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N. H. Huan <sup>a</sup>; H. V. Chien <sup>b</sup>; P. V. Quynh <sup>c</sup>; P. S. Tan <sup>d</sup>; P. V. Du <sup>d</sup>; M. M. Escalada <sup>e</sup>; K. L. Heong <sup>f</sup>

<sup>a</sup> Plant Protection Department, Ho Chi Minh City, Vietnam <sup>b</sup> Southern Regional Plant Protection Center, Long Dinh, Tien Giang, Vietnam <sup>c</sup> Sub Plant Protection Department, Can Tho, Vietnam <sup>d</sup> Cuulong Rice Research Institute, Omon, Vietnam <sup>e</sup> Department of Development Communication, Visayas State University, Baybay, Leyte, Philippines <sup>f</sup> International Rice Research Institute, Los Banos, Metro Manila, Philippines

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## Motivating rice farmers in the Mekong Delta to modify pest management and related practices through mass media

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<sup>a</sup>Plant Protection Department, Ho Chi Minh City, Vietnam; <sup>b</sup>Southern Regional Plant Protection Center, Long Dinh, Tien Giang, Vietnam; <sup>c</sup>Sub Plant Protection Department, Can Tho, Vietnam; <sup>d</sup>Cuulong Rice Research Institute, Omon, Vietnam; <sup>e</sup>Department of Development Communication, Visayas State University, Baybay, Leyte, Philippines; <sup>f</sup>International Rice Research Institute, Los Banos, Metro Manila, Philippines

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A participatory planning process was applied to develop a media campaign to motivate rice farmers in the Mekong Delta to modify pest management practices together with seed and fertilizer inputs. Locally named 'Ba Giam Ba Tang' or 'Three Reductions, Three Gains', campaigns were launched in two provinces, Can Tho and Tien Giang. In both provinces, farmers' practices changed significantly. Their insecticide sprays reduced by 13–33% while their seed rates dropped ~10% and nitrogen rates, ~7% and proportion of farmers using insecticides declined by ~11%. These practices were supported by modifications in belief attitudes that favored high inputs. Farmers who reported significant reductions in the three inputs also changed their perception of yield loss. The campaigns in Can Tho and Tien Giang had significant multiplier effects. They stimulated several provincial governments as well as the Ministry of Agriculture and Rural Development to provide additional resources to reproduce the materials and campaign process for local use which eventually reached more than 3 million farmers in south and central Vietnam.

**Keywords:** rice; Vietnam; fertilizers; pesticides; multi-media campaign; mass media; resource management

### 1. Introduction

Rice farmers in Vietnam mainly use pesticides for pest control and often large proportions of their sprays are misused because of poor knowledge and decisions (Heong and Escalada 1997). Most farmers pay high attention to highly visible pest damage, like that caused by leaf folders in the early crop stages. However, these damages have little or no yield loss consequences (Graf et al. 1992). These early season insecticide perturbations are instead favorable to some r-strategist pest species, like the planthoppers (Schoenly et al. 1994; Heong and Schoenly 1998).

In the Mekong Delta of Vietnam, farmers also use high seed rates, followed by high rates of nitrogen. Over the period 1990–2004, seed rates increased by 50% from 95 to 144 kg ha<sup>-1</sup> while nitrogenous fertilizer use has doubled from 70 to 140 kg ha<sup>-1</sup> and yields have increase 50% from 3.2 to 4.8 t ha<sup>-1</sup> (FAOSTAT 2005). In general farmers' seed and fertilizer applications differ from the 'optimum' application levels established in research (Luat et al. 1998), thus reducing their profits and polluting the environment. These practices may be due to perceptions that high inputs of seeds and fertilizers will lead to high yields. High seed and fertilizer rates would also enhance pest and disease developments thus stimulating higher use of pesticides (Webster and Gunnell

