Economic Analysis of Direct Seeded Rice Production in Zeyarthiri Township, Nay Pyi Taw Union Territory

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Abstract
As rice is the most important income crop in Myanmar and the direct seeded rice production method is the most commonly used in Nay Pyi Taw Union Territory. The objectives of the study were to observe economic analysis and factor shares of direct seeded rice production and examine the reasons and constraints of the farmers for using direct seeded rice methods in the study area. The survey was conducted in August 2023. A total of 75 direct-seed farmers from three village tracts in Zeyarthiri Township were selected by using the purposive sampling method, only DSR farmers. Descriptive, economic analysis and factor shares were used to fulfill the objectives of the study. In terms of cost and return analysis, the benefit-cost ratios were 1.79 for wet DSR, 1.74 for dry DSR and 2.21 for DSR with drum seeder indicating that the sampled farmers profit from their DSR methods. Higher input costs were the major constraints faced by the DSR methods of the sampled farmers. The reasons for changing DSR methods are low cost than transplanting, labor scarcity at peak season. The major constraints were loss of seeds in the fields, high price of fertilizers and labor scarcity at peak season. To achieve increased productivity DSR with drum seeder method should be encouraged for getting more profits and farm mechanizations also should be supported in time to farmers who are faced with labor scarcity problem. And the availability of adequate irrigated water sources should be provided for rice production.

Key words: benefit cost ratio, Constraint, Drum seeder, Dry DSR, Wet DSR
JEL code: D24, D33, E23, O12
SDG goals: Zero Hunger; Industry, Innovation and Infrastructure; Responsible Consumption and Production; Partnerships for the Goals

Introduction
Rice is a staple food for over half of the world's 7.7 billion people (Bhandari, 2019). It is an important economic, social, political, and cultural commodity in most Asian countries.
Rice is the 1st most widely consumed, 2nd most largely produced, and 3rd most widely grown food crop in the world. About (90%) of the total rice is produced in Asia. China and India, the two biggest rice producers, account for over half of the world's rice production.

The world's average annual per capita milled rice consumption is 64 kg per year providing (19%) of daily calories. Asia accounted for (84%) of global consumption, followed by Africa (7%), South America (3%), and the Middle East (2%). Asia's per capita rice consumption is 100 kilograms per year, providing (28%) of daily calories. The top five rice exporting countries are India, Thailand, Vietnam, Pakistan, and China, accounting for (74%) of the global rice export. The top five rice-importing countries are China, the Philippines, Nigeria, the European Union, and Saudi Arabia, which account for (26%) of global rice imports.

Rice is known as the grain of life and is synonymous with food for Asians. In addition to being a staple food and an integral part of social rites, rituals, and festivals in almost all Asian countries, it has a medicinal value too, which was clearly recognized by the medicine systems of the region centuries ago. Rice (*Oryza sativa*, L) is the most important food crop in the developing world. Rice production is central to the economy and food security of Myanmar. In Myanmar, rice is not only known as the main staple food but also as an important national crop. Rice cultivation in Myanmar is crucial for the country's economy, employment, and food security.

Rice is grown throughout the agro-climatic conditions of the country (Oo and Kyu, 2012). Among the regions and states, Ayeyawady, Sagaing, Bago, Mandaly and Yangon are major rice growing areas (MOALI, 2021). The cultivation methods have a great impact on the growth and yield of rice and the choice of planting method may be influenced by the availability of technology and labor, particularly in developed countries where labor is scarce (Birhane, 2013). There are different rice planting methods but the most common ones are transplanting and direct seeding methods. DSR is a major yield declining factor and if managed well can help to increase yields by substantial level. Furthermore, DSR avoids the transplanting shock hence attains the physiological maturity earlier than transplanted rice and reduces the vulnerability to late season drought. Yield in DSR is expected to be often lower than TPR principally due to poor crop stand, high percentage of panicle sterility, higher weed and root-knot nematode infestation. But, higher yield, root dry matter, benefit cost ratio and infiltration rate was recorded in DSR than TPR while comparing productivity and economics of various planting techniques in rice based cropping systems in the Indo-Gangetic Plains (Gangwar et al., 2008). It is reported that productivity of DSR is (5-10%) more than the yield of transplanted rice. Farmers get a higher net economic return under wet or dry DSR than TPR, with (13%) higher for wet DSR (Chakraborty et al., 2017). Sahrawat et al., (2010) also observed under dry DSR input and cost of cultivation, (13-16%) labor saving in DSR as compared to manual puddled transplanted rice. Direct seeded rice (DSR) consumed (12-17%) less water as compared to puddled transplanted rice during 2011, whereas, it consumed (5-9%) more water as compared to puddled transplanted rice during 2012. The BCR was highest in direct seeded rice (DSR) in zero till condition 1.74 as compared to manual puddled transplanted rice 1.62 (Kumar et al., 2015). The drum seeder method, the highest benefit cost ratio of 1.92 were obtained whereas the transplanted rice recorded Benefit cost ratio (BCR) of 1.73 and for the broadcast method it was only 1.13.

