Rice Science FOR DECISION-MAKERS
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WHAT DRIVES RICE PRODUCTION GROWTH IN PH?

KEY POINTS

- Rice production growth (RPG) in the Philippines has slowed since 2014, with the primary driver of growth shifting from area expansion to yield improvements. Moving forward, this necessitates a greater focus on productivity enhancements.
- Research and Development (R&D) is a significant driver of RPG, with additional contributions from farmer attributes, infrastructure, extension services, and environmental factors. Efforts to optimize these areas are vital for future growth.
- Policy priorities include boosting R&D investments, enhancing farmers' access to technology and extension services, improving infrastructure such as irrigation and farm-to-market roads, and establishing a centralized database to streamline data sharing and support evidence-based policymaking.

INTRODUCTION

Producing enough rice to feed the growing Filipino population remains a daunting challenge. Population increased rapidly from 92 million in 2010 to 109 million in 2022, confounded by rising per capita net rice disposable consumption, from 114 kg/year to 136 kg/year during the same decade. Although milled rice production grew substantially, from 10.3 million metric tons (Mt) to 12.9 million Mt, it was not enough to cater to the increasing demand. Moreover, increasing production has been slowed down by several challenges, such as climate change, biotic factors, biodiversity loss, small farm sizes, aging farmers, slow diffusion and adoption of technologies, slow progress in farm modernization, and weak value chain development. Nonetheless, being our staple food, the struggle to seek alternative strategies to augment rice production continues to be our top priority.

RPG can result from increases in either area harvested or yield. Adoption of technology, better crop management practices, and optimal input utilization are instrumental in yield growth. On the other hand, with the competing land uses, area harvested can only be expanded by constructing more irrigation facilities and intensifying planting frequency. Table 1 shows that rice production has continuously increased since 2004, but decelerated during 2014-2023. In 2004-2013, area harvested drove RPG, contributing nearly 62%. Growth in 2014-2023 was fueled by higher yields, contributing 62.5% (Table 2). The periods' growth rate of rice yield was 1.06% during 2004-2013, but fell to 0.41% in 2014-2023. That of harvested rice area declined from 1.5% during 2004-2013 to 0.16% in 2014-2023 (Table 1). The slowdown in growth of rice area harvested signals that future rice production will come mainly from higher productivity.

Table 1. Period growth rates (percentage) of rice production, harvested area, and yield.

	Rice production		Area harvested		Yield	
	2004-2013	2014-2023	2004-2013	2014-2023	2004-2013	2014-2023
Philippines	2.72	0.58	1.50	0.16	1.06	0.41
Cordillera	2.93	-2.68	1.97	-1.88	0.80	-0.98
Ilocos Region	3.28	1.08	1.21	-0.04	1.85	1.12
Cagayan Valley	2.81	2.03	1.98	0.69	0.69	1.25
Central Luzon	3.82	-0.34	2.56	-0.34	1.00	0.00
CALABARZON	0.24	0.69	-0.45	-0.71	0.73	1.50
MIMAROPA	2.93	1.19	1.66	1.04	1.09	0.13
Bicol Region	3.18	0.35	1.42	0.44	1.54	-0.08
Western Visayas	0.80	1.03	0.23	0.77	0.56	0.24
Central Visayas	5.19	-1.35	1.87	-0.63	2.79	-0.77
Eastern Visayas	3.71	-1.41	2.30	-1.47	1.14	0.08
Zamboanga Peninsula	1.69	0.72	0.34	0.46	1.30	0.25
Northern Mindanao	4.49	1.55	2.19	0.78	1.89	0.71
Davao Region	-1.22	1.12	-0.68	0.68	-0.58	0.41
SOCCSKSARGEN	2.28	-0.79	0.78	-0.24	1.40	-0.57
Caraga Region	6.60	-0.54	5.31	-0.64	0.85	0.11
BARMM	2.47	6.07	2.18	1.87	0.24	3.54

Note: Raw data on rice production and area harvested were collected from PSA, and were used to calculate yield data. Period growth rate was calculated from the following formula: PGR = (X2 - X1) /X1*100/ N, where X1 is the value of the variable in rate in period 1, X2 is the value of the variable in period 10, and N is the number of years in a period, which is 10 years.

Table 2. Contribution (percentage) of area and yield to rice production growth.