1992; Lu et al. 2004). An increase in nitrogen use from 100 to 200 kg ha<sup>-1</sup> would increase the brown planthopper's survival rates by 28%, egg production by 100% and total dry weight of hopper by 100% (Lu et al. 2004). High nitrogen applications also produce dense crop canopies which are conducive to disease development. Farmers' high seed and fertilizer rates in the Mekong Delta are thus increasing the vulnerability of their crops to pest and diseases. If farmers were to reduce their seed and nitrogen rates, it is likely that their need for insecticides can be further reduced. Huan et al. (2005) invited 951 volunteer farmers to evaluate the reduction of seeds, nitrogen and insecticides using recommended ranges of applications (see Table 1) and monitored their pesticide sprays, yield and profits and found that that none of the volunteer farmers reported pest problems or lost yields in their evaluation fields. They had higher incomes of about US\$58 ha<sup>-1</sup> in the winter–spring season and US\$ 35 ha<sup>-1</sup> in the summer–autumn season from the evaluation fields. In an economic impact analysis, Huelgas et al. (2008) compared adopters and non adopters and found significant increase in gross incomes of US\$ 54.6 ha<sup>-1</sup> in the dry season and US\$ 49.2 ha<sup>-1</sup> in the wet season among the adopters.

The use of media to motivate farmers in the Mekong to reduce insecticides had successfully

\*Corresponding author. Email: kheong@cgiar.org

Table 1. Guidelines of the 'Three Reductions' practices provided to participating farmers.

	Seasons	
	Winter-Spring	Summer-Autumn
Seed rates	70–100 kg/ha	100–120 kg/ha
Fertilizer rates (for alluvium soils)		
Nitrogen	120	100
Potassium	30	50
Phosphorus	30	30
	Farmers were provided with leaf color charts for them to determine if the crop needed more nitrogen based on how green the leaves were.	
Insect control	No insecticide use in the first 40 days for leaf feeding insects. For other insect problems as required.	
Disease control	Take action when blast symptoms on three leaves are visible during the booting stage.	

decreased use by 53% (Heong et al. 1998; Escalada and Heong 2004) and subsequently prompted several provincial governments to adopt the media approach. The message 'spraying in the first 40 days is not necessary' eventually reached an estimated 2 million farmers (Huan et al. 1999) where farmers' attitudes were changed and their insecticide use was reduced and their yields remained unchanged. We adopted a similar process involving multi-stakeholders to evaluate the use of media to motivate farmers to reduce seed and fertilizer rates in addition to insecticides – which was branded 'Three Reductions – 'Three Gains' or 'Ba Giam – Ba Tang' in Vietnamese. This paper reports the scaling up of the farmer participatory results reported earlier by Huan et al. (2005) through the use of a multi media campaign and its effects on farmers' beliefs and practices and changes in government policies.

## 2. Theoretical frameworks

### 2.1. Theory of social learning

The project applied social learning theory in developing interventions to motivate farmers to reduce seed rate, nitrogen fertilizer and insecticides. Bandura's social learning theory (1977) stressed the importance of observational learning, imitation, and modeling to explain media effects. Social learning theory argues that people learn from one another by observing others and the outcomes of certain behaviors. Through social modeling, an individual can adapt critical aspects of the behavior they want to adopt. Awareness and expectations of future reinforcements or punishments can have a major effect on an individual's behavior. As social learning theory considers external factors to the individual as important in behavior change, it is essentially social as it views communication as a cause of behavior change (Rogers 2003). New behavior is learned by

observing other people model various behaviors (Severin and Tankard 2001).

### 2.2. Theory of planned behavior

In developing the campaign approach and media materials, the project drew largely from the strategic communication campaign framework (Adhikarya 1994) and adapted the Theory of Planned Behavior (Ajzen 1988) and Theory of Reasoned Action (Ajzen and Fishbein 1980) to understand and promote individual behavior change. The Theory of Reasoned Action asserts that intention to perform certain behavior is determined by the individual's attitude toward the performing the behavior and subjective norm held by the individual. The theory has been applied to many health issues such as breastfeeding, AIDS campaign, anti-smoking campaign, safety belt usage, and anti-drug campaign, etc., to determine which factors influence individuals to act in certain ways and try to develop better ways to effectively communicate the message.