Appropriate agricultural practices have positive and sustainable impacts on rural farmers' livelihood and decision making activities. It is necessary to improve the production of rice in order to have sufficient domestic food consumption and foreign income. Rice production and yield are increasing year by year, at the same time input and labor costs are also increasing.

Due to the high cost of production, farmers made little or no profit (Kusrini and Rizieq, 2019). There is different between input prices and output prices for agricultural products. Currently, the system of rice production run by farmers becomes more vulnerable to fluctuations in profit and loss. One way to mitigate the risk that farmers face is through the application of economic analysis of DSR production. Additionally, it is important to examine farmers' perspectives and attitudes on the DSR approach. Although manual transplanting is the common method of rice cultivation but it is too much laborious, slow and inefficient, time consuming and a lot of expenditure on raising, uprooting and transplanting of nursery (Rana et al., 2014). Also, transplanting has added disadvantages such as stress on seedlings and raising nurseries. While the economic situation has stabilized over the past months in Myanmar, the economic climate during the 2022 rice season has reportedly affected rice cultivation. The devaluation of

Myanmar's currency coupled with inflation has increased the costs associated with rice farming inputs, including seeds, fertilizers, and labor. Due to higher input costs rice farming has become more arduous for farmers, diminishing their yields' profitability. In this scenario, farmers around the world have shifted toward water and labor saving direct seeding of rice. Direct seeding also reduces methane emission. DSR saves labor as it avoids nursery raising, uprooting seedlings, transplanting as well as pudding. In Myanmar, different DSR methods were cultivated nationwide area for long period. However, need to analyze the comparison of which DSR methods is the most profitable. In Nay Pyi Taw Union Territory, the rice is one of the main income crops for farmers accounted for (79,334 ha) of total rice sown area. This study mainly focuses on the economic analysis of rice production in Nay Pyi Taw Union Territory using various DSR techniques.

The main objectives of this paper were,
1. To conduct economic analysis and factor shares of direct seeded rice production by selected farmers in Nay Pyi Taw Union Territory
2. To examine the reasons and constraints of the farmers for using direct seeded rice methods in the study area

Methodology

General description of the study area

Nay Pyi Taw Union Territory is located between the Bago Yoma and Shan Yoma mountain ranges. The city covers an area of 7,054 km^2 (2,724 sq miles) and has a population of 924,608 according to records (GAD, 2022). Zeyarthiri Township is selected as a sample survey area in this study. It is situated in North latitude 19˚24 ′ and East longitude 96˚40 ′, estimated to be 400 feet above sea level. The total population was 114 ('000) (2021-2022). The reasons for choosing these areas were that Zeyarthiri Township has a total rice sown area of 4,931 ha and utilizes 4,882 ha as direct seeded area, or about (99%) of the total rice sown area (DOA, 2022).

Yezin Agricultural University and the Department of Agricultural Research are closely located in this area. Major crops grown in Zeyarthiri Township are rice, groundnut, green gram, etc. The most common crop grown is rice. Therefore, this study investigates the factor share contribution to the profit of rice. The total 75 direct seeded farmers from three village tracts in Zeyarthiri Township were selected by using the purposive sampling method, only DSR farmers.

