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CROP DIVERSIFICATION MITIGATES CLIMATE-CHANGE IMPACTS

KEY POINTS

- Aside from income benefits, crop diversification (CD) enhances soil health by increasing organic matter and improving soil structure, which helps sequester carbon and mitigate climate change impacts on farming.
- Only a limited number of farmers engage in crop diversification due to various issues, including land suitability, irrigation and drainage structures, inadequate postharvest facilities, and a lack of marketing information to address crop perishability, as well as certain sociodemographic factors.
- Since majority of rice areas have flooded conditions, CD can be mainstreamed initially in selected farms.
- Adoption can expand in irrigated areas with good drainage facilities and more efficient irrigation scheduling by the National Irrigation Administration.
- Technologies that can help farmers crop-diversify even with unfavorable field conditions (e.g., flood-prone and water-scarce lands) can be promoted.
- Crop perishability adds to farmers' reluctance to plant non-rice crops. Hence, adequate postharvest facilities, including infrastructure for processing and storage, must be provided. Wholesale market centers should also be established near production areas, connecting farmers with consolidators and processors for easier harvest disposal.
- Rice farmers need to be educated on growing and marketing non-rice crops. CD requires complex landscape management for different crops.
- CD schemes should include appropriate and updated spatio-temporal information and advisories on crop seasonality, market demand, and product transportation challenges to optimize production and profit.

INTRODUCTION

Climate change refers to the gradual rise in global temperatures and adjustments in weather patterns. This is primarily caused by greenhouse gases (GHG) released into the atmosphere either by natural forces, such as volcanic eruptions, or human activities, such as fossil fuels burning. GHG are said to envelop the earth's surface preventing the sun's heat from escaping, thus leading to global warming (United Nations, n.d.). This means more warmer days, extreme droughts, water scarcity, rise in sea water levels, heavier rainfall causing floods, more frequent devastating storms, among other climate hazards.

These changes have negatively impacted the Philippine rice sector, spawning El Niño and La Niña that caused significant production losses (Rosegrant et al., 2016; Climate Change Commission, n.d.).

In 2023-2024, El Niño battered the Philippines anew prompting the Department of Agriculture (DA) to reactivate and reconstitute the inter-agency El Niño Task Force, which is mandated to improve the Strategic El Niño National Action Plan. The Task Force identified Crop Diversification (CD) as one of the strategies to alleviate the climate-change impacts on farming.

This policy brief wishes to guide policymakers in coming up with interventions that could create a favorable environment that accelerates the adoption of CD.

What is crop diversification (CD)?

It involves planting additional crops either sequentially (crop rotation) or concurrently (intercropping) with a main crop such as rice. Studies show that CD improves soil health and fertility, reduces pests and diseases, and maximizes land resource use that can consequently increase yield and income (Sekhar et al., 2024).

What are the benefits of CD?

Many studies (DA-PhilRice, 2021; Food and Agriculture Organization [FAO], 2018; Makate et al., 2016) have characterized CD as an agronomically stable and resilient farm practice. Planting other crops alongside rice can distribute production and market across multiple crops, cushioning the adverse effects of climate change on yields. CD strengthens local food systems, reduces reliance on imported food, and enhances community resilience.

A PhilRice-developed production system called Palayamanan that incorporates the principles of diversification, intensification, and integration has shown that farmers can earn more income and ensure food security sustainably (Corales et al., 2019).

CD can also promote a circular economy that helps adapt to climate change. One of the aspects of a circular economy is waste reduction through recycling, reusing, and returning materials or resources back into the system (United Nations, 2023). An example of this is rice-based mushroom production, wherein rice straw is used as a growing substrate. CD can also enhance soil health by boosting organic matter and improving soil structure, which reduces erosion and maintains fertility (Upadhaya et al., 2022).

How many farmers practice CD?