The Theory of Planned Behavior, an extension of the Theory of Reasoned Action, can help to explain why some media campaigns have limited success. Increasing knowledge alone does not help to substantially change behavior but campaigns aimed at attitudes, perceived norms and control in making adoption decisions have better results. Studies of behavioral intentions suggest that the likelihood of intended audiences' adopting a desired behavior can be predicted by assessing and then trying to influence their attitudes toward and perceptions of benefits of the behavior, along with how they think that their peers will view their behavior. Research by Fishbein and Ajzen (1975) supports the idea that individuals' and society's (perceived) attitudes are an important predecessor to action. Therefore, an important step toward influencing behavior is an assessment of intended

audience attitudes, and subsequent monitoring to identify any attitudinal changes.

### 3. Methodology

#### 3.1. The project areas

Vietnam is a net rice exporter and rice production contributes significantly to her economy. About 51% of Vietnam's production or ~1.7 million tons comes from the Mekong Delta which covers ~2 million ha of fertile land where ~2.3 million farmer households cultivate rice as a livelihood (GSO 2004). Two provinces, Can Tho and Tien Giang, of the 13 in the Mekong Delta were selected as project areas primarily because rice growing is the primary economic income source and the local Governments would provide matching funds to support local operations and training activities. Detailed characteristics of these two provinces are found in Table 2.

#### 3.2. The participatory planning process

To facilitate the development of quality partnerships and local ownerships, we adopted a multi stakeholder participatory planning process involving research, extension, mass media, universities, NGOs and local governments. This process involved a series of workshops focusing on jointly identifying the problems, needs and opportunities, developing and evaluating intervention options and prototype materials, and developing hypotheses, instruments and data for research. Further details of this process are found in Snapp and Heong (2003) and Heong and Escalada (2005). The first workshop reviewed the research information on farmers' current attitudes and practices and results of farmers' evaluation of modified practices (Huan et al. 2004). The group then brainstormed for intervention ideas and developed a consensus on using a mass media approach. In the second workshop the stakeholders, together with professional artists, developed concepts and prototypes for print and broadcast media, a work plan for pretesting, mass production, distribution, a launching ceremony and post-launch

monitoring management survey. The third workshop was planned in conjunction with the launching ceremony. The campaign was officially launched by the vice chair of the provincial Peoples' Committee on 8 March 2003 in Can Tho City and by the provincial director of agriculture on 10 October 2003 in Tien Giang province. In the fourth workshop, results of pre- and post-test surveys were presented to an audience from outside the project areas to share experiences.

#### 3.3. Materials distributed and broadcast

The campaign communicated three basic messages on seed rates, fertilizer rates and insecticide use that had been evaluated by farmers (Huan et al. 2004). Details are shown in Table 3. The final versions of a poster and leaflet were duplicated and distributed immediately after the launching day. At the same time a radio drama, a television drama and a 30-s TV commercial were recorded and broadcast over local radio and TV stations. Details of materials distributed in the campaign are shown in Table 4.

### 4. Data collection and analysis

In each province, three surveys were conducted, pre test, management monitoring and post-test. As the campaign was first implemented in Can Tho and later in Tien Giang province, surveys and management monitoring were conducted a year apart because of the time difference in implementation. In the survey farmers were asked to recall their practices and yields in their last summer winter season. Details of surveys are found in Table 4. Before each survey, a focus group discussion was conducted and its results were used to develop the survey instruments. The prototype questionnaires were developed in English and then translated into Vietnamese for pretesting before they were finalized. Enumerators were trained final year students from the local agricultural technical colleges under the direct supervision of one of the authors to ensure quality control. Data obtained from the questionnaires were coded using Microsoft Excel and then up loaded into SPSS 11.5 (SPSS 2002) for analyses.

Table 2. Background characteristics of the two project areas (adapted from General Statistic Office 2004).

Characteristics	Can Tho	Tien Giang
Total area planted to rice (ha)	453,400	260,700
Total annual rice production (tons in 2003)	2145,440	1265,400
Total rural population	1211,000	1430,600
Average yields (kg/ha)	4730	4850
Average income/person/month US\$ in 1999	23	26
Matching funds from local governments US\$	131,000	16,000

Table 3. Summary of materials distributed and in Can Tho and Tien Giang provinces.

Materials distributed	Can Tho	Tien Giang
Leaflets	170,000	44,500
Posters	2,000	300
Leaf color charts	40,000	33,700
Radio drama cassettes	100	145
TV drama VHS tapes	100	—

Table 4. Details of the farmer surveys conducted.