Methods of analysis

Both quantitative and qualitative data were first entered into the Microsoft Excel program. The analytical techniques, which included descriptive statistics such as frequency, percentage, etc., Economic analysis and factor shares with related methods were calculated by using Microsoft excel program to fulfill the research objectives.

Economic analysis

An enterprise budget includes all the costs and returns associated with producing one enterprise in a particular manner. Enterprise budgets are constructed on a per-unit basis, such as per hectare or per head, to facilitate comparisons among alternative enterprises. Enterprise budget analysis was used to calculate the cost and benefit of rice production in the study area. In the analysis, the following variable costs are included material input cost, family labor cost, and hired labor cost.

Both cash and non-cash items were included in the estimation of material and labor costs. Non-cash items for material costs included seeds, family labor, and cow dung. Cash payment for the labor involved; hired labor payment for production. Total gross returns or benefits were calculated by total variable cash costs, excluding opportunity costs. Return above variable costs, or gross margin, and return above variable cash costs were also calculated.

Methods to economic analysis

Factor	Unit	How to calculate
Return above variable cost	MMK/ha	RAVC = TR-TVC
Return above variable cash cost	MMK/ha	RAVCC = TR-TVCC
Gross margin	MMK/ha	GM = TR-TVC
Benefit cost ratio (BCR)		BCR = TR/TVC
Break-even yield	Ton/ha	TVC/Average market price per ton
Break-even price	MMK/ton	TVC/Average yield per hectare

Source: Olson, 2003

Where;

TR = Total revenue
TVC = Total variable cost
TVCC = Total variable cash cost

Analysis of factor shares

Factor shares are the ratio of the costs of factor inputs used in a production process to the total value of output, i.e., total revenue. Consider a production process in which a firm uses four inputs: current input (C), capital (K), labor (L), and land (A) to produce a single output, paddy (Q). All variables are defined in terms of flow.

If the firm purchases inputs and sells output at constant unit prices (p, i, w, r, and P, respectively), factor shares of the firm's input are: where C, K, L, and A are the physical quantities of each input factor used in production, and Q is the physical quantity of output produced (IRRI 1991).

Factor share of gross margin (%) = Gross margin/Total revenue x 100
Factor share of interest cash cost (%) = Interest cash cost/Total revenue x 100
Factor share of hired labour cost (%) = Hired labour cost/Total revenue x 100
Factor share of family labour cost (%) = Family labour cost/Total revenue x 100
Factor share of material cost (%) = Material cost/Total revenue x 100
Total input share (%) = Material cost+ Labour cost + Interest cost
Farmers' farm income = Gross margin + Family labour cost

Results and discussion

This chapter includes a description of households' socio-economic characteristics, economic analysis and factor shares analysis, as well as reasons and constraints of farmers for using DSR methods in the study area.

Description of Households' Socio-economic Characteristics

Age, education levels and farming experience of household heads, farm assets, were principally considered as vital socio-economic characteristics of sampled farmers in this study. The average age of household heads was 54 years ranging from 30 years to 80 years in Table 1. The finding highlighted that majority of the sampled farmers were about 54 years with 28 years average farming experience.

The education levels of sampled farm household heads were presented in Table 4.2. The sampled household heads education levels were distributed into five categories. Monastery education referred to informal schooling although they could read and write, primary level referred to formal education up to 5 years, middle level referred to formal schooling up to 9 years, high school level referred to formal schooling up to 11 years and graduate level mentioned to those who was attending the university and received a bachelor from university. Majority of sample household heads were middle school level (34%), primary school level (31%), and monastery education level (12%), respectively, while the rest of the farmers had undergone higher level of education. Among the gender status of household heads, there were (75%) of male headed households and (25%) of female headed households respectively (Table).

Farming experience of farmers play a vital role in agricultural production to make correct decision and to adopt DSR and take the risk. It is estimated that the higher the farmers' experience in farming, the better production capacity of the farmers. The sampled household heads operated rice production with the farming experience from 4-64 years in Table 1. As they spend almost half of their lives in farming, they had more productive experiences and potential for decision-making in rice production.

