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ENABLING THE SHIFT FROM TRANSPLANTED TO DIRECT-SEEDED RICE SYSTEMS IN THE PHILIPPINES

INTRODUCTION

Manual transplanting is the dominant rice crop establishment method in the Philippines. This partially causes the high labor cost that drives up rice production cost in the country, along with the inflating fertilizer and fuel prices. Consequently, it has become more challenging to make farmers competitive with the cheap imported rice from neighboring countries. This policy brief explores the viability of transitioning from transplanted rice (TPR) to direct-seeded rice (DSR) to support government efforts to make rice production competitive and sustainable.

KEY POINTS

- Studies show the potential of DSR to reduce hired labor cost, boost farm income, facilitate crop intensification, and help farmers adapt to climate change.
- Despite the advantages of DSR, only 31 to 43% of rice farmers in the Philippines adopt it. The level of adoption varies across provinces and seasons.
- Risks in crop establishment, greater weed, insect and disease incidence, availability of suitable cultivars, higher seed use, and water availability are among the issues that must be addressed to maximize the yield of and effectively scale DSR.
- DSR is a more resource-efficient and sustainable alternative to TPR, but gaps remain that may be addressed through training programs, Research for Development (R4D), and appropriate technologies.

DSR AS A CROP ESTABLISHMENT SYSTEM

DSR is the sowing of dry or pregerminated seeds into the dry or puddled soils (Pandey & Velasco, 2002) unlike TPR that involves the growing and transplanting of seedlings from the nursery to the puddled field. Among the advantages of DSR as a crop establishment system are the following:

Reduces cost on hired labor. Filipino farmers can save PhP1.14/kg on hired labor cost through DSR (Bordey et al., 2016). This is because DSR requires 1-2 man-days (md) per ha only relative to TPR that requires 20-25 md/ha (Mataia et al., 2016). With this, DSR can reduce total labor requirements per ha by up to 50% based on the production system (Pandey & Velasco, 2002). As such, DSR enables farmers to effectively deal with labor scarcity and to the rising wage rates in rural areas.

Boosts farm income. The labor savings from DSR particularly on crop establishment appears to be more than enough to cover the additional costs on seeds and agro-chemical inputs. Partial budget analysis show that rice farmers especially in favorable rainfed areas may gain as much as PhP3,500/ha additional net income by shifting to DSR (Table 1).

Facilitates crop intensification. DSR enables farmers in areas with reliable water supply to plant thrice yearly as the rice crop matures faster. DSR eliminates plant stress from uprooting and transplanting that allows for a shorter growth duration of rice by 5-7 days relative to TPR (Beltran et al., 2015; Moya et al., 2004). The higher cropping intensity may increase rice production in the country such seen in the case of Vietnam (Beltran et al., 2015).

Helps farmers adapt to climate change. DSR reduces the amount of water for crop establishment and irrigation by 12 to 35% under efficient water management practices (IRRI, 2019). It enables farmers to plant even with minimal soil moisture during early drought instead of waiting for sufficient rainfall for puddling and transplanting. This is important as drought is expected to occur more frequently and for longer periods in Southeast Asia given rising global temperatures (ADB, 2009), which makes TPR unsustainable in the long-term. Methane emission is also lower in DSR with the aerobic conditions during the early growth stages in dry DSR and until seedling establishment in wet DSR (Kaur & Singh, 2017).

ADOPTION CONSTRAINTS

In 2016-2017, only 31 to 43% of rice farmers adopted DSR across ecosystems and seasons (Figure 1). Most of the adopters were from Iloilo, Antique, Capiz, Palawan, Aurora, and Sultan Kudarat (Figure 2). DSR is practiced more in the dry season (DS) than in the wet season (WS) implying that some farmers alternate DSR with TPR in the DS.

