ASSESSING FARMERS' KNOWLEDGE AND PRACTICES OF COMMUNITY TRAP BARRIER SYSTEM (CTBS) IN AN GIANG PROVINCE

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ABSTRACT

Assessment of farmers' knowledge and rice cultural practices before and after application of community trap barrier system (CTBS) to control rats in An Giang province through basic survey in 2006 and post survey in 2009 revealed that farmers increased their knowledge in rice production and rat control. Farmers reduced rice inputs (as reduction of seed rate, frequency of fertilizer applications and labor investment) in the post survey rather than in basic survey in which rice yield was higher in post survey than in basic survey. Rice production, rice income and net return in the post survey were higher than those in basic survey. Community trap barrier system (CTBS) to control rats was based on community action organized by people in locality with strong social unity and with assistance of the local authorities. This system was effective and it brought benefits to the people in halo area. However, its cost was high and it is difficult to maintain among farmers without self raising funds and appropriate policy from the government.

Keywords: *rat, community trap barrier system, rice production.*

INTRODUCTION

Rats are the small animal and cause vast damage in agricultural production in Vietnam and many countries in the world. The average food crop damaged annually could feed hundred millions people on the earth. According to National Plant Protection of Vietnam, rats damaged 129,512 ha of agricultural land in the Mekong Delta (Nguyen Quy Hung *et al*., 1999). In Vietnam, there was presence of more than 30 rat species. Rat caused crop loss, especially rice from 50 to 90% in many locations. Aside from crop loss, rats also caused disease for people, especially bubonic plague transmitted by rats (Le Vu Khoi and Luu Nguyen Khanh 2000). The potential of rat reproduction is very high. Under favorable conditions as availability of food, habitats, suitable temperature and humidity... together with no attack by their natural enemies and diseases, rat will increase their huge population. Rat population, food, crop seasons, weather are interrelated. Rat damaged rice crop in different stages from sowing, tillering, and booting to harvesting stages and storages (Nguyen Van Tuat, *et al*., 2005). The scientists from International Rice Research Institute (IRRI) and Vietnam government had intended to facilitate the adaptation and adoption of community Trap Barrier Systems (cTBS) for rat management in rice fields in Vietnam. Among many provinces in the North, Central and South Vietnam, An Giang province was selected to assess farmers' knowledge and practices and the results are used as evidence for spreading this kind of technologies widely. In a community TBS system, the institutional arrangement of farmers is critical to success. In particular, farmers must organize themselves, and coordinate their behavior, to implement the system. The benefits are for a group of farmers in the community. In community, farmers have received benefits regardless of their individual input.

An institution is a group of people who act in a concerted way. In resource management the

institution is typically comprised of those people who collectively manage the resource. For the purposes of the community TBS system, the existing plant protection department of An Giang province and plant protection station at the district coordinated farmer groups as IPM club, extension club to practice this system.

This paper aims to assess farmers' knowledge and practices of community TBS system.

METHODS OF DATA COLLECTION AND ANALYSIS

Farmer focus group discussion (FGD) and individual surveys were conducted in Tinh Bien and Tri Ton districts, An Giang province. The instruments for the surveys were constructed questionnaires which were pre-tested. Farmers were stratified into 3 groups: farmers participated in CBTS, farmers in traditional community action group (CA), farmers outside the above mentioned groups (control group). Farmers in each stratum were randomly selected for direct interview.

Data were summarized by descriptive statistics in the forms of frequency, mean and percentage. T- test was used to compare the differences of data between survey in 2006 and 2009 (before and after implementing of cTBS).

To calculate NPK in household survey data, use the standard conversion factor to convert fertilizer quantity to nutrient equivalent. Exclude the weight of oxygen from the oxides. For example, urea has 46% N. Hence, 100 kg of urea contains (100*46%=) 46kg of N. This calculation is simple since Urea contains only the nitrogen nutrient without oxides. Other types fertilizers contain all 3 elements with P and K in their oxide form. For example, fertilizer A which contains 10% N, 26% P_2O_5 (Phosphate) and 26% K_2O (Potassium Oxide). A 100kg of fertilizer A contains 10kg of N. It also contains 26kg of P_2O_5 but only (26*44%=) 11.44kg of P. It has 26kg of K_2O but only (26*83%=) 21.58kg of K. The compound P_2O_5 contains 44% P and the compound K_2O contains 83% K. Follow a similar procedure for other fertilizers.

