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## **Fertilizer Sector Improvement (FSI+)**

### **Crop Cut Survey Report**

**(2015/16 Dry Season)**

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**Funded by**



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## Acronyms and Abbreviations

ANOVA	Analysis of Variance
BR	Broadcast Rice
BS	Broadcast Seeded
BU	Briquette Urea
FSI	Fertilizer Sector Improvement
GM	Gross Margin
HYV	High-Yielding Variety
IFDC	International Fertilizer Development Center
MOP	Muriate of Potash
TR	Transplanted Rice
TSP	Triple Superphosphate
UDP	Urea Deep Placement
USAID	United States Agency for International Development

## Conversions

To Convert	To	Multiply by
acre	hectare	0.4047
hectare	acre	2.47
U.S. ton/acre	metric ton/ha	2.24
lb/acre	kg/ha	1.12
kg/ha	lb/acre	0.89
K <sub>2</sub> O	K	0.83
K	K <sub>2</sub> O	1.2047
P <sub>2</sub> O <sub>5</sub>	P	0.4364
P	P <sub>2</sub> O <sub>5</sub>	2.2915

# **Crop Cut Survey Report (2015/2016 Dry Season)**

## **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 (2014-2019). Its first season was the 2014 wet season, when it ran nine field trials to test the adaptation of urea deep placement (UDP) technology in the Ayeyarwady, Bago, and Yangon regions. Farmer training on UDP was provided to the farmers in 10 townships (from three regions) in the 2014/15 summer paddy season. In the 2015 wet season, the farmers in 14 townships from three regions received UDP training. In the 2015/16 dry season, the farmer trainings were provided in 18 townships, and more than 1,400 farmers adopted the UDP technology.

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 using UDP to compare with their fields without UDP. Two 5 x 2 meter (m) plots are cut in fields with and without UDP. The crop cuts are threshed and weighed, and moisture is measured to calculate yield per hectare at 14% moisture. At the time of the cut, a questionnaire is filled out by the field officer to collect data required for calculation of gross margins (Appendix 1). A total of 144 crop cuts were collected from April to June 2016. This report describes the results for the crop cuts taken at the end of the 2015/16 dry season.

## **Sample Size and Random Sampling of UDP-Adopting Direct Beneficiary Farmers**

The list of direct beneficiary farmers (who attended the farmer trainings and applied UDP in dry season paddy) was received from a farmer census (taken by project staff during February-March 2016). The census found that there were 1,432 farmers (1,008 male and 424 female) who adopted UDP in the 2015/16 dry season. A 10% sample was selected by first sorting by gender in each township. Then, using a random integer generator (non-repeating), the random

sample numbers were obtained (in ascending numerical order) by gender in each township. There were 32 male sample farmers and 16 female sample farmers in the Yangon region, covering six project townships. There were 14 female sample farmers and 27 male sample farmers from four project townships in the Bago region and 17 female sample farmers and 45 male sample farmers from eight townships in the Ayeyarwady region (Appendix 2).

Some farmers in the sample had already harvested paddy before field officers could arrive for the crop cut. Therefore, there were some gaps (three female sample farmers in Ayeyarwady and two male sample farmers in Yangon and Bago) in collecting the sample crop cuts.

Overall, 100 UDP-adopting male beneficiary farmers and 44 UDP-adopting female beneficiary farmers were randomly selected (Table 1). Data on crop cut paddy yield with and without UDP (or non-UDP), inputs used, summer paddy cultivated area, irrigation access, percentage of total production to sell, farm-gate paddy price received, etc., were collected.