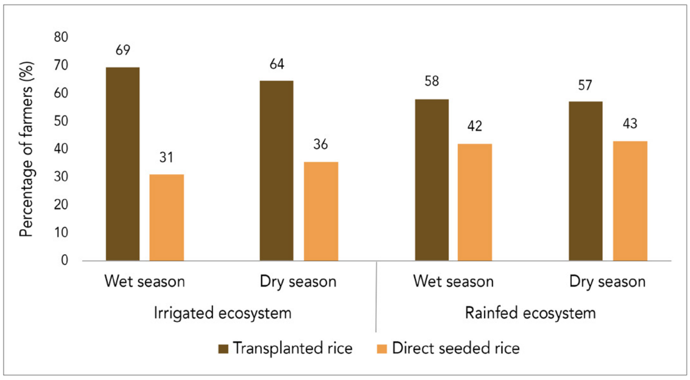
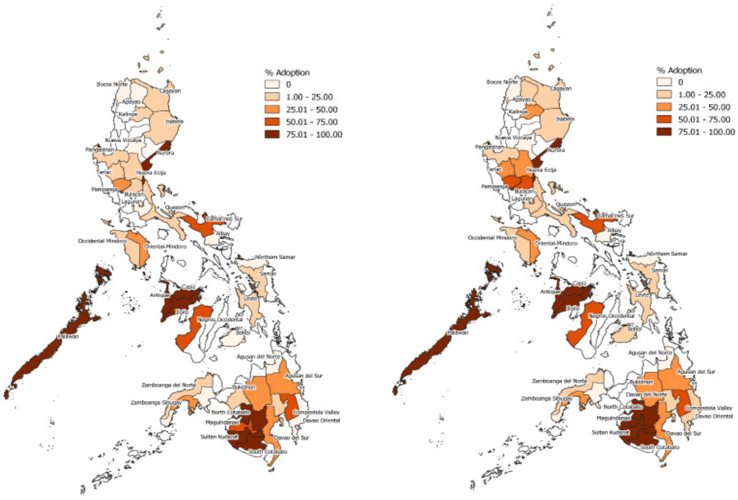


Figure 1. Adoption rate of DSR by ecosystem and by season, Philippines, 2016-2017 (PhilRice Rice-based Farm Households Survey, 2016-2017).



Wet Season (%)　　Dry Season (%)

Figure 2. Percentage of DSR farmers by province and by season, Philippines, 2016-2017 (PhilRice Rice-based Farm Households Survey, 2016-2017).

A more recent data from the Rice Competitiveness Enhancement Fund (RCEF) shows that DSR farmers increased from 38% in 2019 DS to 43% in 2021 DS. Still, this begs the question as to why TPR remains widely adopted despite the advantages of DSR. Perhaps, the generally lower yield in DSR at farmers' fields is the primary factor that makes it unappealing to farmers. The yield gap can reach around 400 kg/ha (Figure 3) depending on the production system and management practices of farmers. Related to this, studies show the following issues with DSR:

Risks in crop establishment. The poor and uneven establishment of seedlings may cause lower yield in DSR (Pandey & Velasco, 2002). The uneven distribution of seeds when broadcasted by hand results in differences in planting densities per area causing uneven growth and crop stand. This also makes DSR more vulnerable to lodging as root penetration and anchorage may not be as deep and as even as TPR.

Greater weed, insect, and disease incidence. Weeds significantly reduce grain yield in DSR (Ahmed et al., 2020; Younas et al., 2015). With no/less water to control them, weeds grow more easily in DSR fields competing with the crop for soil nutrients. Additionally, the higher plant density in DSR provides a cooler, more humid, and shadier microenvironment favorable to insect pests and diseases (Balasubramanian & Hill, 2002). These result in higher herbicide and insecticide costs (Table 1) that affect farmers' perception of DSR.

Suitable cultivars. Most of the developed rice varieties are suitable for TPR; thus, the yield penalty when direct-seeded (Pandey & Velasco, 2002). Varieties that are better adapted to DSR must be used to maximize the potential yield from DSR.

Higher seed use. More seeds are used by rice farmers when broadcasting by hand to cover for seeds that might fail to germinate as the seeds are more exposed to biotic and abiotic stresses. This practice affects the farmers' adoption of quality seeds as it will entail higher cost, which then affects yield (IRRI, 2019).

Water availability. Irrigation schedules have mostly been developed for TPR, but not much for DSR (IRRI, 2019). Lack of adequate water is also a concern in rainfed areas. Proper water management is important, as DSR seeds might fail to germinate with insufficient or excessive water.

Despite its limitation, several studies prove that yield penalties in DSR can be avoided given appropriate conditions and proper crop management practices. In 2021, manual DSR yield reached 5,496 kg/ha surpassing the 4,579 and 5,135 kg/ha yield from manual and mechanical TPR, respectively. This was conducted in suitable local conditions with favorable weather and using the recommended or best farm practices as well as the different yield-enhancing and cost-reducing farm technologies showcased in RCEF's 2021 WS *PalaySikatan* technology demonstration. Several researcher-managed trials conducted in the Philippines also showed higher yield from wet-DSR (broadcast) with 6.02 mt/ha and dry-DSR (both broadcast and drill/line sowing) with 6.04-6.07 mt/ha compared with TPR yield at 5.94 mt/ha. Yield from wet-DSR using line sowing was even significantly higher at 6.84 mt/ha (Kumar & Ladha, 2011).

