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Fertilizer Sector Improvement (FSI+)

Crop Cut Survey Report | 2017 Dry Season

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Acronyms

ADS	Agriculture Development Strategy
ANOVA	analysis of variance
BP	broadcast seeding paddy
BU	briquette urea
DOA	Department of Agriculture
FSI	Fertilizer Sector Improvement
GM	gross margins
ha	hectare
HYV	high-yielding variety
IC	input cost
IFDC	International Fertilizer Development Center
kg	kilograms
m	meter
MOP	muriate of potash
mt	metric ton
N	nitrogen
NUDP	non-urea deep placement
PU	prilled urea
S	sulfur
TP	transplanting paddy
TSP	triple superphosphate
UDP	urea deep placement
USAID	United States Agency for International Development

Introduction

The Fertilizer Sector Improvement (FSI) project, implemented by the International Fertilizer Development Center (IFDC), is funded by the United States Agency for International Development (USAID) for five years. Its first season was the wet season of 2014 when it ran nine field trials to test the adaptation of urea deep placement (UDP) technology in Ayeyarwady, Bago, and Yangon regions of Myanmar. Farmer training on UDP was provided in 10 townships (from three regions) in the summer paddy season of 2014/2015. In the wet season of 2015, farmers in 14 townships from three regions received UDP training. In the dry season of 2015/2016, farmer trainings were provided to more than 1,700 farmers in 18 townships from three regions. In the wet season of 2016, training was provided on UDP and good seed selection to more than 1,900 farmers in 27 townships. In the wet season of 2016, a refresher training was started for the previous beneficiary farmers. More than 2,463 farmers attended training in the 2016/2017 dry season (696 male and 248 female farmers attended first-time farmer training and 999 male and 520 female farmers attended refresher training) (Figure 1). Overall, 6,542 males and 2,909 females attended farmer training over the last five seasons.

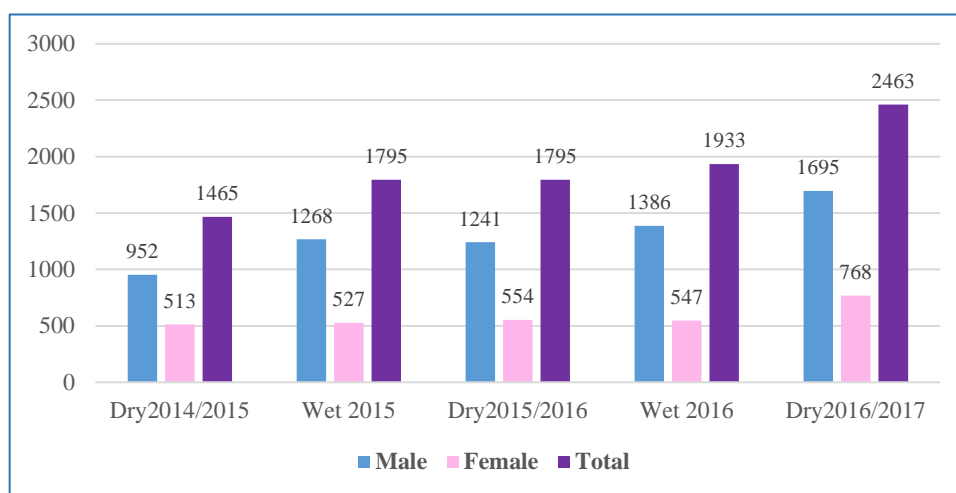


Figure 1. Number of Direct Beneficiary Farmers by Gender (2014/2015 – 2016/2017)

To measure the impact of the technology on rice yield, at the end of each season, the project takes crop cuts from a random sample of farmers who apply UDP and compare it with crop cuts from their fields without UDP. Two 5 meter (m) x 2 m plots are cut in each field with and

without UDP, threshed, weighed, and moisture measured to calculate yield per hectare (ha) at 14% moisture. Crop cuts were collected from a sample of 81 direct beneficiary farmers' fields during April to May 2017. This report describes the results for the crop cut taken at the end of the dry season of 2016/2017 in 18 townships.

Sample Size and Random Sampling of Direct Beneficiary Farmers Applying UDP

Lists of direct beneficiary farmers (who attended the farmer trainings and applied UDP in the dry season paddy) were received from field monitoring by the partners and extension team and from key farmers. A total of 831 farmers (615 male and 216 female) applied UDP in the dry season of 2016/2017 (by the end of March 2017). They were sorted by gender in each township and then, by using a random integer generator (non-repeating), a 10% random sample was obtained (in ascending number order) by gender in each township. The numbers of male and female farmers in the sample for the Yangon region were 14 and four, covering two project townships. There were 23 males and 11 females from three project townships in the sample for Bago region and 10 males and four females from two townships in the sample for Ayeyarwady region. Overall, **62 male** farmers and **22 female** farmers were randomly selected (Table 1).

Due to farmers' early harvesting date, data from four male farmers could not be collected. Data from one more female farmer was collected in Taikkyi. The numbers of collected samples are also given in Table 1 and Appendix 1.

Data on crop cut paddy yield with and without UDP (non-UDP), inputs used, dry season paddy cultivated area, percentage of total production sold, farm gate paddy price received, etc., were collected to estimate the gross margin of dry season paddy in 2017.

Table 1. Direct Beneficiary Farmers Applying UDP and Collected Sample Crop Cut Farmers by Gender

Region	Township	Apply UDP			Sample			Collected		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Ayeyarwady	Pyapon	32	15	47	3	2	5	3	2	5
Ayeyarwady	Kangyidaunt	72	23	95	7	2	9	6	2	8
Ayeyarwady	Einme	3	2	5	0	0	0	0	0	0
Ayeyarwady	Maubin	5	0	5	1	0	1	0	0	0
Ayeyarwady	Mawgyun	8	2	10	1	0	1	1	0	1
Ayeyarwady	Bogale	81	30	111	8	3	11	9	3	12
	Sub-total	201	72	273	20	7	27	19	7	26
Yangon	Khawmu	60	19	79	6	2	8	5	2	7
Yangon	Htantabin	88	23	111	9	2	11	9	2	11
Yangon	Taikkyi	15	3	18	2	0	2	2	1	3
	Sub-total	163	45	208	17	4	21	16	5	21
Bago	Daik-U	81	38	119	8	4	12	7	4	11
Bago	Thayarwady	87	36	123	9	4	12	8	4	12
Bago	Minhla	83	25	108	8	3	11	8	3	11
	Sub-total	251	99	350	25	11	35	23	11	34
	TOTAL	615	216	831	62	22	83	58	23	81

Farm Size Groups of the Sample Crop Cut Farmers

In all regions, the majority of both male and female farmers (more than 80%) were smallholders¹ working on 5 ha of paddy land or less. Using the Agriculture Development Strategy (ADS) farm size groups, 86% of total farmers in Yangon region were smallholders and the rest were medium-scale farmers. In Bago, 82% were smallholders, 15% were medium-scale, and 3% were in the large size group. In Ayeyarwady, 88% were smallholders, 4% were medium-scale, and 8% were large-scale farmers (Table 2). Disaggregating by gender, Table 2 shows that 20% of female farmers and 12% of male farmers owned medium-sized farms in Yangon region; 18% of female

¹ The Agriculture Census, 2014, classified farm size groups into five categories: Landless, Marginal (less than 2 acres [0.8 ha]), Small (2-5 acres [0.8-2.02 ha]), Medium (5-10 acres [2.02-4.05 ha]), and Large (greater than 10 acres [4.05 ha]). However the Agriculture Development and Investment Strategy (ADB 2017) refers to a smallholder as having less than 10 acres (4.05 ha). The Myanmar Agriculture Development Bank also provides credit to smallholders and defines this as those who own 10 acres (or 4.05 ha) or less. Therefore this report defines a smallholder as a farmer with less than 5 hectares.

farmers and 13% of male farmers owned medium-scale farms in Bago; and in Ayeyarwady, 14% of female farmers and 5% of male farmers owned large-scale farms.

Table 2. Farm Size Groups of Crop Cut Farmers by Gender and Region

		Farm Size Group				Total
		Small (<5 ha)	Medium (5.1 – 10 ha)	Large (>10 ha)		
Yangon	Female	Count	4 (80%)	1 (20%)	0	5 (100%)
	Male	Count	14 (87.5%)	2 (12.5%)	0	16 (100%)
	Total	Count	18 (85.7%)	3 (14.3%)	0	21 (100%)
Ayeyarwady	Female	Count	6 (85.7%)	0	1 (14.3%)	7 (100%)
	Male	Count	17 (89.5%)	1 (5.3%)	1 (5.3%)	19 (100%)
	Total	Count	23 (88.5%)	1 (3.8%)	2 (7.7%)	26 (100%)
Bago	Female	Count	9 (81.8%)	2 (18.2%)	0	11 (100%)
	Male	Count	19 (82.6%)	3 (13%)	1 (4.3%)	23 (100%)
	Total	Count	28 (82.4%)	5 (14.7%)	1 (2.9%)	34 (100%)
Total	Total Female	Count	19 (82.6%)	3 (13%)	1 (4.3%)	23 (100%)
	Total Male	Count	50 (82.6%)	6 (10.3%)	2 (3.4%)	58 (100%)
	TOTAL	Count	69 (85.2%)	9 (11.1%)	3 (3.7%)	81 (100%)

Average Dry Season Paddy Land With and Without UDP by Gender and Region

The average area of dry season paddy land with UDP was larger for male farmers than the average area of UDP land for female farmers in Yangon and Ayeyarwady regions (Table 3). But the average area of UDP land was the same for both male and female farmers (0.06 ha) in Bago region.

For non-UDP land, the average area for female farmers was larger than for male farmers in Yangon and Ayeyarwady regions. For example, the average non-UDP land area for female farmers was 3.5 ha while non-UDP land area for male farmers was 3.0 ha in Ayeyarwady region. Both male and female farmers in Bago region worked on the same size of non-UDP land in dry season paddy, 2017.

The Analysis of Variance (ANOVA) table shows that there is no significant difference in both UDP and non-UDP land size among the regions. The t-test also shows no significant difference in both UDP and non-UDP land size between male and female farmers.