To compare the values of input and output in 2006 and 2009, the values in 2006 were converted into 2009 by the formula:

Value converted = Value of T_1 x $(1+R)^{(T_2-T_1)}$

Where, T_1 = previous year (2006); T_2 = later year (2009); R= interest rate from the bank (R= 14%/year)

RESULTS AND DISCUSSION

The trend of distribution of off-farm and non-farm occupation of the household members was not different between the survey in 2006 and 2009. However, the income from off-farm and non-farm sources in the later year was relatively lower than the previous years meanwhile the rice income in the later years was higher than the previous year. Analysis the resource availability showed that farmers obtained inherit land from the parents from 1.36 -1.37 ha. The land owned by farmer was less than 1 ha. Farming machines and tools were own by some households indicated that farmers are poor in farm assets and they had to hire from the other services.

The land for rice cultivation was less than 3 ha which cannot improve the living standard of the household with 5 members if they do not find the additional income activities from off-farm and non-farm. Rice yield was highest in dry season (Winter- Spring) when the weather is more favorable for crop development, following by wet season (Summer-Autumn) and third season (Autumn-Winter). The rice yields in the 2009 were higher than in 2006 in all rice seasons. This increase was due to various technologies adopted by farmers. It is not sure that how much is the contribution of CTBS in the increase of rice yield (Table 1).

Table 1. Rice area and yield by rice crop season in 2006 and 2009

Items	2006				2009			
	Control (n=90)	TBS+CA (n=70)	CA (n=63)	All (n=223)	Control (n=88)	TBS+CA (n=70)	CA (n=63)	All (n=221)
Rice area for rice crop (ha)								
Dry season (Winter-Spring)	2.72	2.03	2.98	2.58	2.44	1.67	2.61	2.25
Wet season (Summer-Autumn)	2.72	2.01	3.05	2.59	2.45	1.67	2.61	2.25
Third season (Autumn-Winter)	0.84	-	-	-	-	0.52	0.28	0.25
Rice yield (t/ha)								
Dry season (Winter-Spring)	6.25	5.86	6.46	6.19	7.23	7.06	6.74	7.05
Wet season (Summer-Autumn)	4.79	4.75	5.30	4.92	5.14	6.05	5.72	5.56
Third season (Autumn-Winter)	4.27	-	-	4.27	-	5.77	4.92	5.47
All	5.51	5.31	5.88	5.55	6.19	6.45	6.11	6.25

Note: TBS= trap barrier system; CA= community action

Most of the farm lands are low land rice areas. The low or high field mentioned by farmers was concerned. The medium field was considered at 0 point. The low field has topography relatively lower than the 0 point and the high fields are higher than the 0 point. The relative higher field had the problem of weeds and water receding faster than the lower field. Farmers had to spend more labor and cost for weeding and pumping water into the high fields than into the low fields. Most of the farmers are land owners. Few of them cultivated rice on the leased land or borrowed land. The borrowed lands are mostly from the siblings or closed relatives. Majority of the farmers (74 to 76%) used rice seeds from the previous season. In their opinion, the reason for use rice variety again was mostly high yield. The other reasons included easy to plant (means less insect pest attack, adaptable to soil condition and less labor requirement), less pest damage, good price at sell, and stiff stems/plant for tolerance to lodging.

