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Paddy rice productivity and profitability in Myanmar

Assessment of the 2022 monsoon season

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ABSTRACT

We analyze paddy rice productivity and profitability data for the monsoon season of 2022 from the Myanmar Agriculture Performance Survey (MAPS), fielded in the beginning of 2023. The survey covered plots of 3,076 paddy rice producers, spread across all states/regions of the country. We find that:

1. Paddy rice productivity – tons of paddy produced per unit of cultivated land – at the national level decreased on average by 7.5 percent during the monsoon of 2022 compared to the monsoon of 2021. The lower productivity is mostly explained by adverse weather conditions, with negative impacts of droughts during the monsoon of 2022. Lower input use and other factors - such as increased insecurity - played an important role as well. Paddy rice yields were lowest in Kayah and Chin, two conflict-affected states.
2. Prices for most inputs used in paddy rice cultivation increased significantly between these two seasons. Prices of urea, the most important chemical fertilizer used by paddy rice farmers, increased by 87 percent on average while mechanization costs increased by 27 percent. Small decreases are noted, on average, in the use of paddy rice inputs over the last two monsoons. Despite the large price increases for chemical fertilizer, its use declined only by 8 percent compared to the previous monsoon.
3. Paddy prices at the farm level increased by 81 percent, reflecting changes in international rice prices as well as the depreciation of the MMK. Gross revenues per acre increased in nominal terms by 67 percent, mostly due to these high price increases.
4. Real profits, with nominal prices corrected by the change in the cost of an average food basket, from paddy rice farming during the monsoon of 2022 increased by 26 percent and 10 percent compared to the monsoon of 2021 and 2020 respectively. While nominal profits for paddy rice farmers increased by 95 percent over the last two seasons, price inflation has been high in the country and real profit increased much less.

While the rice sector demonstrated resilience in the country, the current situation is concerning given productivity declines and high price increases, raising fears for increased food insecurity in the country. We have found improved farm profitability this year and as fertilizer prices for the coming monsoon (the monsoon of 2023) are down (due to international price decreases) and international rice prices are up (due to lower global stocks), this might further improve profitability - and incentives - for paddy production in 2023. These price developments might possibly reverse the declining productivity trend. The big unknowns that might impact paddy production in 2023 though are the weather - with less rainfall expected due to El Niño conditions in the second half of the year - and the evolution of conflict-related insecurity in the country.

1. INTRODUCTION

Paddy rice is a very important product for farmers' livelihoods and for food security in Myanmar. Rice is the main staple, accounting for 51 and 62 percent of urban and rural calories consumed, respectively, making it crucial for food security in the country.[1] It is also the predominant crop for a large number of farmers, especially during the monsoon season, as well as an important export product. However, large international changes in commodity markets and twin local crises – COVID-19 and political problems with ensuing conflict due to the military take-over – have hit the agri-food sector of Myanmar hard and have raised concerns on the performance of the agricultural sector overall and the rice sector in particular.

Internationally, there have been large changes in commodity markets in 2021 and 2022. International fertilizer prices increased significantly due to high prices of raw materials (Hebebrand and Laborde 2022). Moreover, international shipping costs in 2021/2022 were substantially higher due to a global shortage of containers, which was especially problematic in Asia due to COVID-19 related trade reductions. International freight costs in the Southeast Asian region in 2021 were estimated to be two to four times higher than during normal times (USDA 2021). Following Russia's invasion of Ukraine in February 2022, fertilizer prices have increased even further, given that Russia and Ukraine are major suppliers of raw materials for fertilizers (Hebebrand and Laborde 2022). These high prices of fertilizers are leading to global worries about food security.[2]

Locally, the COVID-19 and political crises have created unprecedented challenges to the functioning of agricultural value chains and the agri-food system in Myanmar. The COVID-19 crisis has led to large income declines in the country overall and to substantial disruptions in Myanmar's agri-food system (Boughton et al. 2021). The political crisis has caused substantial problems in the banking and finance sector, in international trade, and in the local transport sector, among others (USDA 2021). Moreover, the currency of Myanmar, the kyat (MMK), was rapidly depreciating in 2022. At the farm level, the political crisis in 2021 led to lower credit availability for farmers, a decrease in farm prices for some crops, and more uncertainty in agricultural profitability (MAPSA 2021).

The assessment on farmers' paddy rice productivity during the monsoon of 2022 presented in this paper is based on data from the Myanmar Agriculture Performance Survey (MAPS) that was conducted with 3,076 paddy rice producers, in all states/regions of the country, over the period January – February 2023. Detailed questions were asked to farmers about their background, input use and input prices, farm management practices, paddy rice output and output prices, and natural and other shocks during the monsoon of 2021 and 2022.[3] This Working Paper presents the results from this assessment and then discusses implications of the findings.

The structure of the paper is as follows. In section 2, we present the data collection method and descriptive statistics. Section 3 looks at prices of inputs and outputs over the last two monsoons. In Section 4, results on input use and farm management practices in paddy rice production are presented. Section 5 looks at the prevalence of natural and other shocks for these two seasons. Section 6 presents results on paddy rice productivity and production. We finish in the last section with conclusions and implications.

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[1] Estimated in 2015 (based on Myanmar Poverty, Livelihood, and Consumption Survey).

[2] For food markets, we note important price increases for some major staples. Grain prices in March 2022 were on average 23 percent higher than a year earlier, especially driven by high price increases of wheat (Hebebrand and Laborde 2022).

[3] In this paper, rice refers to rice in paddy form throughout.

2. DATA

The Myanmar Agricultural Performance Survey (MAPS) is a sub-sample of almost 13,000 households interviewed by phone during the fourth round of the Myanmar Household Welfare Survey (MHWS) that was fielded at the end of 2022 (MAPSA 2023a). In the MHWS, information was collected, among others, on the background of these households, welfare indicators, and livelihoods. The follow-up MAPS focused on the agricultural activities of those households that were identified as crop farmers in the MHWS. This survey was implemented by phone by Myanmar Survey Research (MSR) over the period January 23rd until February 22nd, 2023. Almost 5,000 farmers (4,961) that were interviewed in the fourth round of the MHWS could be reached for a second follow-up interview.