Table 3. UDP and Non-UDP Dry Season Paddy Land by Gender and Region

		UDP (ha)		NUDP (ha)	
Yangon	Female	Mean	.0960	3.6280	
		N	5	5	
		Std. Deviation	.08050	2.54543	
	Male	Mean	.1381	3.3331	
		N	16	16	
		Std. Deviation	.19900	2.26268	
	Total	Mean	.1281	3.4033	
		N	21	21	
		Std. Deviation	.17702	2.26985	
Ayeyarwady	Female	Mean	.0800	3.5629	
		N	7	7	
		Std. Deviation	.00000	3.48278	
	Male	Mean	.1253	3.0521	
		N	19	19	
		Std. Deviation	.19274	4.40003	
	Total	Mean	.1131	3.1896	
		N	26	26	
		Std. Deviation	.16482	4.11143	
Bago	Female	Mean	.0600	3.0309	
		N	11	11	
		Std. Deviation	.00000	2.22808	
	Male	Mean	.0609	3.1065	
		N	23	23	
		Std. Deviation	.00417	3.08842	
	Total	Mean	.0606	3.0821	
		N	34	34	
		Std. Deviation	.00343	2.80438	

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
UDP (ha) * Bago=1, Aye=2,YGN=3	Between Groups	(Combined)	.072	2	.036	2.142	.124
	Within Groups		1.306	78	.017		
	Total		1.378	80			
NUDP(ha) * Bago=1, Aye=2,YGN=3	Between Groups	(Combined)	1.344	2	.672	.067	.935
	Within Groups		785.171	78	10.066		
	Total		786.515	80			

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
UDP (ha)	Equal variances assumed	2.683	.105	-.907	79	.367	-.02936	.03238	-.09381	.03508
	Equal variances not assumed			-1.363	71.280	.177	-.02936	.02154	-.07231	.01358
NUDP(ha)	Equal variances assumed	.054	.816	.221	79	.826	.17140	.77727	-1.37571	1.71852
	Equal variances not assumed			.245	51.425	.807	.17140	.69934	-1.23229	1.57510

Seed

Sources of Seeds by Gender and Region

Half or more than half of the sample farmers sowed seed from their own harvest rather than purchasing certified seeds from seed growers, seed companies, or the Department of Agriculture (DOA). More male farmers used their own seeds in Yangon (50%), Ayeyarwady (58%), and Bago (52%) regions (Table 4) than female farmers. The second most prevalent source of seed was buying seeds from other farmers. A higher percentage of male farmers (44% male vs. 40% female) in Yangon, the same percentage of both male and female farmers in Ayeyarwady (42%), and more female farmers than male farmers in Bago region (45% vs. 43%) bought seeds from other farmers. A higher percentage of female farmers in Yangon (20% female vs. 6% male) and Bago (9% female vs. 4% male) bought seeds from DOA, but no farmers bought seeds from DOA in Ayeyarwady region.

Table 4. Sources of Paddy Seeds by Gender and Region

		Seed Sources				Total
		Own Seed	Buy from Seed Growers	Buy from DOA		
Yangon	Female	Count	2	2	1	5
		%	40.0%	40.0%	20.0%	100.0%
	Male	Count	8	7	1	16
		%	50.0%	43.8%	6.2%	100.0%
	Total	Count	10	9	2	21
		%	47.6%	42.9%	9.5%	100.0%
Ayeyarwady	Female	Count	4	3		7
		%	57.1%	42.9%		100.0%
	Male	Count	11	8		19
		%	57.9%	42.1%		100.0%
	Total	Count	15	11		26
		%	57.7%	42.3%		100.0%
Bago	Female	Count	5	5	1	11
		%	45.5%	45.5%	9.1%	100.0%
	Male	Count	12	10	1	23
		%	52.2%	43.5%	4.3%	100.0%
	Total	Count	17	15	2	34
		%	50.0%	44.1%	5.9%	100.0%

Seed Selection and/or Treatment

Farmers either sow raw seed, pre-germinate raw seed by soaking in fresh water, select good seed by immersing in salt water, and/or pre-germinate good seed by soaking in fresh water. Most farmers pre-germinate raw seed. Figure 2 shows the highest percentage of both male (68%) and female (100%) farmers in Ayeyarwady region treated raw seeds in fresh water before planting. In Yangon, it was 56% of male farmers and 40% of the female farmers. Bago had the lowest percentage for both male (30%) and female (27%) farmers.

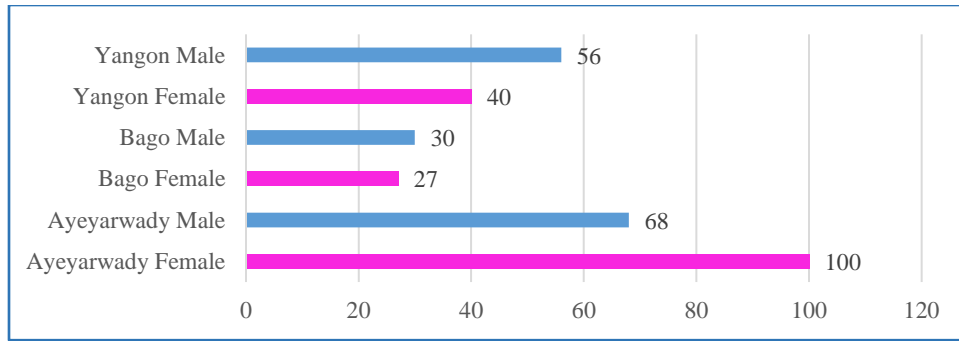


Figure 2. Applied Seed Treatment by Gender and Region in Dry Season of 2017

Some farmers did the seed selection in salt water before planting. For example, about 20% of female and 31% of male farmers in Yangon region selected paddy seeds in salt water to remove unfilled seeds (Table 5). But no female farmers in Bago and Ayeyarwady regions did seed selection. A lower percentage of male farmers in Bago and Ayeyarwady regions did seed selection in the dry paddy season of 2017.

To get the pre-germinated seeds, some farmers did seed treatment in fresh water (but not selected seeds in salt water) before planting. All female farmers and 68% of male farmers in Ayeyarwady region used pre-germinated seeds. A higher percentage of male farmers treated raw seeds in fresh water in Yangon and Bago regions. Overall, 77%, 52%, and 29% of farmers in Ayeyarwady, Yangon, and Bago regions treated seeds in fresh water. About 72% of female and 65% of male farmers in Bago region did not do seed selection or seed treatment.

Table 5. Paddy Seed Treatment and Seed Selection in Dry Season, 2017

			Seeds Before Growing			
			Did Nothing (Raw Seeds)	Selected Seeds in Salt Water but Not Treated	Treated Seeds in Fresh Water but Not Selected	Total
Yangon	Female	Count	2	1	2	5
		%	40.0%	20.0%	40.0%	100.0%
	Male	Count	2	5	9	16
		%	12.5%	31.2%	56.2%	100.0%
	Total	Count	4	6	11	21
		%	19.0%	28.6%	52.4%	100.0%
Ayeyarwady	Female	Count	0	0	7	7
		%	.0%	.0%	100.0%	100.0%
	Male	Count	4	2	13	19
		%	21.1%	10.5%	68.4%	100.0%
	Total	Count	4	2	20	26
		%	15.4%	7.7%	76.9%	100.0%
Bago	Female	Count	8	0	3	11
		%	72.7%	.0%	27.3%	100.0%
	Male	Count	15	1	7	23
		%	65.2%	4.3%	30.4%	100.0%
	Total	Count	23	1	10	34
		%	67.6%	2.9%	29.4%	100.0%

Establishment Practices of the Sample Crop Cut Farmers

Ninety-seven percent of farmers in Bago region, 96% in Ayeyarwady, and 76% in Yangon used broadcasting seeds as their crop establishment practice. A higher percentage of female farmers in Yangon (80%) and Ayeyarwady (100%) region practiced “broadcasting seeds” in the dry season of 2017. Only 20% of female farmers in Yangon region used a drum seeder, and no female or male farmers in other regions used a drum seeder (Table 6). All male farmers in Bago, 95% in Ayeyarwady, and 75% of male farmers in Yangon practiced broadcasting seeds. Only two male farmers in Yangon region used a drum seeder. No female farmers in Yangon or Ayeyarwady regions practiced transplanting paddy, and only one female farmer in Bago region transplanted rice. One male farmer in Ayeyarwady and two male farmers in Yangon region transplanted rice.

Table 6. Establishment Practice of Sample Crop Cut Farmers in Dry Season 2017

		Transplant=1, Broadcast=2, Seeder=3				
		Transplant	Broadcast	Seeder	Total	
Yangon	Female	Count	0	4	1	5
		%	.0%	80.0%	20.0%	100.0%
	Male	Count	2	12	2	16
		%	12.5%	75.0%	12.5%	100.0%
	Total	Count	2	16	3	21
%	9.5%	76.2%	14.3%	100.0%		
Ayeyarwady	Female	Count	0	7		7
		%	.0%	100.0%		100.0%
		Count	1	18		19
	%	5.3%	94.7%		100.0%	
	Total	Count	1	25		26
%	3.8%	96.2%		100.0%		
Bago	Female	Count	1	10		11
		%	9.1%	90.9%		100.0%
	Male	Count	0	23		23
		%	.0%	100.0%		100.0%
	Total	Count	1	33		34
%	2.9%	97.1%		100.0%		

Seed Rate by Establishment Practice With UDP or Non-UDP in Dry Season Paddy Land

The male farmers in Yangon region used a higher seed rate (125 kilograms per hectare [kg/ha]) in broadcasting seeds than transplanting paddy (90 kg/ha) or with a seeder (103 kg/ha). The average seed rate of female farmers was higher when using a seeder (155 kg/ha) than broadcasting (123 kg/ha) (Table 7). The female farmers in Ayeyarwady region used a lower seed rate (129 kg/ha) than male farmers (145 kg/ha) using the broadcasting method. The only male farmer who practiced transplanting paddy used a higher seed rate of 155 kg/ha. The female farmers who practiced the broadcasting method in Bago region used a higher seed rate (135 kg/h) than male farmers (119 kg/ha). The only female farmer in Bago region who practiced the transplanting method used a lower seed rate (129 kg/ha) than what was used for the broadcasting method.