One-fourth of the farmers did not use seeds from the previous season again with several reasons as low yield, susceptible to pests, impurity variety, long rice duration, not suitable for the crop season, degeneracy of variety and difficult to plant (this means that the plants are easily affected by pest, disease…). Most of rice (90 to 95%) was sold by farmers after harvested, only 3 to 4% was kept for seeds and 2 to 5% for home consumption. Keeping rice to sell later with higher price was impossible because most of the farmers lack of capital for rice investment in next season. They bought fertilizer and pesticide on credit and obtained loan from the bank. These debts need to pay after rice harvest. This is one of the constraints for the farmers to put money aside for the investment of next crop season. Most of the farmers sell rice products to the middlemen. Therefore, there is the need of forming many farmer groups to access markets for better price. Most of the farmers used their own seeds produced from previous season. Only 9 % of them bought seeds from the seed companies. Few of them obtained seed from other farmers (13% and 4% in 2006 and 2009, respectively) (Table 2).

Table 2. Source of seed

Item	2006		2009	
	No.	%	No.	%
Seed source				
Owned	174	78	193	87
Purchased from seed company	20	9	19	9
Exchange with co-farmers	29	13	9	4
Total	223	100	221	100

Other materials as fertilizer and pesticide were all purchased from shops

Regarding to input use, the data were collected in 2006 and 2009 wet seasons (Summer-Autumn). Farmers used both granular fertilizer and foliar fertilizer. Granular fertilizer is fundamental and foliar fertilizer is supplemental for good plant development. Most of farmers applied granular fertilizer for 4 times or 3 times/ crop season. More farmers in 2009 (42%) than in 2006 (29%) applied 3 times of granular fertilizer per crop season rather than 4 times in the previous years indicated that farmers had attention in reduction of fertilizer use. The trends of insecticide, fungicide and molluscide use were not different in 2006 and 2009.

The input-output analysis showed that the seed rates were reduced in 2009 as compared to the year 2006 significantly in all groups of farmers. The amounts of N, K and K fertilizer applied were not significant difference between 2006 and 2009. The labor investment (both male and female labors) in the later year (2009) was lower than the past year (2006). The introduction of labor saving technologies as combined-harvesting machines, row seeders reduced labors in crop care. Rice production in the later year was higher than the past year significantly. Therefore, the rice income in the later year was higher than those in the past year.

Regarding to input cost, seed and fertilizer costs were not different between two surveys. However, the cost of pesticide (insecticide, fungicide, herbicide and molluscide) was reduced in the later year as compare to the past year. The technical training kept repeating by the extension center and plant protection department of An Giang province which impeded the practice change among farmers. The training related to rice productions includes "3 reductions and 3 gains", and other technologies with the aim of reducing input cost. The total labor cost in the later year was lower than those in the past year. The imputed family labors mostly contributed to reduction of labor input rather than hired labors.

The total input cost in 2009 was lower than in 2006, therefore the net return and benefit-cost ratio in 2009 were higher than those in 2006 (Table 3a). Similar trends were found if the inputs and returns were converted in US dollars (Table 3b).

Table 3a. Input and output analysis (Summer-Autumn season)

Item	2006				2009				T-value compared (a) & (b)	Sig. (2-tailed)
	Control (n=90)	TBS+CA (n=70)	CA (n=63)	All (n=223) (a)	Control (n=88)	TBS+CA (n=70)	CA (n=63)	All (n=221) (b)		
Seed rate (kg/ha)	217	265	244	239	185	190	170	182	**6.7581**	0.0000
N-kg/ha	124	138	158	138	117	156	147	138	0.0357	0.9715
P kg/ha	31	32	38	34	28	35	35	32	0.6977	0.4858
K-kg/ha	47	38	51	46	37	48	44	43	0.8994	0.3691