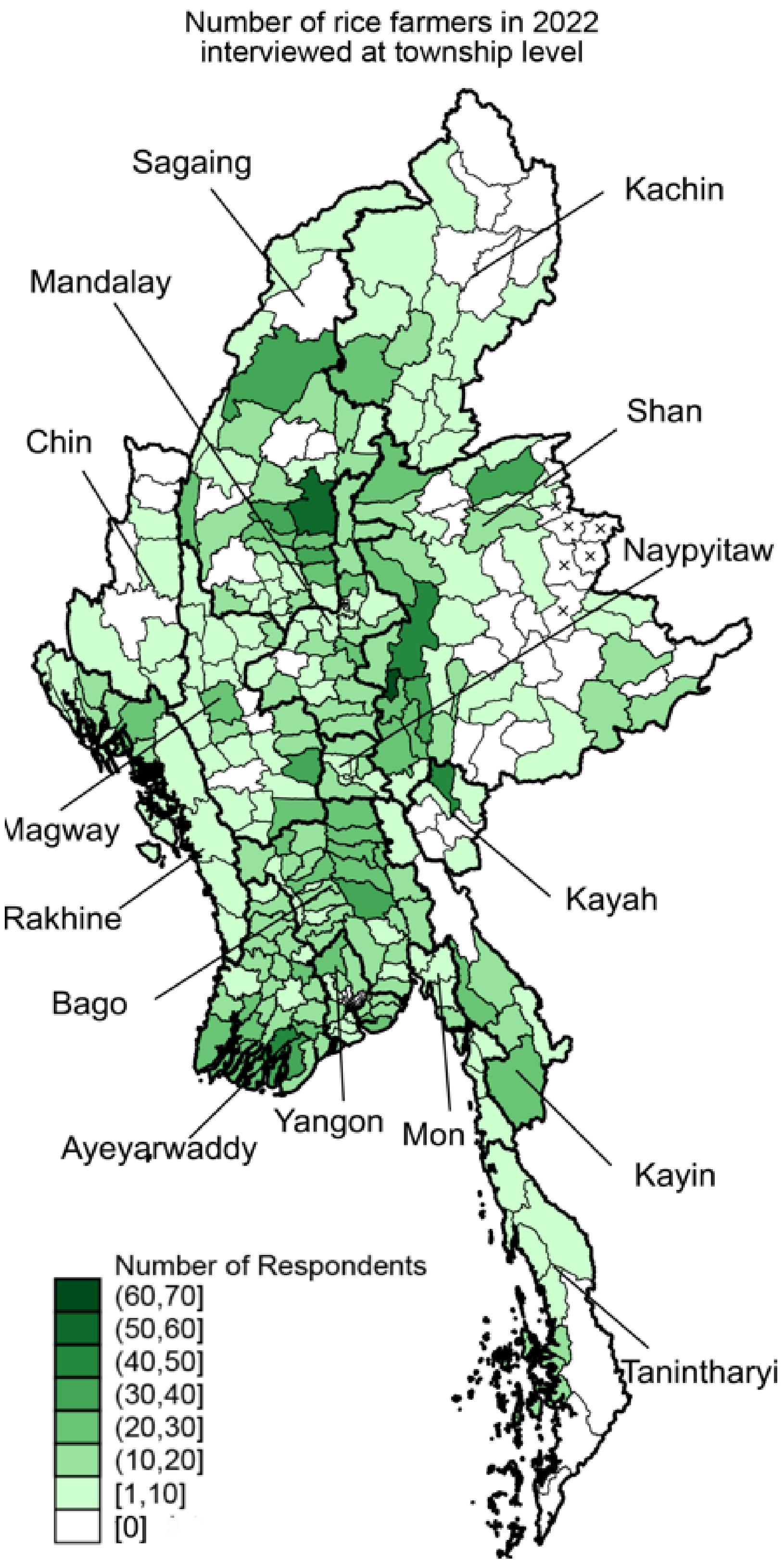
Of the 4,961 crop farmers in the MHWS, 3,076 farmers (62 percent) cultivated paddy rice in the 2022 monsoon (Table 1). The number of paddy rice farmers interviewed by township is shown in Figure 1, indicating their spread in the country. The analysis that is presented in this paper focuses on these paddy rice farmers. Table 1 shows the number of paddy rice farmers interviewed by state and region compared to the paddy rice area harvested as estimated by the Ministry of Agriculture, Livestock, and Irrigation (MoALI). MoALI evaluated the paddy rice area cultivated during the monsoon of 2020 at 14.6 million acres. This implies that with the MAPS, 2.1 paddy rice farmers were interviewed, on average, for each 10,000 acres of paddy rice cultivated in the country.

Table 1: Sample paddy rice farmers, MAPS

	MAPS			Paddy harvested area 2020 (1,000 acres)
	Crop farmers	Paddy rice Farmers 2021	Paddy rice Farmers 2022	MoALI
By State/Region				
Kachin	146	105	103	486
Kayah	109	63	57	82
Kayin	148	82	77	430
Chin	95	12	13	69
Sagaing	702	496	492	1,552
Tanintharyi	124	53	53	224
Bago	525	450	446	2,683
Magway	486	242	242	579
Mandalay	559	238	238	487
Mon	111	61	62	685
Rakhine	194	148	144	980
Yangon	209	144	141	1,166
Shan	808	471	473	1,262
Ayeyawady	664	458	466	3,751
Nay Pyi Taw	81	70	69	166
By agro-ecological zone				
Hills and mountains	1,306	733	723	2,329
Dry zone	1,828	1,046	1,041	2,784
Delta region	1,509	1,113	1,115	8,284
Coastal zone	318	201	197	1,203
Total	4,961	3,093	3,076	14,601

Source: Authors' calculations based on MAPS, monsoon season 2022

Figure 1: Sample of paddy rice farmers by township, MAPS monsoon season 2022



Source: Authors' calculations based on MAPS, monsoon season 2022

To assure that crop farmers are representative of the crop farming population in their state or region, a weighting factor was calculated building on the method used for the MHWS (MAPSA 2022a). We use the share of the respondents that reported living in a household where crops were harvested in the past 12 months as our measure of a crop farming household. The share of crop farming households was also calculated based on the same question in the 2017 Myanmar Living Conditions Survey (MLCS) implemented by the Myanmar Central Statistical Organization (CSO), UNDP, and The World Bank (CSO, UNDP & World Bank 2019), which was the last nationally representative socioeconomic survey conducted in Myanmar. Basic weights are calculated to match the MAPS numbers to this crop farming population of the MLCS. The basic weights further correct for education bias in the sample (based on MLCS numbers) and to ensure that we matched overall population numbers of the 2019 Inter-Censal Survey (at urban/rural and State and Regional level) (DOP, UNFPA 2020). An entropy correction approach was then implemented to additionally correct for large farm bias (using 5 land sizes) as well as adjust the share of women-adult-households in the farm population to the MLCS number.

The MAPS collected information on household characteristics, overall area cultivated, crops grown, paddy rice production and sales, agricultural input and output prices, and the incidences of natural and other shocks. In this paper, we focus in particular on the information that was collected on the biggest paddy rice plot of paddy rice producers in the monsoon seasons of 2021 and 2022. Data for these plots were collected on input use and farm management practices, such as the use of seeds, agro-chemicals, fertilizers, labor and mechanization and paddy rice output. Farmers were also asked to estimate overall monetary input expenditures on these plots. While we collected these data from 3,076 paddy rice farming households, caution is warranted in interpretation and extrapolation to national and state/region-wide paddy rice production as we only collected information on the largest paddy rice plot.

We divide the country into four major agro-ecological zones that are commonly used in Myanmar and present our results at that level.[4] The average farm size of the interviewed paddy rice farmers was 5.0 acres (Table 2). The biggest paddy rice farms are seen in the Delta region (7.7 acres) while farms in the Hills and Mountains agro-ecological zone are substantially smaller (2.9 acres). Nationally, the size of the largest plot was on average 1.3 acres while the median was 1.0 acre. A large majority of paddy rice plots at the national level are in lowlands (89 percent), whereas in the Hills and Mountains zone 32 percent are in the uplands.