Table 7. Mean Seed Rate by Cultural Practice and UDP and Non-UDP for Dry Season Paddy Land

				Seed Rate (kg/ha)	UDP (ha)	NUDP (ha)	
Yangon	Female	Broadcast	Mean	122.6025	.1050	2.6275	
			N	4	4	4	
		Seeder	Mean	154.8700	.0600	7.6300	
			N	1	1	1	
		Total	Mean	129.0560	.0960	3.6280	
	N		5	5	5		
	Male	Transplant	Mean	90.3400	.0900	3.5550	
			N	2	2	2	
		Broadcast	Mean	124.7558	.1592	3.4575	
			N	12	12	12	
		Seeder	Mean	103.2500	.0600	2.3650	
			N	2	2	2	
		Total	Mean	117.7656	.1381	3.3331	
			N	16	16	16	
		Total	Transplant	Mean	90.3400	.0900	3.5550
				N	2	2	2
	Broadcast		Mean	124.2175	.1456	3.2500	
			N	16	16	16	
	Seeder		Mean	120.4567	.0600	4.1200	
			N	3	3	3	
	Total	Mean	120.4538	.1281	3.4033		
N	21	21	21				
Ayeyarwady	Female	Broadcast	Mean	129.0586	.0800	3.5629	
			N	7	7	7	
		Total	Mean	129.0586	.0800	3.5629	
			N	7	7	7	
	Male	Transplant	Mean	154.8700	.0800	1.3400	
			N	1	1	1	
		Broadcast	Mean	144.8322	.1278	3.1472	
			N	18	18	18	
		Total	Mean	145.3605	.1253	3.0521	
			N	19	19	19	
	Total	Transplant	Mean	154.8700	.0800	1.3400	
			N	1	1	1	
		Broadcast	Mean	140.4156	.1144	3.2636	
			N	25	25	25	
Total		Mean	140.9715	.1131	3.1896		
		N	26	26	26		

			Seed Rate (kg/ha)	UDP (ha)	NUDP (ha)	
Bago	Female	Transplant	Mean	129.0600	.0600	1.5600
			N	1	1	1
		Broadcast	Mean	134.8910	.0600	3.1780
			N	10	10	10
		Total	Mean	134.3609	.0600	3.0309
			N	11	11	11
	Male	Broadcast	Mean	118.9596	.0609	3.1065
			N	23	23	23
		Total	Mean	118.9596	.0609	3.1065
			N	23	23	23
	Total	Transplant	Mean	129.0600	.0600	1.5600
			N	1	1	1
		Broadcast	Mean	123.7873	.0606	3.1282
			N	33	33	33
Total		Mean	123.9424	.0606	3.0821	
		N	34	34	34	

The majority of both male and female farmers used a seed rate of over 80 kg/ha in Ayeyarwady and Bago regions. For example, 94% of male and 86% of female farmers in Ayeyarwady region used a seed rate of more than 80 kg/ha. About 91% of male and 90% of female farmers in Bago region used a seed rate of more than 80 kg/ha (Table 8). Half of female farmers and 75% of male farmers in Yangon region used a seed rate of over 80 kg/ha in dry season paddy.

Table 8. Seeding Rate of Broadcast Seeded Rice by Gender and Region

		Seed Rate			
		Used Less Than 80 kg/h	Used More Than 80 kg/h	Total	
Yangon	Female	Count	2	2	4
		%	50.0%	50.0%	100.0%
	Male	Count	3	9	12
		%	25.0%	75.0%	100.0%
	Total	Count	5	11	16
		%	31.2%	68.8%	100.0%
Ayeyarwady	Female	Count	1	6	7
		%	14.3%	85.7%	100.0%
	Male	Count	1	17	18
		%	5.6%	94.4%	100.0%
	Total	Count	2	23	25
		%	8.0%	92.0%	100.0%
Bago	Female	Count	1	9	10
		%	10.0%	90.0%	100.0%
	Male	Count	2	21	23
		%	8.7%	91.3%	100.0%
	Total	Count	3	30	33
		%	9.1%	90.9%	100.0%

Paddy Variety Planted in Dry Season 2017

All female farmers in Yangon and Ayeyarwady regions used a high-yielding variety (HYV) in the dry season of 2017. About 88% and 95% of male farmers in Yangon and Ayeyarwady regions also used an HYV. About 12% and 5% of male farmers in Yangon and Ayeyarwady regions used a hybrid variety of rice. No female farmers used a hybrid variety in these regions (Table 9). All male farmers and 73% of female farmers in Bago region used an HYV. About 27% of female farmers in Bago region used a hybrid variety in the dry season of 2017.

Table 9. Paddy Variety Planted by Gender and Region in Dry Season 2017

		Paddy Variety Used				
		HYV	Hybrid	Local	Total	
Yangon	Female	Count	5 (100%)	-	-	5
	Male	Count	14 (87.5%)	2 (12.5%)	-	16
	Total	Count	19 (90.5%)	2 (9.5%)	-	21
Ayeyarwady	Female	Count	7 (100%)	-	-	7
	Male	Count	18 (94.7%)	1 (5.3%)	-	19
	Total	Count	25 (96.2%)	1 (3.8%)	-	26
Bago	Female	Count	8 (72.7%)	3 (27.3%)	-	11
	Male	Count	23 (100%)	-	-	23
	Total	Count	31 (91.2%)	3 (8.8%)	-	34

Fertilizer Practice

Use of Basal Fertilizer by Gender and Region

A higher percentage of female farmers in all regions used a basal fertilizer in dry season paddy, 2017. For example, all female farmers in Yangon and Ayeyarwady regions used a basal fertilizer, whereas 69% and 95% of male farmers in Yangon and Ayeyarwady regions applied a basal fertilizer (Table 10). Between the regions, a lower percentage of both male (22%) and female farmers (36%) in Bago used a basal fertilizer in dry season paddy. Thus, 73% of total farmers in the Bago region did not use a basal fertilizer in dry season paddy, 2017.

Table 10. Use of Basal Fertilizer by Gender and Region

		Use of Basal Fertilizer			
		Used Basal	Did Not Use	Total	
Yangon	Female	Count	5	0	5
		%	100.0%	.0%	100.0%
	Male	Count	11	5	16
		%	68.8%	31.2%	100.0%
Total	Count	16	5	21	
	%	76.2%	23.8%	100.0%	
Ayeyarwady	Female	Count	7	0	7
		%	100.0%	.0%	100.0%
	Male	Count	18	1	19
		%	94.7%	5.3%	100.0%
Total	Count	25	1	26	
	%	96.2%	3.8%	100.0%	
Bago	Female	Count	4	7	11
		%	36.4%	63.6%	100.0%
	Male	Count	5	18	23
		%	21.7%	78.3%	100.0%
Total	Count	9	25	34	
	%	26.5%	73.5%	100.0%	

Basal Fertilizer Used Without UDP by Gender and Region

The type of basal fertilizer used varies among regions (Table 11). About 80% of female farmers and 73% of male farmers in Yangon region used triple superphosphate (TSP) as a basal fertilizer in dry season paddy in their non-UDP fields. The rest of the female farmers (20%) and 18% of male farmers in Yangon region used both TSP and muriate of potash (MOP). Only one male farmer used a compound fertilizer as a basal in Yangon region.

All female and 72% of male farmers in Ayeyarwady region used TSP as a basal fertilizer application in dry season paddy. Eleven percent of male farmers used compound fertilizer and another 11% used TSP plus MOP as a basal fertilizer. Only one male farmer used TSP, MOP, and gypsum as a basal fertilizer in the Ayeyarwady region.

In Bago region, 25% of female farmers used TSP only, 25% used compound fertilizer only, 25% used prilled urea, and 25% used prilled urea coated with herbicide as a basal fertilizer in dry season paddy.

The majority of male farmers (40%) in Bago region used TSP and MOP as a basal fertilizer. Twenty percent of male farmers used TSP and 20% used compound fertilizer and manure (cow dung) as a basal fertilizer in dry season paddy, 2017.

Table 11. Types of Basal Fertilizer Used Without UDP by Gender by Region

		Basal Fertilizer								Total
		TSP	Compound	TSP+MOP	Prilled Urea	Manure	Prilled Urea + Herbicide	TSP+MOP+Gypsum		
Yangon	Female	Count	4		1					5
		%	80.0%		20.0%					100.0%
	Male	Count	8	1	2					11
		%	72.7%	9.1%	18.2%					100.0%
Total	Count	12	1	3					16	
	%	75.0%	6.2%	18.8%					100.0%	
Ayeyarwady	Female	Count	7							7
		%	100.0%							100.0%
	Male	Count	13	2	2				1	18
		%	72.2%	11.1%	11.1%				5.6%	100.0%
Total	Count	20	2	2				1	25	
	%	80.0%	8.0%	8.0%				4.0%	100.0%	
Bago	Female	Count	1	1		1		1		4
		%	25.0%	25.0%		25.0%		25.0%		100.0%
	Male	Count	1	1	2		1			5
		%	20.0%	20.0%	40.0%		20.0%			100.0%
Total	Count	2	2	2	1	1		1	9	
	%	22.2%	22.2%	22.2%	11.1%	11.1%		11.1%	100.0%	

Basal Fertilizer Used With UDP by Gender and Region

In UDP fields, no female farmer in Yangon or Ayeyarwady regions used briquette urea (BU) on its own. About 80% and 20% of female farmers in Yangon region used BU and TSP, and BU, TSP, and MOP, respectively. All female farmers in Ayeyarwady region used BU and TSP (Table 12).

Half of the male farmers in Yangon region used BU and TSP, but about 31% of male farmers used BU only. Twelve percent of male farmers in Yangon region used BU, TSP, and MOP and 6% of male farmers in Yangon region used BU and compound fertilizer.

The majority of male farmers (68%) applied BU plus TSP in Ayeyarwady region. Ten percent of male farmers used BU plus compound fertilizer, and 10% used BU plus TSP and MOP. One male farmer used BU only, and one used BU plus TSP, MOP, and gypsum. The majority of both male (78%) and female (64%) farmers in Bago region used BU only. Nine percent of female farmers used BU and TSP, 9% used BU and compound, 9% used BU and prilled urea, and 9% used BU and prilled urea with herbicide. About 4% of male farmers in Bago region used BU with TSP, 4% used BU with compound, and 4% used BU with manure. The rest of the male farmers (9%) used BU, TSP, and MOP in Bago region.

Table 12. Types of Basal Fertilizer Used in UDP Fields by Gender and Region

		BU Only and BU With Basal Fertilizer									
		BU Only	TSP	Compound	TSP+ MOP	Prilled Urea	Manure	Prilled Urea+ Herbicide	TSP+MOP+ Gypsum	Total	
Yangon	Female	Count	4		1					5	
		%	80.0%		20.0%					100.0%	
	Male	Count	5	8	1	2				16	
		%	31.2%	50.0%	6.2%	12.5%				100.0%	
Total	Count	5	12	1	3				21		
	%	23.8%	57.1%	4.8%	14.3%				100.0%		
Ayeyarwady	Female	Count	7							7	
		%	100.0%							100.0%	
	Male	Count	1	13	2	2			1	19	
		%	5.3%	68.4%	10.5%	10.5%			5.3%	100.0%	
Total	Count	1	20	2	2			1	26		
	%	3.8%	76.9%	7.7%	7.7%			3.8%	100%		
Bago	Female	Count	7	1	1		1		1	11	
		%	63.6%	9.1%	9.1%		9.1%		9.1%	100.0%	
	Male	Count	18	1	1	2		1		23	
		%	78.3%	4.3%	4.3%	8.7%		4.3%		100.0%	
	Total	Count	25	2	2	2	1	1	1	34	
		%	73.5%	5.9%	5.9%	5.9%	2.9%	2.9%	2.9%	100.0%	

Fertilizers Used Without UDP by Gender and Region

At the different growth stages of paddy plant, paddy farmers used different kinds of fertilizers. Most male farmers in all regions applied “prilled urea”² in dry season paddy. In Ayeyarwady, all male farmers applied prilled urea, while it was 94% in Yangon and 91% in Bago (Table 13). For female farmers, all applied prilled urea in Ayeyarwady, but only 80% in Yangon and 73% in Bago.