	2004-2013		2014-2023	
	Area	Yield	Area	Yield
Philippines	61.71	38.29	37.50	62.50
Cordillera	59.58	40.42	60.07	39.93
Ilocos Region	44.53	55.47	0.00	100.00
Cagayan Valley	77.15	22.85	40.15	59.85
Central Luzon	75.93	24.07	57.85	42.15
CALABARZON	0.00	100.00	0.00	100.00
MIMAROPA	70.19	29.81	92.47	7.53
Bicol Region	53.48	46.52	100.00	0.00
Western Visayas	19.40	80.60	72.15	27.85
Central Visayas	48.13	51.87	33.86	66.14
Eastern Visayas	69.59	30.41	96.46	3.54
Zamboanga Peninsula	24.78	75.22	72.59	27.41
Northern Mindanao	56.98	43.02	52.91	47.09
Davao Region	48.11	51.89	67.40	32.60
SOCCSKSARGEN	34.66	65.34	20.84	79.16
Caraga Region	83.58	16.42	100.00	0.00
BARMM	82.33	17.67	42.79	57.21

Notes: The contribution of area and yield to rice production growth was computed as follows: (1) the differences in rice area and yield are computed for the period 2004-2013 and 2014-2023; (2) production change due to area (yield) is computed by multiplying the change in area harvested (change in yield) by the new yield (old areas harvested); (3) he contributions of area and yield are calculated by dividing the production change due to area and yield by the total difference in production in the period under review.
Source of raw data: Philippine Statistics Authority

The cumulative percentage increase (CPI) in national RPG was higher in 2004-2013, with 27% increase relative to 2014-2023, which had a 6% increase (Figure 1). A similar pattern is also noticeable across regions, except in BARMM. For 2010-2023, the rise in production growth was more pronounced in Cagayan Valley and BARMM, where the CPI was 20% or higher. National rice production growth was driven by yield instead of area (Table 2).

To further understand the growth in production, there is a need for a more granular dissection of its sources. While this has been previously studied, results are not reflective of current circumstances, highlighting the need for updating. The following are the objectives of the study:

1. Examine RPG based on farm household survey data;
2. Determine and pinpoint the contributions of possible sources of RPG based on farm household survey and the Delphi method; and
3. Recommend actionable policies from the results that can help in designing effective programs for increasing rice production.

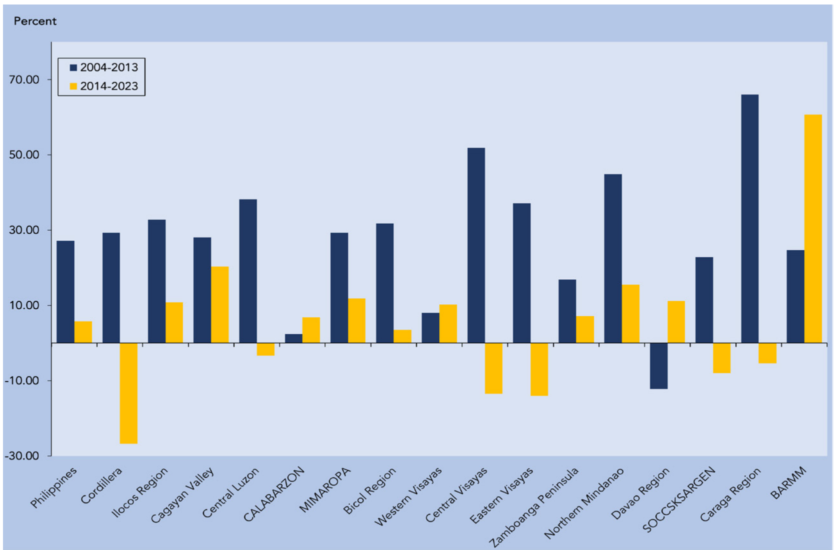

Figure 1. Cumulative percentage increase in production growth.

Derived from Philippine Statistics Authority

FACTORS AFFECTING PRODUCTION

A Pooled Ordinary Least Squares (POLS) regression was used to determine the factors that shape production, grouped into: 1) Research and Development; 2) Farmer attributes; 3) Infrastructure; 4) Extension; and 5) Environment and other factors (Figure 2a).

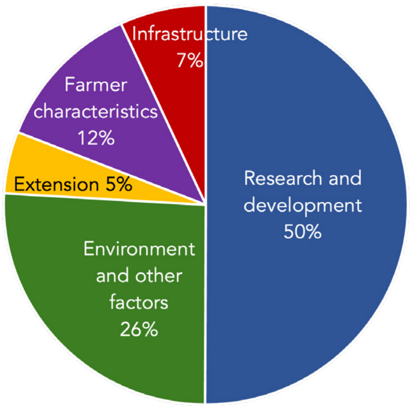

Figure 2a. Results of the regression model on rice production.

