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FARMERS' NUTRIENT MANAGEMENT IN INTENSIVE IRRIGATED AND DIRECT SEEDED RICE PRODUCTION SYSTEM IN MEKONG DELTA, VIETNAM

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ABSTRACT

The investigation of 294 farmers in intensive irrigated and direct seeded rice production areas in Mekong delta indicates that farmers basically applied fertilizers three times per season and mostly used granular and compound fertilizers. More than half of farmers participated in the project of nutrient management, and only one-fourth of non-project participants and farmers outside the project zone applied foliar fertilizers. Farmers participated in the project of nutrient management used lower seed rate and nitrogen fertilizer than other farmers. Participation in nutrient management project, season, and nature of seed or rice variety, rice farm size significantly affected rice yield. Participated farmers in nutrient project and high yielding area projection affected the use of fertilizer.

INTRODUCTION

Improvements of fertilizer use in rice production have created benefits for farmers and society as a whole. Soil scientists have developed a technique of nutrient management, which employs right time in nitrogen (N) management, and the rates of nitrogen, phosphorus, potassium (NPK) fertilizers. Rice farmers in the Mekong Delta also have methods to determine NPK timing and rates based on their observation of field-level variability, season, weather, expected yield levels, and other factors. Determination of rates and timing of nutrient applications are different from scientists' viewpoints, which might be barriers to optimization of nutrient use efficiency. This paper, we tried to assess farmers' practices in nutrient management, which can be employed in improvement of time and rate of fertilizer application in order to reduce input cost and natural environment depletion.

MATERIALS AND METHODS

Data sources

The study was conducted during 2003 September and October in Dinh my and Dinh Khanh B hamlets (Dinh Mon commune), Can Tho province; Binh Trung and Binh Tay hamlets (Thanh Nhut commune), Tien Giang province; and Binh Thanh and Binh Chanh 2 (Binh My Commune), An Giang province. They are representative for intensive irrigated rice areas in Mekong Delta. The data were gathered through personal interview of 294 rice farmers. Of which, a complete enumeration of 43 farmers participated in practising new technique of nutrient management by using "leaf color chart" and "row seeder" to reduce N fertilizer and seed rate. They were recommended to use N P K fertilizer balance. They were classified as project participants. A random of 94 farmers living in the project site were selected and called as non-project participants with the assumption that there is an across information flow from project to non-project participants. A random of 152 farmers living outside the project zone in different hamlets were included for the comparison as check (table 1). The structured questionnaire was formulated to gather information of household socio-economic characteristics, and fertilizer management practices.

Table 1: Sample size classified by types of farmers

Province	Project participants	Non-participants in project site	Outside project	Total
Can Tho	7	43	50	100
Tien Giang	17	28	51	96
An Giang	19	28	51	96
Total	43	99	152	294

Analysis

Descriptive statistics such as percentages and means were used to summarize the data. T-test (2-tailed) was applied to compare the differences in rice yield, inputs and rice income between types of farmers. A multiple regression analysis was employed to determine factors affecting rice yield and the farmers' fertilizer management practices. The input cost and benefit cost ratio were able to compare among the groups of farmers in two provinces of An Giang and Tien Giang.

RESULTS AND DISCUSSION

Socio-economic profile of the farmers

Table 2 indicates that farmers are all middle-aged. The average educational level was grade 8 in high school for project participants, which is higher than those of non-project participants and farmers living out of the project sites. Family size was different among the farmer groups. It varied from 4.9 to 5.1 members / family. Number of male and female members per household was similar. The project participants hold bigger rice farm (1.33ha) as compared to other farmers because of the bias in selection of farmers by managers. Sutherland (1994) reported that agricultural staff (both field staff and specialists) often pays more attention to progressive and cooperative farmers who have more resources. Most of the farmers are landowners.

Table 2: Socio-economic profile of the farmers

Characteristics	Project participants (n=43)	Non-participants in project site (n=99)	Outside project (n=152)	Total (n=294)
Age (years old)	46.5 a	46 a	44.9 a	46
Education (years in school)	8.0 c	7.0 b	6.0 ab	7.0
Family size	5.1 a	4.9 a	5.1 a	5.0
Number of male members	2.5 a	2.3 a	2.5 a	2.3
Number of female members	2.7 a	2.5 a	2.4 a	2.8
Number of children	0.7 a	1.0 b	0.9 a	1.0
Total farm area (ha)	1.38 b	1.07 a	1.41 b	1.29
Rice farm area (ha)	1.33 c	0.95 a	1.23 b	1.14
Land owners (%)	100	97	97	98

Same letter within a row is not significant different at 0.05 level

Farmers' fertilizer management practices.