Table 13. Use of Prilled Urea in Non-UDP fields by Gender and Region

			Use of Prilled Urea in NUDP		Total
			Used PU	Did Not Use	
Yangon	Female	Count	4 (80%)	1 (20%)	5
	Male	Count	15 (94%)	1 (6%)	16
	Total	Count	19 (91%)	2 (9%)	21
Ayeyarwady	Female	Count	7 (100%)		7
	Male	Count	19 (100%)		19
	Total	Count	26 (100%)		26
Bago	Female	Count	8 (73%)	3 (27%)	11
	Male	Count	21 (91%)	2 (9%)	23
	Total	Count	29 (85%)	5 (15%)	34

A higher percentages of farmers in Yangon (71%) and Ayeyarwady (96%) did not use compound fertilizers. In Bago, 56% did use compound fertilizer – 73% of female farmers and 48% of male farmers.

Table 14. Use of Compound Fertilizer in Non-UDP Fields by Gender and Region

			Use of NPK		Total
			Used NPK	Did Not Use	
Yangon	Female	Count	2 (40%)	3 (60%)	5
	Male	Count	4 (25%)	12 (75%)	16
	Total	Count	6 (29%)	15 (71%)	21
Ayeyarwady	Female	Count	0	7 (100%)	7
	Male	Count	1 (5%)	18 (95%)	19
	Total	Count	1 (4%)	25 (96%)	26
Bago	Female	Count	8 (73%)	3 (27%)	11
	Male	Count	11 (48%)	12 (52%)	23
	Total	Count	19 (56%)	15 (14%)	34

² Prilled or granular.

Very few farmers applied TSP. Only 25% of male farmers in Yangon region and 4% of male farmers in Bago region used TSP. No female farmers in any region applied TSP (Table 15).

Table 15. Use of TSP in Non-UDP Fields by Gender and Region

		Use of TSP			
		Used TSP	Did Not Use	Total	
Yangon	Female	Count	0	5 (100%)	5
	Male	Count	4 (25%)	12 (75%)	16
	Total	Count	4 (19%)	17 (81%)	21
Ayeyarwady	Female	Count		7 (100%)	7
	Male	Count		19 (100%)	19
	Total	Count		26 (100%)	26
Bago	Female	Count	0	11 (100%)	11
	Male	Count	1 (4%)	22 (96%)	23
	Total	Count	1 (3%)	33 (97%)	34

A higher percentage of female farmers in Yangon and Bago regions used MOP (Table 16). No female and 32% of male sample farmers applied MOP in non-UDP plots in Ayeyarwady region. Overall, 33%, 23%, and 6% of total sample farmers used MOP in dry season paddy in 2017.

Table 16. Use of MOP in Non-UDP Fields by Gender and Region

		Use of MOP			
		Used MOP	Did Not Use	Total	
Yangon	Female	Count	2 (40%)	3 (60%)	5
	Male	Count	5 (31%)	11 (69%)	16
	Total	Count	7 (33%)	14 (67%)	21
Ayeyarwady	Female	Count	0	7 (100%)	7
	Male	Count	6 (32%)	13 (68%)	19
	Total	Count	6 (23%)	20 (77%)	26
Bago	Female	Count	2 (18%)	9 (82%)	11
	Male	Count	0	23 (100%)	23
	Total	Count	2 (6%)	32 (94%)	34

Only one male farmer in Yangon and one in Bago used gypsum in their non-UDP plots (Table 17).

Table 17. Use of Gypsum in Non-UDP Fields by Gender and Region

		Use of Gypsum			
		Used Gypsum	Did Not Use	Total	
Yangon	Female	Count		5 (100%)	5
	Male	Count	1 (6%)	15 (94%)	16
	Total	Count	1 (5%)	20 (95%)	21
Ayeyarwady	Female	Count		7 (100%)	7
	Male	Count		19 (100%)	19
	Total	Count		26 (100%)	26
Bago	Female	Count		11 (100%)	11
	Male	Count	1 (4%)	22 (96%)	23
	Total	Count	1 (3%)	33 (97%)	34

About half of the total sample farmers in Yangon and Bago regions applied the special fertilizers only for paddy in dry paddy production (Table 18). These included, for example, gypsum-coated urea fertilizer (slowly released N), compound fertilizer with herbicide (most popular), Comet brand fertilizer with S, special fertilizer to get maximum tillers, and special fertilizer to get good panicles.

The higher percentage of female farmers in Yangon (60% of total females) and Bago (82% of total females) regions applied special fertilizers. No female farmers and 10% of male farmers applied special fertilizers in non-UDP paddy fields in Ayeyarwady region.

Table 18. Use of Other Specialized Fertilizers for Rice in Non-UDP Fields by Gender and Region

		Use of Special Fertilizers			
		Used Special Fertilizers	Did Not Use	Total	
Yangon	Female	Count	3 (60%)	2 (40%)	5
	Male	Count	7 (44%)	9 (56%)	16
	Total	Count	10 (48%)	11 (52%)	21
Ayeyarwady	Female	Count	0	7 (100%)	7
	Male	Count	2 (10%)	17 (90%)	19
	Total	Count	2 (8%)	24 (92%)	26
Bago	Female	Count	9 (82%)	2 (18%)	11
	Male	Count	8 (35%)	15 (65%)	23
	Total	Count	17 (50%)	17 (50%)	34

Use of Organic Fertilizer and Types of Organic Fertilizer by Gender and Region

Among the regions, a higher percentage of both male (26%) and female (18%) farmers in Bago region applied organic fertilizer than the farmers in Yangon and Ayeyarwady regions (Figure 3). No female farmer in Yangon or Ayeyarwady regions used organic fertilizer. About 6% of male farmers in Yangon and 10% in Ayeyarwady used organic fertilizer in dry season paddy. The female and male farmers who applied organic fertilizer in all regions used only cow dung.

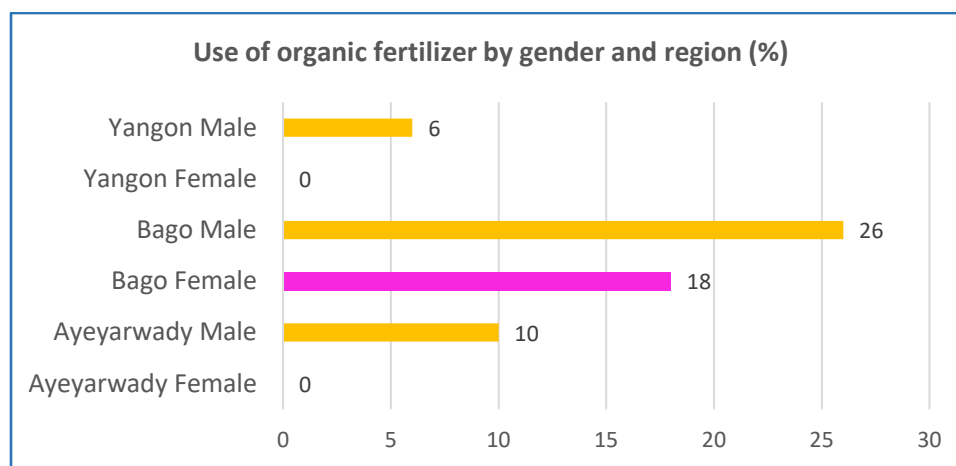


Figure 3. Use of Organic Fertilizer (%) by Gender and Region

Rates of Fertilizer Application in Dry Season Paddy by Gender and Region

The average rate of prilled urea for a unit of land was higher for male farmers than female farmers in all regions. Male farmers in Yangon and Ayeyarwady applied prilled urea at about two bags (50 kg/bag) for one acre (Table 19). The female farmers in Ayeyarwady region used the lowest rate of prilled urea (168 kg/ha). Both male and female farmers in Bago region used about 200 kg/ha in summer rice production. Male farmers in Ayeyarwady applied compound fertilizer at a rate of 247 kg/ha but no female farmers used a compound fertilizer. In Yangon, the rates of compound fertilizer were 179 and 134 kg/ha for male and female farmers, respectively. In Bago region, female farmers applied 108 kg/ha and male farmers applied 96 kg/ha.

The ANOVA table shows that the rate of prilled urea was not significantly different among the regions, but the rate of compound fertilizer application was significantly different at a 1% significant level.

Table 19. Rate of Prilled Urea and Compound Fertilizer Application (kg/ha) by Gender and Region

		Prilled Urea (kg/ha)		Compound (kg/ha)	
Yangon	Female	Mean	216.125	154.375	
		N	4	2	
		Std. Deviation	61.7500	43.663	
	Male	Mean	247.000	179.075	
		N	15	4	
		Std. Deviation	123.5000	79.078	
	Total	Mean	240.500	170.841	
		N	19	6	
		Std. Deviation	112.5416	65.544	
Ayeyarwady	Female	Mean	167.607		
		N	7		
		Std. Deviation	58.7360		
	Male	Mean	243.750	247.000	
		N	19	1	
		Std. Deviation	90.8322	.	
	Total	Mean	223.250	247.000	
		N	26	1	
		Std. Deviation	89.1888	.	
Bago	Female	Mean	200.688	108.062	
		N	8	8	
		Std. Deviation	97.6353	28.584	
	Male	Mean	205.245	95.993	
		N	21	11	
		Std. Deviation	98.8367	29.142	
	Total	Mean	203.988	101.075	
		N	29	19	
		Std. Deviation	96.7735	28.758	

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
prilled urea(kg/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	15693.321	2	7846.660	.808	.450
	Within Groups		689069.868	71	9705.209		
	Total		704763.189	73			
compound (kg/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	38241.183	2	19120.592	12.093	.000
	Within Groups		36367.251	23	1581.185		
	Total		74608.434	25			

Use of Pesticide and Herbicide by Gender and Region

A higher percentage of male farmers in Yangon (69%) used pesticide than female farmers (40%) (Table 20). The same percentage of male and female farmers (42%) used pesticide in Ayeyarwady region. In Bago, 36% of female farmers and 35% of male farmers used pesticides in summer paddy production, 2017.