**Table 1. Sample Size and Collected Sample Crop Cuts for the 2015/16 Dry Season Paddy**

Sr. No.	Region	Township	Beneficiary Farmer Who Used UDP in 2016 Dry Season		Sample Farmers (10% of UDP-Adopting Farmers)		Collected No. of Sample Beneficiary Farmers		Gaps in Collecting Sample Crop Cuts	
			Female	Male	Female	Male	Female	Male	Female	Male
1	Yangon	1. Htantabin	1	2	1	2	1	2	0	0
		2. Hmawbi	10	40	1	4	1	4	0	0
		3. Hlegu	45	27	5	3	6	2	(+1)	(-1)
		4. Taikkyi	27	84	3	8	3	7	0	(-1)
		5. Twantay	20	81	2	8	2	8	0	0
		6. Kungyungon	35	66	4	7	4	7	0	0
		<b>Total Yangon</b>	<b>138</b>	<b>300</b>	<b>16</b>	<b>32</b>	<b>17</b>	<b>30</b>	<b>(+1)</b>	<b>(-2)</b>
2	Bago	1. Bago	11	45	1	5	1	5	0	0
		2. Letpadan	35	63	4	6	4	6	0	0
		3. Thayarwady	46	77	5	8	5	7	0	(-1)
		4. Daik-U	38	76	4	8	3	7	(-1)	(-1)
		<b>Total Bago</b>	<b>130</b>	<b>261</b>	<b>14</b>	<b>27</b>	<b>13</b>	<b>25</b>	<b>(-1)</b>	<b>(-2)</b>
3	Ayeyarwady	1. Maubin	22	36	2	4	2	3	0	(-1)
		2. Pantanaw	26	17	3	2	2	2	(-1)	0
		3. Mawgyun	35	201	4	20	2	22	(-2)	(+2)
		4. Kyaiklat	9	21	1	2	1	2	0	0
		5. Myaungmya	16	64	2	6	2	6	0	0
		6. Kangyidaunt	24	45	3	5	3	5	0	0
		7. Bogale	24	39	2	4	2	4	0	0
		8. Nyaungdon	0	24	0	2	0	1	0	(-1)
		<b>Total Ayeyar</b>	<b>156</b>	<b>447</b>	<b>17</b>	<b>45</b>	<b>14</b>	<b>45</b>	<b>(-3)</b>	<b>0</b>
		<b>Grand Total</b>	<b>424</b>	<b>1,008</b>	<b>47</b>	<b>104</b>	<b>44</b>	<b>100</b>	<b>(-3)</b>	<b>(-4)</b>

## Survey Results

### Cultural Practices of UDP-Adopting Sample Farmers

Overall, the majority (92%) of UDP-adopting farmers broadcast seeds, and the rest (7%) transplanted seedlings. One male farmer used a drum seeder in the Ayeyarwady region. A higher percentage of female farmers (93% of total female farmers) broadcast seeds than male farmers (91%) in 2016 dry season paddy. There was less variation in cultural practice among the different regions (as the majority of both male and female farmers broadcast seeds). The main reason for broadcasting seeds was scarcity of labor for transplanting rice.

**Table 2. Cultural Practice of Sample Farmers by Gender by Region**

Region				Cultural Practice			Total
				Transplant	Broadcast	Drum Seeder	
Yangon	Gender	Female	Count	2	150		17
			%	11.8%	88.2%		100%
	Male	Count	2	28		30	
		%	6.7%	93.3%		100%	
	Total		Count	4	43		47
			%	8.5%	91.5%		100%
Bago	Gender	Female	Count	1	12		13
			%	7.7%	92.3%		100%
	Male	Count	3	22		25	
		%	12%	88%		100%	
	Total		Count	4	34		38
			%	10.5%	89.5%		100%
Ayeyarwady	Gender	Female	Count	0	14	0	14
			%	0%	100%	0%	100%
	Male	Count	3	41	1	45	
		%	6.7%	91.1%	2.2%	100%	
	Total		Count	3	55	1	59
			%	5.1%	93.2%	1.7%	100%
<b>Total</b>	Gender	Female	Count	3	41	0	44
			%	6.8%	93.2%	0%	100%
	Male	Count	8	91	1	100%	
		%	8%	91%	1%	100%	
	Total		Count	11	132	1	144
			%	7.6%	91.7%	0.7%	100%

