Adoption of Research Recommendations by Rice Farmers: A Case Study on Bangkok Plain

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Summary

Farm survey and field experiments on farmers' fields and at Suphanburi Rice Experiment Station were conducted from April 1993 to January 1994 to gather information on crop management practices followed by farmers and to evaluate applied N response. Field experiments consisted of three treatments: i) control with no N but recommended P fertilizer applied; ii) fertilizer dosage by the farmer or average dosage used by farmers in the survey; and iii) fertilizer dosage recommended by the Department of Agriculture (DOA).

Thirty-nine% of farmers used herbicide and pesticide dosages in excess of the DOA recommended dosage. 18 types of pesticides of class Moderate to Extremely Hazardous not recommended by DOA were used by farmers. Only 18% of farmers were aware of the recommended herbicide and pesticide dosages. Not all farmers (only 65%) were aware of proper handling and storage procedures for herbicides and pesticides.

Only 11% of farmers were aware of fertilizer recommendations. 84% used fertilizer dosage higher than the DOA recommended dosage. On average, 34 kg of N ha^{-1} and 5 kg of P ha^{-1} were used in excess of the DOA recommended dosage in one season. The excess dosage did not produce grain and straw yields higher than the recommended dosage on both farmers' fields and at the experimental station. Furthermore, N response (kg grain per kg N) was 60% lower than at DOA recommended dosage.

Farmers trusted results from their own field experiment more than results from the experimental station. They were willing to adopt DOA recommendations during the next growing season. However, a follow-up survey conducted in the next season showed that farmers had not adopted the DOA recommendations. Reason given was that they are used to applying high doses and that it gives high yields.

Résumé

Adoption des recommandations de la recherche par les riziculteurs : étude du cas des producteurs de la plaine de Bangkok

Une enquête sur les pratiques culturales et des essais agronomiques ont été réalisés chez des agriculteurs de la plaine de Bangkok et au niveau de la station expérimentale rizicole de Suphanburi d'avril 1993 à janvier 1994 pour caractériser les itinéraires techniques suivis et évaluer la réponse du rendement aux doses d'engrais employées. Les essais comportaient trois traitements: i) un témoin sans azote mais avec la dose recommandée de phosphore, ii) la dose moyenne d'engrais appliquée par les agriculteurs interrogés, iii) la dose d'engrais recommandée par le département de l'Agriculture (DOA).

Trente-neuf pour cent des agriculteurs utilisaient des doses de pesticides et d'herbicides qui excédaient les recommandations du DOA. Dix-huit types de pesticides moyennement ou très dangereux, non recommandés par le DOA, étaient utilisés par les agriculteurs. Seulement 18% des agriculteurs connaissaient les doses préconisées pour les pesticides et les herbicides mais 65% d'entre eux savaient comment appliquer et emmagasiner correctement ces produits.

Seulement 11% des agriculteurs connaissaient les doses d'engrais recommandées et 84% utilisaient une quantité d'engrais supérieure à celle préconisée par le DOA. En moyenne, 34 kg de N et 5 kg de P étaient appliqués en excès par ha. Ces dosages supérieurs aux recommandations n'ont pas permis d'obtenir plus de grain et plus de paille que les quantités obtenues avec la dose recommandée par le DOA en station expérimentale et en milieu paysan. De plus, la réponse du rendement à l'azote (kg de grain par kg d'N appliqué) était inférieure de 60% à celle obtenue avec la dose recommandée par le DOA. D'une manière générale, les agriculteurs ont manifesté une plus grande confiance vis-à-vis des résultats expérimentaux obtenus dans leurs parcelles que pour ceux obenus dans la station de recherche. Au cours de l'enquête, la grande majorité d'entre eux se sont déclarés prêts à adopter les recommandations du DOA. Lors de la saison de culture suivante, une enquête complémentaire a été organisée en vue d'évaluer le suivi des résolutions prises par les agriculteurs. Cette enquête n'a pas mis en évidence un changement dans les pratiques des agriculteurs par rapport à la première investigation. Lors de cette deuxième enquête, les agriculteurs ont déclaré être habitués à utiliser des doses élevées d'engrais et être satisfaits des rendements obtenus.

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Introduction

Sustainable agriculture requires an active participation on the part of the farmers in terms of adoption of appropriate research findings. The goal of sustainability cannot be attained without the proper adoption of technologies. This is especially the case with fertilizers and pesticides since their misuse can lead to environmental pollution and increased input costs. In most parts of Asia, fertilizer and pesticide use is lower than the optimal requirement of rice crop. However, in intensive rice growing regions, fertilizer and pesticide use has increased sharply during the last decade and there are reports of ground water pollution with nitrate (2,6,7).