Table 3 shows that farmers applied fertilizers three times per season in average. One third of them applied four times. Only 2 to 5 percent of farmers applied fertilizer five times. Farmers initially applied fertilizer at 8 to 9 days after sowing (DAS) to make young plant grow well. The second application was at 19-22 DAS for producing tillers. The third application was at 35-38 DAS for panicle initiation. The fourth and fifth applications were for heading and grain filling.

Table 3: Timing of fertilizer application by farmers

Item	Project participants	Non-participants in project site	Outside project	Total mean
Total application number				
Summer-Autumn				
Mean	3	3	3	3
Range	2-5	2-5	2-5	2-5
Winter-Spring				
Mean	3	3	3	3
Range	2-5	3-5	2-5	2-5
Timing of application (DAS)				
Summer-Autumn				
1st application	8 (100)	9 (100)	9 (100)	9 (100)
2nd application	19 (100)	20 (100)	22 (100)	21 (100)
3rd application	35 (98)	35 (95)	37 (98)	36 (97)
4th application	52 (30)	48 (32)	51 (34)	50 (33)
5th application	75 (2)	70 (5)	58 (3)	65 (4)
Winter-Spring				
1st application	9 (100)	9 (100)	9 (100)	9 (100)
2nd application	21 (100)	20 (100)	22 (100)	21 (100)
3rd application	37 (95)	35 (100)	38 (98)	37 (96)
4th application	55 (26)	49 (32)	51 (34)	51 (33)
5th application	75 (2)	67 (5)	59 (3)	64 (4)

DAS = Days after sowing
Figures in parentheses are the percentages of farmers applying fertilizer for each timing

All farmers used granular (solid) fertilizer for both wet (Summer-Autumn) and dry (Winter-Spring) seasons. More than haft of project participants used foliar fertilizer meanwhile about one third of non-project participants and farmers outside the project used this form of fertilizer (table 4). Farmers believed that foliar fertilizers (such as Atonik, Bioted 601, Bioted 603, HPP, HQ 201, HQ701, HVP 201, HVP 501, HVP 601, K-Humate, KNO_3, Super 401, Super 402, Super 403, Tam Nong, Ba La Xanh, Crop- Master, An Sinh 401, An Sinh 402, An Sinh 403…) can be typically sprayed at the later fertilizer application. The last 2 applications were often combined with pesticide. Farmers believed that foliar fertilizers function to repair damaged leaves and to ensure panicle and seed growth.

Most of farmers (94%) used compound fertilizer (NPK) rather than single fertilizer. Farmers said that compound fertilizer is more convenient in applying multiple nutrients, available in the markets, and it makes rice plant healthier and is slowly released after applying into soil. This might be associated with the advertisement of fertilizer companies. According to Ban and Hawkins (1988), farmers accept or reject a kind of fertilizer based on its advantage or disadvantage. The clever advertisers pay much attention to increase yields, low cost and slow lower soil fertility of a fertilizer. The company also indicates chemical content with appropriate ratio of nitrogen, phosphorus and potash including in compound fertilizer bag. However, new approach in nutrient management developed by soil scientists recommends farmers to use single fertilizer, which can be easily added or reduced the rate of each component depending on plant need. Dobermann and Fairhurst (2000) reported that the approach to site-specific nitrogen (N), phosphorus (P) and potash (K) management in irrigated rice assumes balanced fertilizer use and proper crop management by estimating crop N P K demand, potential indigenous N P K supply, calculating N P K fertilizer rate, and deciding about splitting and timing of N P K applications and N P K fertilizer sources.

Table 4: Percentage of farmer used foliar fertilizer

Season	Project participants (n=43)	Non-participants in project site (n=99)	Outside project (n=152)	Total
Summer-Autumn	65	22	25	46
Winter-Spring	51	25	25	30

Seed rate, rice yield and NPK fertilizer used farmers.

Farmers participated in the project used 144-145 kg of seed per ha which is significant less than those of other groups of farmers are. They also used lesser nitrogen (N) fertilizer and relatively higher potassium than others did. Rice yield was not different among the groups of farmers in both wet and dry seasons. Farmers participated in the project used good quality rice variety such as Jasmine, Soc Trang 3, and VD20 which is higher seed price than the other varieties such as IR50404, OM1490, OMCS99, planted by other groups of farmers.

