this climate variability affects the region's agricultural production like cacao, banana, coconut, rice, corn, and many others. Hence, losses in soil fertility, reduction in yield and income, and increased incidence of pest and diseases are experienced by farmers in the region.

Some of the common agricultural production practices are multiple cropping, crop rotation, contour farming, and monocropping.

Prioritized CRA Practice

Intercropping is the cultivation of two or more crops simultaneously on the same field. It is a type of multiple cropping where farmers manage more than one crop at a time in the same field. Some of the commonly intercropped commodities in the region are coconuts with fruit trees, bananas and/or legumes, cacao under coconuts and/or other fruit trees.

Intercropping is one of the ways to reduce soil erosion and surface run-off hence protects topsoil. Intercropping also utilizes the farm area efficiently resulting to potential increase in total production and farm profitability. It reduces plant diseases and attracts more beneficial insects thus reduces insect pest population because of the diversity of the crops grown. Thus, intercropping maximizes land use potential and labor and payback period in less time.

Davao region ranks first in the production of coconuts, cacao , durian, and banana. Some farmers are already practicing multiple cropping however, some are still practicing the monocropping. Hence, intercropping cacao with the established bearing coconuts are considered as priority climate resilient agriculture practice in the region.

Data Gathering and Methodology

The data were gathered through key informant interviews (KII), literature reviews, experts opinion, and survey among the farmers who are practicing the intercropping as identified climate resilient agriculture practice of the region. Coordination with the Department of Agriculture personnel was done in reaching the prospect respondents. Municipal Agriculturists and Agricultural Technicians were also invited during workshops and interviews. There were twenty-five farmers interviewed who practiced intercropping and three farmers using monocropping as conventional method.

Results

Climate-Smart Agriculture Practices Investment Prioritization

CBA tool summary Farm (1 ha) results	Net present value (NPV)	Internal rate of return (IRR)	Payback Period	Initial investment	Social NPV	Social IRR	Scenario in the analysis (10 years)	
Unit	**US$**	**%**	**Years**	**US$**	**US$**	**%**	**Before**	**After**
Value	11, 293	44	5	1,675.00	11,896	47		
Aggregate analysis CBA tool summary	**Total area of intercrop**	**Current adoption rate**	***Adoption rate***	***Aggregated NPV***			**Period**	
		1%	60%	29,057,653			5years	

Recommendations

Based on the results, intercropping cacao to established coconuts is recommended for the farmers to be resilient amidst changing climate environment.

6. Summary of Findings

Davao Region was considered agriculture-based region. Some of its agricultural areas were affected by climate change and natural disasters. Thus, in order for the agriculture sector to become resilient in this environmental variation, there is a need to assess the climate risk and vulnerabilities. AMIA 2 aims to address resilience in agriculture through climate risk vulnerability assessment and climate resilient agriculture practices analysis.

Results of the CRVA analysis had identified places or municipalities in Davao del Sur the most vulnerable to climate change and knowledge thereof could be used by policy maker to address this and able to make measures to minimize the effect of climate change in the future.

Results of Cost Benefit Analysis on the most common Climate Resilient Agriculture Practice in the sample site revealed that two practices were found to be privately and socially feasible and viable, i.e., intercropping (cacao-coconut) and crop change with integrated nutrient management.

C. PROJECT MANAGEMENT

1. Updated Work Plan Schedule

Activities	Methods/Tools	Timetable 7/16 – 5/17
1. Capacity strengthening for CRA research & development*(Output: enhanced **capacities** of AMIA partner organizations in the region)*		
Capacity strengthening on CRVA	Training	6/16
Capacity strengthening on CRA prioritization	Training	8/16
Capacity strengthening on CRA knowledge hub development	Training	9/16
Capacity strengthening on CRA M&E	Training	11/16
2. Geospatial assessment of climate risks *(Output: geospatially referenced data on climate-risks: biophysical-agricultural-socioeconomic parameters)*		
Collection of secondary data for exposure-sensitivity	CRVA guidelines	10/16 – 1/17
Collection of secondary-primary data for adaptive capacity	CRVA guidelines, FGDs (3)	1-2/17
Preliminary data analysis	GIS-climate modeling Run species distribution model (EcoCrop/Maxent)	3/17
Cross-regional/national data analysis workshop	Workshop Open-source GIS tools(DIVA GIS), QGIS) or ArcGIS	4/17
3. Stakeholders' participation in climate adaptation planning*(Output: Local stakeholders' CRA-related demographic/institutional profiles & knowledge/perceptions/strategies)*		
Regional-level CRVA stakeholders' validation	Workshop	10/16
Community-level CRVA stakeholders' validation	FGDs/meetings (3)	9-10/16
Regional-level CRA stakeholders' validation	Workshop	9/16
Community-level CRA stakeholders validation	FGDs/meetings (3)	9-10/16
4. Documenting & analyzing CRA practices*(Output: data on CRA practices analyzed for costs-benefits & trade-offs)*		
Key informant survey on CRA practices	Survey checklist	9-10/16
Cost-benefit and trade-off analyses	Analytical tools (CBA tool)	11/16 – 1/17
National knowledge-sharing event on CRVA and CRA)	Workshop	2/17
Planning workshop for AMIA2+	Workshop	4/16
5. AMIA baseline study for monitoring & evaluation *(Output: M&E baseline data for CRA communities & livelihoods)*		
Survey on target communities & livelihoods	Survey questionnaire	12/16-1/17
Cross-regional/national data analysis workshop	Workshop	2/17