Despite its benefits, very few farmers engage in CD (Table 1). The latest PhilRice's Rice-Based Farm Household Survey (RBFHS) data covering 59 major rice-producing provinces assert that less than 10% of the respondents diversified their production in both seasons. Most of their diversified parcels were dependent on rain and small-scale irrigation systems, with an average size of 1.27 hectares. Farmers diversified more during the wet season (WS), possibly because they want to take advantage of the available rainfall.

In WS 2021, over 15% of farmer-respondents practiced CD in eight provinces: Ilocos Sur, Ilocos Norte, Tarlac, Pampanga, Zambales, Cavite, and Occidental Mindoro, and Iloilo. In 2022 dry season (DS), only Tarlac and Zambales had more than 15% of crop diversifiers.

Table 1. Percent distribution of farmers by cropping system in 59 major rice-producing provinces, WS 2021 and DS 2022

Cropping System	2021 WS		2022 DS	
	No.	%	No.	x%
Monocropping	3,899	93.64	4,059	97.43
Diversified Cropping	268	6.44	109	2.62
Relayed Cropping	263	6.32	92	2.21
Mixed Cropping	5	0.12	15	0.36
Both	0	0.00	2	0.05

Why is CD unpopular among rice farmers?

Logistic regression analysis using the 2021-2022 RBFHS data pointed out that farmer-respondents would diversify depending on market-related factors, their lands' physical characteristics and irrigation facilities, planting season, and sociodemographic matters.

Market-related factors. Farms which are farther from the market or have unpaved farm-to-market roads are less inclined to diversify as transportation distance negatively affects the quality of perishable commodities (e.g., vegetables) during transportation. It is best to transport vegetables and fruits in the shortest time possible to control postharvest losses.

Farm's physical characteristics. Rice farms with soils that do not easily dry up (e.g., clayey soils) and those with access to large-scale irrigation systems have less inclination to diversify. Rice and non-rice crops require contrasting water management strategies; rice grows best with continuous irrigation whereas non-rice crops require a controlled rate of irrigation (World Bank, 2005). Our National Irrigation Systems (NIS), however, are designed for rice cultivation (World Bank, 2020); they lack good drainage facilities for non-rice crop growing. Shifting from monocropping to CD requires a major change in water management strategies and the construction of drainage facilities.

Planting season. Farmers diversify more during WS possibly to maximize the use of available rainfall. Most diversified parcels were rainfed and dependent on small-scale irrigation systems.

Sociodemographic factors. Farmers with lower educational attainment would be less receptive to a complex production system like CD. Land owners tend to practice less of CD; tenants or lessees would practice CD because it means extra income to pay off huge expenses on land rent, which occupies 12-13% of total rice production cost (PSA, 2022). Likewise, farmers cultivating only a few rice-based farm parcels are less likely to crop-diversify.

Innovations that can encourage diversified farming

As discussed above, one of the many considerations of farmers in adopting CD is the suitability of their lands. The following technologies can overcome unfavorable field conditions that constrain farmers from crop-diversifying.

Low-cost drip irrigation. Vegetables require sufficient water to grow and produce good harvest. This is a water-saving technology that can be used in water-scarce areas, and is recommended for both rice and vegetables. It allows water to gradually drop directly to plant roots, thereby reducing water loss due to "seepage, evaporation, and percolation" (Samoy-Pascual et al., 2022).

Sorjan cropping system. This is a technology originally developed by Indonesian farmers, which may be adopted in flood-prone areas. Under this system, canals or sinks are established in between raised beds. The sinks can be used to store rainwater and later be used to irrigate cash crops planted in the raised beds. Rice, gabi, kangkong, and fish can be grown in the sinks (DA-PhilRice, 2016).

Floating vegetable garden. This is a strategy in flooded areas that uses floating "beds" where vegetables can be grown (DA-PhilRice, 2019).

Vertical farming. Crops are grown in vertically stacked layers or on inclined surfaces instead of traditional flat land. This allows planting more crops in a limited land area (DA-PhilRice, 2020).