### Seed Use and Cost

It is obvious that the practice of broadcasting uses a greater amount of seeds than transplanting rice. Among the regions, farmers in Ayeyarwady used a higher seeding rate (164 kg/ha) than in Yangon (152 kg/ha) and Bago (140 kg/ha) when broadcasting seeds (Table 3). The sample farmers in all regions used a seed rate of 103 kg/ha for transplanting



rice. The F test shows that there is a significant difference in the amount of seed use by practice by region.

Nineteen farmers in Yangon, 16 farmers in Bago, and 15 farmers in Ayeyarwady bought seeds. The cost of broadcast seeds was higher than seeds for transplanting in Yangon (\$43/ha for transplanting and \$55/ha for broadcasting) and Bago (\$28/ha for transplanting and \$39.6/ha for broadcasting) (Table 3). This was mainly because of the higher rates used, although the cost of seed per kilogram was highest in Yangon (\$0.37/kg), and the one farmer who bought seed for transplanting in Yangon paid \$0.42/kg. Seed price was cheapest in Bago (\$0.29/kg). No farmers purchased seed for transplanting in Ayeyarwady, and those buying seed for broadcasting paid \$0.33/kg.

**Table 3. Seeding Rate and Seed Cost by Cultural Practice in Each Project Region**

Region	Transplant/Broadcast/ Drum Seeder		Seed Rate (kg/ha)	Cost of Seed (\$/ha)	Cost of Seed (\$/kg)
Yangon	Transplant	Mean	103.2450	42.9800	0.42
		N	4	1	
	Broadcast	Mean	152.0700	55.1128	0.36
		N	43	18	
	Total	Mean	147.9147	54.4742	0.37
		N	47	19	
Bago	Transplant	Mean	103.2475	27.9200	0.27
		N	4	1	
	Broadcast	Mean	139.6868	39.6907	0.28
		N	34	15	
	Total	Mean	135.8511	38.9550	0.29
		N	38	16	
Ayeyarwady	Transplant	Mean	103.2433	0	
		N	3		
	Broadcast	Mean	163.8344	53.9533	0.33
		N	55	15	
	Drum Seeder	Mean	77.4300	0	
		N	1		
	Total	Mean	159.2890	53.9533	0.34
		N	59	15	

**ANOVA Table**

			Sum of Squares	df	Mean Square	F	Sig.
Cost of Seeds (\$/ha)* Region Name	Between Groups	(Combined)	2,545.650	2	1,272.825	1.854	.168
	Within Groups		32,258.422	47	686.349		
	Total		34,804.071	49			
Qty Seed Used (kg/ha)* Region Name	Between Groups	(Combined)	12,849.218	2	6,424.609	2.931	.057
	Within Groups		309,057.426	141	2,191.897		
	Total		321,906.644	143			

## Sources of Seeds by Gender by Region

Table 4 shows that more than half the farmers in all regions use their own seed (60% in Yangon, 58% in Bago, and 75% in Ayeyarwady). A higher percentage of female farmers bought seed in Bago region (54% of females vs. 36% of males) and Yangon region (47% vs. 37%). In Ayeyarwady, there was a higher percentage of male farmers (27%) buying seed than female farmers (21%). Regardless of gender, farmers mostly buy seeds from other farmers who grow paddy purposely to sell seeds. Registered and certified seeds are not available in the project locations.

