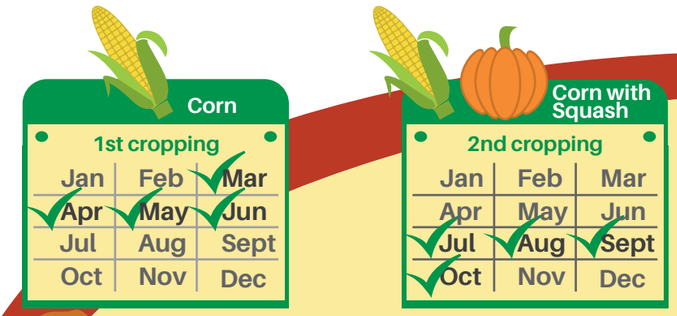
Context

The Caraga Region is located in the northeastern part of Mindanao, where the climate is Type 2 (no pronounced dry season), leaving the region prone to flooding. Climate risks are points of great concern in the region due to its economy being largely agriculture-based. In the province of Agusan del Norte, the climatic variability hampers rice and corn farming. This is especially evident in the municipality of Jabonga and other towns situated near Lake Mainit, the fourth largest lake in the country. Every November to February, the municipality experiences inundation when the water from the lake swells due to heavy rains. The inundation can reach up to 4-5 meters high affecting the low-lying barangays. As the water overflows, it washes away crops in farmlands, destroys poultry and swine production, and turns the area into a fishing ground for 3-4 months.

Corn-Squash+Corn Crop Rotation

The Corn-Squash+Corn Crop Rotation allows the farmers to produce corn for two straight seasons (March-June and July-October) and squash for one season as intercropped with corn. High yielding variety of yellow corn is planted in the 1st season followed by yellow corn intercropped with squash in the 2nd season. The squash produced in the second cropping is either sold in the market or stored as feeds for swine during the flooding season. Impacts of flooding are cushioned by shortened cropping periods and by the intercropping of corn and squash. This enables the farming household to establish a diverse income stream, earning from corn and squash production as well as swine production during the off-season.



Available Technical Briefs

LUZON

Cordillera Administrative Region (CAR)
- Water Harvesting Tank for Cabbage in Benguet
- Blight-Tolerant Potatoes in Benguet

Region I-Ilocos Region
- Mango Production in Ilocos
- Rice-Corn Crop Rotation in in Ilocos
- Rice-Tomato Rotation in Ilocos

Region II-Cagayan Valley
- Rice-Rice-Mungbean Crop Rotation/Diversification in Isabela
- Climate-Smart Rice in Isabela

Region III-Central Luzon
- Water Conservation Technology (AWD) in Tarlac
- Climate-Smart Rice in Tarlac
- Crop Rotation-Zero Tillage Combination in Tarlac

Region IVA-CALABARZON
- Coconut-based Integrated Farming System in Quezon
- Rainwater Harvesting in Vegetable Production in Quezon

Region IVB-MIMAROPA
- Rice-Onion Crop Rotation in Oriental Mindoro
- Stress-Tolerant Rice in Oriental Mindoro

Region V-Bicol Region
- Organic Corn Farming in Camarines Sur
- Climate-Smart Rice (Green Super Rice) in Camarines Sur

VISAYAS

Region VI-Western Visayas
- Sloping Agricultural Land Technology for Corn in Iloilo
- Small Water Impounding Project for High Value Crops in Iloilo

Negros Island Region (NIR)
- Use of Submerence-Tolerant Rice Variety in Negros Occidental
- Organic Red Rice Production in Negros Occidental

Region VII-Central Visayas
- Corn-Peanut Crop Rotation in Cebu
- Protected Vegetable Cultivation in Cebu

Region VIII-Eastern Visayas
- Alley Cropping Using Pineapple as Hedgerow in Upland Rice Production in Samar
- Protected Vegetable Cultivation in Samar

MINDANAO

Region IX-Zamboanga Peninsula
- Alternate Wet And Drying for Rice in Zamboanga Sibugay
- Coconut-Yellow Corn Intercropping in Zamboanga Sibugay

Region X-Northern Mindanao
- Biodynamics in Corn Production in Bukidnon
- Corn-Banana Crop Diversification in Bukidnon

Region XI-Davao Region
- Crop Rotation with Integrated Nutrient Management in Davao
- Cacao-Coconut Intercropping in Davao

Region XII-SOCCSKARGGEN
- Organic Rice Farming in North Cotabato
- Integrated Rice-Duck Farming System (IRDFS) in North Cotabato

Region XIII-Caraga
- Corn-Rice-Green Corn Crop Rotation in Agusan Del Norte
- Corn-Squash+Corn Crop Rotation in Agusan Del Norte

Autonomous Region of Muslim Mindanao (ARMM)
- Coconut-White Corn Intercropping in Lanao Del Sur
- Coconut-Banana Intercropping in Lanao Del Sur

References

Acosta-Michlik, L. and Espaldon, V., 2008. Assessing vulnerability of selected farming communities in the Philippines based on a behavioural model of agent's adaptation to global environmental change. Global Environmental Change, 18(4), pp.554-563.

DA-BAR AMIA Project Documents

Lin, B.B., 2011. Resilience in agriculture through crop diversification: adaptive management for environmental change. BioScience, 61(3), pp.183-193.

Tschakert, P. and Dietrich, K.A., 2010. Anticipatory learning for climate change adaptation and resilience. Ecology and society, 15(2), p.11.

About the Authors

This technical brief was produced through the CSU-CIAT-DA partnership under DA-BAR project titled "Climate-Resilient Agriculture (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) Phase 2 in Agusan del Norte Province (Caraga Region)".