The main farm management decision maker for these paddy rice farms was male in 60 percent of the cases and 48 years old on average. Three percent of these agricultural decision makers had no education at all while 87 percent indicated that they had completed standard levels from 1 to 10. Three percent reported that they had obtained a bachelor's degree. The number of household members working on the farm was on average 2.1. Similar to previous surveys, there were relatively more adult males working on the farm (57 percent of all labor) than females (43 percent of all labor) (Lambrecht et al. 2021), while work by children (defined as less than 15 years old) was reported by respondents to be less important.

[4] Delta (Ayeyawaddy, Bago, Mon, Yangon); Coastal (Rakhine, Tanintharyi); Central Dry (Mandalay, Magwe, NPT, Sagaing); Hills and Mountains (Chin, Kachin, Kayah, Kayin, Shan).

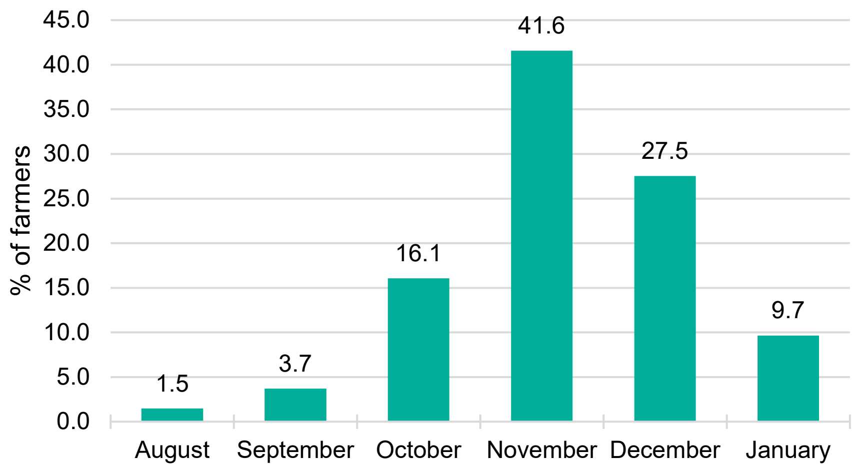
Table 2: Descriptive statistics of paddy rice farmers, MAPS

				Monsoon 2022		
	Unit	National	Hills	Dry	Delta	Coastal
Total number of paddy rice farmers	Number	3,076	723	1,041	1,115	197
Background paddy rice farm						
Average size paddy rice farm - mean	Acres	5.0	2.9	3.7	7.7	5.1
Size largest plot - mean	Acres	1.3	1.4	1.2	1.3	1.5
Size largest plot - median	Acres	1.0	1.0	1.0	1.0	1.0
Land type largest plot						
Upland	%	10.9	32.4	4.8	3.5	3.1
Lowland	%	89.1	67.6	95.2	96.5	96.9
Background of main farm management decision maker of paddy rice farms						
Age	Years	48	45.0	48.0	48.0	51.2
Gender	% male	60	55	62	62	59
Highest level of education achieved						
None	%	3	9	1	1	2
Standard 1-10	%	87	83	87	89	94
Bachelor	%	3	1	4	3	2
Other	%	7	7	8	7	2
Household members working regularly on the paddy rice farm						
Adult male - mean	Number	1.2	1.3	1.2	1.2	1.3
Adult female - mean	Number	0.9	1.1	1.0	0.6	0.9
Children - mean	Number	0.0	0.0	0.0	0.0	0.0

Source: Authors' calculations based on MAPS, monsoon season 2022

MAPS was conducted at the end of January and during the month of February to assess the situation of the monsoon crop in 2022. We asked farmers to indicate what they considered the main harvest month of paddy on their most important paddy plot (Figure 2). The main harvest month was November as reported by 42 percent of farmers. Twenty-seven percent reported December and 16 percent October as their main harvest period. Almost 10 percent of the farmers reported that the main harvest was during the month of January, just before the survey was fielded. It seems therefore that at the time of the survey, most of the monsoon paddy rice was harvested for most states and regions in the country.

Figure 2: Main harvest month of monsoon paddy 2022



Source: Authors' calculations based on MAPS, monsoon season 2022

3. INCENTIVES FOR PADDY RICE CULTIVATION - INPUT AND OUTPUT PRICES

Input prices for paddy rice farmers have changed dramatically over the last two monsoons (Table 3). First, chemical fertilizer prices reflected by the price of urea, the most important fertilizer used by paddy rice farmers, have increased by 87 percent on average (the median by 94 percent) during the monsoon of 2022 compared to a year earlier. These high fertilizer price increases were mostly driven by international price changes, by the depreciation of the local currency, and increased fuel and transportation costs locally (MAPSA 2023d). Table 3 also shows that urea prices are relatively higher in the Coastal zone compared to the rest of the country, likely reflecting distances from the entry points of fertilizer imports from abroad (MAPSA 2021).

Second, agricultural mechanization has rapidly taken off in the last decade and is now being used by a large majority of farmers (Belton et al. 2021). As a measure of the costs of mechanization, Table 3 presents the prices for plowing 1 acre of land by a four-wheel tractor. Farmers report that those costs have increased by 27 percent on average, mostly reflecting the higher cost of fuel in the country over these two seasons. However, a survey of mechanization service providers during the monsoon of 2022 showed in addition that they faced financial challenges and fears of foreclosure on machinery loans (MAPSA 2023b), possibly contributing to further price increases to farmers.

Third, the use of wage labor in agricultural activities is very common in Myanmar. It has been shown that wage levels in the past (before the COVID-19 pandemic) had been increasing fast because of the increasing possibilities of alternative employment in cities and neighboring countries. This partly explains the rapid adoption of agricultural mechanization in the country (Belton et al. 2021). However, this increase in real wages has come to a halt, seemingly due to mobility restrictions linked to COVID-19 as well as the widespread economic problems because of the political crisis (World Bank 2022, MAPSA 2021). Table 3 shows that average daily wages of hired labor of men increased in nominal terms by 20 percent and for women by 19 percent on average. However, wages decreased in real terms as inflation has been high in the country. MAPSA (2023c) estimated, based on a large food vendor survey in different parts of the country at the same time as the MAPS, that the costs of a typical food basket increased by 50 percent compared to a year earlier, substantially higher than these changes in wages. Real wages therefore declined by almost 30 percent over the previous 12 months (MAPSA 2023b).

We also see large increases in paddy prices, impacting the profitability of paddy rice production. Table 3 shows that at the national level average prices for paddy increased by 81 percent. Paddy prices were relatively lower in the Delta region and the Dry Zone, likely reflecting their surplus status.