Survey details	Can Tho	Tien Giang
Districts where surveys were conducted	Vi Thuy Omon	Cailay Cho Gao
Total number of farmer respondents		
Pre-test	606	600
Management monitoring		
Pre-test	1079	520
Post-test	611	640
Dates surveys were conducted		
Pre-test	August 2002	August 2003
Management monitoring		
Pre-test	May 2003	February 2004
Post-test	February 2004	September 2004

#### 4.1. Measuring farmers' belief attitudes

We used the Theory of Planned Behaviour (TpB) (see details in Theoretical Frameworks), to develop constructs to measure farmers' belief attitudes. Sets of beliefs related to farmers' decisions to use high seed rates, high fertilizer rates and insecticides were developed from focus group discussions conducted by the authors. The belief statements were structured so that respondent farmers could choose from a five-point Likert scale, their respective degrees of agreement. Each degree of agreement was described with a Likert scale score and a descriptor statement and all five statements were presented to the respondent in a prompt card. The descriptors were 'definitely not true', 'in most cases not true', 'may be true', 'in most cases true' and 'always true'. The belief scores between pre- and post-test surveys were compared using the two-sample Kolmogorov-Smirnov Z-test, a non-parametric technique for comparing two independent samples of an ordinal variable.

## 5. Findings

### 5.1. Profiles of respondents

The respondent farmers in pre- and post-tests were ~44 years old with 6 or 7 years education and ~22 years experience in rice farming. In Cantho province, the post-test sample had about 0.5 years more education than the pre-test sample. This difference, though statistically significant might not be a major factor determining changes in beliefs and practices. Their farm sizes were ~0.8 ha, grew modern cultivars and obtained average yields of ~5 t ha<sup>-1</sup>. There were no significant difference between pre- and post-tests in farmers' age, land holdings and farming experience although a significant yield increase was recorded. Details are shown in Table 5.

### 5.2. Monitoring management surveys

The monitoring surveys conducted about 2 months after the launch focused primarily on materials distributions, media broadcasts and how the

Table 5. Profiles of farmer respondents in pre- and post-tests surveys conducted in the provinces of Can Tho and Tien Giang.

Characteristics	Can Tho		Tien Giang	
	Pre-test	Post-test	Pre-test	Post-test
Age (years)	43.6	43.2	45.7	47.3
Years in school (years)	6.5	7.1**	6.7	6.9
Farming experience (years)	20.4	20.8	21.7	23.0
Area rice for summer autumn (ha)	–	–	0.8	0.6**
Yields (t ha <sup>-1</sup> ) Summer–Autumn	4.6	5.6**	4.5	5.0**

\*\*Indicates significant difference ( $P < 0.01$ ) between pre- and post-tests.

messages were received. Table 6 shows the details. In Can Tho province 81% of the respondents had heard about 'Ba Giam Ba Tang' while in Tien Giang province, 56% had heard. Farmers had information from multiple sources and a large proportion was through the TV drama (60% Can Tho, 28% Tien Giang). Some were through the leaflet (37% Can Tho, 28% Tien Giang), radio drama (36% Can Tho, 11% Tien Giang) and poster (Can Tho 18%, Tien Giang 12%), while a considerable proportion had heard about it from neighbors and friends (21% Can Tho, 23% Tien Giang). In both provinces, farmers perceived that the campaign would help them reduce the use of seeds, fertilizers and pesticides which are consistent with the campaign's main themes.

### 5.3. Changes in farmers' uses of seeds, fertilizers and pesticides

Farmers' uses of seeds, nitrogen and insecticides were significantly reduced between pre and post campaign surveys in both provinces (Table 7). In Can Tho farmers' seed rates dropped ~11% from an average 234 to 208 kg ha<sup>-1</sup>, while in Tien Giang the decrease was ~10% from 189 to 170 kg ha<sup>-1</sup>. In Tien Giang province, farmers' usual fertilizer application rates for the summer–autumn crop is 106-65-31 (N-P-K), while in Can Tho province, the usual fertilizer rate is 123-69-31 (N-P-K). Farmers' use of nitrogen reduced from 100 to 92 kg ha<sup>-1</sup> (8%) in Can Tho and from 106 to 100 kg ha<sup>-1</sup> (6%) in Tien Giang. Insecticide use declined 33% from 1.2 to 0.8 sprays season<sup>-1</sup> in Can Tho and 13% from 2.3 to 2 sprays season<sup>-1</sup> in Tien Giang. In Can Tho province there was no significant change in farmers' use of phosphorus retaining ~55 kg ha<sup>-1</sup>, while in Tien Giang farmers reduced phosphorus applications substantially from 64 to 53 kg ha<sup>-1</sup> or 17% in Tien Giang.