Research and development (R&D). Regression results show that R&D contributed the largest share to rice production growth (RPG), estimated at 50%. Breaking it down, seeds, integrated crop management (ICM), and mechanization contributed 19%, 24%, and 7%, respectively. Seeds comprise fourth-generation modern varieties, and the use of inbred certified and hybrid seeds—the main products of previous investments in breeding R&D. Under ICM are the use of appropriate amounts of fertilizer and herbicide, the adoption of recommended seeding rates, and the timely application of appropriate fertilizer grades. Mechanization covers power costs from machine rentals, as well as fuel and oil expenses.

Farmer attributes. About 12% of RPG can be attributed to farmer characteristics, such as machine ownership (6.3%), education (4.4%), and the share of rice income in total household income (1.3%). Ownership ensures the timely use of machines in carrying out farm activities. This is in congruence with the findings that mechanization is one of the contributors to production growth under R&D. On the other hand, education enables farmers to acquire effective skills relevant to better crop management. Meanwhile, a higher share of rice income, indicative of their main source of livelihood, warrants farmers to focus more on rice farming activities to ensure better income.

Infrastructure. As approximated by irrigation, infrastructure contributes 7% to RPG. Previous studies have highlighted the twofold importance of irrigation in increasing production. First, it allows the expansion of area planted through higher cropping intensity. Second, it is crucial as rice is a water-intensive crop, and the application of fertilizer and other inputs requires water.

Extension. Farmer attendance in government-implemented rice production training programs and access to information from private sources account for 5% of RPG. Training sharpens farmers' knowledge, attitudes, skills, and practices resulting in the adoption of technologies and improved crop management. Not only that, but the presence of private entities as sources of information complements government efforts in promoting rice technologies and changing farmers' practices.

Environment and other factors. These account for the remaining 26%, accentuating the limitations of the regression model. This implies that other variables not included in the model may also significantly contribute to RPG, necessitating further investigation. Hence, vetting based on experts' opinion and experiential knowledge facilitates consensus-building to explore other key factors not supported by available data. The regression results served as the basis for industry experts in recalibratingthe contributions of various factors to RPG.

RESULTS OF VETTING ON SOURCES OF RICE PRODUCTION GROWTH

The process of consensus-building from a policy workshop refined and reinforced the contributions of the aforementioned factors. Experts' opinion gravitated toward the following: 1) Research and Development (27%); 2) Infrastructure (26%); 3) Farmer attributes (17%); 4) Extension (15%); and 5) Environment and other factors (15%) (Figure 2b).

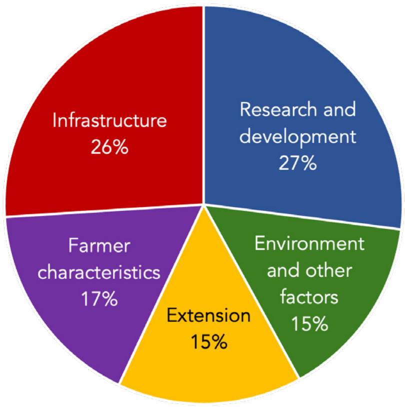

Figure 2b. Results of the vetting process on factors affecting rice production.

While R&D is still the major contributor, the consulted experts assigned smaller shares of contribution to seeds (8%), fertilizers (7%), integrated crop management (9%), and mechanization (6%) in driving RPG.

They estimated a greater contribution of infrastructure to account for farm-to-market roads (5%), postharvest facilities (7%), and transportation and logistics facilities (4%), in addition to irrigation's contribution of 10%. The consensus also assigned higher shares to both extension and farmer attributes as drivers of RPG. This includes a call to strengthen the connection between providers and receivers of rice-related information. Without this links, the adoption of technologies and the application of sound management practices will be severely impaired.

The vetting process also lowered the estimated contribution of environmental and other unaccounted factors, such as impacts of weather, insect pests and diseases, as well as the effects of policy, market, and other risks.

CALL FOR ACTION

The results of the regression and vetting processes highlight the importance of R&D, infrastructure, farmer attributes, extension, and environmental and other factors as distinct and critical drivers of RPG. The following actions are therefore recommended:

- **Augment R&D investments.** Most of the technologies we apply today are products of previous R&D investments. Hence, new investments should be increased to ensure the availability of future sources of RPG. At least 1% of the rice Gross Value Added (GVA) should be allocated to R&D programs.