Table 3: Input and output prices in paddy rice cultivation, monsoon 2021 and 2022

	Unit	Monsoon 2021 National	National	Hills	Monsoon 2022 Dry	Delta	Coastal
Inputs							
Urea price (kg)	Mean	1,257	2,352	2,298	2,356	2,309	2,677
	Median	1,240	2,400	2,240	2,400	2,200	2,800
Costs plowing 1 acre (4-wheel)	Mean	34,503	44,015	47,277	44,355	43,098	42,437
	Median	30,000	42,000	45,000	42,000	40,000	40,000
Daily wage man	Mean	6,200	7,448	7,642	6,883	7,423	9,275
	Median	6,000	7,000	7,000	6,000	7,000	10,000
Daily wage woman	Mean	4,972	5,893	6,304	5,565	5,676	6,922
	Median	5,000	6,000	6,000	5,000	5,000	7,000
Output							
Paddy price (kg)	Mean	380	685	706	702	668	656
	Median	359	670	694	718	670	658

Source: Authors' calculations based on MAPS, monsoon season 2021 (round 1) and monsoon season 2022 (round 3)

4. INPUT USE AND FARM MANAGEMENT PRACTICES

In this section, we look at input and farm management practices used in paddy cultivation, including seeds, agro-chemical and fertilizer use, and labor and mechanization as well as assess overall commercial input expenditures. Paddy rice farmers in Myanmar predominantly rely on their own saved paddy rice seeds from the previous harvest (Table 4). For the monsoon of 2022, 56 percent of the seed planted were own saved seeds, 23 percent of the paddy rice farmers indicated that they bought seeds from agri-input suppliers or the government, while 21 percent bought them from other farmers. Purchased seeds are usually improved seeds. The quality of reused seeds typically worsens the longer they are used by farmers suggesting that this lower reliance on the market likely leads to lower paddy rice yields overall (Spielman and Kennedy 2016; Denning et al. 2013).

We also note strong regional differences in the source of paddy rice seeds. Farmers use less purchased seeds in the Coastal areas while paddy rice farmers in the Dry Zone rely the most on purchased seeds. It is surprising that the market-oriented Delta region – the major paddy rice bowl – is relying less on purchased seeds. Only 17 percent of the farmers bought their seed from an agri-input dealer while 61 percent of the farmers relied on seeds obtained from their previous harvest.

Table 4: Paddy rice seed use (percentage of farmers)

	Unit	National	Hills	Dry	Delta	Coastal
Seed source						
Purchased from agri-input retailer or government	%	23.1	24.2	31.7	17.0	12.0
Purchased from other farmer	%	20.6	20.2	20.2	22.0	17.0
Left over (unused) purchased seed from last year	%	0.3	0.4	0.4	0.2	0.0
Saved (harvested) from last year	%	55.6	54.5	47.3	60.7	70.7
Other	%	0.3	0.7	0.4	0.1	0.2
Total	%	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations based on MAPS, monsoon season 2022

Table 5 gives an overview of fertilizer and other agro-chemical use on the largest paddy rice plot in the monsoon of 2022. Despite the large price increases of these inputs, we see relatively high shares of farmers that use chemical fertilizers and other agro-chemicals, with 90 percent of the farmers using chemical fertilizer during the 2022 monsoon. Seventy-one percent of the farmers used urea on their largest plot. The share of other types of fertilizers being used is much lower than urea.

Twenty percent of the farmers used compound 15-15-15 while other compound fertilizers were used by 13 percent of the farmers in the monsoon of 2022. Organic fertilizers were used by 49 percent, lime/gypsum by 9 percent), herbicides by 56 percent, and other pesticides by 45 percent.

We further note that chemical fertilizer use is widespread in all agro-ecological zones. In the Dry Zone, 88 percent of farmers were using chemical fertilizer compared to 92 percent in the Hills and Delta areas. Organic fertilizer use is significantly higher in the Dry Zone, likely linked to the higher prevalence of livestock ownership in that area. The use of lime and gypsum (probably associated with the management of salt water intrusion and the management of salinity), and herbicide is most prevalent in the Delta region.

Table 5: Agro-chemicals and fertilizer use on paddy rice cultivation (percentage of paddy rice farmers)

	Unit	National	Hills	Dry	Delta	Coastal
Chemical fertilizer						
Any chemical fertilizer	%	90.1	91.7	88.2	91.6	86.1
Urea	%	71.4	64.7	72.0	75.0	73.7
Ammonium sulphate	%	1.6	1.3	2.0	1.8	0.9
Compound 15_15_15	%	19.7	25.5	21.1	17.6	5.3
Other compound combined	%	13.2	16.9	13.4	11.9	7.4
Tsuper	%	8.4	7.7	4.2	10.2	20.1
Potash	%	1.9	1.8	0.9	3.0	0.9
Low quality fertilizer	%	1.4	1.9	1.8	0.8	0.7
Other fertilizer and agro-chemicals						
Organic fertilizer	%	49	46	63	40	41
Lime - gypsum	%	9	3	8	16	3
Herbicides	%	56	62	50	64	33
Other pesticides	%	45	55	41	44	37

Source: Authors' calculations based on MAPS, monsoon season 2022

During the monsoon of 2022, paddy rice farmers used 54 kgs of fertilizer per acre on average (Table 6). Despite the relatively large price increase, we only see a relatively small decline, of 8 percent on average, in the amount of chemical fertilizer used between the two last monsoon seasons, suggesting that chemical fertilizer is seen by farmers as a priority input for paddy rice productivity. Urea is the most important fertilizer used on paddy rice, making up 61 percent of all fertilizers used. Fertilizer use on paddy rice differs between regions and states in the country (Figure 3). Fertilizer use on paddy rice in the monsoon season is highest in the Hills and Mountains (63 kgs per acre) and lowest in the Coastal areas (41 kgs per acre).

Table 6: Chemical fertilizer use in paddy rice cultivation (kgs per acre)

		Monsoon 2021	Monsoon 2022				
	Unit	National	National	Hills	Dry	Delta	Coastal
Urea - kg	mean	32.9	33.3	32.5	31.7	36.1	29.5
	median	25.0	25.0	25.0	25.0	33.3	25.0
Ammonium sulphate - kg	mean	4.1	0.8	0.7	0.8	1.0	0.4
	median	0.0	0.0	0.0	0.0	0.0	0.0
Other fertilizer - kg (compound 15_15_15)	mean	8.8	9.1	14.2	9.4	7.1	1.8
	median	0.0	0.0	0.0	0.0	0.0	0.0
Other fertilizer - kg (other compound combined)	mean	8.9	6.2	9.2	6.2	4.9	2.6
	median	0.0	0.0	0.0	0.0	0.0	0.0
Other fertilizer - kg (T_super)	mean	3.9	3.7	4.6	1.8	4.3	6.1
	median	0.0	0.0	0.0	0.0	0.0	0.0
Other fertilizer - kg (Potash)	mean	0.8	0.6	0.7	0.2	1.1	0.3
	median	0.0	0.0	0.0	0.0	0.0	0.0
Other fertilizer - kg (Low quality - aukkone)	mean	-	0.6	0.7	0.8	0.4	0.2
	median	-	0.0	0.0	0.0	0.0	0.0
Total fertilizer - kg	mean	59.3	54.3	62.6	50.9	54.9	40.8
	median	50.0	50.0	50.0	48.0	50.0	33.0

Source: Authors' calculations based on MAPS, monsoon season 2022

The MAPS also captures the extent to which paddy rice farmers relied on hired labor, draught animals, and mechanization during the monsoon of 2022 (Table 7). During the monsoon of 2022, only 15 percent of the paddy rice farmers relied exclusively on their own family labor and 85 percent used outside help. On top of their own household labor, 63 percent of paddy rice farmers used solely hired labor, 8 percent used exchange labor, and 13 percent used a combination of hired and exchange labor. Substantial differences are noted over agro-ecological zones with 89 percent of paddy rice farmers in the Dry Zone relying on outside help while farmers in the coastal zones rely more on their own labor. However, outside help is still high, with 83 percent of famers relying on hired labor. In contrast with other zones, in the Hills we see relatively more reliance on exchange labor. In the Delta area, 75 percent of paddy rice farms relied on hired labor.