Table 6. Delivery, reach and specific information farmers learned from media materials of the 'Reductions, Three Gains' campaign.

	Percent farmers	
	Can Tho	Tien Giang
Farmers who had heard of the campaign	80.9	55.8
	Percent farmers who had heard	
Media materials where farmers obtained information		
Poster	17.5	11.5
Leaflet	37.2	28.3
Radio drama	36.2	10.8
TV drama	60.1	28.3
Neighbors	21.4	22.7
Farmers who said the campaign would to help them		
Reduce input costs	13.7	35.9
Reduce seed rates	83.0	55.3
Reduce fertilizers	77.8	52.0
Reduce pesticides	75.8	53.1
Increase incomes	35.8	48.8
What farmers said they learnt from media materials		
To reduce input costs	57.8	57.5
To increase income	22.3	15.1
To use less insecticides	24.2	16.4
To use less fertilizers	3.2	9.6
To use less seeds	35.0	16.4

Between pre- and post-test surveys, there were increase in farmers' use of potassium, while for fungicides and herbicides were mixed. In Can Tho farmers increased their use of potassium by ~43% from 23 to 33 kg ha<sup>-1</sup>, while Tien Giang potassium use increased by ~23% from 31 to 40 kg ha<sup>-1</sup>. Can Tho farmers increased their use of fungicides from 0.4 to 0.9 sprays season<sup>-1</sup> and herbicides from 0.1 to 0.4 sprays season<sup>-1</sup>, while Tien Giang farmers decreased both fungicide and herbicide uses. In both provinces, farmers' yields were significantly increased from 4.6 to 5.6 t ha<sup>-1</sup> in Can Tho or 22% and from 4.5 to 5.0 t ha<sup>-1</sup> or 11% in Tien Giang (Table 7).

#### 5.4. Changes in farmers' belief attitudes

Respondent farmers between pre- and post-surveys reported significant reductions in loss perceptions (Table 8) when the three inputs were reduced. In Can Tho province, farmers' perceived yield losses when seed and fertilizer rates averaged 808 and 1233 kg ha<sup>-1</sup> before the campaign and were reduced by 44% to 454 and 57% to 533 kg, respectively, after the campaign. Similarly in Tien Giang, loss perceptions when seed rates were halved reduced by 60% from 1095 to 443 kg ha<sup>-1</sup> and loss perceptions when fertilizer rates were halved reduced by 67% from 1328 to 440 kg ha<sup>-1</sup>. Farmers' perceived losses from no insecticides use in both provinces were also markedly

Table 7. Changes in farmers' seed rates, fertilizer and pesticide use in the summer-autumn season.

	Can Tho		Tien Giang	
	Pre-test 2002	Post-test 2004	Pre-test 2003	Post-test 2004
Seed rates (kg/ha)	234.1	208.0**	189.0	170.2**
Fertilizer use (kg/ha)				
Nitrogen	100.4	92.3**	105.9	100.0**
Phosphorus	54.1	55.4	64.3	53.0**
Potassium	23.4	33.0**	31.2	40.1**
Pesticide use (sprays/season)				
Insecticides	1.2	0.8**	2.03	1.55**
Fungicides	0.4	0.9**	0.49	0.23**
Herbicides	0.1	0.4**	0.05	0.01**
Percent farmers using				
Insecticides	56.9	50.2	89.4	79.7
Fungicides	22.1	53.6	12.3	5.6
Herbicides	0.5	32.4	0.5	0.2

\*\*Indicates significant difference ( $P < 0.01$ ) between pre- and post-tests.

reduced by 94% from 743 to 47 kg ha<sup>-1</sup> in Can Tho and by 58% from 1857 to 771 kg ha<sup>-1</sup> in Tien Giang.

