Context

Benguet province, covering the municipality of Atok, is one of the major producers of highland vegetables in Luzon. However, the province is prone to a number of climate risks. Records from the PAGASA Agro-meteorological station in La Trinidad, Benguet have shown trends in increasing temperature, longer droughts, and irregular rainfall pattern. These drought events cause delays in planting as farmers have to wait for rain, otherwise crops will wither or die. Dry spells also increase the number of plant pest and diseases that lead to yellowing or blackening of cabbage leaves and stunted growth. Additionally, Atok is also vulnerable to other climate-related hazards such as frost (Calora et al. 2011).

Use of Water Harvesting Tank

In the 1950's, Small Water Impounding Projects or SWIPs were implemented primarily for soil and water conservation. These are structures constructed across a narrow depression or valley to hold back water and develop a reservoir that will store rainfall and run-off to provide supplemental irrigation during the rainy season (DA- BSWM, 2008). Some farmers improvise catchment basins for rainwater harvesting (locally called "kwelo") by digging large pits lined with large plastic sheets or tarpaulins. While others can afford to build concrete water tanks. Depending on the rainwater harvested, farmers are able to cultivate a limited area for vegetable production.

Rainwater harvesting innovations provide a ready source of water during dry seasons and drought to support cabbage production or to establish cabbage seedling production. Water spraying is equally important during frost occurrence to liquefy ice covering the leaves of the crops.

The on-site water harvesting tank described in this practice is a cemented tank structure, designed to collect rainwater during the rainy months that would enable farmers to have continuous cropping to help solve water shortage during dry months. The small water impounding projects remains one of the key options for climate change adaptation that aim to increase production and farm income.

Use of Water Harvesting Tank

✓ *can replace:*

Rainwater-dependence as source of irrigation water during droughts

✓ *uses:*

Cement water tank as a ready source of water during drought and frost

✓ *supports:*

Cabbage production and other vegetables

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

CALORA, JR., F.G. ET AL. 2011. Biophysical Characterization and Socio Economic Profiling in Benguet, Philippines (Vulnerability and Adaptation Capacity Assessment SYNTHESIS REPORT). Retrieved on 21 March 2018 from https://issuu.com/mdgf1656/docs/bsu_synthesis_report_final.

DAVID ,C. 2014. Frost attacks Benguet veggies, DA promised to help farmers. Retrieved on 21 March 2018 http://bayanihannews.com.au/2014/01/09/frost-attacksbenguet-veggies-da-promised-to-help-farmers/

FAGYAN.A.W. 2017. 8 villages in Benguet susceptible to climate change. Retrieved on 21 March 2018 from http://www.sunstar.com.ph/baguio/opinion/2017/06/07/8-villages-benguet-susceptible-climate-change-546212

FAST FACTS. Retrieved on 21 March 2018 from http://www.benguet.gov.ph/index.php/2-uncategorised?start=15.

MALAMUG, J.F., CARLOS, E.D., TIW-AN, C.C., AND GUDAYEN, D.S. 2017. Alternative Crop Shelter Designs for the Production of High-Value Crops (Lettuce, Broccoli, and Strawberry) in the Highlands. 7th Joint HAARRDEC-CIERDEC and 27th HAARRDEC Regional Symposium on RDE Highlights (RSRDEH) for Agriculture, Forestry and Natural Resources (AFNR), Industry and Social Sectors and 1st Regional Student Research Congress.

LAPNITEN K.S. 2015. Drought takes toll on Benguet farms. Retrieved on 21 March 2018 from https://www.rappler.com/nation/91025-drought-toll-benguet-farms

LAUREAN C.P, BATANI S.R, TAD-AWAN B.A., FAGYAN A.W., LAGMAN C.A., NAGPALA A.L., BASALONG A.A., BARTOLO D., LUIS L.L., AND LIMWAS J. 2017. Building Farmers' Resilience in Disaster Prone Vegetable Terrace in Atok and Buguias, Benguet, Philippines. Proceedings of BSU RDE In-house Review 2017.

PHILIPPINE DAILY INQUIRER. 2010. Benguet 2nd 'most vulnerable' province. Retrieved on 21 March 2018 from http://climatechange.searca.org/index.php/climatechange-latest-news/philippines/102-benguet-2nd-most-vulnerable-province

PHILIPPINE STATISTICS AUTHORITY. 2016. AGRICULTURE AND FISHERY STATISTICS. October 25, 2017. Retrieved on 21 March 21 2018 from http://rssocar.psa.gov.ph/agriculturereleases/2016%20Crop%20Production:%20Cabbage,%20Carrot%20and%20Potato.

About the Authors

This technical brief was produced through the UPLB-BSU-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 Benguet Province (Cordillera Administrative Region)".

UPLB-BSU team
Ms. Elizabeth Supangco, Project Leader
Dr. Janet Pablo, Agriculture Specialist
Ms. Charis Mae Tolentino-Neric, Socio-Economist
Mr. Ralphael Gonzales, Research Assistant

CIAT team
Ms. Paula Beatrice M. Macandog, Environmental & Natural Resource Economist
Dr. Sekou Amadou Traore, Agricultural Economist
Dr. Godefroy Grosjean, Climate Policy Expert
Mr. Rowell C. Dikitanan, Socio-Economist
Ms. Maureen Agatha L. Gregorio, Research Assistant
Ms. Pattricia Eliz M. Legaspi, Research Assistant

Acknowledgment

The authors would like to acknowledge the active participation of our farmer respondents, the local counterparts from the Local Government and the Department of Agriculture Regional Field Office - CAR and the financial support provided by the DA-Bureau of Agricultural Research (DA-BAR) and DA AMIA.