Paddy rice farmers in Myanmar rely heavily on mechanization for their paddy rice farm activities. Draught animals have traditionally been very important in paddy rice cultivation but were only used by 35 percent of paddy rice farmers. Draught animals are still important in the Dry Zone where 68 percent of the paddy rice farmers used them. Nationally, 82 percent of farmers used a tractor for plowing plots and half of the farmers used combine-harvesters to harvest paddy. Combine-harvesters are relatively less used in the Hills and Mountains, likely due to the higher share of upland paddy rice cultivation making it more difficult for combine-harvesters to move around there. Most paddy rice farmers relied on mechanization service providers for plowing, but it is noteworthy that 24 percent used their own tractor for plowing. Again, we see little changes over time, despite increases in prices of fuel for the running of tractors and in the charges by service providers for plowing as well as harvesting services (MAPSA 2023b).

Table 7: Labor use and mechanization in paddy rice cultivation (% of paddy rice farmers)

	Unit	National	Hills	Dry	Delta	Coastal
Non-family labor						
Hired	%	63.1	46.8	60.7	75.3	69.7
Exchange	%	8.2	15.4	10.2	2.7	2.5
Both	%	13.7	25.1	18.2	2.2	10.7
No	%	15.0	12.8	10.8	19.9	17.2
Draught animals						
Hired	%	10.6	8.3	20.6	3.8	6.9
Own	%	22.5	10.7	43.3	11.4	22.5
Both	%	2.2	1.5	4.2	1.0	1.0
No	%	64.7	79.4	32.0	83.8	69.6
Tractor for plowing						
Hired	%	56.2	0.5	0.6	0.6	0.6
Own	%	23.7	0.3	0.2	0.2	0.2
Both	%	2.6	0.0	0.0	0.0	0.0
No	%	17.5	0.2	0.3	0.1	0.2
Combine-harvester						
Hired	%	48.3	23.2	44.2	70.7	43.3
Own	%	1.3	1.1	0.9	1.6	1.5
Both	%	50.5	75.7	54.8	27.7	55.2
No	%	50.5	75.8	54.9	27.7	55.2

Source: Authors' calculations based on MAPS, monsoon season 2022

Finally, we assess overall (commercial) input expenditures on paddy rice. Commercial input expenditures might give a good indication of the intensity of input use in paddy rice production.[5] Table 8 shows that input expenditures per acre increased on average by 35 percent, and by 38 percent using the median, during the 2022 monsoon compared to the previous one. Despite the significant reduction in credit from the government, micro-finance institutions, and the private sector (MAPSA 2021) and the reductions in income (MAPSA 2023a), it seems that farmers were somehow able to still increase expenditures on their paddy rice plots and (partially) compensate for the increased prices of most inputs. The highest input expenditures per acre were noted in the Hills and Mountains and the Dry Zone (Table 8). Input expenditures were lowest in coastal areas.

Table 8: Monetary input expenditures (MMK/acre) on paddy rice

	Monsoon 2021	Monsoon 2022				
	National	National	Hills	Dry	Delta	Coastal
Mean	223,297	300,990	342,480	305,157	280,718	248,300
Median	200,000	277,778	300,000	278,424	266,667	233,333

Source: Authors' calculations based on MAPS, monsoon season 2022 (round 3) and monsoon season 2021 (round 1)

Despite the problems with declining incomes overall, the problematic banking situation, and the reduced access to credit, we note relatively small changes in farm management practices, input use, and input expenditures over the last two seasons. Paddy rice farmers were, on average, able to

[5] There are likely a number of issues with the measurement of input expenditures in MAPS. First, we only rely on monetary input expenditures. This is an imperfect way of assessing inputs into rice production as there are a number of non-monetary inputs going into rice production as well, such as family labor, organic fertilizer, and animal traction. Second, monetary input expenditures were approximated by farmers asking for a simple measure of what they spent on their largest rice plot. This might have been complicated to answer for farmers given that a number of inputs are bought in bulk and getting at the exact costs for a plot might therefore have been wrongly evaluated. Coming with a single number at once – combining all costs of fertilizer, agro-chemicals, mechanization, and hired labor – might also have been problematic. It is therefore likely that there is measurement error in this variable and a caveat for further analysis.

increase expenditures on paddy rice production and were therefore able to maintain most agricultural input use at similar levels in the monsoon of 2022 as in the previous monsoon.

5. NATURAL AND OTHER SHOCKS

Agriculture is a risky business. Climatic shocks are generally important risks in agricultural production.[6] When asked about the incidence of natural or other production shocks, 21 and 34 percent of the paddy rice farmers indicated that they were negatively impacted by at least one of these shocks in 2021 and 2022 respectively. Weather events were therefore seemingly not favorable for agricultural production in 2022. Moreover, the shocks reported over these two years were different. Drought negatively impacted 24.5 percent of (shock-affected) paddy rice farmers in 2021 while 36 percent were impacted in 2022. There were also more complaints in 2022 of irregular rains (17 percent in 2022; 15 percent in 2021) but less for heavy rains (16 percent in 2021; 12 percent in 2022). Incidences of pests, diseases, and weeds have the highest frequency overall. It is possible that less labor is used for weeding as farmers give priority to fertilizer in use of financial resources for inputs.

A variety of shocks have impacted agro-ecological zones and states/regions differently (Table 9). In the Dry Zone, 46 percent of (shock-affected) farmers were impacted by drought in 2022 and 33 percent during the monsoon season of 2021 (Figure 5). The effects were worse in the coastal zone where 66 percent of the shock-affected farmers complained about droughts. That was only 22 percent in the Hills and Mountains. Pests and disease problems were mentioned by 40 percent of the (shock-affected) paddy rice farmers in 2022, lower than in the previous monsoon (45 percent).

In an analysis of rainfall patterns during the monsoon of 2022 (ADPC 2023), it was found that compared to normal years, the South of the country received more and the North received less rainfall compared to normal. It was also found that Rakhine - part of the coastal area - received much less rainfall than the rest of the country. Moreover, the timing of rainfall was problematic during the monsoon of 2022. For the Delta, there was a large rainfall deficit during the month of June, which affected paddy rice growth.

[6] It is expected that such climatic shocks will increase in the future. Myanmar is seen as one of the countries most affected by climate change globally (IFRC 2021).