Table 5: Seed, seed price, yield and NPK fertilizers used by farmers

Item	Project participants (n=43)	Non-participants in project site (n=99)	Outside project (n=152)	Total mean
Seed rate (kg/ha)				
Summer-Autumn	144 a	208 b	211 b	200
Winter-Spring	145 a	199 b	205 b	194
Seed price (1000 VND/kg)				
Summer-Autumn	3107 b	2125 a	2171 a	2292
Winter-Spring	2917 b	2235 a	2206 a	2320
Rice yield (t/ha)				
Summer-Autumn	4.53 a	4.31 a	4.42 a	4.40
Winter-Spring	6.71 a	6.70 a	6.40 a	6.55
Fertilizer amount				
Summer-Autumn				
N (kgN/ha)	93.7 a	104.3 b	109.1 b	105.2
P (kg P_2O_5/ha)	26.1 a	34.5 b	24.4 a	28.1
K (kgK_2O/ha)	30.4 b	22.9 a	24.4 ab	24.8
Winter-Spring				
N (kgN/ha)	97.0 a	105.4 ab	108.8 b	105.9
P (kgP_2O_5/ha)	26.7 a	34.3 b	24.0 a	27.9
K (kgK_2O/ha)	33.1 b	25.6 a	22.9 a	25.3

Same letter within a row is not significant different at 0.05 level

Inputs and benefit cost ratio in rice production

In both wet (Summer-Autumn) and dry (Winter-Spring) seasons, the input costs for seeds, and pesticides were similar among farmer groups. However, project participants spent relatively less fertilizer cost than other groups. Non- participant farmers in the project sites also imitate the use of fertilizer from project participants. Total rice income of project participants in wet season was higher than those of other groups of farmers. Thus, their benefit cost ratio was significant higher. However, in dry season, rice income and benefit cost ratio of project participants were higher though they were not significantly different (table 6).

Table 6: Input cost and rice income per hectare (1000 VND) and benefit cost ratio

Item	Project participant (n=36)	Non-project participant (n=56)	Outside project (n=102)
Summer Autumn			
Seed cost	425 ab	388 a	457 b
Herbicide cost	202 b	187 ab	142 a
Insecticide cost	150 abc	161 bc	119 a
Fungicide cost	164 a	256 b	247 b
Fertilizer & other nutrient cost	922 a	937 ab	1064 b
Total cost (materials and labor)	4541 ab	4622 b	4368 a
Total rice income	10328 b	8472 a	8171 a
Net-rice income	5787 b	3850 a	3803 a
Benefit cost ratio	1.35 b	0.93 a	0.97 a
Winter-Spring			
Seed cost	409 a	407a	459 b
Herbicide cost	206 a	188 a	154 a
Insecticide cost	148 ab	165 a	124 b
Fungicide cost	179 a	225 ab	255 b
Fertilizer & other nutrient cost	905 a	970 ab	1039 b
Total cost (materials and labor)	4262 a	4465 a	4177 a
Total rice income	12633 b	11629 b	10685 a
Net-rice income	8371 b	7164 ab	6506 a
Benefit cost ratio	1.99 a	1.76 a	1.71 a

Same letter within a row is not significantly different at 0.05 level

Factors affecting rice yield and N, P, K fertilizer use

Participation in nutrient management project, season, and nature of seed or rice variety, rice area and family size significantly affected rice yield. Farmers who participated in the project of nutrient management produced higher rice yield than those of other groups of farmers. Rice yield is higher in dry season than in wet season because of sufficient sunlight, water and good weather for plant growth. Seed price reflects the nature of seed or rice variety. The seed price of good eating quality variety is high. Almost good eating rice varieties produce lower yield than highly yielding rice at the time of this study. Farmers who hold bigger rice farms produced higher yield. This might be associated with the bias in selection of farmers to participate in the project as mention by Sutherland (1994). They have more resources and are able to invest to obtain high yield. Household with larger family size produced lower rice yield than those with small family size (table 7).

Farmers who participated in nutrient management project reduced N and P fertilizer in wet season. Farmers wanted to have high yield, thus they increased potassium (K) fertilizer in wet season. Farmers said that lodging and disease are vulnerable to rice yield in wet season. Increase the use of potassium can prevent lodging and disease attack.

Farmers in the project sites used higher P fertilizer than farmers out of project sites in both wet and dry seasons. Farmers who participated in project reduced phosphorus and increased potassium use in dry season. Targeting high yield by farmers increased phosphorus fertilizer in dry season (table 8).