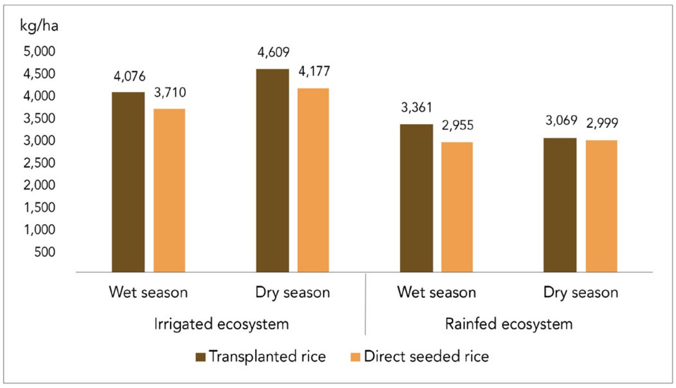


Figure 3. Average yield of DSR vs. TPR by ecosystem and by season, Philippines, 2016-2017 (PhilRice Rice-based Farm Households Survey, 2016-2017).

CONCLUSION

The rice sector in the Philippines faces many challenges from high production cost to climate change. Hence, the need for resource-efficient and sustainable measures. Part of this is the scaling of DSR to rice farmers as an alternative crop establishment system to TPR, where suitable. Field trials have shown that with appropriate practices and technologies, DSR may enhance the profitability and sustainability of rice cultivation. Compared with TPR, DSR needs more work to guarantee its high yield performance. Farmers may need to go through a series of adjustments to ensure that DSR becomes a competitive and highly productive practice on actual field conditions. Hence, it is important to raise awareness and train farmers, and to deploy technologies to enhance DSR's technical and economic viability.

Table 1. Partial budget analysis of rice farmers' shift from TPR to DSR by ecosystem, Philippines, 2016-2017.

Item	Irrigated Ecosystem	Rainfed Ecosystem
Added income due to change:		
None		
Reduced costs due to change (PhP/ha):		
Crop establishment cost	6,255.99	7,134.88
Crop care and maintenance cost	862.80	909.32
Harvesting and threshing cost	1,209.02	825.01
Subtotal	8,327.80	8,869.21
Added costs due to change (PhP/ha):		
Seed cost	1,083.50	889.50
Herbicide cost	470.50	687.50
Insecticide cost	394.00	102.00
Reduced income due to change:		
Yield reduction (kg/ha)	399.50	234.50
Farmgate price (PhP/kg)	15.69	15.69
Value of yield reduction (PhP/ha)	6,267.54	3,592.90
Subtotal	8,215.54	5,271.90
Net change (PhP/ha)	**112.26**	**3,597.31**

Source: PhilRice Rice-based Farm Households Survey, 2016-2017

CALL FOR ACTION

- **Address the knowledge gap on DSR.** Conduct experiential training on the recommended and best crop management strategies. The training will help farmers improve their practices particularly on land preparation to minimize weed competition by exhausting the weed reserves in the soil; water management to suppress weed growth; integrated weed management practices; and proper care of seeds. The PalayCheck system may also serve as a useful reference, at least for farmers practicing wet DSR, in irrigated lowland areas.

- **Develop and provide appropriate technologies.** This will facilitate the adoption of technologies like drones, drum seeders, precision seeders, seed spreaders, and similar technologies by farmers who are unable to access them due to limited capital. Demonstration trials using seed drills in Thailand have shown 50% less seed cost and 30% higher yield with mechanized DSR (mDSR) relative to manual broadcasting, making farmers' net income even higher than manual TPR by 19% (Kanlaya et al., 2019). Several PhilRice demonstrations of mDSR in Zambales also showed higher yield using drumseeder and precision seeder compared with farmers' practices. Accordingly, technology demonstrations and training programs are needed to make farmers more receptive to such technologies.

- **Conduct of research and development on DSR.** New rice varieties suitable for DSR should be developed and promoted. This includes varieties with early seedling vigor, high resistance to lodging, tolerance of low oxygen level, resistance to drought, and/or high weed resistance (Pandey & Velasco, 2002). Breeding for DSR may start with the selection of materials that can survive prolonged seed submergence. Existing rice varieties suitable for DSR should also be promoted in viable environments to ensure better germination and post-seed survival. Provinces that are conducive for DSR should be identified, and irrigation schedules must be adjusted or tailored for DSR.

- **Increase the volume of seeds given to farmers.** The current 40 kg per ha volume of seeds from the RCEF inbred seed program, sends the message that the government promotes TPR. Higher seed allocation, at least for suitable provinces, is needed to meet the 40-80 kg per ha seeding rate in DSR, depending on the method.

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ABOUT THE MATERIAL

Rice Science for Decision-Makers is published by the Department of Agriculture-Philippine Rice Research Institute (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 featured articles here aim to improve the competitiveness of the Filipino rice farmers and the Philippine rice industry through policy research and advocacy.

This issue presents measures to promote the adoption and realize the full potential of direct-seeded rice, a more resource-efficient and sustainable alternative crop establishment system to transplanted rice.

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