Suphanburi province, on Bangkok plain, is an intensive rice growing region in Thailand. In 1977, fertilizer dosage applied by farmers was only half the recommended dosage (6) and recent statistics show that the total fertilizer use in the region has increased fourfold in the last decade (1). However, information on the extent of the appropriate or proper use of herbicides, pesticides and fertilizers is limited (5,8). The objectives of the study were i) to determine the extent of the use of farm chemical inputs in the intensive rice growing region; and ii) to evaluate the extent of farmers adoption of the Department of Agriculture (DOA) recommended fertilizer and pesticide technologies in the region.

Material and Methods

The study was conducted in three phases: i) an initial survey to record the crop management practices followed by the farmers; ii) concurrent field experiments on farmers' fields and at a local research station to compare fertilizer practice followed by the farmers with the DOA recommendations; and iii) a follow-up survey to study whether farmers had adopted DOA recommendations after participating in the field experiments. Results from study were presented to the farmers at a meeting before the follow-up survey.

1. Site

Muan an Sripachan regions, located close to (within 10 km radius) the Suphanburi Rice Experiment Station, of Suphanburi province were selected as the project areas as these are the most intensive rice growing areas of Thailand.

2. Initial Farm Survey

Survey on crop management practices was conducted from April to December 1993 (wet season) through interviews using questionnaires. With the assistance of the local extension agents, 40 farmers growing high yielding rice cultivar Suphanburi-90 by wet seeding method of cultivation (broadcasting of pregerminated seeds on to puddled soil) were contacted. Thirty-one of them were willing to participate in the survey. Every three weeks, farmers were visited to obtain information on fertilizer, herbicide or pesticide application: product name, amount applied, method and time of application, storage and handling, reason for control, and source of recommendation.

3. Field Experiments

Field experiments on 11 farmers' fields and at Suphanburi Rice Experiment Station were conducted concurrently during the dry season from September 1993 to January 1994 with cultivar Suphanburi-90 by wet seeding method of cultivation.

On 11 Farmers' Fields

The experiments consisted of three treatments: i) fertilizer dosage and timing as recommended by DOA i.e. 30.0 kg N ha^{-1} plus 16.5 kg P ha^{-1} 30 days after seeding and 32.8 kg N ha^{-1} just before panicle initiation stage; ii) fertilizer dosage and timing as determined by the farmer; and iii) control with no N but recommended P (16.5 kg P ha^{-1}) applied. On each of the 11 farmer's fields, there were two control plots of 25 m^2 while that of fertilizer treatments varied from 0.25 to 0.5 ha. Except for fertilizer application, any other crop management practice performed by farmer was common to all three treatments. Every three weeks, farmers were visited to obtain information on the crop management (fertilizer, herbicide or pesticide application) performed since the previous visit. At harvest, from each treatment plot, grain and straw yields (at 14% moisture) were measured from four 4 m^2 area.

At the Experimental Station

Experiment at the Suphanburi Rice Experiment Station consisted also of three treatments: i) control with no N but recommended P (16.5 kg P ha^{-1}) applied; ii) average dosage applied by the farmers in the initial survey; and iii) DOA recommended dosage. Experimental plots were laid out as Randomised Block Design with five replicates, each plot having an area of 25 m^2. In all treatments, all other field and crop management operations were performed as recommended by DOA. At harvest, grain and straw yields from each plot were measured from a harvest area of 20 m^2.

4. Meeting with the Farmers

After the completion of the field experiments, a meeting with the farmers who participated in the survey and field experiment was held to inform them about the results obtained from the study. Results from each of the farmer's field experiment were presented together with the results from the experimental station. Any excess use of fertilizer or pesticide was presented in terms of both quantity and input cost. Presentation was done using overhead transparencies and a copy of the presentation materials was provided to all farmers. The local extension agent assisted in the formulation of presentation materials. After the presentation of results farmers were provided with a questionnaire to record their opinion on the study and the extent of adoption of DOA recommendations for the next crop.

5. Follow-up survey

In order to evaluate whether the farmers had adopted the DOA recommendations after having participated in the study a follow-up survey was conducted in November 1994. Farmers who participated in the field experiment and who also attended the meeting were

interviewed to record fertilizers used for the rice crop grown after the experiment, i.e. in the wet season (May-September) of 1994. Only six of the 11 farmers could be contacted.

6. Statistical Analysis

Data on the application of herbicides, pesticides and fertilizers from the surveys were analysed by the one-sample sign test at 95% confidence level using the DOA recommend dosage as the reference. Farmers' field experiment data were analysed by two factors Anova (location and treatments) and the experimental station data also by two factors Anova (block and treatment). Means were separated by LSD at 95% confidence level. The analysis was performed using Statgraphics Version 7.O.