Table 7: Factor affecting rice yield

Factor	Coefficients	T-value
(Constant)	4.7643	13.9866**
Project site (1=Yes; 0= No)	0.0754	0.6796
Project participants (1= Yes; 0= No)	0.3492	1.9871*
Season (1= dry; 0= wet)	2.7286	22.9338**
Seed price (1000 d)	-0.0003	-2.7536 **
N fertilizer (kgN/ha)	0.0031	1.779618
P fertilizer (kgP_2O_5/ha)	0.0001	0.022756
K fertilizer (kgK_2O/ha)	0.0034	1.371766
Rice area (ha)	0.2306	5.2645**
Family size	-0.0669	-2.2694*
Education (years in school)	-0.0214	-1.5402
F= 80.839		

Table 8: Factor affecting N P K (kg/ha) used by farmers

Factor	N (kgN/ha)		P (kgP_2O_5/ha)		K (kgK_2O/ha)	
	Coefficients	T Value	Coefficients	T Value	Coefficients	T Value
Wet season						
(Constant)	94.0783**	8.8462	27.2587**	4.1342	8.4501	1.2090
Project site (1=Yes; 0= No)	-4.0454	-1.0305	10.5637**	4.3404	-1.2549	-0.4864
Project participants (1= Yes; 0= No)	-11.6558*	-2.1088	-8.4998*	-2.4804	6.9022	1.9001
Rice area (ha)	1.2678	0.7619	1.4189	1.3753	-0.5387	-0.4926
Yield (ton/ha)	3.8788	1.8905	0.1589	0.1249	3.9715**	2.9454
Family size for male	-0.5839	-0.3799	-0.6969	-0.7312	-0.4589	-0.4542
Family size for female	-0.9305	-0.6406	-1.4896	-1.6541	0.0645	0.0675
	F= 2.477		F= 3.804		F= 2.305	
Dry season						
(Constant)	98.7797**	9.1025	8.1436	1.3117	20.5844**	3.0868
Project site (1=Yes; 0= No)	-3.7518	-0.9245	9.0264**	3.8878	2.6709	1.0710
Project participants (1= Yes; 0= No)	-8.7618	-1.5552	-6.9869*	-2.1678	7.0830*	2.0460
Rice area (ha)	0.2103	0.1181	-1.1187	-1.0978	0.5833	0.5329
Yield (ton/ha)	0.9741	0.6852	3.0852**	3.7933	-0.0565	-0.0647
Family size for male	0.2675	0.1702	-0.5351	-0.5951	-0.1524	-0.1578
Family size for female	1.1986	0.7951	-0.4892	-0.5673	1.0055	1.0854
	F=1.056		F=6.416		F=1.944	

CONCLUSION

Farmers in the Mekong Delta applied fertilizers 3 times per season mostly used granular and compound fertilizers. The initial fertilizer application is within 10 early days of plant growth. The second application is about at 3 weeks and the third at 5 weeks after seed sowing. More than half of farmers participated in the project of nutrient management applied foliar fertilizers meanwhile only one-fourth of non-project participants and farmers outside the project zone used the liquid fertilizer. Farmers participated in the project of nutrient management used lower seed rate and nitrogen fertilizer than other farmers. Thus,

they spent less cost for fertilizer inputs. Participation in nutrient management project, season, and nature of seed or rice variety, rice area significantly affected the rice yield. Farmers who participated in the project of nutrient management produced higher rice yield than those of other farmers. Rice yield is higher in the dry season than in the wet season due to good weather. High seed price or good eating rice varieties produced lower yield than other rice varieties at the time of study. Farmers who have more resources as bigger land produce higher yield than the small land-holding farmers do. Participating in nutrient project and the target of obtaining high yield affected the use of fertilizer. Farmers who participated in project generally reduced nitrogen and increased potash fertilizer. Farmers who wanted to obtain high yield increased potash in wet season and phosphorus in dry season.

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Quản lý dinh dưỡng theo nông dân ở vùng lúa có nước tưới và sạ thẳng

Kết quả điều tra 294 nông dân ở vùng lúa có nước tưới và sạ thẳng tại Đồng Bằng Sông Cửu Long cho thấy về cơ bản nông dân bón phân 3 lần/vụ và hầu hết dùng dạng phân hỗn hợp. Hơn 50% nông dân tham gia dự án quản lý dinh dưỡng tổng hợp và một phần tư nông dân không tham gia chương trình và nông dân ngoài vùng dự án sử dụng phân bón lá. Nông dân có tham gia dự án quản lý dinh dưỡng đã giảm hàm lượng phân đạm và hạt giống có ý nghĩa. Việc tham gia dự án, yếu tố mùa vụ, bản chất hạt giống và qui mô ruộng lúa có ảnh hưởng đến năng suất lúa. Yếu tố tham gia dự án của nông dân và việc hoạch định vùng lúa năng suất lúa cao đã ảnh hưởng đến sử dụng phân bón của nông dân. .