Table 1. Demographic characteristics of farm household heads of sampled farmers (n=75)

Items	Unit	Average	Range
Age	Year	53.81	30-80
Farming experience	Year	27.65	4-64
Experience by using DSR method	Year	11.33	3-51
Experience by using previous transplanted method	Year	12.05	1-57
Household size	No.	4.76	1-10
Farm size (Lowland)	ha	2.05	0.5-12
Farm size (Upland)	ha	0.80	0-8

Source: Own survey, 2023

Table 2. Gender and education level of sampled farm household heads (n=75)

Variables	Number	Percent
1.Education level of household head		
Monastery (only read & write)	9	12.00
Primary (up to 5 years)	23	30.66
Middle (up to 9 years)	26	34.67
High (up to 11 years)	11	14.67
Bachelor	6	8.00
2.Gender status of household heads		
Male	56	75.00
Female	19	25.00

Source: Own survey, 2023

Table 3. Farm assets of sampled farmers (n=75)

Items	Frequency	Percent	Items	Frequency	Percent
Hoe	72	96.00	Bullock cart	35	46.66
Sickle	64	85.33	Inter cultivator	10	13.33
Sprayer (battery)	46	61.33	Threshing machine	7	9.33
Sprayer	43	57.33	Hand tractor	6	8.00
Plough/Harrow	36	48.00	Tractor	2	2.66
Water pump	36	48.00	Combine harvester	1	1.33

Source: Own survey, 2023

Descriptive statistics of output based on each sampled farmers

According to the results presented in Table 4, the average yield of wet DSR farmers was 4.07 ton/ha, with a minimum yield of 2.47 ton/ha and a maximum yield of 5.54 ton/ha. The average yield of dry DSR farmers was 4 ton/ha, with a minimum yield of 2 ton/ha and a maximum of 5 ton/ha. The average yield of DSR by using drum seeder for DSR farmers was 4.49 ton/ha, with a minimum yield of 2.97 ton/ha and a maximum of 5.44 ton/ha. The average market price of rice received by the wet DSR sampled farmers was 637 (′000 MMK/ton), with a minimum of 400 (′000 MMK/ton) and a maximum of 900 (′000 MMK/ton). The average market price of rice received by the dry DSR sampled farmers was 610 (′000 MMK/ton), with a minimum of 425 (′000 MMK/ton) and a maximum of 900 (′000 MMK/ton). The average market price of rice received of DSR by using drum seeder was 832 (′000 MMK/ton), with a minimum of 600 (′000 MMK/ton) to the maximum of 1,750 (′000 MMK/ton).

Table 4. Descriptive statistics of output based on each sampled farmers (n=75)

Variable	Unit	Average			Range		
		Wet DSR	Dry DSR	DSR with drum seeder	Wet DSR	Dry DSR	DSR with drum seeder
Yield	Ton/ha	4.07	4.00	4.49	2.47-5.54	2-5	2.97-5.44
Price	*MMK/ton	637	610	832	400-900	425-900	600-1,750

Source: Own survey, 2023

Note * refers to the (′000 MMK)

Material costs of different DSR methods in the study area

The material costs of different DSR cultivated methods in the study area who applied seed, FYM, urea, T-super, potash, compound, gypsum, lime, compose, herbicide, pesticides, foliar, and diesel in rice production were described in Table 5. All sample farmers used for seeds about 121 (′000 MMK/ha) in wet DSR production, 132 ('000 MMK/ha) in dry DSR production, and 131 (′000 MMK/ha) in DSR with drum seeder production. For crop protection, most farmers applied for urea about 228 (′000M MK/ha) in wet DSR, 216 (′000 MMK/ha) in dry DSR, and 257 (′000 MMK/ha) in DSR with drum seeder, and as compound about 165 (′000 MMK/ha) in wet DSR production, 153 (′000 MMK) in dry DSR and 189 (′000 MMK) in DSR with drum seeder production.