Male labors	54	56	55	55	39	39	35	38	**7.7582**	0.0000
Female labors	14	16	16	15	4	3	4	4	**11.2863**	0.0000
Total labors	68	72	71	70	43	42	39	41	**9.9590**	0.0000
Rice production (kg/ha)				4918.113				5661.475	**-6.8662**	0.0000
Rice income (VND 1,000 /ha)	15886	15795	17499	16313	18356	26036	24832	22634	**-11.7490**	0.0000
Input cost and return (VND 1,000 /ha)										
Seed cost	849	1028	1050	962	893	976	972	942	0.4288	0.6682
Fertilizer cost	8484	7267	9948	8515	6769	8175	8344	7663	1.2909	0.1977
Insecticide cost	1173	802	757	939	1072	447	479	703	**2.0740**	0.0387
Fungicide cost	781	1334	796	959	543	454	521	508	**4.6704**	0.0000
Herbicide cost	336	295	358	329	259	245	197	237	**3.0733**	0.0023
Molluscide cost	53	76	47	59	13	25	47	27	1.9947	0.0471
Total pesticide cost	2344	2506	1958	2286	1875	1171	1244	1472	**4.9932**	0.0000
Hired labor cost	4682	4592	5362	4846	3602	4837	4849	4349	1.3381	0.1816
Imputed family labors	2283	2284	2353	2303	1778	1521	1259	1549	**4.5935**	0.0000
Total labor cost	6965	6876	7716	7149	5380	6358	6108	5897	**3.1506**	0.0018
Overall Input cost	18641	17676	20671	18912	14917	16680	16667	15974	**3.9596**	0.0001
Net Return (VND 1,000 /ha)	-2755	-1881	-3172	-2598	3439	9357	8164	6660	**-10.5883**	0.0000
Benefit cost ratio (BCR)	0.97	1.01	1.03	1.00	1.31	1.71	1.83	1.58	**-9.9590**	0.0000

Note: Values of 2006 were converted into 2009 to compare between 2 years by the formula:
Value converted = Value of T_1 x $(1+R)^{(T_2-T_1)}$
Where, T_1 = previous year (2006); T_2 = later year (2009); R= interest rate from the bank (R= 14%/year)

Table 3b. Input and return converted to USD (rate 1USD=17500 VND) (Summer-Autumn season)

Item	Year 2006				Year 2009			
	Control (n=90)	TBS+CA (n=70)	CA (n=63)	All (n=223)	Control (n=88)	TBS+CA (n=70)	CA (n=63)	All (n=221)
Rice income (USD/ha)	908	903	1000	932	1049	1488	1419	1293
Input and return (USD/ha)								
Seed cost	49	59	60	55	51	56	56	54
Fertilizer cost	485	415	568	487	387	467	477	438
Insecticide cost	67	46	43	54	61	26	27	40
Fungicide cost	45	76	45	55	31	26	30	29
Herbicide cost	19	17	20	19	15	14	11	14
Molluscide cost	3	4	3	3	1	1	3	2
Total pesticide cost	134	143	112	131	107	67	71	84
Hired labor cost	268	262	306	277	206	276	277	248
Imputed family labors	130	131	134	132	102	87	72	88
Total labor cost	398	393	441	409	307	363	349	337
Overall Input cost	1065	1010	1181	1081	852	953	952	913
Net Return (USD/ha)	-157	-107	-181	-148	197	535	467	381
Benefit cost ratio (BCR)	0.97	1.01	1.03	1.00	1.31	1.71	1.83	1.58

The factors that limited rice production in both year 2006 and 2009 included blast disease, brown plant hopper (BPH), rats, leaf blade borer, golden snail, stem borer, leaf folder, panicle mite (*Oligonycus Oryzae*), rice yellow stunt virus/rice ragged stunt viruses, case-worm, cut worm, leaf blade borer, sheath blight disease, brown spots. Rat problem in 2009 was at less extent as compared with 2006. Farmers assessed rat damage mostly based on unearthed plants/seeds, followed by run-ways of rats, rat's burrows, visual observation and tracks. The other ways were damaged plants in patch, cut seedlings, and dropping. The occurrence of rat damage was more regular in 2006 than in 2009. According to farmers, high rat population were in the year 1992, 1993, 1997, 1998, 1999, 2003, 2006, 2007, 2008. Highest rat population was in 2006, followed 1993. The community action was taken by the local government and by the state to reduce rat at the peak period of rat population. The reasons for high rat population in the past mostly were low flooding water level and rats migrating from Cambodia. The other reasons were highly reproductive rats, a lot of grasses in the bunds, practicing 3 rice crops per year, building closed boundary to plant third rice. Various rat species in the rice fields were found. Most popular species is Cong dong (*Rattus losae, R. argentiventer*). The other species were Cong nhum (*Bandicota indica setifera*), Cong lang (*Rattus sp),* Lat (*Rattus exulans*), Xa (*Rattus norvegicus*), Bo (*Mus calori*), and Xu. All rat species mostly were found in the rice fields, followed by the rice storages. Rats were also found in the earth mound and bushes where are rat habitats.