Table 1
Extent of use of herbicides by 31 farmers in Muan and Sripachan areas during the 1993 growing season.

In relation to DOA recommendations	Number of farmers using herbicides of class	
	Slightly Hazardous[a]	Almost Non-hazardous[b]
1. According to recommendations	1	1
2. More than the recommended amount	9	0
3. Less than the recommended amount	14	4
Inappropriate use of herbicides[c]	23	4
Total = 27[d]		

[a] Acute oral LD_{50} = 500-5000 mg kg^{-1}
[b] Acute oral LD_{50} = 5,000-15,000 mg kg^{-1}
[c] Farmers in group 2 and 3.
[d] There are more inappropriate users of herbicides according to the one-sample sign test at $p<0.05$.

Table 2
Extent of use of pesticides by 31 farmers in Muan and Sripachan areas during the 1993 growing season.

In relation to DOA recommendations	Number of farmers using pesticides of class		
	Extremely Hazardous[a]	Highly Hazardous[b]	Moderately Hazardous[c]
1. According to DOA recommendations	0	0	1
2. More than the recommended amount	0	2	1
3. Less than the recommended amount	0	5	3
3. Use of not recommended pesticides	9	0	6
Inappropriate use of pesticides[d]	9	7	10
Total = 26[e]			

[a] Acute oral LD_{50} = solid < 5 mg kg^{-1}; fluid < 20 mg kg^{-1}
[b] Acute oral LD_{50} = solid 5-50 mg kg^{-1}; fluid 20-200 mg kg^{-1}
[c] Acute oral LD_{50} = solid 50-500 mg kg^{-1}; fluid 200-2,000 mg kg^{-1}
[d] Farmers in group 2, 3 and 4.
[e] There are more inappropriate users of pesticides according to the one-sample sign test at $p<0.05$.

Table 3
Amount of fertilizer applied by 31 farmers in Muan and Sripachan during the 1993 growing season. Department of Agriculture (DOA) recommended dose: 62.8 kg N, 16.5 kg P and O K ha^{-1}

	N	P	K
Range (kg ha^{-1})	20-192	3-53	0-12.5
Average (kg ha^{-1})	96.8	21.7	1.7
Median (kg ha^{-1})	94.4[a]	20.0[a]	0[b]
No. of farmers applying more than DOA recommended dosage	26	19	8

[a] Median is higher than the recommended dose at $p < 0.05$ using the one-sample sign test.
[b] Median is equal to the recommended dose at $p < 0.05$ using the one-sample sign test.

Results

1. Farm Surveys

In the Muan and Sripachan area, 87% of farmers used herbicides inappropriately: either more or less than the DOA recommendations (Table 1). Thirty percent of them used a higher dosage than the recommended doses and the herbicides belonged to Slightly Hazardous Class of the Thai Pesticide Classification. Similarly, 84% of farmers used pesticides inappropriately (Table 2). Forty-eight percent of them used 18 types of pesticides (mostly insecticides) which were not recommended by the DOA and they belonged to Class Moderate to Extremely Hazardous.

Not all farmers (only 18%) were aware of the recommended dosage or formulation of pesticides. They followed mostly their own or their neighbours' recommendations. Some farmers also received information from the sales agents. Chemical control was undertaken as a preventive measure rather than as a curative action. Survey also showed that not all farmers (only 65%) followed proper handling (wearing masks and gloves) and storage procedures, but all of them were aware of the harmful effects of herbicides and pesticides.

Eleven percent of farmers knew about fertilizers recommendations by DOA and 82% of farmers considered recommended dosages to be low. Eighty-four percent of farmers used N fertilizer dosage higher than the recommended N dosage (Table 3). Similarly, 61% of farmers used higher P dosage. On average, 34.0 kg N, 5.2 kg P and 1.7 kg K ha^{-1} were used in excess of the DOA recommended dosage in one season.

2. Field Experiments

On farmers's field there were no significant differences in grain or straw yields with farmer applied and DOA recommended fertilizer dosages (Table 4). Similar results were obtained at the experimental station (Table 5).

Grain yield response to farmer N dosage (kg grain per kg N), both on farmers' fields and at the experimental station, was around 60% of the response at DOA recommended N dosage (Tables 4 and 5).

Table 4
Grain and straw yields and N response of lowland rice. Experiments conducted on 11 farmers' fields in 1993.