Table 5. Material costs of different DSR methods in the study area (n=75)

Items	Wet DSR	Dry DSR	DSR with drum seeder	Total DSR
	('000 MMK)			
Seed	121	132	131	128
FYM	39	29	25	31
Urea	228	216	257	234
T-super	13	18	61	31
Potash	8	9	31	16
Compound	165	153	189	169
Gypsum	0.5	7	7	5
Lime	0.3	0	0.34	0.23
Compose	3	0	1	1
Herbicide	40	52	38	43
Pesticide	34	21	39	31
Foliar	16	12	15	14
Diesel	1	15	11	9
Others	16	4	17	13
Total materials cost/ha	690	673	830	731

Source: Own survey, 2023

Family labour and hired labour costs of different DSR methods of sampled farmers

The total labor costs of sample farm households for the wet DSR method was 713 ('000 MMK/ha), with the family labor costs of 151 ('000 MMK/ha) and the hired labor costs of 562 ('000 MMK/ha). The total labor costs of sampled farmers for the dry DSR method was 690 ('000 MMK/ha), with the family labor costs of 136 ('000 MMK/ha) and the hired labor costs of 554 ('000 MMK/ha). The total labor costs of sampled farmers DSR with drum seeder method was 815 ('000 MMK/ha), with the family labor costs of 208 ('000 MMK/ha) and the hired labor costs of 607 ('000 MMK/ha) in Table 7. The largest amount of hired labor costs of the combine harvester was 196 ('000 MMK/ha) in wet DSR, 186 ('000 MMK/ha) in dry DSR, and 207 ('000 MMK/ha) in DSR with drum seeder. Followed by wet DSR total labor costs for ploughing 114 ('000 MMK/ha), family labor costs of ploughing 26 ('000 MMK/ha), and hired labor costs of 118 ('000 MMK/ha), which are presented in Tables 6 and 7.

Table 6. Family labour costs of different DSR methods in the study area (n=75)

Type of operation	Wet DSR	Dry DSR	DSR with drum seeder	Total DSR
	('000 MMK)			
Ploughing	26	19	24	23
Harrowing	19	13	37	23
Leveling	1	1	13	5
Basal fertilizer application	7	5	5	6
Seed broadcasting	5	6	0.69	4
Fertilizer application	11	8	20	13
Weeding	7	14	5	9
Irrigation	25	18	24	23
Roughing	2	2	10	5
Pesticide application	6	5	10	7
Herbicide application	10	10	10	10

Type of operation	Wet DSR	Dry DSR	DSR with drum seeder	Total DSR
	('000 MMK)			
Transportation (home)	2	3	10	5
Drying	22	23	24	23
Storage	1	3	9	4
Total family labor cost/ha	151	136	208	165

Source: Own survey, 2023

Table 7. Hired labour costs of different DSR methods in the study area (n=75)

Items	Wet DSR	Dry DSR	DSR with drum seeder	Total DSR
	('000 MMK)			
Ploughing	118	103	103	109
Harrowing	75	87	88	84
Leveling	11	9	25	15
Basal fertilizer application	5	4	2	4
Seed broadcasting	8	9	42	19
Fertilizer application	10	9	4	7
Weeding	50	79	54	61
Irrigation	5	0.49	0	1
Roughing	7	9	18	12
Pesticide application	10	3	8	7
Herbicide application	10	10	4	8
Combined harvester	196	186	207	196
Threshing	0	0	4	1
Transportation (home)	25	17	13	17
Drying	19	19	13	17
Storage	9	2	13	8
Transportation (sell)	0	2	1	1
Total hired labor cost/ha	562	554	607	576

Source: Own survey, 2023

Economic analysis of DSR production in Zeyarthiri Township

The enterprise budget was calculated to analyze the cost and return of DSR production in Zeyarthiri Township. A detailed calculation of cost and return in DSR production is shown in Table 8, the different costs of DSR production for the sampled farmers in the study area. Total material cost included seed, urea, T-super, compound, foliar, FYM, pesticides, herbicides, and diesel used in different DSR production. The opportunity cost of family labor was also calculated by mentioning the wage rate of hired labor. Interest on paid-hired labor costs and material cash costs were also included. The total variable cost or total production cost of different DSR per hectare was then computed by combining total material costs, family labor and hired labor costs, and total interest on cash costs.