Table 9: Natural and other production shocks faced by paddy rice farmers (percentage of farmers)

	Unit	National	Hills	Dry	Delta	Coastal
				Monsoon 2021		
Crop negatively affected by any shock	%	21.4	19.5	19.8	26.1	13.1
If yes, which one (for shock-affected farmers)?						
Drought	%	24.5	25.0	32.6	16.7	38.3
Poor access to irrigation water	%	4.5	5.9	3.3	3.3	14.8
Irregular rain	%	14.7	19.9	10.9	15.0	11.6
Heavy rains	%	15.8	18.7	16.8	14.4	8.7
Floods	%	13.3	14.4	9.8	14.9	16.9
Flash floods	%	0.5	1.2	0.7	0.2	-
Extreme temperature	%	0.9	2.5	0.6	-	2.6
Pest, diseases, weeds	%	45.3	40.6	43.4	50.6	32.1
Damage by animals	%	5.8	7.7	1.7	6.9	12.5
Damaged by rats	%	4.3	1.0	4.6	5.9	2.8
Storm	%	1.4	-	1.4	2.0	2.8
Others	%	2.8	1.7	3.8	2.8	2.4
				Monsoon 2022		
Crop negatively affected by any shock	%	33.8	29.0	31.9	37.7	39.1
If yes, which one (for shock-affected farmers)?						
Drought	%	36.1	22.3	46.0	28.5	65.8
Poor access to irrigation water	%	3.5	3.6	5.2	0.9	8.0
Irregular rain	%	17.1	14.5	13.8	21.6	15.3
Heavy rains	%	12.4	23.6	11.1	9.8	2.6
Floods	%	9.4	15.5	6.5	7.7	12.3
Flash floods	%	0.6	1.3	0.5	-	1.7
Extreme temperature	%	1.4	0.7	0.7	1.0	7.7
Pest, diseases, weeds	%	40.0	34.9	37.0	48.9	24.0
Damage by animals	%	5.0	8.3	0.1	7.4	3.3
Damaged by rats	%	9.1	6.7	15.1	7.4	1.6
Storm	%	1.5	1.2	-	2.5	3.2
Others	%	3.0	5.2	2.4	1.9	4.7

Source: Authors' calculations based on MAPS, monsoon season 2022

6. PADDY RICE PRODUCTIVITY DURING THE MONSOONS OF 2022, 2021 AND 2020

National yields – based on reported yields of the largest plot – averaged 1,163 kgs per acre or 3.1 tons per hectare for the monsoon of 2022 (Table 10). Compared to the monsoon of 2021, we note a decrease in yields of 7.5 percent on average. The biggest decrease is noted in Rakhine state where productivity went down by 26 percent. This was seemingly linked to adverse weather conditions. For the Dry Zone overall, we note a yield decrease of 9 percent (we note yield decreases of 10 percent in Sagaing and 12 percent in Magway – both areas with high conflict). The Delta – the major paddy rice production area of the country – also saw a decrease (of 6 percent on average). Yields were overall lowest in Chin and Kayah, also two states with high levels of conflict.

Table 10: Paddy rice yields on the largest plot (kgs/acre), monsoon 2020, 2021 and 2022

	2020		2021		2022	
	Mean	Median	Mean	Median	Mean	Median
Kachin	1,496	1,568	1,319	1,254	1,225	1,254
Kayah	1,092	948	1,014	941	903	652
Kayin	1,232	1,254	1,264	1,254	1,138	1,045
Chin	988	896	845	980	809	557
Sagaing	1,404	1,393	1,406	1,393	1,265	1,313
Tanintharyi	1,129	1,150	1,060	1,045	1,098	1,086
Bago	1,401	1,393	1,343	1,359	1,204	1,254
Magway	1,470	1,463	1,503	1,463	1,325	1,358
Mandalay	1,465	1,463	1,450	1,463	1,341	1,293
Mon	1,106	1,045	1,212	1,150	1,027	1,045
Rakhine	1,251	1,115	1,275	1,189	938	836
Yangon	1,198	1,115	1,172	1,069	1,133	1,059
Shan	1,172	1,045	1,165	1,045	1,142	1,045
Ayeyawady	1,201	1,045	1,142	1,045	1,139	1,045
Nay Pyi Taw	1,355	1,463	1,408	1,393	1,443	1,493
Hills	1,216	1,170	1,187	1,087	1,141	1,045
Dry	1,429	1,418	1,438	1,463	1,306	1,358
Delta	1,277	1,254	1,232	1,229	1,159	1,115
Coastal	1,224	1,115	1,229	1,176	965	836
Area-weighted national average*	1,285		1,257		1,163	

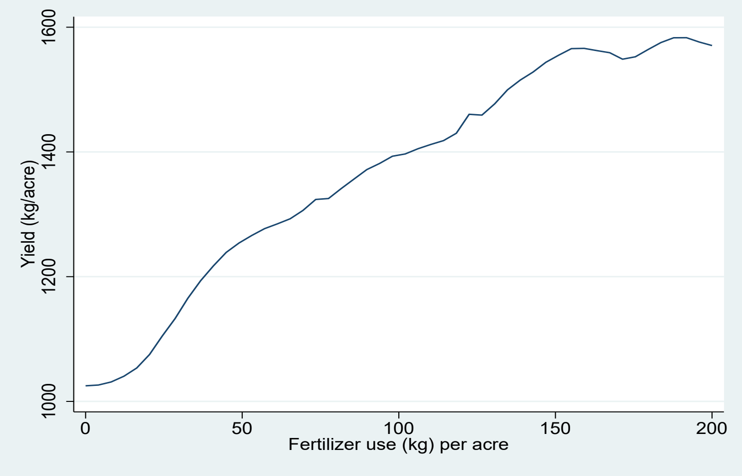
*: Using the cultivated areas of MoALI of 2020.
Source: Authors' calculations based on MAPS

We do not have good data on changes in paddy rice area cultivated during the monsoon of 2022 per state or region and therefore rely on alternative area estimates to make estimates of paddy rice production at the national level. Using area estimates done by the Asian Disaster Preparedness Center (ADPC) for major paddy rice areas in the country, paddy rice production at the national level is estimated to have decreased by 13 percent (ADPC 2023).[7]

To evaluate the impact of changes in yields over these two monsoons, we look at two important factors in particular. First, fertilizer use is strongly linked to higher paddy rice yields as shown in Figure 3. Comparing plots that did not receive any fertilizer with those that received 100 kgs per acre, paddy rice yields increased by almost 400 kgs of paddy per hectare or an increase of almost 40 percent. At average fertilizer use (56 kgs per acre in 2022 and 54 kgs in 2021), 1 kg of fertilizer generates approximately 4 kgs of extra paddy rice, confirming results found in earlier studies (MAPSA 2022b).

[7] However, as we lack good data on yields on all paddy rice plots and on areas cultivated for all states and regions, more research is needed to better assess national paddy rice production levels.