Protected cultivation. Using greenhouses, polytunnels, and shade nets to protect crops from adverse weather conditions, pests, and diseases, these structures extend the growing season, enable year-round production, and enhance crop quality by providing a controlled environment for optimal growth (Khan et al., 2023).

Soil improvement practices. Cover cropping, composting, and other soil amendments improve soil health. Biochar and organic matter are used to enhance water retention and nutrient availability.

CALL FOR ACTION

- **Prioritize CD-ready communities.** Given that majority of rice fields have flooded conditions, only selected areas, as of now, can be suitably grown with non-rice crops. With limited government resources, it is best to properly target farming communities where CD can be initially mainstreamed. Intensified promotion and provision of support (machines, postharvest facilities, and processing and marketing infrastructures) should initially target these communities.

- **Prepare areas for expansion.** CD can be adopted even in areas with abundant water supply if the National Irrigation Administration constructs proper drainage facilities.

- **Technologies that can help transform farm areas with unfavorable conditions (e.g., water-scarcity, flood-prone areas, limited land, or poor soil health) into diversified systems should be strongly promoted.** These, however, have to be augmented with financial support because their adoption entails cost.

- **Coordinated production and marketing activities to manage surpluses.** Crop zoning or clustering is recommended in target areas considering harvest transport and market price dynamics. This means that production of one crop is concentrated in one cluster, and another crop in a separate cluster to potentially avoid oversupply of a single crop and falling farmgate prices.

- **Product consolidation may be facilitated through farmer clusters that can be linked to institutional buyers and exporters for bulk procurement.** Assistance may be sought from the DA-Agribusiness and Marketing Assistance Service and Department of Trade and Industry.

- **Address the perishability of farmers' produce.** Assist farmers in accessing postharvest and transport facilities, and construct better farm-to-market roads that can help reduce postharvest losses. Links to food processors and establishment of a wholesale market center near the production sites can be explored to facilitate disposal of produce. Farmers can also be trained to process their own surplus to add value to their produce.

- **Educate rice farmers on producing and marketing non-rice crops.** They need education on the best production practices for non-rice crops, not to mention easy and sufficient credit. This can help them produce and earn more, thus, sustain production. Market information such as price movements can also help especially in deciding where and when to sell their produce.

- **Establish an information system.** This has to contain updated spatio-temporal information and advisories on prices, market demand, crop seasonality, and other concerns, that can help optimize production and profit.

- **Continue supporting research for development on non-rice crops.** Availability of appropriate technologies that can efficiently produce and market these crops can encourage farmers to crop-diversify.

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ABOUT THE MATERIAL

Rice Science for Decision-Makers is published by the Department of Agriculture-Philippine Rice Research Institute (DA-PhilRice). It synthesizes findings in rice science to help craft decisions relating to rice production and technology adoption and adaptation. It also provides recommendations that may offer policy triggers to relevant rice stakeholders in search of opportunities to share their knowledge on rice-related products.

The articles featured here aim to improve the competitiveness of the Filipino rice farmers and the Philippine rice industry through policy research and advocacy.

This issue of RS4DM presents recommendations that could maximize the potential of crop diversification as an income source to farmers and as a strategy to alleviate climate-change impacts on farming.

For comments and requests for additional copies, please write to:
Socioeconomics Division
DA-Philippine Rice Research Institute
Maligaya, Science City of Muñoz, Nueva Ecija
Contact: prri.mail@philrice.gov.ph
PhilRice Text Center: 0917-111-7423

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Technical Team: Aileen C. Litonjua, Myrna D. Malabayabas, Kristine S. Pascual, Jovino L. de Dios, Rizal G. Corales, Nojie L. Nojor, Alice B. Mataia, Jesusa C. Beltran, Jaime A. Manalo IV, Rowena G. Manalili, Marco Antonio M. Baltazar
Editorial and Advisory: Eduardo Jimmy P. Quilang, Hazel V. Antonio
Design and Layout: Mark Joseph R. Zuñiga

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Philippine Rice Research Institute
Central Experiment Station
Maligaya, Science City of Muñoz, 3119 Nueva Ecija