Table 20. Use of Pesticides by Gender and Region

		Use of Pesticide			
		Used	Did Not Use	Total	
Yangon	Female	Count	2 (40%)	3 (60%)	5
	Male	Count	11 (68.8%)	5 (31.2%)	16
	Total	Count	13 (61.9%)	8 (38.1%)	21
Ayeyarwady	Female	Count	3 (42.9%)	4 (57.1%)	7
	Male	Count	8 (42.1%)	11 (57.9%)	19
	Total	Count	11 (42.3%)	15 (57.7%)	26
Bago	Female	Count	4 (36.4%)	7 (63.6%)	11
	Male	Count	8 (34.8%)	15 (65.2%)	23
	Total	Count	12 (35.3%)	22 (64.7%)	34

No female farmers used herbicide in dry season paddy, 2017. Only four male farmers in Bago region use herbicide (Table 21).

Table 21. Use of Herbicides by Gender by Region

		Use of Herbicide			
		Used	Did Not Use	Total	
Yangon	Female	Count		5 (100%)	5
	Male	Count		16 (100%)	16
	Total	Count		21 (100%)	21
Ayeyarwady	Female	Count		7 (100%)	7
	Male	Count		19 (100%)	19
	Total	Count		26 (100%)	26
Bago	Female	Count		11 (100%)	11
	Male	Count	4 (17.4%)	19 (82.6%)	23
	Total	Count	4 (11.8%)	30 (88.2%)	34

Use of Tractor, Draught Cattle, and Harvester by Gender and Region

Eighty-one percent of farmers (81% male and 80% female) owned and used a tractor for land preparation in Yangon (Table 22). In Bago, it was 35% (35% male and 36% female) and 54% (53% male and 57% female) in Ayeyarwady. All other farmers in all regions hired a tractor service for land preparation in dry season paddy. Only one male farmer used cattle in Ayeyarwady region.

Table 22. Use of Tractors and Draught Animals for Land Preparation by Gender and Region

		Use of Tractor and Cattle in Land Preparation				Total
		Own/Use	Hire/Use	Cattle		
Yangon	Female	Count	4	1		5
		%	80.0%	20.0%		100.0%
	Male	Count	13	3		16
		%	81.2%	18.8%		100.0%
	Total	Count	17	4		21
		%	81.0%	19.0%		100.0%
Ayeyarwady	Female	Count	4	3	0	7
		%	57.1%	42.9%	.0%	100.0%
	Male	Count	10	8	1	19
		%	52.6%	42.1%	5.3%	100.0%
	Total	Count	14	11	1	26
		%	53.8%	42.3%	3.8%	100.0%
Bago	Female	Count	4	7		11
		%	36.4%	63.6%		100.0%
	Male	Count	8	15		23
		%	34.8%	65.2%		100.0%
	Total	Count	12	22		34
		%	35.3%	64.7%		100.0%

Eighty-one percent of farmers (81% male and 80% female) used a harvester in Yangon (Table 23). In Bago, it was 94% (91% male and 100% female) and 54% (47% male and 71% female) in Ayeyarwady.

Table 23. Use of Harvester in Dry Season Paddy by Gender and Region

		Use of Harvester			
		Used Harvester	Did Not Use	Total	
Yangon	Female	Count	4 (80%)	1 (20%)	5
	Male	Count	13 (81%)	3 (19%)	16
	Total	Count	17 (81%)	4 (19%)	21
Ayeyarwady	Female	Count	5 (71%)	2 (29%)	7
	Male	Count	9 (47%)	10 (53%)	19
	Total	Count	14 (54%)	12 (46%)	26
Bago	Female	Count	11 (100%)	0	11
	Male	Count	21 (91%)	2 (9%)	23
	Total	Count	32 (94%)	2 (6%)	34

Labor

Hiring of Permanent Labor and Contract Service Labor for Dry Season Paddy in 2017

Table 29 indicates most farmers hired casual labor (20/21 in Yangon, 23/26 in Ayeyarwady, and 30/34 in Bago). Most farmers in all regions did not hire permanent labor in the dry season of 2017. Yangon had the highest percentage hiring permanent labor (29%), with Ayeyarwady at 19% and Bago at 6%. In all regions, female farmers had the highest percentage hiring permanent labor with 40% in Yangon, 57% in Ayeyarwady, and 9% in Bago (Table 24).

Table 24. Hiring Permanent Labor for Dry Season Paddy by Gender and Region

		Permanent Labor			
		Hired	Did Not Hire	Total	
Yangon	Female	Count	2 (40%)	3 (60%)	5
	Male	Count	4 (25%)	12 (75%)	16
	Total	Count	6 (29%)	15 (71%)	21
Ayeyarwady	Female	Count	4 (57%)	3 (43%)	7
	Male	Count	1 (5%)	18 (95%)	19
	Total	Count	5 (19%)	21 (81%)	26
Bago	Female	Count	1 (9%)	10 (91%)	11
	Male	Count	1 (4%)	22 (96%)	23
	Total	Count	2 (6%)	32 (94%)	34

Hiring contract service labor is common for transplanting and harvesting paddy. However, the majority of farmers in all regions practiced broadcasting seeds and used machines for land

preparation and harvesting. Therefore, the percentage of farmers hiring contract service labor in summer paddy production of 2017 was low (Table 25) – 46% in Ayeyarwady, 29% in Yangon, and 9% in Bago.

More male farmers hired the contract service labor than female farmers in Yangon (31% male farmers hired contract services vs. 20% female farmers) and Ayeyarwady (53% male farmers hired contract services vs. 29% female farmers).

Table 25. Hiring Contract Service Labor for Dry Season Paddy by Gender and Region

		Contract Service Labor			
		Hired	Did Not Hire	Total	
Yangon	Female	Count	1	4	5
		%	20.0%	80.0%	100.0%
	Male	Count	5	11	16
%		31.2%	68.8%	100.0%	
Total	Count	6	15	21	
	%	28.6%	71.4%	100.0%	
Ayeyarwady	Female	Count	2	5	7
		%	28.6%	71.4%	100.0%
	Male	Count	10	9	19
		% =2	52.6%	47.4%	100.0%
Total	Count	12	14	26	
	%	46.2%	53.8%	100.0%	
Bago	Female	Count	1	10	11
		%	9.1%	90.9%	100.0%
	Male	Count	2	21	23
		%	8.7%	91.3%	100.0%
	Total	Count	3	31	34
%		8.8%	91.2%	100.0%	

Input Costs

Mean Costs for Seeds, Seedbed, and Land Preparation

The cost of seed for farmers averages \$40/ha in Ayeyarwady, \$35/ha in Bago, and \$22/ha in Yangon. The average cost of seed paid by male farmers is higher than the average seed cost paid by female farmers in Yangon and Bago regions (Table 26). For example, the seed cost paid by

male and female farmers in Bago region is \$36/ha and \$34/ha, respectively. The female farmers in Ayeyarwady paid a higher seed cost (\$42/ha) than that paid by male farmers (\$40/ha). One male farmer in Yangon, one male in Ayeyarwady, and one female in Bago prepared a seedbed for transplanting paddy. The seedbed preparation cost ranged from \$36/ha in Bago to \$62/ha in Ayeyarwady region (Table 26).

The average land preparation cost for female farmers was higher than the average cost for male farmers in all regions. Overall, the land preparation cost of farmers for dry season paddy was \$42/ha, \$37/ha, and \$41/ha in Yangon, Ayeyarwady, and Bago regions, respectively (Table 26).

The ANOVA table shows that the average cost for seeds is significantly different among the regions at a 1% significant level in dry season paddy, 2017. The land preparation cost is not significantly different among the regions.

Table 26. Mean Costs of Seeds, Seedbed, and Land Preparation by Gender and Region

			Seed Cost (\$/ha)	Seed Bed Cost (\$/ha)	Land Preparation (\$/ha)
Yangon	Female	Mean	21.5767		54.5220
		N	3		5
		Std. Deviation	17.06844		35.08694
	Male	Mean	22.6738	41.9300	38.4000
		N	8	1	16
		Std. Deviation	9.24116	.	23.07813
	Total	Mean	22.3745	41.9300	42.2386
		N	11	1	21
		Std. Deviation	10.87696	.	26.36621
Ayeyarwady	Female	Mean	41.6100		38.4343
		N	3		7
		Std. Deviation	8.82063		9.82434
	Male	Mean	39.8675	61.9800	35.9637
		N	8	1	19
		Std. Deviation	9.20013	.	18.94219
	Total	Mean	40.3427	61.9800	36.6288
		N	11	1	26
		Std. Deviation	8.68751	.	16.81529
Bago	Female	Mean	34.1567	36.4600	41.2627
		N	6	1	11
		Std. Deviation	15.99185	.	14.63961
	Male	Mean	35.8718		40.3961
		N	11		23
		Std. Deviation	17.50262		21.92172
	Total	Mean	35.2665	36.4600	40.6765
		N	17	1	34
		Std. Deviation	16.49533	.	19.63387

ANOVA Table^a

			Sum of Squares	df	Mean Square	F	Sig.
seed cost(\$/h) * Bago=1, Aye=2,YGN=3	Between Groups (Combined)		1922.152	2	961.076	5.499	.008
	Within Groups		6291.345	36	174.760		
	Total		8213.497	38			
Land preparation(\$/h) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		412.434	2	206.217	.477	.622
	Within Groups		33693.515	78	431.968		
	Total		34105.949	80			

a. Too few cases - statistics for seed bed cost(\$/h) * Bago=1,Aye=2,YGN=3 cannot be computed.

Mean Costs for Basal, Urea, Compound Fertilizer, and Total Fertilizer With UDP and Non-UDP

For prilled urea, the average cost was \$65, \$66, and \$64/ha in Yangon, Ayeyarwady, and Bago regions, respectively. It was higher for male farmers in Ayeyarwady (\$73/ha) and Bago (\$64/ha) regions when compared with female farmers at \$48/ha in Ayeyarwady and \$63/ha in Bago but higher for female farmers in Yangon (\$68/ha) compared with male farmers at \$64/ha. Regardless of the region, the mean cost of BU was the same (\$49.22/ha) in dry season paddy, 2017.

For basal fertilizer, the average cost was \$40, \$41, and \$45/ha in Yangon, Ayeyarwady, and Bago regions, respectively (Table 27). The cost was higher for male farmers in Ayeyarwady (\$43/ha) and Bago (\$51/ha) than for female farmers at \$38 and \$40. In Yangon, the cost was higher for female farmers at \$47/ha compared with male farmers at \$37/ha.