**Table 4. Sources of Seed by Gender by Region**

Region			Cultural Practice		Total	
			Own Seed	Bought Seed		
Yangon	Gender	Female	Count	9	8	17
			%	52.9%	47.1%	100%
	Male	Count	19	11	30	
		%	63.3%	36.7%	100%	
	Total	Count	28	19	47	
		%	59.6%	40.4%	100%	
Bago	Gender	Female	Count	6	7	13
			%	46.2%	53.8%	100%
	Male	Count	16	9	25	
		%	64.0%	36.0%	100%	
	Total	Count	22	16	38	
		%	57.9%	42.1%	100%	
Ayeyarwady	Gender	Female	Count	11	3	14
			%	78.6%	21.4%	100%
	Male	Count	33	12	45	
		%	73.3%	26.7%	100%	
	Total	Count	44	15	59	
		%	74.6%	25.4%	100%	

## Paddy Variety Planted in the 2016 Dry Season

The majority of both UDP-adopting male and female farmers in all regions used high-yielding variety (HYV) in dry season paddy. A hybrid variety was used by one male and one female in Yangon and Bago regions. No farmers in Ayeyarwady used a hybrid variety. One male farmer in Ayeyarwady region used a local variety, while 17% of farmers in Yangon and 16% of farmers in Bago used a local variety (such as local sticky<sup>1</sup> rice variety, Marla Hmwe, Thukha Hmwe, etc.). More male farmers (20%) in the Yangon region used a local variety, while more female farmers (23%) in the Bago region used a local variety.

<sup>1</sup> These are not glutinous rice varieties but local white rice varieties that cook with a more sticky texture.

**Table 5. Paddy Variety Planted by Gender by Region**

Region				Type of Paddy Variety			Total
				HYV	Hybrid	Local	
Yangon	Gender	Female	Count	14	1	2	17
			%	82.4%	5.9%	11.8%	100%
	Male	Count	23	1	6	30	
		%	76.7%	3.3%	20.0%	100%	
	Total	Count	37	2	8	47	
		%	78.7%	4.3%	17.0%	100%	
Bago	Gender	Female	Count	9	1	3	13
			%	69.2%	7.7%	23.1%	100%
	Male	Count	21	1	3	25	
		%	84.0%	4.0%	12.0%	100%	
	Total	Count	30	2	6	38	
		%	78.9%	5.3%	15.8%	100%	
Ayeyarwady	Gender	Female	Count	14		0	14
			%	100%		0%	100%
	Male	Count	44		1	45	
		%	97.8%		2.2%	100%	
	Total	Count	58		1	59	
		%	98.3%		1.7%	100%	

### Average Paddy Land and Different Land Size Groups by Gender by Region

Table 6 shows the total cultivated paddy land for female farmers in the 2015/16 dry season was higher than for male farmers in Yangon (3.4 ha for females and 2.7 ha for males) and Bago (4.1 ha for females and 2.8 ha for males) but not in Ayeyarwady (where males cultivated 3.9 ha and females 2.9 ha). However, female farmers applied UDP to larger areas than did male farmers in all regions.

The analysis of variance (ANOVA) table shows that the differences between gender and region are not significant for areas cultivated with or without UDP.

**Table 6. Average Paddy Land Areas With and Without UDP by Gender by Region**

Farmers' Gender	Region Name		UDP Land (ha)	Non-UDP Land (ha)	Total Paddy Land (ha)
Female	Yangon	Mean	.3159	3.0994	3.4153
		N	17	17	17
	Bago	Mean	.4146	3.6938	4.1085
		N	13	13	13
	Ayeyarwady	Mean	.0686	2.8879	2.9564
		N	14	14	14
	Total	Mean	.2664	3.2077	3.4741
		N	44	44	44
Male	Yangon	Mean	.1293	2.5467	2.6760
		N	30	30	30
	Bago	Mean	.2384	2.5588	2.7976
		N	25	25	25
	Ayeyarwady	Mean	.0662	3.8824	3.9487
		N	45	45	45
	Total	Mean	.1282	3.1508	3.2791
		N	100	100	100