Regarding knowledge related to rats, farmers' knowledge in 2009 was higher than those in 2006. Farmers mostly knew that "Planting almost at the same time (within a span of two weeks) can reduce rat population', "The practice of fallow (no crops planted) almost at the same time can reduce rat population during the following crop", "Cleaning on farm and surroundings areas (general hygiene including village gardens) can reduce rat population", "Small width of paddy bund (<=30 cm) can reduce rat population." and "Community rat control is best to control rat damage because it is done at the same time" (Table 4).

Table 4. Farmers' knowledge in rodent management

Item	BASE Knowledge in Rodent Management (2006)				POST Knowledge in Rodent Management (2009)				Key correct answer
	Yes (%)	No (%)	Maybe (%)	No Information (%)	Yes (%)	No (%)	Maybe (%)	No Information (%)	
Planting almost at the same time (within a span of two weeks) can reduce rat population.	86	0.5	13	0.5	94	1	5	-	Yes
The practice of fallow (no crops planted) almost at the same time can reduce rat population during the following crop.	76.6	10	13.1	0.5	83	5	12	-	Yes
Cleaning on farm and surroundings areas (general hygiene including village gardens) can reduce rat population.	93.7	1.8	3.6	0.9	96		4	-	Yes
Wide width of paddy bunds (>30 cm) can reduce rat population.	7.7	83.8	7.2	1.4	3.6	93.6	2.7	-	No
Small width of paddy bund (<=30 cm) can reduce rat population.	86.5	8	5	0.5	89.5	3.2	6.8	0.5	Yes
Individual rat control action is best to control rat damage because farmer has option when and where to conduct rat cont	27	52	20	1	16.4	47.3	36.4	-	No
Community rat control is best to control rat damage because it is done at the same time.	92.8	1.8	5	0.5	80	5	15	-	Yes
Community rat control at a specific stage of crop is most effective in reducing rat population.	75.2	2.7	21.6	0.5	64	5	30	1	Yes
Community rat control at anytime of the cropping season is most effective in reducing rat population.	47	26	26	1	14	62	24	-	No

Community rat control for 2 continuous weeks at the early stage of the rice crop (before the tillering stage) is most effective in reducing rat population	42	31	26	1	39	23	38	-	Yes
Rats are too clever and cannot be successfully controlled	-	-	-	-	10	67.7	21.8	0.5	No
Rodenticide is the best way to control rats.	-	-	-	-	3.6	80	15.9	0.5	No

Farmers' attitude in 2009 was better than those in 2006. Most of them said that "Controlling rats is important", "Rats can be controlled", ". Rats can cause severe yield losses", "Rats can be only controlled if farmers work together with other farmers at the same time". They also knew that "Chemicals used to control rats are not safe" (see in table 5). Because of several reasons as rat significantly reducing yield, thus control rat to ensure rice yield. Rat can be controlled because of existing of many control methods, easy to catch or bait, easy to find rodenticide (not many answers in 2009). Less using rodenticide was noticed in 2009. In addition, rat controlling at early stage is possible because of rat residence identified by farmers. Rat control in the early rice stage was more effective as seedling stage and from sowing to flowering stage. Rat also can be control after rice harvesting to prevent high rat population in the next crop. Rat catching was also used for family food. Chemical control is not safe because farmers knew that chemicals are very poisonous. It contaminates water source, kills fish and other animal and causes human health problems. The surveys in both 2006 and 2009 showed that rat could cause severe yield loss because rats are very destructive pest in all rice stages.