TECHNICAL BRIEF
on Climate-Resilient Agriculture (CRA)
Cordillera Administrative Region

Use of Water Harvesting Tank

Water harvesting tanks are adopted in Atok, Benguet to support rainfall-dependent cabbage production during drought events. Established on the farm, this system is used to harvest surplus rainfall (runoff) in the catchment area and in-situ rainfall, then stores water for subsequent use.

Productivity

Increase yield and income during longer drought and irregular rainfall periods

Adaptation

Capability to sustain cabbage production during drought

Cost & Benefit

Initial Investment / ha
PhP 133,000

Payback Period
1 year

**On top of profit from conventional practice*

Estimated Additional Annual Profit / ha*
PhP 52,860
USD 1,030

Yield & Prices

Plant

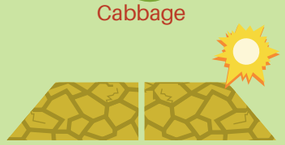
Without CRA

Limited water availability

Average annual farm yield

Price

Cabbage



11,287
kg/ha
PhP 16.00/kg

vs

With CRA

Water Harvesting Tank

1 structure costs PhP 288,000 and can support 20 hectares

Average annual farm yield

Price

16,421
kg/ha
PhP 14.86/kg

4 Reasons to Invest

1. Ready source of water during dry seasons and drought
2. Source of water to liquefy frost on vegetables
3. Opportunity to sustain cabbage production during drought
4. Higher potential yield and farm income

Financial Analysis

Net Present Value	IRR
PhP 315,310 USD 6,144	126%

Sensitivity Analysis

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

Yield of Cabbage decreases by **20%**

Externalities

Further research is needed to quantify the externalities.

Aggregate Impact*

*within the Province of Benguet

Current Adoption Rate	Projected Adoption Rate
15%	100%

Total Area Planted (ha)	Aggregate NPV
3,895 ha	PhP 708 million

Assumptions:

Period of Analysis	Discount Rate	Exchange Rate
10 years	8.5%	$1 = PhP 51.32

Recommendations

When & Where?

The use of water harvesting tank is recommended in vegetable-producing areas where limited water availability and/or occurrence of frost are constraints on productivity.

What?

The government through its line agencies and SUCs could expand its efforts in distributing small farm reservoirs or water tanks in drought- and frost-prone production areas.

Who?

Currently, the water harvesting tanks in the study areas were established through a CHED-funded BSU project.

Other line agencies with similar mandates such as the NIA, DA, LGUs, DENR, SUCs can collaborate to upscale efforts. Other funding agencies to be tapped can include DOST, DA, CHED.

Initial Investment Breakdown

Initial Investment
PhP 133,000

Labor & Services
PhP 76,500

Water Harvesting Tank
PhP 14,500
per hectare
PhP 288,000
per structure

Inputs
PhP 42,000

Cost of Adopting CRA

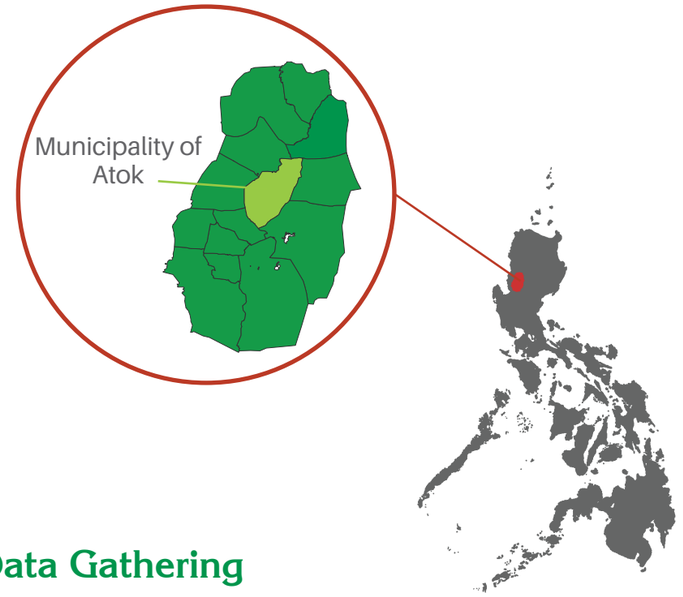
Initial Investment
Installation costs (Year 1)
PhP 133,000

Maintenance
(Years 2-10)
PhP 119,000

Operations
Irregular/ non-permanent costs
PhP 8,500

Study Site

Benguet Province



Data Gathering

1. Analysis of experiences of 37 farmers in five barangays in the municipality of Atok in Benguet province.
2. Conduct of Experts' Workshop with experts from the academe (University of the Philippines Los Baños and Benguet State University) and the government (Municipal Agriculture Officers and Department of Agriculture – Cordillera Administrative Region) pooling knowledge and insights on emerging climate resilient farm practices
3. 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/