Fertilizer treatment	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	N response (kg grain kg N^{-1} ha^{-1})
Control	2.82[a] a	4.68 a	NA
Farmer applied dosage	3.63 b	6.38 b	26.5 a
DOA recommended dosage	3.74 b	6.41 b	43.5 b

[a] Means in the same column followed by same letter are not significant at $p < 0.05$ using LSD.
NA: not applicable.

Table 5
Grain and straw yields and N response of lowland rice at Suphanburi Rice Experiment Station in 1993.

Fertilizer treatment	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	N response (kg grain kg N^{-1} ha^{-1})
Control	1.85[a] a	3.4 a	NA
Farmers dosage - survey	3.18 bc	4.0 a	32.1 a
DOA recommended dosage	3.23 c	3.9 a	51.4 b

[a] Means in the same column followed by same letter are not significant at $p < 0.05$ using LSD.
NA: not applicable.

Table 6
Amount of fertilizers applied during the 1994 growing season in the follow-up survey. Data from 6 of the 11 farmers who took part in the field experiment.

	N	P
Range (kg ha^{-1})	89-265	10-29
Average (kg ha^{-1})	162.0	17.9
Median (kg ha^{-1})	151.5[a]	14.3
No. of farmers applying more than DOA recommended dosage	6	2

[a] Median is higher than the recommended dose at $p < 0.05$ using the one-sample sign test.

3. Meeting with the Farmers

It was noted from the meeting that 89% of the farmers trusted results from the experimental station. On the other hand, there was a complete trust on results obtained from field trials conducted on their field with their full participation and monitored by the research staff. Most farmers (94%) showed interest in adopting the recommended dosages for the next crop to reduce input costs and to help protect the environment.

4. Follow-up survey

The follow-up survey showed that farmers had not adopted the DOA recommendations for the next crop although they acknowledged DOA recommendations as appropriate at the meeting (Table 6). On an average, 99.2 kg N and 1.4 kg P ha^{-1} were used in excess of DOA recommended dosage in the crop grown after the experiment.

Discussion

In intensive rice growing areas around the Suphanburi Rice Experiment Station, improper and/or excess use of herbicides was observed. In wet seeding method of rice cultivation, weeding is a major problem. Mechanical weeding is not possible and manual weeding is expensive. Furthermore, it is difficult to hire labourers during the season due to manpower shortage. Thus, farmers had to adopt chemical control. Due to the lack of effective extension service, as can be deduced from the low awareness of DOA recommendations by farmers, they followed their own or neighbours' recommendations, which were apparently not correct.

The misuse of pesticide was more wide spread than herbicides and the toxicity class of the pesticides used was much higher than that of herbicides. Moreover, farmers applied pesticides as a preventive measure rather than as a curative action. However, most rice pests do not require preventive control. Studies in various Asian countries have shown that adoption of integrated pest management (IPM) can drastically reduce or eliminate the use of pesticides (3,4,9). The improper and excess use of chemical control was partly due to the lack of farmers' awareness of DOA recommendations. Thus, there is a need for campaigns to promote the appropriate use of herbicides and pesticides together with the implementation of IPM in the region.

Excess application of fertilizers was also common in the region. This resulted in an extra input cost of 9-18 US$ ha^{-1} $season^{-1}$ with no additional returns in terms of grain or straw yields. As farmers mostly applied compound fertilizers, excess P was also added unnecessarily. In 1994, Olk et al (7) also found that farmers living around Suphanburi Rice Experiment Station used excess of N fertilizer (51 kg N ha^{-1}) without any additional benefits. They also found such trends in four other Asian countries. However, they did not investigate the reasons for the excess use of fertilizers.

In the present study, only some farmers were aware of fertilizer recommendations by DOA and most farmers had the misconception that the recommended dosages were low. This could be due to their conviction that applying high amounts gives high yields. At the meeting, farmers expressed high satisfaction with the results of the study and were willing to reduce input costs and to protect the environment by adopting the DOA recommendations. However, they did not follow the recommendations for the next rice crop. The reason given was that they are used to applying high amounts because it gives high yields. Though experiments were conducted on their own fields with their active participation, showing the contrary, they did not adopt the results. Repetitive field trials may be required to prove that recommendations hold good for many seasons. It is essential that the local extension service takes initiative to promote proper use of fertilizers in the region.

Excess use of fertilizer and pesticides has been a problem in many industrialised countries and the present study shows that such problems can also be observed in a non-industrialised country, especially in in-

tensive growing areas (2,5). The reason could be that as the farmers' income raise, the expenditure on chemical inputs would also increase. Farmers are aware that fertilizers and pesticides are essential inputs for high yields. However, they are not aware of the optimal recommended dosages. Thus, an effective dissemination of research findings by the extension service is essential for a proper adoption of these technologies by farmers.

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