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TECHNICAL BRIEF on Climate-Resilient Agriculture (CRA)

Caraga (Region XIII)

Corn-Squash+Corn Crop Rotation

Crop rotation is a time-tested strategy that ensures crop harvest even with climate change. It is a production system that promotes biodiversity conservation while protecting crops from pests and diseases as well as promoting nutrient cycling. It also provides an economic buffer during times of inundation of the area.

Productivity

Year-round productivity for continuous flow of income for farmers

Adaptation

Optimized cropping calendar

Better pest and disease management

Cost & Benefit

Initial Investment/ha
PhP 28,600

Payback Period
2 years

*On top of profit from conventional practice

Estimated Additional Annual Profit/ha*
PhP 12,368
USD 241

Yield & Prices

	Without CRA: Corn Production	With CRA: Corn-Corn+Squash Production
Plant	1st cropping; 2nd cropping	1st cropping; 2nd cropping
Average annual farm yield	3,742 kg/ha; 1,123 kg/ha*	3,742 kg/ha; 2,350 kg/ha + 4,591 kg/ha
Price per kg	PhP 15.14; PhP 12.4	PhP 15.14; PhP 12.4; PhP 3.00

*With losses due to flooding

5 Reasons to Invest

1. Diversification of income source to reduce risk of financial losses
2. Higher potential farm income
3. Optimized cropping calendar
4. Better pest and disease management
5. Nutrient cycling

Externalities

Social and Environmental NPV
PhP 106,848
USD 2,082

Social IRR
110%

Financial Analysis

Net Present Value	IRR
PhP 62,610 USD 1,220	70%

Sensitivity Analysis

The CRA practice will still be **more profitable** than non-CRA practice even when:

- Yield of Yellow Corn in 2nd cropping decreases by **20%**
- Yield of Squash in 2nd cropping decreases by **30%**

Aggregate Impact*

*within the Province of Agusan del Norte

Current Adoption Rate	Projected Adoption Rate
3%	30%

Total area planted to Corn	Aggregate NPV
232 hectares	PhP 3.9 million

Assumptions:

Period of Analysis	Discount Rate	Exchange Rate
10 years	10%	$1 = PhP 51.32

Recommendations

When & Where?
The CRA practice can be adopted year-round in corn-producing areas of Agusan del Norte that are susceptible to flooding that lasts for 2-4 months.

What?
Financial support is necessary to upscale this practice to farmers in flood-prone areas. Due to lack of capital, some farmers are unable to start planting on time to avoid the flood.

Who?
LGUs could strengthen information dissemination campaigns to inform farmers of the advantages of the Corn-Squash+Corn Crop Rotation practice.

The Local Government Unit (LGU) in partnership with government line agencies (e.g., DA and DTI) can enroll more farmers to existing and future programs that help secure markets for corn and squash produce of smallholder farmers.

Initial Investment Breakdown

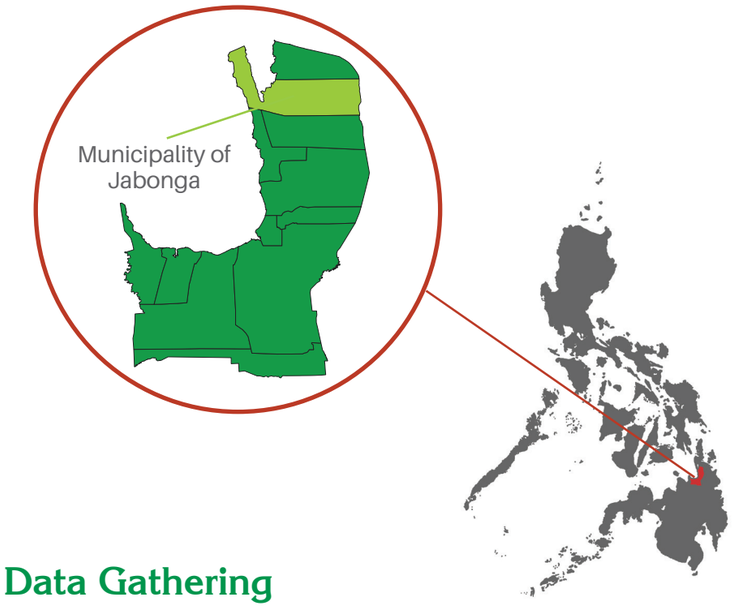
- Initial Investment: **PhP 28,600**
- Labor & Services: **PhP 6,600**
- Equipment: **PhP 10,400**
- Inputs: **PhP 11,600**

Cost of Adopting CRA

- Initial Investment — Installation costs (Year 1): **PhP 28,600**
- Maintenance — Annual costs (Years 2-10): **PhP 28,600**
- Operations — Irregular/ non-permanent costs: **PhP 11,500**

Study Site

Agusan del Norte



Data Gathering

1. Analysis of experiences of 30 farmers in three barangays in the municipality of Jabonga in Agusan del Norte province.
2. Conduct of Experts' Workshop with experts from the academe (Caraga State University) and the government (Department of Agriculture Region 13) pooling knowledge and insights on emerging climate resilient farm practices
3. Conduct of interviews with the Municipal Agricultural Officer (MAO) and Barangay Captains to validate results from Experts' Workshop
4. Review and synthesis of secondary information

The CIAT CBA Methodology

Cost-Benefit Analysis (CBA) is used to determine the relative profitability of alternative cropping practices, involving the comparison of the annual flows of incremental benefits with that of incremental costs. The CIAT CBA Online Tool analyzes the full benefits and costs of identified practices and adoption response at both individual farmer level and at aggregate level for a particular area.

Specifically, the tool can:

1. Quantify economic and some environmental trade-offs of adopting CRA practices.
2. Provide sensitivity analysis
3. Estimate the level of peak adoption

http://cbatool.ciat.cgiar.org/