Total variable costs of sampled farmers were 1,442 ('000 MMK/ha) in wet DSR, 1,401('000 MMK/ha) in dry DSR and 1,690 ('000 MMK/ha) in DSR with drum seeder, while total variable cash costs were 1,290 ('000 MMK/ha) in wet DSR, 1,264 ('000 MMK/ha) in dry DSR and 1,481 ('000 MMK/ha) in DSR with drum seeder.

Total revenue was computed by multiplying the yield and price received by sampled farmers. Total revenue was 2,593 (′000 MMK/ha) in wet DSR, 2,442 (′000 MMK/ha) in dry DSR and 3,736 (′000 MMK/ha) in drum seeder, while return above variable cost was 1,151 (′000 MMK/ha) in wet DSR, 1,041 (′000 MMK/ha) in dry DSR and 2,045 (′000 MMK) in DSR with drum seeder.
In addition, return above variable cash cost was 1,302 (′000 MMK/ha) in wet DSR, 1,178 (′000 MMK/ha) and 2,254 (′000 MMK/ha) for sampled farmers as presented.

Return per unit of capital invested and return per unit of cash expensed in the study area were presented in Table 8. Benefit cost ratios were 1.79 in wet DSR, 1.72 in dry DSR and 2.21 in DSR with drum seeder. The findings indicated that DSR production in the study area was profitable because farmers get back 0.79 MMK in wet DSR, 0.74 MMK in dry DSR and 1.21 MMK in DSR with drum seeder if they invest a unit cash expense in DSR production. The findings of the study were nearly similar to those obtained by Meena et al., (2013).

The break-even yield was the yield that could cover the total variable cost at the current rice price, and the break-even price was the price that could cover the total variable cost at the current rice production. Actual yield and market price of rice production by sampled farmers were 4.07 ton/ha and 637 (′000 MMK/ton) in wet DSR, 4 ton/ha and 610 (′000 MMK/ton) in dry DSR and 4.49 ton/ha and 832 (′000 MMK/ton) in DSR with drum seeder. The break-even yield and break-even price of rice production by sampled farmers were 2.26 ton/ha and 354 (′000 MMK/ton) in wet DSR, 2.43 ton/ha and 329 (′000 MMK/ton) in dry DSR and 2.03 ton/ha and 376 (′000 MMK) in DSR with drum seeder in the study area, respectively. The finding indicated that even if the sample farmer's actual yield cover the total variable cost at the current rice price. Therefore, the sampled farmers in the study area were in a profitable position.

Table 8. Enterprise budgets by using different DSR methods of sampled farmers (n=75)

Items	Unit	Wet DSR	Dry DSR	DSR with drum seeder	Total DSR
Total revenue	(′000 MMK/ha)	2,593	2,442	3,736	2,924
Total variable cost		1,442	1,401	1,690	1,513
Total variable cash cost		1,290	1,264	1,481	1,347
Return above variable cost		1,151	1,041	2,045	1,410
Return above variable cash cost		1,302	1,178	2,254	1,576
Gross Margin		1,151	1,041	2,045	1,410
Benefit cost ratio		1.79	1.74	2.21	1.92
Break-even price	*MMK/ton	354	329	376	352
Break-even yield	Ton/ha	2.26	2.43	2.03	2.21

Source: Own survey, 2023
Note: * refer to (′000 MMK)

Factor share analysis
The revenue received from DSR production was shared among the following: material costs, earnings of the household's own labour and hired labour, interest on cash costs, and gross margin. The factor share was divided based on the gross revenue of rice production. Figure 1 and Table 6 showed the factor share percentage of gross margin (profit), interest on cash costs, hired labour costs, family labour costs, and material costs. The gross margin (profit) factor share was the largest in DSR production (44.39%) in wet DSR, (42.63%) in dry DSR and (54.74%) in DSR with drum seeder.