Table 5. Farmer's Attitude and Beliefs Towards Rats and Rat management

Attitude No.	**Year 2006**				**Year 2009**			
	Yes (%)	**No (%)**	**Don't know (%)**	**No information (%)**	**Yes (%)**	**No (%)**	**Don't know (%)**	**No Information Percentage**
Controlling rats is important?	97.7	2.3	-	-	98	1	-	1
Rats can be controlled?	67.0	28.1	5.0	-	93.2	6.3	-	0.5
Rat control must be done during rice growing season?	68.0	29.7	2.3	-	31	67	-	2
Rats have to be controlled after harvest or in the fallow season?	53.4	43.4	3.2	-	33	63	3	1
Chemicals used to control rats are safe (for humans, other animals and the environment)?	34.1	62.3	2.7	0.9	16	75	7	3
By controlling rats, a farmer can increase his rice yields?	56.3	37.4	4.5	1.8	42	41	5	12
Rats can cause severe yield losses?	97.7	0.9	0.9	0.5	98	1	-	1
Rats can be only controlled if farmers work together with other farmers at the same time?	97.7	-	2.3	-	97	2	0	1

Various methods to control rats applied by farmers were found. In 2006, most of the farmers controlled rats by poison, digging, traps and electricity. The other methods used in 2006 were hunting, cleaning the field (field hygiene), smoke out, wood trap, net rounding, filling rat's hole with water, plastic fence, rodenticides + motor oil, water filling + Cyanamide, synchronized cropping and trap system barrier. In 2009, non-chemical measures were used more than in 2006. Farmers increased the method of synchronized cropping, hunting and field cleaning as compared to 2006. In 2009, there was no more using of electricity because it is dangerous to people which is inhibited to use by the government. The poison use in 2009 was lower than in 2006 (Table 6).

Table 6. Rat control method used by farmers

Control method (*)	2006 (n=222)		2009 (n=218)	
	Frequency	%	Frequency	%
Synchronized cropping	3	1	85	39
Hunting	35	16	123	56
Trap barrier system	17	8	7	3
Digging	106	48	84	39
Field hygiene	23	10	45	21
Rat poison	139	63	70	32
Smoke-out	34	15	1	0.5
Wood trap (Chat cha)	1	0.5	1	0.5
Net rounding	27	12	4	2
Traps	88	40	1	a
Water pumping (filling rat's hole with water)	24	11	3	1
Electricity	53	24	-	-
Plastic fence	19	9	3	1
Digging + Hunting	9	4	3	1
Pesticide spray	4	2	-	-
Rodenticides + motor oil	6	3	1	0.5
Water filling + Cyanamide	9	4	-	-

(*) Multiple responses; a= less than 1%

In 2009, the control methods as synchronized cropping, hunting were increasingly operated by farmer groups. No more farmers used trap barrier system in 2009. Farmers working as group together were found in many more activities in 2009 than in 2006. Most of the farmers' rat control methods were less cost. Trap barrier system and plastic fence were higher cost. These methods and digging, traps need more labor than other methods. Women also participated in various rat control methods. However, there were more male than female in rat control. About effectiveness of the control methods, in 2006 the most effective methods were wood trap (chất chà) and pesticide. However, pesticide was not recommended by scientists. The other methods with high effectiveness were net rounding, plastic fence, water pumping (filling rat's hole with water), electricity and trap barrier system. The other methods were effective at lower extent. In 2006, farmers mostly preferred various control methods as hunting, water pumping (filling rat's hole with water), net rounding, rat poison, electricity, traps, and diggings. However, rat poison and electricity were not recommended.

In 2009, the most effective rat control methods mentioned by farmers were trap barrier system, net rounding, plastic fence, digging + hunting, synchronized cropping and digging. The other methods which were

effective at lower extent included smoke out, hunting, field hygiene. The poison was still used by farmers in 2009 and farmers said it is effective. In 2009, farmers preferred the methods in rat control as trap barrier system, synchronized cropping, digging, field hygiene. The preferred methods at lower rank in 2009 were rat poison and smoke out.

The common preference in 2006 and 2009 by farmers regarding to rat control methods were hunting, digging, field hygiene, and rat poison (Table 7).

