**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 wilt or die. Dry spells also increase the number of plant pests 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 improve 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 replace irrigation water during droughts. Farmers in Atok (Calora et al., 2016) and the Philippines (Ross et al., 2018) have adapted this practice to sustain cabbage production in Atok, Benguet province, covering the municipality of Atok, Benguet, the main cabbage producer in the Philippines. In Iloilo, small water impounding projects have been implemented for high value crops (Calora et al., 2017).

**Available Technical Briefs**

**LUZON**
- Cordillera Administrative Region (CAR) - Water Harvesting Tank for Cabbage in Benguet (Baguio) (Gerald Patroza in Benguet)
- Region II-Camiguin Region - Mango Production in Iloilo (Rice-Corn Crop Rotation in Iloilo) (Rene Tupiamon in Iloilo)
- Region II-Cagayan Valley - Rice-Corn-Mungbean Crop Rotation/Interplantation in Isabela (Climate Smart Rice in Isabela)
- Region III-Central Luzon - Water Conservation Technology (AWDI) in Tarlac (Climate Smart Rice in Tarlac) - Crop Rotation Zero Tillage Combination in Tarlac

**VISayas**
- Region VI Western Visayas - Stopping Agricultural Land Technology for Corn in Bulacan (In situ rainfall, then stores water for subsequent use) - Use of Submergence Tolerant Rice Varieties in Negros Occidental (Organic Rice Production in Negros Occidental)
- Region VII Central Visayas - Rice-Onion Crop Rotation in Oriental Mindoro (Organic Rice Farming in North Cotabato)
- Region VIII Eastern Visayas - Corn-Banana Crop Rotation in Davao (Integrated mixed farming of rice and bananas in Davao)
- Region IX Mindanao - Alternate Drying and Steaming of Rice in Zamboanga (Alternative Drying and Steaming of Rice in Zamboanga)
- Region X Northern Mindanao - Red Rice Production in Negros Occidental (Organic Rice Production in Negros Occidental)
- Region XI Davao Region - Crop Rotation with Integrated Nutrient Management in Davao (Cereal-Coconut Interplanting in Davao)

**MINDANAO**
- Region XII Soccsksargen - Organic Rice Farming in North Cotabato - Integrated mixed farming of rice and bananas in Davao
- Region XIII Caraga - Corn-Rice-Green Corn Crop Rotation in Agusan Del Norte (Protected High Production in Samar)
- Autonomous Region of Muslim Mindanao (ARMM) - Crop Rotation with Integrated Nutrient Management in Samar (Protected High Production in Samar)
- Region X - North Cotabato (Integrated mixed farming of rice and bananas in Davao)
- Region VIII - Eastern Visayas - Rice-Onion Crop Rotation in Oriental Mindoro (Organic Rice Farming in North Cotabato)
- Region VII - Central Visayas - Corn-Banana Crop Rotation in Davao (Integrated mixed farming of rice and bananas in Davao)
- Region IX - Mindanao (Integrated mixed farming of rice and bananas in Davao)

**References**

- CALAGAS, J.J. 2017. Alternative Crop Shelter Designs for the Production of High-value Crops: Lettuce, Broccoli, and Strawberries in the Western Visayas. HAARRDEC Regional Symposium on R 26 Highlights on SCRI for Agriculture, Forestry and Natural Resources (AFNR), Industry and Social Sectors and 1st Regional Student Research Congress.

**About the Authors**

This technical brief was produced through the UPLB-BSU-CIAT partnership under DA-BAR project titled “Climate Resilient Agriculture (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiatives in Agriculture (AMIA) Phase 2 in Benguet Province (Cordillera Administrative Region)”.

**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 financial support provided by the DA Bureau of Agricultural Research (DA-BAR) and DA AMIA.

**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

**Use of Water**

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.
Cost of Adopting CRA

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.

Yield & Prices

- Planting Costs: PhP 288,000 per structure can support 20 hectares
- Average annual farm yield: 11,287 kg/ha
- Price: PhP 16.00/kg

- Planting Costs: PhP 288,000 per structure can support 20 hectares
- Average annual farm yield: 16,421 kg/ha
- Price: PhP 14.86/kg

Reasons to Invest

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

Externalities

Further research is needed to quantify the externalities.

Financial Analysis

Net Present Value: PhP 315,310 USD 6,144
IRR: 126%
Current Adoption Rate: 15%
Projected Adoption Rate: 100%
Total Area Planted (ha): 3,895 ha
Aggregate NPV: PhP 708 million

Sensitivity Analysis

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

1. Yield of Cabbage decreases by 20%
2. Limited water availability
3. Source of water to liquify frost on vegetables
4. Opportunity to sustain cabbage production during drought
5. Higher potential yield and farm income

Cost & Benefit

Initial Investment / ha
PhP 133,000

Payback Period
1 year

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

Recommendations

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.

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.

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.

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

The CIAT CBA Methodology

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

Study Site

Benguet Province

Municipality of Atok

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: PhP 133,000
- Installation costs (Year 1): PhP 133,000
- Maintenance: PhP 119,000
- Water Harvesting Tank: PhP 288,000 per structure
- Operations: PhP 8,500

Externalities

Further research is needed to quantify the externalities.

Period of Analysis: 10 years
Discount Rate: 8.5%
Exchange Rate: PhP 51.32

Aggregate Impact*

*within the Province of Benguet

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

Assumptions:

- Period of Analysis: 10 years
- Discount Rate: 8.5%
- Exchange Rate: PhP 51.32

Further research is needed to quantify the externalities.