It was followed by material cost (26.47%) in wet DSR, (27.57%) in dry DSR and (22.24%) in DSR with drum seeder, hired labor cost (21.70%) in wet DSR, (22.69%) in dry DSR and (16.27%) in DSR with drum seeder, family labour cost (5.84%) in wet DSR, (5.60%) in dry DSR and (5.59%) in DSR with drum seeder, and the interest on cash cost (1.45%) in wet DSR, (1.51%) in dry DSR and (1.16%) in DSR with drum seeder, respectively. Therefore, farm income factor shares for DSR were (50.22%) in wet DSR, (48.23%) in dry DSR and (60.33%) in DSR with drum seeder.

Table 9. Factor shares by using different DSR methods of sampled farmers (n=75)

Variables	Factor shares (%)			
	Wet DSR	Dry DSR	DSR with drum seeder	Total DSR
Total revenue	100.00	100.00	100.00	100.00
Factor share (%)				
Gross margin	44.39	42.63	54.74	48.25
Interest on cash cost	1.45	1.51	1.16	1.34
Hired labor cost	21.70	22.69	16.27	19.72
Family labor cost	5.84	5.60	5.59	5.67
Material cost	26.62	27.57	22.24	25.02
Farmers' farm income	50.22	48.23	60.33	53.99

Source: Own survey, 2023

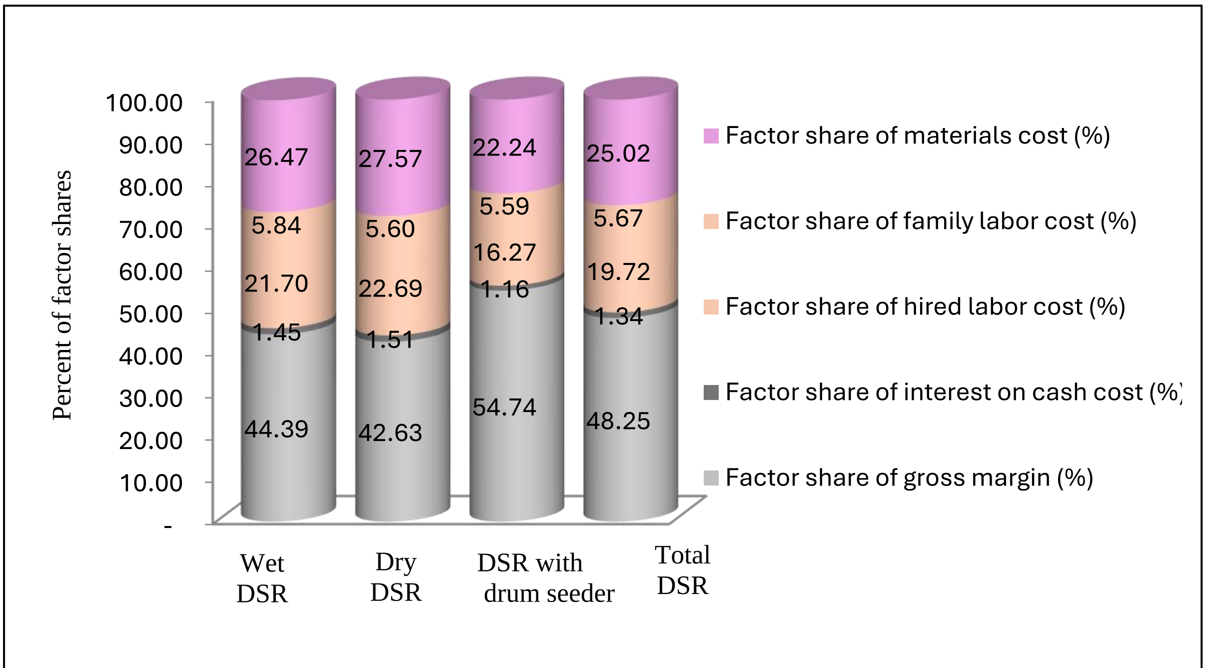

Figure 1. Factor shares by using different DSR methods of sampled farmers
Source: Own survey, 2023

Reasons for changing DSR methods of sampled farmers

The reasons for changing DSR methods of sampled farmers are presented in Table 10. The study area sampled farmers explained about the reasons for changing DSR methods as lower cost than transplanting method (76.00%), labor scarcity at peak season (32.00%), getting higher yield than transplanting method (14.66%), not available irrigation water (12.00%), and adaptation to climate change than transplanting method (12.00%).