Table 7. Farmers' ranking of control methods

Control method	2006 (n=222)		2009 (n=218)	
	Rank of effective	Rank of preference	Rank of effective	Rank of preference
Synchronized cropping	2.00		1.05	1.05
Hunting	1.75	1.00	1.46	1.39
Trap barrier system	1.33		1.00	1.00
Digging	1.80	1.12	1.10	1.08
Field hygiene	1.47	2.50	1.25	1.29
Rat poison	1.72	1.00	1.96	1.55
Smoke-out	1.36		2.00	2.00
Wood trap (Chat cha)	1.00			
Net rounding	1.10	1.00	1.00	
Traps	1.67	1.04		
Water pumping (filling rat's hole with water)	1.29	1.00	3.00	
Electricity	1.33	1.00		
Plastic fence	1.11		1.00	
Digging + Hunting	1.71		1.00	
Pesticide spray	1.00			
Rodenticides + motor oil	1.67			
Water filling + Cyanamide	1.75			
Note: 1 is highest				

Around one-fourth of the farmers ranked synchronized cropping, hunting and digging as high effective rat control method in 2009. This was not much mentioned by farmers in 2006. In both 2006 and 2009, there was only few farmers knew that trap barrier system was highly effective method in rat control (Table 8).

Table 8. Percentage of farmers' ranking of control methods distributed by rank level

Control method	2006 (n=222)				2009 (n=218)			
	Rank of effective		Rank of preference		Rank of effective		Rank of preference	
	No.	%	No.	%	No.	%	No.	%
Synchronized cropping								
High	-	-	-	-	54	24.8	55	25.2
Medium	1	0.5	-	-	3	1.4	3	1.4
Low	-	-	-	-	-	-	-	-
Total	1	0.5	-	-	57	26.1	58	26.6
Hunting	-	-	-	-	-	-	-	-
High	7	3.2	7	3.2	59	27.1	55	25.2
Medium	6	2.7	-	-	33	15.1	27	12.4

Control method	2006 (n=222)				2009 (n=218)			
	Rank of effective		Rank of preference		Rank of effective		Rank of preference	
	No.	%	No.	%	No.	%	No.	%
Low	3	1.4	-	-	6	2.8	3	1.4
Total	16	7.2	7	3.2	98	45.0	85	39.0
Trap barrier system								
High	4	1.8	-	-	4	1.8	4	1.8
Medium	2	0.9	-	-	-	-	-	-
Low		-	-	-	-	-	-	-
Total	6	2.7	-	-	4	1.8	4	1.8
Digging								
High	26	11.7	15	6.8	63	28.9	59	27.1
Medium	27	12.2	2	0.9	5	2.3	5	2.3
Low	13	5.9	-	-	1	0.5	-	-
Total	66	29.7	17	7.7	69	31.7	64	29.4
Field hygiene								
High	10	4.5	-	-	27	12.4	25	11.5
Medium	9	4.1	2	0.9	2	0.9	3	1.4
Low	-	-	2	0.9	3	1.4	3	1.4
Total	19	8.6	4	1.8	32	14.7	31	14.2
Rat poison								
High	43	19.4	26	11.7	20	9.2	21	9.6
Medium	48	21.6	-	-	14	6.4	6	2.8
Low	14	6.3	-	-	18	8.3	6	2.8
Total	105	47.3	26	11.7	52	23.9	33	15.1
Smoke-out								
High	18	8.1	-	-		-		-
Medium	5	2.3	-	-	1	0.5	1	0.5
Low	2	0.9	-	-		-		-
Total	25	11.3	-	-	1	0.5	1	0.5
Wood trap (Chat cha)								
High	1	0.5	-	-	-	-	-	-
Medium	-	-	-	-	-	-	-	-
Low	-	-	-	-	-	-	-	-
Total	1	0.5	-	-	-	-	-	-
Net rounding								
High	9	4.1	3	1.4	2	0.9	-	-
Medium	1	0.5	-	-	-	-	-	-
Low	-	-	3	1.4	-	-	-	-
Total	10	4.5	-	-	2	0.9	-	-
Traps								
High	25	11.3	25	11.3	-	-	-	-
Medium	23	10.4	1	0.5	-	-	-	-
Low	7	3.2	-	-	-	-	-	-
Total	55	24.8	26	11.7	-	-	-	-
Water pumping (filling rat's hole with water)								