**ANOVA Table**

			Sum of Squares	df	Mean Square	F	Sig.
UDP Land (ha)* Farmer's Gender	Between Groups	(Combined)	.583	1	.583	2.295	.132
	Within Groups		36.097	142	.254		
	Total		36.680	143			
Non-UDP Land (ha)* Farmer's Gender	Between Groups	(Combined)	.099	1	.099	.006	.937
	Within Groups		2,249.915	142	15.844		
	Total		2,250.014	143			
Total Paddy Land (ha)* Farmers Gender	Between Groups	(Combined)	1.162	1	1.162	.072	.789
	Within Groups		2,293.851	142	16.154		
	Total		2,295.013	143			

Based on the total cultivated paddy land, the sample farmers (144) can be categorized into four different farm size groups:<sup>2</sup> marginal (paddy land size 0.01-0.81 ha), small (0.82-2.02 ha), medium (2.03-4.05 ha), and large (above 4.05 ha). Averaging across all regions, 47% of total female farmers are smallholders, 7% are marginal, 23% work on medium, and 23% work on large paddy lands. For males, 13% are marginal, 40% are smallholder, 28% are medium, and 19% are large-scale farmers.

The majority of both male and female farmers in the sample fit into the “small paddy land” category in all regions. For example, 53% of females and 43% of males in the Yangon

<sup>2</sup> The landholding size groups used in the Agriculture Census have 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]).

region, 38% of females and 40% of males in the Bago region, and 50% of females and 38% of males in the Ayeyarwady region are “small farmers.”

A larger percentage of *female farmers* fit the “large paddy” category than male farmers in all regions. More *female farmers* fit the “medium paddy” category in Yangon, but more *male farmers* are found in the “medium paddy” category in Bago and Ayeyarwady.

A higher percentage of *male farmers* cultivate “marginal paddy” in all regions (17% in Yangon, 8% in Bago, and 13% in Ayeyarwady). No females work as marginal farmers in Yangon, but they comprise 7.7% in Bago and 14% in Ayeyarwady.

**Table 7. Different Land Size Groups by Gender by Region**

Region				Marginal=0.01-0.81 ha, Small=0.82-2.02 ha, Medium=2.03-4.05, Large=above 4.05 ha				Total
				Marginal	Small	Medium	Large	
Yangon	Gender	Female	Count	0	9	5	3	17
			%	0%	52.9%	29.4%	17.6%	100%
	Male	Count	5	13	7	5	30	
		%	16.7%	43.3%	23.3%	16.7%	100%	
	Total	Count	5	22	12	8	47	
		%	10.6%	46.8%	25.5%	17.0%	100%	
Bago	Gender	Female	Count	1	5	4	3	13
			%	7.7%	38.5%	30.8%	23.1%	100%
	Male	Count	2	10	9	4	25	
		%	8.0%	40.0%	36.0%	16.0%	100%	
	Total	Count	3	15	13	7	38	
		%	7.9%	39.5%	34.2%	18.4%	100%	
Ayeyarwady	Gender	Female	Count	2	7	1	4	14
			%	14.3%	50.0%	7.1%	28.6%	100%
	Male	Count	6	17	12	10	45	
		%	13.3%	37.8%	26.7%	22.2%	100%	
	Total	Count	8	24	13	14	59	
		%	13.6%	40.7%	22.0%	23.7%	100%	

### Type of Fertilizer Used in UDP and Non-UDP Plots by Gender by Region

UDP can reduce urea losses by more than 50%, and it needs one application only. The majority of both male (96%) and female (85%) farmers in the Bago region used briquette urea (BU) only (without any basal P and K). The application rate was 66 kg/acre or 163 kg/ha in their UDP plot.

Table 8 shows that the majority of both male and female farmers in the Yangon and Ayeyarwady regions used triple superphosphate (TSP) or muriate of potash (MOP)<sup>3</sup> as basal fertilizer with UDP.<sup>4</sup> Overall, 83% and 85% of total farmers in the Yangon and Ayeyarwady regions applied both TSP and BU, but this was not the case in Bago, where only 8% used a basal TSP with UDP. The Pearson Chi-square test shows the type of fertilizer used is significantly different among the regions.