All farmers (100%) in Ayeyarwady region and most (91%) in Yangon and Bago (85%) (see Table 13) applied prilled urea. Eighty-five percent applied basal fertilizer in Ayeyarwady and 76% in Yangon but only 26% in Bago (see Table 10).

Female farmers in Ayeyarwady region did not apply compound fertilizer in dry season paddy, 2017. The mean cost of compound fertilizer was higher in Ayeyarwady region (\$84/ha) than Yangon (\$54/ha) and Bago (\$46/ha) regions.

The total fertilizer cost with UDP (BU only or basal plus BU) was significantly different among the regions at 1% level. The average total fertilizer cost with UDP in Yangon, Ayeyarwady, and Bago regions was \$80/ha, \$89/ha, and \$60/ha, respectively. The total fertilizer cost with UDP was similar between male and female farmers in Ayeyarwady (female \$87 vs. male \$89) and Bago (female \$63 vs. male \$58) regions. The female farmers in Yangon had a higher total fertilizer cost (\$96/ha) with UDP than male farmers (\$75/ha).

The total fertilizer cost without UDP (prilled urea, compound, TSP, MOP, special fertilizer for paddy, etc., with or without basal) was significantly different among the regions at 5% level. The average total fertilizer cost without UDP in Yangon, Ayeyarwady, and Bago regions was

\$134/ha, \$117/ha, and \$105/ha, respectively. From these data, it is noted that farmers who grow summer paddy pay twice the total fertilizer cost of wet season paddy.

Table 27. Mean Cost of Basal, Urea, Compound Fertilizer, and Total Fertilizer With UDP and Without UDP (with PU) by Gender and Region

			Basal Fertilizer Cost (\$/ha)	PU Cost in NUDP (\$/ha)	Compound Fertilizer in NUDP Cost (\$/ha)	Total Fertilizer Cost With UDP (\$/ha)	Total Fertilizer Cost Without UDP (\$/ha)
Yangon	Female	Mean	47.0280	68.8150	38.5100	96.2480	156.4080
		N	5	4	2	5	5
	Male	Mean	37.1682	64.4673	61.9775	74.7719	126.5737
		N	11	15	4	16	16
	Total	Mean	40.2494	65.3826	54.1550	79.8852	133.6771
		N	16	19	6	21	21
Ayeyarwady	Female	Mean	38.0186	47.6543		87.2371	85.6743
		N	7	7		7	7
	Male	Mean	42.6350	73.3000	83.8500	89.6105	128.9042
		N	18	19	1	19	19
	Total	Mean	41.3424	66.3954	83.8500	88.9715	117.2654
		N	25	26	1	26	26
Bago	Female	Mean	40.3325	62.7738	50.3588	63.8845	124.4536
		N	4	8	8	11	11
	Male	Mean	50.7250	63.9562	42.8536	58.0413	95.8857
		N	4	21	11	23	23
	Total	Mean	45.5288	63.6300	46.0137	59.9318	105.1282
		N	8	29	19	34	34

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
basal fert cost(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	154.093	2	77.047	.225	.799
	Within Groups		15759.368	46	342.595		
	Total		15913.462	48			
PU cost(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	107.639	2	53.820	.065	.937
	Within Groups		58588.075	71	825.184		
	Total		58695.714	73			
compound fert cost(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	1540.267	2	770.134	2.471	.107
	Within Groups		7168.369	23	311.668		
	Total		8708.636	25			
Total fert cost UDP(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	13269.576	2	6634.788	14.276	.000
	Within Groups		36250.552	78	464.751		
	Total		49520.128	80			
Total fert cost NUDP (\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	10607.702	2	5303.851	3.263	.044
	Within Groups		126785.965	78	1625.461		
	Total		137393.667	80			

Mean Costs of Pesticide and Irrigation for Dry Season Paddy

Among the regions, the farmers in Ayeyarwady and Bago regions had a higher cost for pesticide and herbicide (\$18/ha) than the farmers in Yangon region (\$9.7/ha) (Table 28). The mean cost of pesticide was higher for male farmers in Yangon and Ayeyarwady regions. However, female farmers in Bago region had a higher cost for pesticide (\$26/ha) than male farmers (\$15/ha). It was noted that neither male nor female farmers in Bago region had to pay for irrigation (the Irrigation Department did not collect the irrigation water tax in the summer season of 2017). The mean cost of irrigation in Yangon region (\$30/ha) was higher than Ayeyarwady region (\$16/ha). The ANOVA table shows that the irrigation cost is significantly different among the regions at 5% level.

Table 28. Mean Cost of Pesticides and Irrigation by Gender and Region

		Pest/Disease (\$/ha)		Irrigation (\$/ha)
Yangon	Female	Mean	7.5200	29.1300
		N	2	5
		Std. Deviation	.96167	23.53302
	Male	Mean	10.1164	30.0220
		N	11	15
		Std. Deviation	8.21941	27.80079
	Total	Mean	9.7169	29.7990
		N	13	20
		Std. Deviation	7.57143	26.19619
Ayeyarwady	Female	Mean	12.3000	19.5186
		N	4	7
		Std. Deviation	6.38000	11.69372
	Male	Mean	19.8700	15.1119
		N	10	16
		Std. Deviation	15.40102	10.24427
	Total	Mean	17.7071	16.4530
		N	14	23
		Std. Deviation	13.64541	10.63698
Bago	Female	Mean	25.9775	
		N	4	
		Std. Deviation	19.31457	
	Male	Mean	15.3817	
		N	12	
		Std. Deviation	15.31423	
	Total	Mean	18.0306	
		N	16	
		Std. Deviation	16.40275	

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
pest/disease(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	605.103	2	302.552	1.694	.197
	Within Groups		7144.240	40	178.606		
	Total		7749.343	42			
Irrigation(\$/ha) * Bago=1, Aye=2,YGN=3	Between Groups	(Combined)	1905.412	1	1905.412	5.031	.030
	Within Groups		15527.767	41	378.726		
	Total		17433.179	42			

Mean Costs of Casual Labor, Contract Service Labor, and Permanent Labor

It is noted that six farmers (out of 81 total farmers) used family labor only in summer paddy production. Most farmers used daily casual labor. The mean cost for casual labor was \$41/ha, \$42/ha, and \$43/ha in Yangon, Ayeyarwady, and Bago regions. The daily casual labor cost of male farmers was higher than female farmers in Yangon region. But female farmers paid more for casual labor in Bago region. The mean cost of casual labor was the same regardless of gender in Ayeyarwady region (Table 29).

For contract labor services, the mean cost was \$72/ha in Yangon region and \$70/ha in Ayeyarwady and Bago regions. The male farmers in Ayeyarwady and Bago regions paid a higher cost for contract service labor. The female farmers in Yangon region (\$82/ha) paid a higher cost for contract service labor than the male farmers (\$70/ha).

For permanent labor, the mean cost was \$51/ha, \$47/ha, and \$93/ha in Yangon, Ayeyarwady, and Bago regions, respectively. The male farmers in Yangon (\$61/ha) and Bago (\$121/ha) regions paid a higher cost for permanent labor.

Overall, the mean cost for total labor in Yangon, Ayeyarwady, and Bago regions was \$78/ha, \$85/ha, and \$54/ha, respectively. The F test shows that total labor cost is significantly different at 5% level among the regions. The total labor cost for male farmers was higher than female farmers in Yangon and Ayeyarwady regions. For example, male farmers paid \$82/ha in Yangon, and female farmers paid \$65/ha (Table 29).

Table 29. Mean Cost of Daily Casual Labor, Contract Service Labor, Seasonal Labor, and Total Labor by Gender and Region

			Casual Labor (\$/ha)	Contract Service Labor (\$/ha)	Permanent/Seasonal Labor (\$/ha)	Total Labor Cost (\$/ha)
Yangon	Female	Mean	35.5460	82.0300	32.1100	64.8000
		N	5	1	2	5
	Male	Mean	42.5340	69.8160	61.1075	82.1013
		N	15	5	4	15
	Total	Mean	40.7870	71.8517	51.4417	77.7760
		N	20	6	6	20
Ayeyarwady	Female	Mean	42.0767	59.2450	53.8775	83.7814
		N	6	2	4	7
	Male	Mean	42.0865	72.0060	18.2300	85.5135
		N	17	10	1	17
	Total	Mean	42.0839	69.8792	46.7480	85.0083
		N	23	12	5	24
Bago	Female	Mean	51.0412	54.6900	63.8000	58.5356
		N	8	1	1	9
	Male	Mean	40.0614	77.4750	121.5300	52.6286
		N	22	2	1	22
	Total	Mean	42.9893	69.8800	92.6650	54.3435
		N	30	3	2	31

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Causal labor (\$/h) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	58.213	2	29.106	.088	.916
	Within Groups		23227.662	70	331.824		
	Total		23285.875	72			
Contract Labor(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	16.672	2	8.336	.015	.985
	Within Groups		9815.400	18	545.300		
	Total		9832.072	20			
Permanent Labor(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	3241.306	2	1620.653	2.158	.166
	Within Groups		7508.662	10	750.866		
	Total		10749.968	12			
Total Labor (\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	14201.886	2	7100.943	4.734	.012
	Within Groups		108006.048	72	1500.084		
	Total		122207.934	74			

Mean Costs of Harvesting and Threshing Machine and Total Production in UDP and Non-UDP

The cost of harvesting and threshing by machine in Yangon, Bago, and Ayeyarwady regions was \$82/ha, \$76/ha, and \$60/ha, respectively; it was highest for female farmers in all regions. The F test shows that the cost of harvesting by machine is significantly different at 1% level among the regions (Table 30).

Total Production Costs

Total Production Costs (PC) refer to all costs for production, including labor for a unit of paddy land. This differs from Input Costs (IC), which is one of the five data points in the gross margin calculation. IC is calculated by total production cost multiplied by total cultivated paddy land (not for 1 ha or a unit of paddy land).

The total production cost when farmers applied UDP in Yangon, Ayeyarwady, and Bago regions was \$314/ha, \$305/ha, and \$253/ha, respectively (Table 30). The female farmers had a higher cost of production for summer paddy production with UDP in all regions. For farmers not applying UDP, the average cost of total production was \$368, \$334, and \$299/ha in Yangon, Ayeyarwady, and Bago regions, respectively. The total production cost without UDP was also higher for female farmers in all regions. The F test results show that the total production cost both in UDP and non-UDP is significantly different among the regions at 1% level.