Farmers' belief attitudes regarding seed and nitrogen rates and insecticide use were evaluated using belief statements. The mean belief scores and the Kolmogorov-Smirnov  $Z$ -values in the pre- and post-test surveys in each statement are presented in Tables 9, 10 and 11. Between pre- and post-test surveys there were significant changes in some common belief attributes that favor reduction in all inputs, namely to association of high inputs to high yields and being modern. Farmers' beliefs that high seed and fertilizer rates would reduce weeds were reduced while there were no significant changes in scores related beliefs associated with increasing pest and diseases. Farmers' attitude scores that the rice leaf folders could cause serious damage and needed to be sprayed in the early crop stages were significantly lowered and that the rice crop could easily recover from leaf damage was significantly increased.

#### 5.5. Multiplier effects

The local governments of the Mekong provinces provided about US\$345,000 additional resources to launch similar campaigns. Initial budgets of the two pilot campaigns totaled only US\$40,000. A popular radio soap opera, Chuyen Que Minh, devoted 29 episodes on 'three reduction' practices. There were numerous reports in newspapers (both local and national), radio and television programs. The Can Tho TV included 'three reduction' principles in a popular quiz show and an agricultural programme. Thirteen provincial governments adopted 'three reductions' in their agricultural programmes and in

Table 8. Changes in farmers' loss perceptions (in average kg/ha) after the campaign.

Farmers' reports of yield loss in kg	Can Tho		Tien Giang	
	Pre-test	Post-test	Pre-test	Post-test
When half their current of seeds were used	808	454**	1095	443**
When half their current nitrogen were used	1233	533**	1328	440**
When no insecticide sprays were used	743	47**	1857	771**

\*\*Indicates significant difference ( $P < 0.01$ ) between pre- and post-tests.

Table 9. Changes in farmer beliefs in seed rate decisions.

Belief statements	Mean belief scores					
	Can Tho			Tien Giang		
	Pre	Post	Z	Pre	Post	Z
High seed rates will						
Give high yields	2.46	2.18	2.4**	2.41	2.20	1.6*
Result in more disease problems	3.95	3.83	1.3ns	3.85	3.88	1.0ns
Result in more insect problems	3.91	3.87	1.0ns	3.93	3.93	0.8ns
Result in lodging problems	3.78	3.69	0.8ns	3.37	3.46	1.4*
Reduce weed problems	3.09	2.46	5.2**	3.08	2.59	3.8**
Increase seed germination	2.72	2.41	2.8**	2.59	2.62	0.9ns
Be for modern farmers	2.28	2.01	2.2**	2.22	1.97	2.3**

\*,\*\*Indicates significant difference between pre- and post-tests at  $P < 0.05$  and  $P < 0.01$ , respectively, using two sample Kolmogorov-Smirnov Z-test.

Table 10. Changes in farmer beliefs in fertilizer rate decisions.

Belief statements	Mean belief scores					
	Can Tho			Tien Giang		
	Pre	Post	Z	Pre	Post	Z
High application of nitrogen will						
Produce more filled grains	2.41	2.20	1.8**	2.21	2.20	0.5ns
Produce healthier crops	3.01	2.85	1.9**	2.89	3.02	1.9**
Result in higher yields	2.45	2.21	2.5**	2.49	2.40	0.9ns
Produce crops that will not lodge	2.09	2.08	0.4ns	2.21	2.03	1.1**
Have less weed problems	2.40	2.22	1.5**	2.48	2.21	2.3**
Improve the soil	3.06	2.52	4.8**	3.31	2.75	4.9**
Increase disease problems	3.88	3.87	0.7ns	3.80	3.88	1.5*
Increase insect problems	3.87	3.85	1.0ns	3.89	3.92	0.8ns
Improve plant compensation	3.38	3.18	1.8**	3.38	3.35	1.1ns
Increase pesticide use	3.95	3.95	0.3ns	3.87	2.62	8.9**
Modern farmers use more fertilizers	2.32	2.06	2.5**	2.46	2.00	3.5**

\*,\*\*Indicates significant difference between pre- and post-tests at  $P < 0.05$  and  $P < 0.01$ , respectively, using two sample Kolmogorov-Smirnov Z-test.