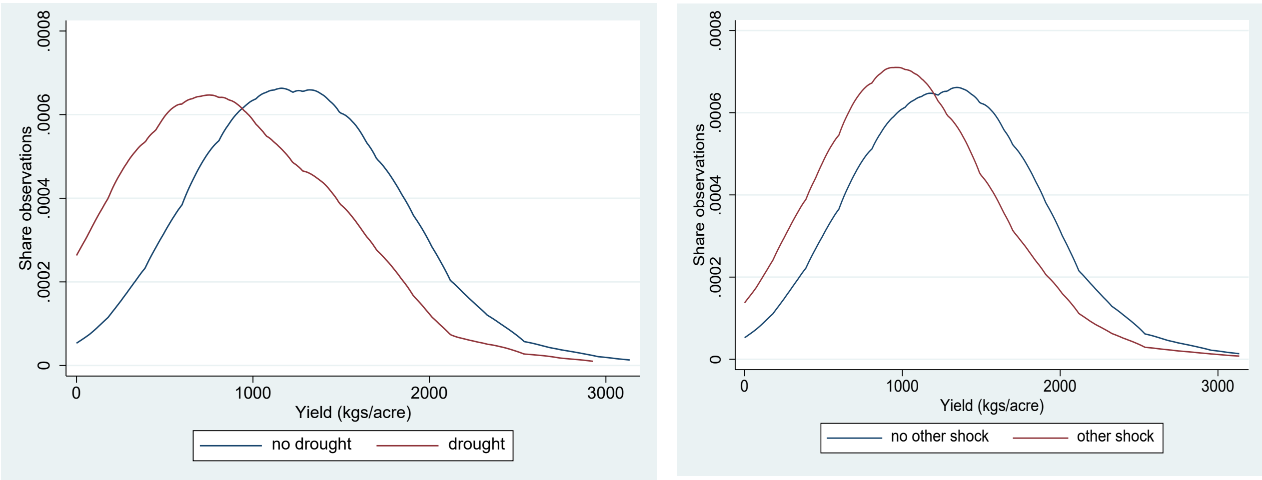
Figure 3: Fertilizer use and paddy rice yields, monsoon 2021 and 2022 data combined



Source: Authors' calculations based on MAPS, monsoon season 2022

Second, Figure 4 shows the extent that shocks influenced yields in the monsoon of 2021 and 2022. We distinguish the effects on yields of droughts and other shocks (i.e. all the shocks mentioned in Table 9) in Figure 4. We see a clear reduction in yields when plots are hit with any shock, as shown in the substantial left-ward shift of the distribution of paddy rice yields in the case of a shock. In the case of drought, average yields are 30 percent lower than in the case of no drought. In the case of other shocks, we note a reduction of 18 percent on average.

Figure 4: Droughts, other shocks, and paddy rice yields, monsoon 2021 and 2022 data combined



Source: Authors' calculations based on MAPS, monsoon season 2022

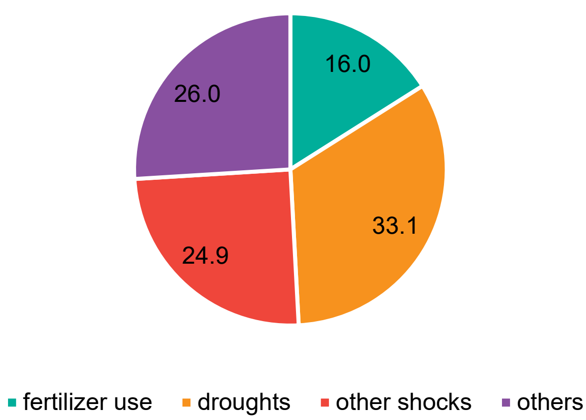
As other factors play a role in yields as well, we run a multivariate regression with paddy yields as the dependent variable and inputs, shocks during the growing season, upland or lowland growing conditions, and other factors as independent variables. Different specifications are presented in Table 11. We rely on data from those farmers that reported input and output data during the monsoon of 2022 and 2021 and rely on a fixed effects model to evaluate the impact of these variable factors on yields. In such a fixed effect model, time-invariant factors – such as characteristics of household, agro-ecological conditions, and asset ownership – are controlled for. Different specifications are presented in Table 11.

In the parsimonious model where we only control for a yearly dummy, we see a significant reduction in yields in 2022 compared to the monsoon of 2021 as shown by a significant coefficient on this dummy. When we additionally add fertilizer use, droughts, and other shocks, that significance on the yearly dummy disappears (at conventional statistical levels), indicating that most of the reduction in yields during the monsoon of 2022 is explained by these factors. The returns to 1 kg of fertilizer are 5 kgs of paddy rice at low levels of use. Due to a significant negative quadratic term, marginal returns decrease with increasing use, becoming zero at 219 kgs of fertilizer applied. Returns to fertilizers for an average paddy rice plot during the monsoons of 2022 and 2022 (55 kgs of fertilizer use per acre) is 3.8 kgs respectively. Incidences of droughts and other shocks are associated with a significant reduction of yields, by 273 and 167 kg per acre respectively.

In specification 3, we add a number of additional factors. Returns on fertilizer use change a bit when we control for other inputs in the longer specification. The estimates of these returns decrease and overall returns at low levels of use are 4.8 kgs of paddy rice (model 3). In specification 4, we estimate a pooled model. As few of the explanatory variables changed at the household level, this model might better reflect associations. Most of the explanatory variables of paddy rice yields show expected associations. We note lower yields for upland fields and fields where seeds are broadcast instead of row-planted or transplanted. Higher levels of labor from the household or less hired labor use are associated with lower paddy rice yields, seemingly indicating the importance of labor for paddy yields in the current settings, especially given their importance for weed control. Purchased seeds are associated with higher yields. Controlling for inputs and shocks, yields in the monsoon of 2022 were not significantly different from those in 2021, indicating that the variables used in the model mostly explain the differences.

We also assess to what extent these different factors explain the overall yield reduction in the monsoon of 2022 compared to the monsoon of 2021 (through the combination of these coefficients with the change in incidences of shocks or in input use) (Figure 5). We find that the biggest part of the change in yields is explained by the impact of shocks. One-third of the reduction in paddy yields is explained by the increasing incidence of droughts. The impact of other shocks explains a quarter of the decline. While the reduction in fertilizer use has also been a major factor, its impact has been much less than anticipated (MAPSA 2022b). It is estimated that 16 percent of the decline was explained by lower fertilizer use. The change in other factors - such as reduced access to labor, insecurity issues, but also factors that we were unable to measure well in our data - explains the rest of the reduction (26 percent).