MONITORING AND EVALUATION FORM

Project Title:	Region 11 Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) Phase 2	Period covered:	June 2016-February 2017
Proponent:	LARRY V. ACERES, EMELIE G. PELICANO, ROGER C. MONTEPIO, APOLINAR TABANERA, NOEL GLORIA	Agency:	USeP- Region XI

Potential Impact:						
Narrative Summary	Objectively Verifiable Indicators	Actual Accomplishments	%	Influencing Factors and/or Problems Encountered	Action Taken	Significant Findings and/or Remarks
1. **To strengthen capacities for CRA methodologies of key research and development organizations in the region;**	Training on Capacity strengthening on CRVA, CRA prioritization And knowledge hub development	Conducted trainings on CRVA and Cost benefit Analysis for CRA pactices	100%	Key methodologies are not well understood by many researcher participants of the project	Constant communication to key personnel of CIAT and other program leaders in other regions for proper conduct of the study	Unified methodology
2. **To assess climate risks in the region's agri-**	a. Facilitate	Conducted several	100%	/Unavailability of CIAT	/Constant	/Identified and

fisheries sector through geospatial & climate modelling tools;	stakeholders meetings and workshops entitled participatory workshop mapping in Davao City and Davao del Sur b. Attended training on modelling tools	meetings and two workshops with almost 100 participants	100%	personnel during the writeshop due to commitment abroad /some participants were not present during the workshop because of conflict of schedule	communication with the key personnel through emails, phone calls, text messages /the team proceed to municipalities who have not participated to conduct the workshop directly to their site	mapped the dominant crops for every municipality under Davao City and Davao del Sur /created suitability map, hazard map and adaptive capacity index during the modelling tool training
3. To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risk;	c. Conducted meetings, FGDs, KIIs in the identified communities of the target respondents	Conducted several meeting and two workshops with almost 100 participants	100%	Unavailability of CIAT personnel during the writeshop due to commitment abroad	Constant communication with the key personnel through emails, phone calls, text messages	Limited knowledge on the climate risk adaptation among local farmers

4. To document and analyse local CRA To support AMIA2 knowledge-sharing and investing planning	/Conduct survey on local CRA practices /Document lists of CRA practices	Interviewed farmers on their existing CRA practices Listed number of CRA practices adopted by local farmers	100% 100%	Limited awareness of farmers' about CRAs technical aspect Identified CRA for CBA analysis does not coincide with the CRA practices of the farmers	Give sample of CRAs to the farmers Identify the most applicable CRA to be adapted by the farmer	Few farmers are already practicing CRAs without knowing it Farmers are using CRA as to their applicability in their respective farms

Management	Financial	Other
• The regional project team will comprise of members from the SUC and the DA-RFO XI. The core team expertise of SUC team members will cover: a) geo-spatial analysis, b) socio-economics, and c) agriculture/fisheries systems, as applicable. One of the team members shall act as project leader designated to serve in this overall coordination role. • In addition, 2 members from the DA-RFO will join the project team. The members' key role, besides general CRA/AMIA expertise, will be to facilitate institutional linkage and	• Approved Budget:: **PhP 1,000,000.00** • Budget Released: **PhP 1,000,000.00** • Liquidated: **PhP** • Remaining Balance: **PhP** • Financial management of the project followed on what was reflected in the budgetary requirements. No re-alignment was done as of the moment.	• Too slow government procurement activity.

coordination for successful implementation of project activities. **Team Position Name/Institution** • Project leader: LARRY V. ACERES/USeP • GIS specialist : ROGER C. MONTEPIO/ ENGR. APOLINAR TABANERA, USeP • Socio-economist: EMELIE G. PELICANO/USeP • Agriculture specialist:: LARRY V. ACERES/USeP • DA-RFO collaborating staff: JOVITA J. ASTILLA, JOEDEL R. LELIZA		

Submitted by: LARRY V. ACERES, USeP RXI

Project Leader