  Additionally, R&D priorities must be recalibrated to respond to the evolving production landscape, which is increasingly impacted by climate change. These priorities should also recognize and optimize new opportunities, including those offered by digital transformation.

- **Widen and intensify farmers' access to technology.** There is a need to accelerate farmers' adoption of seeds, machineries, and other yield-stimulating technologies like fertilizer. This requires sustained support from the DA-National Rice Program and Rice Competitiveness Enhancement Fund (RCEF). However, farmers' access to these services depends on further refining and updating the Registry System for Basic Sectors in Agriculture (RSBSA) to make it more dynamic and inclusive. As a foundation, the Department of Agriculture should lead strong convergence among implementing agencies to esnure synergy and avoid duplication of efforts.

  Beyond provision of seeds, machines, and fertilizers, support programs must also include critical services such as soil analysis. Establishing mobile soil laboratories, complemented by diagnostic tools like Minus-One Element Technique (MOET), Nutrient Omission Plot Technique (NOPT), and soil test kits (STK) is crucial. Recommendations from soil analysis can then be integrated into existing decision support tools and digital applications, such as Rice Crop Manager (RCM), Leaf Color Chart (LCC), and MOET app. These recommendations should be rapidly implemented and supported through balanced fertilization campaigns (e.g., Abonong Swak). Additionally, real-time insect-pests and disease management advisories should be provided.

- **Strengthen infrastructure development.** Public-Private Partnerships (PPP) should be maximized in the development of new irrigation facilities, while government finances should be focused on operations, maintenance, and rehabilitation of existing structures. A national farm-to-market roads network plan must be crafted to serve as basis for annual investments. This should guarantee interconnectivity and the achievement of targets within a required timeframe.

- **Ramp up need-based extension support and services.** There is a need to evaluate various extension modalities to validate their effectiveness and suitability to farmers' conditions. This information should guide the selection of appropriate modalities, the crafting of local extension plans and interventions, and strengthening the corresponding human resource complement by enhancing their specializations and skills in using digital tools.

  Need-based and partnership-driven extension support and services should be designed to consider farmer attributes, using this information to maximize impact and optimize resource use. In short, farmers should be treated as active partners in crafting innovations and not just as passive recipients of information and technologies. To enable this, a seamless feedback mechanism should be instituted to ensure dynamic interaction among key stakeholders.

  As for the entire agricultural extension system, there is a need to revisit and realign its organizational structure. The roles of national and local government units should be clearly delineated to avoid overlapping functions, address fragmentation, and ensure more relevant and coordinated extension support and services.

- **Establish centralized database and real-time data analytics.** Rice stakeholders have limited access to information necessary to identify sources of and craft policies to speed up rice production growth. This challenge is further compounded even obscured by unstandardized, scattered, and non-interoperable data formats across various sources. Conflicting data governance approaches further hamper smooth data access and sharing. All these issues impair efficient, data-driven decision-making.

  To unify disjointed efforts, the Department of Agriculture could establish a centralized database, standardize rice data definitions, harmonize data collection methods, and leverage digital tools and big data analytics. These efforts should sit well with and complement the initiatives of the Philippine Statistics Authority (PSA). Consequently, this would enable seamless data-sharing among stakeholders, faster and more accurate analysis, and optimized use of data to improve current measurements and monitoring of rice production growth, unlocking well-informed decision-making.

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 explores the key factors behind rice production growth in the Philippines, emphasizing the importance of yield improvements, research and development, infrastructure, and farmer support while recommending actions to enhance productivity and data-driven decision-making.

BAGONG PILIPINAS

DEPARTMENT OF AGRICULTURE 1898

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

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: philrice@philrice.gov.ph
PhilRice Text Center: 0917-111-7423

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Technical Team:
PhilRice: **Jesusa C. Beltran, PhD; Rhemilyn Z. Relado-Sevilla; Rowena G. Manalili, Nefriend M. Francisco; Lea E. Licong; and Flordeliza H. Bordey, PhD**
International Rice Research Institute: **Harold Glenn A. Valera, PhD; Piedad F. Moya; Maureen M. Gimutao; Ronald Jeremy S. Antonio; Ma. Shiela D. Valencia; and David C. Dawe, PhD**
Advisers: **Eduardo Jimmy P. Quilang, PhD; Hazel V. Antonio, PhD; and Karen Eloisa T. Barroga, PhD**
Design and Layout: **Mark Joseph R. Zuñiga**

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