Table 30. Mean Costs of Harvesting and Threshing and Total Production in UDP and Non-UDP Fields by Gender and Region

		Harvesting and Threshing Machine (\$/ha)		Total PC in UDP (\$/ha)	Total PC in NUDP (\$/ha)
Yangon	Female	Mean	88.8625	331.7420	391.9060
		N	4	5	5
	Male	Mean	79.4264	308.6956	360.4969
		N	14	16	16
	Total	Mean	81.5233	314.1829	367.9752
		N	18	21	21
Ayeyarwady	Female	Mean	69.0086	322.8443	321.2814
		N	7	7	7
	Male	Mean	56.7106	299.0442	338.3379
		N	18	19	19
	Total	Mean	60.1540	305.4519	333.7458
		N	25	26	26
Bago	Female	Mean	77.8891	262.3173	322.8855
		N	11	11	11
	Male	Mean	75.2948	249.2496	287.0983
		N	23	23	23
	Total	Mean	76.1341	253.4774	298.6765
		N	34	34	34

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Harvest machine(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		5718.520	2	2859.260	5.434	.006
	Within Groups		38934.759	74	526.145		
	Total		44653.279	76			
Total UDP(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		62479.294	2	31239.647	10.333	.000
	Within Groups		235819.678	78	3023.329		
	Total		298298.972	80			
Total NUDP(\$/ha) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		63651.516	2	31825.758	7.112	.001
	Within Groups		349044.332	78	4474.927		
	Total		412695.848	80			

Average Farm Gate Price

In the dry season of 2017, farmers received a farm gate price for their paddy of \$0.137/kg in Yangon region, \$0.138/kg in Ayeyarwady region, and \$0.134/kg in Bago region (Table 31). Male farmers received a little higher than female farmers in all regions.

Table 31. Average Farm Gate Price of Paddy and Paddy Yield in UDP and Non-UDP Fields by Gender and Region

		Farm Gate Price (\$/kg)		UDP Yield (kg/ha)	NUDP Yield (kg/ha)
Yangon	Female	Mean	0.1300	5,255.8320	4,742.3120
		N	5	5	5
	Male	Mean	0.1400	5,878.8844	4,995.2975
		N	16	16	16
	Total	Mean	0.1376	5,730.5386	4,935.0629
		N	21	21	21
Ayeyarwady	Female	Mean	0.1371	5,700.0729	4,956.2943
		N	7	7	7
	Male	Mean	0.1389	6,133.4163	5,269.5479
		N	19	19	19
	Total	Mean	0.1385	6,016.7469	5,185.2104
		N	26	26	26
Bago	Female	Mean	0.1327	5,546.8909	4,229.6218
		N	11	11	11
	Male	Mean	0.1348	5,347.0574	4,300.5657
		N	23	23	23
	Total	Mean	0.1341	5,411.7094	4,277.6132
		N	34	34	34

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Farmgate (\$/kg) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		.000	2	.000	1.565	.216
	Within Groups		.008	78	.000		
	Total		.008	80			
UDP yield(kg/ha) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		5443351.690	2	2721675.845	1.568	.215
	Within Groups		1.354E8	78	1735564.395		
	Total		1.408E8	80			
NUDP yield(kg/ha) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		1.322E7	2	6610890.470	3.995	.022
	Within Groups		1.291E8	78	1654732.311		
	Total		1.423E8	80			

Paddy Yield

The average paddy yield with UDP was 5.7, 6.0, and 5.4 metric tons (mt)/ha in Yangon, Ayeyarwady, and Bago regions, respectively. Without UDP, the average paddy yield was 4.9, 5.2, and 4.3 mt/ha in Yangon, Ayeyarwady, and Bago regions. Male farmers received a higher summer paddy yield with UDP than female farmers in Yangon and Ayeyarwady regions. For example, male farmers in Ayeyarwady region received 6.1 mt/ha while female farmers received 5.7 mt/ha in UDP plots.

Without UDP, male farmers received higher paddy yields than female farmers in all regions. For example, the average non-UDP yield of male and female farmers in Ayeyarwady was 5.3 and 4.9 mt/ha, respectively.

The F tests present there is no significant difference in the farm gate price of paddy and yield with UDP among the regions, but there is a significant difference in non-UDP yield at 5% level among the regions.

When compared with the previous crop cuts dry season yields in 2015 and 2016, UDP yield has improved regardless of the farmers' gender in the dry season of 2017 (Figure 4).

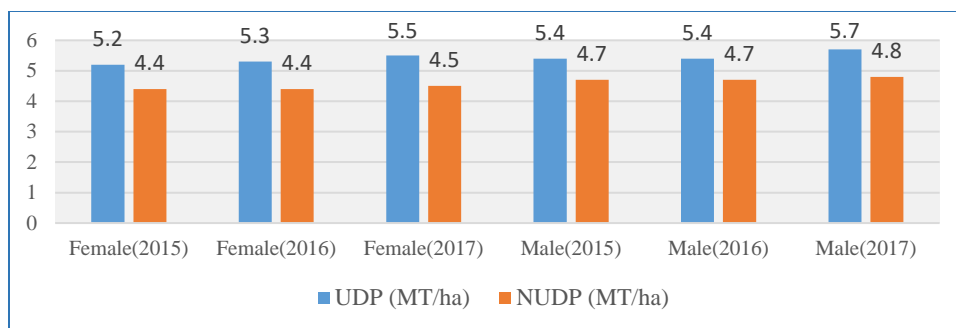


Figure 4. Dry Season Paddy Yield by Gender in 2015, 2016, and 2017

Yield Difference With and Without UDP and Percentage of Total Production Sold

Among the sample farmers, two male farmers in Yangon region and two female farmers in Ayeyarwady region experienced a yield decline with UDP; however, on average, farmers in the sample experienced a yield increment of 795 kg/ha in Yangon, 831 kg/ha in Ayeyarwady, and 1,134 kg/ha in Bago. The average yield increment between UDP and non-UDP was highest among male farmers in Yangon and Ayeyarwady regions. For example, the mean increment for male and female farmers in Ayeyarwady region was 863 and 743 kg/ha, respectively (Table 32).

In terms of percentage yield increment, female farmers in Bago region received a higher percentage yield increase (40%) than male farmers (28%). The lowest percentage of increase in yield was found among female farmers in Yangon and Ayeyarwady regions. Overall, the percentage of yield increase was 16%, 19%, and 32% in Yangon, Ayeyarwady, and Bago regions, respectively. The F test shows that there is a significant difference in yield increase with UDP at 5% level among the regions.

Percent of Total Production Sold

Most of the dry season paddy was sold. The mean percentage of paddy sold at harvesting time was 93%, 94%, and 97% in Yangon, Ayeyarwady, and Bago regions. Female farmers in Yangon and Ayeyarwady regions sold more of their paddy after harvesting than male farmers. For example, in Yangon region, female farmers sold 95% and male farmers sold 93% of total production of dry season paddy in 2017.

Table 32. Average Yield Difference With and Without UDP and Percentage of Total Production Sold by Gender and Region

		Yield Increment With UDP			
			Yield Increment (kg)	% Yield Increase	% Sell
Yangon	Female	Mean	513.5200	11.7260	94.8000
		N	5	5	5
	Male	Mean	883.5869	17.9806	92.7500
		N	16	16	16
	Total	Mean	795.4757	16.4914	93.2381
		N	21	21	21
Ayeyarwady	Female	Mean	743.7786	17.7143	95.0000
		N	7	7	7
	Male	Mean	863.8674	19.6853	93.0526
		N	19	19	19
	Total	Mean	831.5358	19.1546	93.5769
		N	26	26	26
Bago	Female	Mean	1,317.2673	39.6455	93.7273
		N	11	11	11
	Male	Mean	1,046.4909	27.7439	98.3913
		N	23	23	23
	Total	Mean	1,134.0950	31.5944	96.8824
		N	34	34	34

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
yield gap bet UDP&NUDP (kg) * Bago=1,Aye=2, YGN=3	Between Groups	(Combined)	2018550.389	2	1009275.194	1.873	.160
	Within Groups		4.202E7	78	538727.545		
	Total		4.404E7	80			
% yield increase * Bago=1,Aye=2,YGN=3	Between Groups	(Combined)	3747.330	2	1873.665	3.605	.032
	Within Groups		40539.323	78	519.735		
	Total		44286.653	80			
% sell * Bago=1,Aye=2, YGN=3	Between Groups	(Combined)	237.080	2	118.540	1.276	.285
	Within Groups		7243.685	78	92.868		
	Total		7480.765	80			

UDP and Non-UDP Yields, Yield Increase With UDP, and Percentage Increase in Yield by Cultural Practice

The average dry paddy yield with UDP in broadcast seeded fields was higher than yield of transplanted rice and drum seeder planted rice (Table 33). For example, the mean UDP yield of transplanted, broadcast, and drum seeded rice was 4.8, 5.9 and 5.4 mt/ha, respectively, in Yangon region in the dry paddy season of 2017. The average non-UDP yield was nearly the same in both broadcast seeded and drum seeder methods (5 mt/ha) in Yangon region. But the

mean non-UDP yield of broadcasting seeds was higher than transplanting in all regions. The ANOVA table presents that there is a significant difference in non-UDP yield at 5% level among the regions.

The yield difference between UDP and non-UDP was higher when broadcasting seeds than for other practices in Yangon and Ayeyarwady regions. But the yield difference was higher for the transplanting method in Bago region.

A similar trend is found in percentage yield increase with UDP. For example, yield was increased by 19.6% when broadcasting and 7.5% when transplanting in Ayeyarwady region. But a higher percentage yield increase was obtained when transplanting (37%) in Bago region. The ANOVA table shows that there is a significant difference in percentage yield increase at 5% level among the regions.