**Table 8. Type of Fertilizer Used in UDP Plots in the 2015/16 Dry Season**

Region			Apply Fertilizer in UDP Plot		Total	
			BU Only	BU + TSP/MOP		
Yangon	Gender	Female	Count	1	16	17
			%	5.9%	94.1%	100%
	Male	Count	7	23	30	
		%	23.3%	76.7%	100%	
	Total		Count	8	39	47
			%	17.0%	83.0%	100%
Bago	Gender	Female	Count	11	2	13
			%	84.6%	15.4%	100%
	Male	Count	24	1	25	
		%	96.0%	4.0%	100%	
	Total		Count	35	3	38
			%	92.1%	7.9%	100%
Ayeyarwady	Gender	Female	Count	3	11	14
			%	21.4%	78.6%	100%
	Male	Count	6	39	45	
		%	13.3%	86.7%	100%	
	Total		Count	9	50	59
			%	15.3%	84.7%	100%

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	70.191 <sup>a</sup>	2	.000
Likelihood Ratio	74.095	2	.000
Linear-by-Linear Association	.455	1	.500
N of Valid Cases	144		

When not using UDP, Table 9 shows that the majority of female (71%) and male (37%) farmers in Yangon region used “urea and T-super” in their “non-UDP plot.” In the Bago region, 31% of female and 40% of male farmers applied “urea and compound” fertilizer. In Ayeyarwady, 57% of female and 62% of male farmers applied “urea and T-super.” It was

<sup>3</sup> Only two farmers used MOP.

<sup>4</sup> The FSI message is balanced fertilizer with UDP.

noted that in the Bago region more male and female farmers apply “special micronutrient fertilizers for paddy” (*such as combined herbicide and compound fertilizer, Nitrophoska,<sup>5</sup> Comet, etc.*) than in other regions. The farmers’ main goal for using special fertilizers in irrigated rice is to get a higher yield, especially in the “dry season.”

### **Mean Cost of Fertilizer for Dry Season Paddy by Gender by Region**

The ANOVA table shows that there is a significant difference in BU cost, TSP/MOP cost, and total fertilizer cost in UDP and non-UDP plots for summer paddy production by region (t-tests show no significant difference for fertilizer costs between male and female farmers).

Table 10 shows there is very little difference in the cost of briquettes for UDP between male and female farmers in the same region. For example, female and male farmers in Yangon spend nearly the same (\$71/ha and \$72/ha) for BU.

Both male and female farmers in the Bago and Ayeyarwady regions pay about \$1/ha more on UDP than in the Yangon region due to higher transportation cost for the briquettes. Both male and female farmers in Bago region did not use much T-super (or MOP) in the UDP plot, but farmers in Yangon and Ayeyarwady used TSP, thus spending more on fertilizer. Therefore, the total fertilizer cost (briquettes plus TSP) for the UDP plot is higher in the Yangon and Ayeyarwady regions than in the Bago region.

In the UDP plots, the female farmers in Yangon spent more on fertilizers than male farmers (due to higher TSP and/or MOP cost), but both male and female farmers in Yangon spend the same amount for total fertilizer in the non-UDP plot (\$150/ha vs. \$151/ha).

In the Bago region, both male and female farmers spent nearly the same amount for total fertilizer in UDP plots, but male farmers spent more on fertilizers in non-UDP plots (\$116/ha vs. \$100/ha). In Ayeyarwady, the male farmers spent more on total fertilizer in both UDP and non-UDP plots.

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<sup>5</sup> Nitrophoska 15:15:15: S = 2%; CaO = 6.5%; Fe = 1,000 ppm; Mn = 50 ppm; Zn = 30 ppm; Cu = 10 ppm; Mo = 2 ppm.