October 2004, the Ministry of Agriculture and Rural Development officially endorsed 'Three Reductions' and in April 2005, a national committee was established to develop plans to scale up implementation throughout the whole of Vietnam. In addition, the campaigns had been awarded both national and international recognitions.

## 6. Discussion

The use of multimedia strategic extension campaign (SEC) first developed by Adhikarya (1994) had been

found to be a cost effective approach to reach and motivate change in farmers' attitudes and practices. This process was modified for use in Vietnam to persuade farmers to avoid early season insecticide applications (Heong et al. 1999; Escalada et al. 2000). Since farmers' insecticide use is closely linked to their seed and fertilizer rates, we used the incremental approach to information delivery to persuade farmers to reduce all three inputs. The main motivational message of the campaigns was increased profits as farmers can reduce input costs with no change or increase in production thus resulting in an average net

Table 11. Changes in farmer beliefs in insecticide use decisions.

Belief statements	Mean belief scores					
	Can Tho			Tien Giang		
	Pre	Post	Z	Pre	Post	Z
Insecticide sprays will						
Increase yields	3.04	2.71	3.2**	3.72	3.40	2.1**
Harm health	4.38	4.23	2.4**	4.29	4.27	0.5ns
Cause more pests	3.15	3.53	3.0**	2.85	3.13	2.6**
Kill natural enemies	4.08	3.98	1.0ns	3.84	3.85	1.1ns
Leaf folders will cause severe yield loss	3.03	2.48	4.5**	3.40	3.25	1.4*
Rice crop can recover from early season damages by leaf folders	3.38	3.80	4.8**	3.54	3.62	1.4*
Leaf folders should be controlled in the early season	3.22	2.57	5.3**	3.47	3.31	1.7**
Modern farmers use insecticides	2.34	2.03	2.6**	2.47	2.19	2.2**
Insecticides are cheaper and easy to apply	2.49	2.16	2.7**	2.73	2.62	1.1ns

\*,\*\*Indicates significant difference between pre- and post-tests at  $P < 0.05$  and  $P < 0.01$ , respectively, using two sample Kolmogorov-Smirnov Z-test.

profit of US\$58 per ha per season (Huan et al. 2004). As more than 70% of the net profits are from savings from reduced spraying, farmers were motivated to reduce seed and fertilizer rates in order to reduce insecticide use. Although farmers had reduced their nitrogen fertilizer rates by ~7% after the campaign, their applications are still above the recommended rates. Between the years 2003 and 2005, the cost of urea increased by ~41% from US\$0.20 to US\$0.29 per kg. Further increase in fertilizer costs might motivate farmers to further reduce nitrogen use. The increase in seed and insecticide cost over the same period were less than 20%. The drum seeder helps to minimize seed rates and with recent increase in its adoption farmers' seed rates are also likely to decline. Drum seeder adoption between 2004 and 2005 increased by ~44%.

Farmers' reductions in input use were due to modifications in belief attitudes caused by the campaigns. Attitudes that tend to favor high inputs, like 'modern farmers use high inputs' and 'high inputs are required to get high yields' in seed, fertilizer and insecticide use were significantly modified. Often farmers use high seed rates because they believe that this practice would reduce weeds. This belief was also significantly modified. The campaigns further re-enforced the message in earlier campaigns that 'early season insecticide sprays were not needed' and farmers had modified the associated beliefs on leaf damages and plant compensation further.

To enhance multiplier effects we actively involved partners from the central and local government, university, research, extension and media, in planning, development, implementation, and evaluation activities. This was done through a series of participatory workshops with emphasis on establishing quality partnerships and local ownerships (Norton et al. 1999). The workshops developed the strategies, the campaign slogan, 'Ba Giam Ba Tang', selected the media to be used and pilot sites,

prepared and pre-tested the campaign materials. Implementation plans were also finalized by partners in the workshops. The process had encouraged transparency, friendship and cooperation and had served as an important vehicle towards facilitating scaling up extension. It has helped in multiplying the campaign pilot by leveraging local resources to increase spread thus increasing returns to modest project investments. With the limited resources Asian governments are allocating to extension, mass media, especially when implemented through multi-stakeholder partnerships, can be an effective option for reaching farmers.

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