Table 10 Reasons for changing DSR methods of sampled farmers (n=75)

No.	Items	Frequency	Percent
1.	Lower cost than transplanting method	57	76.00
2.	Labor scarcity at peak season	24	32.00
3.	Getting higher yield than transplanting method	11	14.66
4.	Not available irrigation water	9	12.00
5.	Resistance to climate change than transplanting method	9	12.00
6.	Time saving than transplanting method	5	6.66
7.	Easy to manage because of a little practices in DSR methods	1	1.33
8.	DSR by using drum seeder is suitable to produce rice seed	1	1.33
9.	DSR by using drum seeder have fertilizer supporting	1	1.33

Source: Own survey, 2023

General constraints in DSR methods faced by selected farmers in Zeyarthiri Township

The farmers' perceptions of constraints on rice production are presented in Table 11. In Zeyarthiri Township, major constraints described by (72.00%) and (66.66%) of sampled farmers were loss of seeds in the field, high price of fertilizers, crop loss of over harvesting time due to limitation of hiring combined harvester (58.66%), labor scarcity at peak season (54.66%), followed by limitations on quality seed availability (53.33%), and poor germination rates of seed (49.33%).

Table 11. General constraints in DSR methods faced by sampled farmers in Zeyarthiri Township (n=75)

No.	Items	Frequency	Percent
1.	Loss of seeds in the field	54	72.00
2.	High price of fertilizers	50	66.66
3.	Crop loss of over harvesting time due to limitation of hiring combined harvester	44	58.66
4.	Labor scarcity at peak season	41	54.66
5.	Limitation of quality seed availability	40	53.33
6.	Poor germination rate of seed	37	49.33
7.	Poor soil fertility	36	48.00
8.	Weak extension service for production technologies	34	45.33
9.	High fuel cost for irrigation	33	44.00
10.	Not available of required agrochemicals in the market	31	41.33
11.	Crop loss in the field due to weeds and pests	30	40.00
12.	Constraint of available price information in time	20	26.66
13.	Limitation for credit availability	20	26.66

Source: Own survey, 2023

Conclusion

In terms of BCR, the sampled farmers could earn a profit of 0.79 from wet DSR, 0.74 from dry DSR and 1.21 from DSR methods with drum seeder production if one kyat was invested. Among these three different methods in the study area, the BCR of DSR cultivation methods with drum seeder is the highest. Therefore, DSR production was economically more attractive for farmers. The main reasons for changing DSR methods of sampled farmers were lower cost than transplanting methods, insufficient labor in peak season, higher yield than transplanting methods, and not available irrigation water, apart from these reasons farmers are trying to adaptable for climate change. On the other hand, they still had constraints in rice production, particularly loss of seeds in the field, high price of fertilizers, crop loss of over harvesting due to limitation of hiring combined harvester, labor scarcity at peak season, limitation of quality seed availability, and poor germination rates.

Recommendations

In Myanmar, about 70% of country population lives in rural area and their livelihoods mainly rely on agriculture particularly in rice cultivation. Therefore, profitability of rice farming is essential for improving their livelihoods. In order to achieve the purpose of increased rice productivity especially DSR with drum seeder method should be encouraged for getting more profit. The government should encourage not only to use DSR with drum seeder but also to accept new technologies, improved varieties, and extension services. According to the results of labour scarcity in peak season, it was required to reduce the total hired labour cost by using farm machinery in the study area. Therefore, farm mechanization should be supported to farmers who were faced with labour scarcity in rice production. To remedy the constraint of insufficient water for cultivation, the government should provide for the availability of adequate water resources for agriculture. Therefore, adequate water should be supported in time for increased production. According to overcome these constraints, public sector should be aware and formulate the evidence based plan, strategies and policies.

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