Figure 5: Role of different factors in explaining the reduction in yields between the monsoon of 2022 and 2021 (in percentage)



Source: Authors' calculations based on MAPS, monsoon season 2022

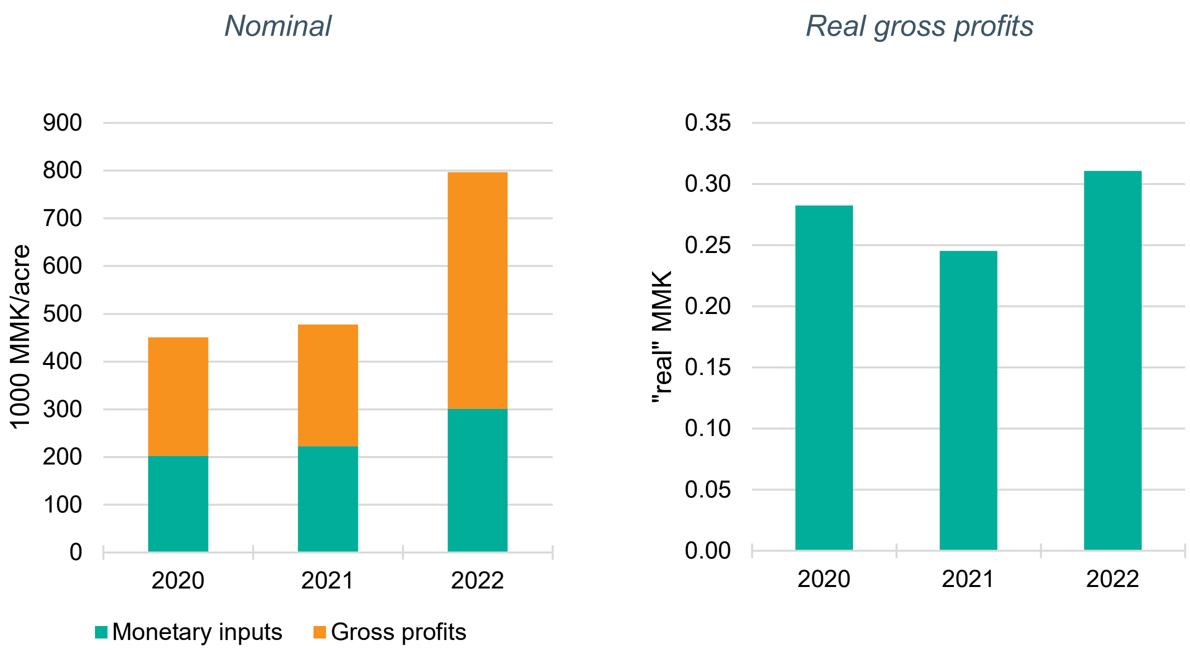
Table 11: Associates of paddy rice yields (kgs per acre), monsoon 2021 and 2022

Variable	Unit	Model 1		Model 2		Model 3		Model 4	
		Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Year 2022	1=yes	-51.64	-6.70	-12.14	-1.63	-11.45	-1.55	-19.18	-1.49
Fertilizer quantity	kg			5.08	8.53	4.82	8.18	3.30	8.66
Fertilizer quantity squared	kg			-0.01	-4.07	-0.01	-3.92	0.00	-1.49
Drought	1=yes			-274.40	-12.08	-273.71	-12.18	-275.63	-10.87
Other shocks	1=yes			-168.45	-11.01	-168.37	-11.11	-194.78	-12.30
Purchased seeds	1=yes					-31.59	-1.44	59.88	3.86
Upland field	1=yes					-263.70	-3.28	-293.98	-11.04
Broadcast	1=yes					-163.51	-5.95	-62.73	-4.59
Organic fertilizer used	1=yes					11.65	0.54	62.82	4.80
Lime used	1=yes					31.89	0.99	116.23	5.44
Pesticides used	1=yes					-6.12	-0.28	42.88	3.22
Mechanization used	1=yes					38.30	0.84	151.90	6.66
No hired labor used	1=yes					-130.50	-4.56	-60.15	-3.19
Working hh members	number					33.36	1.95	8.96	1.38
Household dummies	1=yes	yes		yes		yes		no	
Agro-ecological dummies	1=yes	no		no		no		yes	
Constant		1263.28	235.17	1080.51	49.67	1102.98	17.77	939.29	30.58
Number of observations		6,168		6,168		6,168		6,168	
R2		0.2		13.7		17.6		21.4	

Source: Authors' calculations based on MAPS, monsoon season 2022, robust standard errors

Finally, we assess how gross profits have changed over the last three monsoons, combining data from average yields, paddy prices, and commercial expenditures per acre over these periods. We see a significant improvement for gross revenues per acre in the most recent monsoon (2022): they increased by 67 percent compared to 2021 and by 77 percent compared to 2020 (Figure 6). As commercial expenditures increased by 35 percent over the last year, gross profits - reflecting rewards for family farm labor and the use of land - for paddy rice farmers increased by 95 percent from 2021 to 2022. While profits doubled in nominal terms compared to two years ago, price inflation has been high in the country (MAPSA 2023c) and real profit increased much less. Real profits, with nominal prices corrected by the change in the cost of an average food basket (MAPSA 2023b) evaluated in the beginning of 2021, 2022, and 2023, from paddy rice farming during the monsoon of 2022 increased by 26 percent and 10 percent compared to the monsoon of 2021 and 2020 respectively (Figure 6).

Figure 6: Gross nominal revenue and real - in terms of the cost of an average food basket - profits per acre in paddy rice production, monsoon seasons of 2020, 2021, and 2022



Source: Authors' calculations based on MAPS, monsoon season 2022 (round 3) and monsoon season 2021 (round 1)

7. CONCLUSIONS AND IMPLICATIONS

We analyze paddy rice productivity and profitability data for the monsoon season of 2022 from the Myanmar Agriculture Performance Survey (MAPS), fielded in the beginning of 2023. The survey covered plots of 3,076 paddy rice producers, spread across all states/regions of the country. We find that:

1. Paddy rice productivity – tons of paddy produced per unit of cultivated land – at the national level decreased on average by 7.5 percent during the monsoon of 2022 compared to the monsoon of 2021. The lower productivity is mostly explained by adverse weather conditions, with negative impacts of droughts during the monsoon of 2022. Lower input use and other factors - such as increased insecurity - played an important role as well. Paddy rice yields were lowest in Kayah and Chin, two conflict-affected states.
2. Prices for most inputs used in paddy rice cultivation increased significantly between these two seasons. Prices of urea, the most important chemical fertilizer used by paddy rice farmers, increased by 87 percent on average while mechanization costs increased by 27 percent. Small decreases are noted, on average, in the use of paddy rice inputs over the last two monsoons. Despite the large price increases for chemical fertilizer, its use declined only by 8 percent compared to the previous monsoon.
3. Paddy prices at the farm level increased by 81 percent, reflecting changes in international rice prices as well as the depreciation of the MMK. Gross revenues per acre increased in nominal terms by 67 percent, mostly due to these high price increases.
4. Real profits, with nominal prices corrected by the change in the cost of an average food basket, from paddy rice farming during the monsoon of 2022 increased by 26 percent and 10 percent compared to the monsoon of 2021 and 2020 respectively. While nominal profits for paddy rice

farmers increased by 95 percent over the last two seasons, price inflation has been high in the country and real profit increased much less.

While the rice sector demonstrated resilience in the country, the current situation is concerning given productivity declines and high price increases, raising fears for increased food insecurity in the country. We have found improved farm profitability this year and as fertilizer prices for the coming monsoon (the monsoon of 2023) are down (due to international price decreases[8]) and international rice prices are up (due to lower global stocks (USDA 2023)), this might further improve profitability - and incentives - for paddy production in 2023. These price developments might possibly reverse the declining productivity trend. The big unknowns that might impact paddy production in 2023 though are the weather - with less rainfall expected due to El Niño conditions in the second half of the year (FAO 2023) - and the evolution of conflict-related insecurity in the country.

[8] The urea price - Black Sea, bulk, spot, as reported by the World Bank - was 313 USD per ton in March 2023. This compares to 872 USD per ton a year earlier.

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