Table 33. UDP and Non-UDP Yields, Yield Gap (kg/ha), and Yield Increase with UDP (%) by Cultural Practice

			UDP Yield (kg/ha)	Non-UDP Yield (kg/ha)	Yield Gap (kg/ha)	Yield Increase (%)
Yangon	Transplant	Mean	4,847.1800	4,227.5850	619.5950	15.0050
		N	2	2	2	2
	Broadcast	Mean	5,900.8587	5,014.4612	886.3962	18.3456
		N	16	16	16	16
	Seeder	Mean	5,411.0700	4,983.2567	427.8200	7.5933
		N	3	3	3	3
	Total	Mean	5,730.5386	4,935.0629	795.4757	16.4914
		N	21	21	21	21
Ayeyarwady	Transplant	Mean	5,494.1900	5,108.0000	386.1900	7.5600
		N	1	1	1	1
	Broadcast	Mean	6,037.6492	5,188.2988	849.3496	19.6184
		N	25	25	25	25
	Total	Mean	6,016.7469	5,185.2104	831.5358	19.1546
		N	26	26	26	26
Bago	Transplant	Mean	4,318.9100	3,144.6000	1,174.3100	37.3400
		N	1	1	1	1
	Broadcast	Mean	5,444.8245	4,311.9470	1,132.8764	31.4203
		N	33	33	33	33
	Total	Mean	5,411.7094	4,277.6132	1,134.0950	31.5944
		N	34	34	34	34

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
UDP yield(kg/ha) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		5443351.690	2	2721675.845	1.568	.215
	Within Groups		1.354E8	78	1735564.395		
	Total		1.408E8	80			
NUDP yield(kg/ha) * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		1.322E7	2	6610890.470	3.995	.022
	Within Groups		1.291E8	78	1654732.311		
	Total		1.423E8	80			
yield gap bet UDP&NUDP (kg) * Bago=1,Aye=2, YGN=3	Between Groups (Combined)		2018550.389	2	1009275.194	1.873	.160
	Within Groups		4.202E7	78	538727.545		
	Total		4.404E7	80			
% yield increase * Bago=1,Aye=2,YGN=3	Between Groups (Combined)		3747.330	2	1873.665	3.605	.032
	Within Groups		40539.323	78	519.735		
	Total		44286.653	80			

Gross Margins

Five Data Points and Gross Margin for Sampled Crop Cut Farmers by Gender

Gross margins (GM) are highest at \$493/ha when farmers applied UDP compared to the normal farmer practice of broadcast urea for which gross margins are \$287/ha. For male farmers, the GM for applying UDP was higher than for female farmers applying UDP in dry season paddy. Male farmers received \$507/ha while female farmers received \$442/ha by applying UDP technology in dry season paddy (Table 34). The GM increase when applying UDP was 88% for female farmers and 69% for male farmers, because the percentage of yield increase from UDP was higher for female farmers (27%) than for male farmers (22%). The GM for male farmers (\$300/ha) was higher than for female farmers (\$235/ha) in non-UDP plots in the dry season of 2017.

Table 34. Five Data Points and Gross Margin for Sampled Crop Cut Farmers by Gender

	Gender	UP	TP	QS	VS	IC	GM \$/ha	% GM Increase
UDP	Male(58)	6.04	34,685.08	33,319.55	4,668.65	1,796.36	507	69.0
	Female(23)	1.72	9,497.90	8,980.35	1,198.08	506.41	442	88.1
	Combined(81)	7.76	44,182.98	42,299.91	5,866.73	2,302.77	493	75.4
NUDP	Male(58)	182.74	832,933.34	802,957.40	110,725.63	59,952.39	300	
	Female(23)	76.42	335,492.17	318,548.71	42,370.78	26,637.93	235	
	Combined(81)	259.16	1,168,425.51	1,121,506.11	153,096.41	86,590.32	281	
Whole	Male(58)	188.78	867,618.42	836,276.96	115,394.28	61,748.75	307	
	Female(23)	78.14	344,990.07	327,529.06	43,568.86	27,144.34	240	
	Combined(81)	266.92	1,212,608.49	1,163,806.02	158,963.14	88,893.09	287	

- UP Units of Production (hectares planted)
 TP Total Production (metric tons)
 QS Quantity of sales (metric tons)
 VS Value of sales (USD)
 IC Input costs (recurrent cash costs in USD)
 GM Gross Margin (USD/ha) = $\frac{[(TP \times VS/QS) - IC]}{UP}$

Five Data Points and GM for Sample Crop Cuts Farmers by Cultural Practice

The GM with UDP and without UDP was higher in broadcast seeding paddy (BP) than transplanting paddy (TP) and drum seeder planted paddy. Farmers who used broadcast seeding received \$505/ha with UDP and \$296/ha without UDP. This is mainly due to higher yield in both UDP and non-UDP using the broadcasting method, and the higher cost of total production in the transplanting method (total production costs with transplanting \$364/ha vs. broadcasting \$278/ha). The percentage of GM increased by 232% with UDP when transplanting paddy, by 71% when broadcasting seeds, and by 116% using the drum seeder (Table 35).

Table 35. Five Data Points and Gross Margin for Sampled Crop Cut Farmers by Cultural Practice

	Practice	UP	TP	QS	VS	IC	GM \$/ha	% GM Increase
UDP	TP (4)	0.32	1,645.13	1,441.35	198.86	122.57	322	232.0
	BP (74)	7.26	41,552.02	39,904.15	5,544.24	2,112.20	505	70.6
	Seeder (3)	0.18	985.82	954.41	123.64	68.00	328	115.8
	Combined (81)	7.76	44,182.97	42,299.91	5,866.74	2,302.77	493	75.4
NUDP	TP (4)	10	41,024.18	36,917.54	5,038.61	4,632.85	97	
	BP (74)	236.79	1,072,238.70	1,030,461.37	141,032.91	76,683.24	296	
	Seeder (3)	12.37	55162.63	54,127.20	7,024.88	5,274.23	152	
	Combined (81)	259.16	1,168,425.51	1,121,506.11	153,096.41	86,590.32	281	
Whole	TP (4)	10.32	42669.32	38,358.89	5,237.47	4,755.42	104	
	BP (74)	244.05	1,113,790.72	1,070,365.52	146,577.15	78,795.44	302	
	Seeder (3)	12.55	56148.45	55,081.61	7,148.52	5,342.23	155	
	Combined (81)	266.92	1,212,608.49	1,163,806.02	158,963.15	88,893.09	287	

Five Data Points and GM for Sampled Crop Cut Farmers by Variety

About 8% of total farmers used a hybrid variety in dry season paddy production. The GM with a hybrid variety was higher, especially when applying UDP (hybrid \$600/ha vs. HYV \$487/ha) (Table 36).

Without UDP, the GM was higher for HYVs (\$282/ha) than the GM for hybrid varieties. The percentage of GM increase when applying UDP in hybrid varieties (115%) was higher than in HYVs (73%).

The average yield of hybrid varieties was higher than the HYVs (7 mt/ha vs. 5.5 mt/ha), especially in UDP plots. But the total cost of production for UDP was nearly the same for both the hybrid variety and HYV.

Table 36. Five Data Points and Gross Margins for Sampled Crop Cut Farmers by Variety

	Variety	UP	TP	QS	VS	IC	GM \$/ha	% GM Increase
UDP	HYV (75)	7.38	41,627.07	39,799.19	5,536.22	2,195.59	487	72.7
	Hybrid (6)	0.38	2,555.91	2,500.71	330.52	107.18	600	115.1
	Combined (81)	7.76	44,182.98	42,299.91	5,866.74	2,302.77	493	75.4
NUDP	HYV (75)	236.87	1,057,405.55	1,011,719.02	138,761.58	78,310.89	282	
	Hybrid (6)	22.29	111,019.96	109,787.09	14,334.82	8,279.44	279	
	Combined (81)	259.16	1,168,425.51	1,121,506.11	153,096.41	86,590.33	281	
Whole	HYV (75)	244.25	1,099,032.62	1,051,518.22	144,297.80	80,506.48	288	
	Hybrid (6)	22.67	113,575.87	112,287.80	14,665.34	8,386.62	284	
	Combined (81)	266.92	1,212,608.49	1,163,806.02	158,963.15	88,893.10	287	

Five Data Points and GM for Sampled Crop Cut Farmers by Farm Size

Table 2 reported that 85% of total sampled farmers are working with small paddy land (less than 5 ha). The GM with UDP was higher among medium landholders (\$507/ha) than the GM of smallholders (\$496/ha) and large landholders (\$346/ha) (Table 37). But the GM for non-UDP was higher for smallholder farmers (\$318/ha) than for medium landholders and large landholders in the dry paddy season of 2017. The smallholder farmers had a lower cost of production than other groups but realized a higher paddy yield. The percentage of GM increased by 127% with UDP for medium landholders, by 56% for smallholders, and by 40% for large land holders.

Table 37. Five Data Points and Gross Margin for Sampled Crop Cut Farmers by Farm Size

	Farm Size	UP	TP	QS	VS	IC	GM \$/ha	% GM Increase
UDP	Small (68)	6.89	39,298.94	37,623.35	5,221.77	2,034.81	496	56.0
	Medium (10)	0.65	3,846.65	3,679.59	505.57	200.02	507	127.4
	Large (3)	0.22	1,037.38	996.96	139.39	67.94	346	40.1
	Combined (81)	7.76	44,182.98	42,299.91	5,866.73	2,302.77	493	75.4
NUDP	Small (68)	147.68	705,377.61	670,015.11	90,719.77	48,520.34	318	
	Medium (10)	65.95	273,052.17	267,137.04	36,235.42	22,356.23	223	
	Large (3)	45.53	189,995.73	184,353.96	26,141.22	15,713.75	247	
	Combined (81)	259.16	1,168,425.51	1,121,506.11	153,096.41	86,590.32	281	
Whole	Small (68)	154.57	744,676.55	707,638.47	95,941.54	50,555.14	326	
	Medium (10)	66.60	276,898.82	270,816.63	36,740.99	22,556.25	225	
	Large (3)	45.75	191,033.11	185,350.92	26,280.61	15,781.69	247	
	Combined (81)	266.92	1,212,608.49	1,163,806.02	158,963.14	88,893.09	287	

Appendix 1. Collected Sample of Beneficiary Farmers Applying UDP by Gender and Township, Dry Season, 2017

		Gender			
		Female	Male	Total	
Yangon	Kawhmu	Count	2	5	7
		%	28.6%	71.4%	100.0%
	Htantabin	Count	2	9	11
		%	18.2%	81.8%	100.0%
	Taikkyi	Count	1	2	3
		%	33.3%	66.7%	100.0%
	Total	Count	5	16	21
		%	23.8%	76.2%	100.0%
Ayeyarwady	Bogale	Count	3	9	12
		%	25.0%	75.0%	100.0%
	Kangyidaunt	Count	2	6	8
		%	25.0%	75.0%	100.0%
	Pyapon	Count	2	3	5
		%	40.0%	60.0%	100.0%
	Mawgyun	Count	0	1	1
		%	.0%	100.0%	100.0%
	Total	Count	7	19	26
		%	26.9%	73.1%	100.0%
Bago	Thayarwady	Count	4	8	12
		%	33.3%	66.7%	100.0%
	Minhla	Count	3	8	11
		%	27.3%	72.7%	100.0%
	Daik-U	Count	4	7	11
		%	36.4%	63.6%	100.0%
	Total	Count	11	23	34
		%	32.4%	67.6%	100.0%