Control method	2006 (n=222)				2009 (n=218)			
	Rank of effective		Rank of preference		Rank of effective		Rank of preference	
	No.	%	No.	%	No.	%	No.	%
High	15	6.8	6	2.7		-	-	-
Medium	6	2.7	-	-		-	-	-
Low	-	-	-	-	1	0.5	-	-
Total	21	9.5	6	2.7	1	0.5	-	-
Electricity								
High	23	10.4	17	7.7	-	-	-	-
Medium	4	1.8	-	-	-	-	-	-
Low	3	1.4	-	-	-	-	-	-
Total	30	13.5	17	7.7	-	-	-	-
Plastic fence								
High	8	3.6	-	-	1	0.5	-	-
Medium	1	0.5	-	-	-	-	-	-
Low	-	-	-	-	-	-	-	-
Total	9	4.1	-	-	1	0.5	-	-
Digging + Hunting								
High	4	1.8	-	-	1	0.5	-	-
Medium	1	0.5	-	-	-	-	-	-
Low	2	0.9	-	-	-	-	-	-
Total	7	3.2	-	-	1	0.5	-	-
Pesticide spray								
High	4	1.8	-	-	-	-	-	-
Medium	-	-	-	-	-	-	-	-
Low	-	-	-	-	-	-	-	-
Total	4	1.8	-	-	-	-	-	-
Rodenticides + motor oil								
High	1	0.5	-	-	-	-	-	-
Medium	2	0.9	-	-	-	-	-	-
Low	-	-	-	-	-	-	-	-
Total	3	1.4	-	-	-	-	-	-
Water filling + Cyanamide								
High	1	0.5	-	-	-	-	-	-
Medium	3	1.4	-	-	-	-	-	-
Low	-	-	-	-	-	-	-	-
Total	4	1.8	-	-	-	-	-	-

Farmers applied rat control methods in Summer-Autumn were higher than in the other seasons in both year 2006 and 2009. In Winter-Spring season, there was few rat population due to flood season before staring season. The accumulation of rats through reproduction with many generations in Winter-Spring season led to high rat population in the following season as Summer-Autumn. In both year 2006 and 2009, farmers mostly control rats at beginning of crop season (during land preparation /pumping before crop sowing), and booting stage. According to farmers, booting stage is

favorable stage for rats to consume for their reproduction. The other stages were seedling, tillering heading and maturing stage was also needed to control (Table 9).

Table 9. Percentage of farmers applied rat control in each rice stage

Crop stage	2006 (n=220)						2009 (n=218)					
	Winter-Spring		Summer-Autumn		Third Season		Winter-Spring		Summer-Autumn		Third season	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Land preparation /Pumping	58	26	138	63	1	0.5	42	19	166	76	7	3
Transplanting/sowing/seedling (0-20 Days)	84	38	100	45	-	-	77	35	52	24	-	-
Tillering (21-40 Days)	81	37	87	40	1	0.5	28	13	30	14	1	0.5
Booting (41 - 60 Days)	137	62	165	75	2	0.9	67	31	71	33	5	2
Heading (61 –70 Days)	83	38	99	45	-	-	41	19	39	18	-	-
Maturing (> 70 Days)	27	12	39	18	1	0.5	8	4	11	5	-	-

Majority of the farmers said that control rat before sowing (during land preparation) was highly effective in both 2006 and 2009, followed by booting stage, seedling stage, maturing stage and tillering stage. There were several reasons mentioned by farmers for effectiveness in rice stage of rat control. Farmers can control rats effectively by stage because rats are mainly in their holes, bare field, hungry rats (due to period of food lack to rats before sowing as during land preparation), unknown baits by rat (so that rats can be baited easily because they are known as wisdom pest, if they are familiar with baits, they will not be baited)

Control rat communally was mostly organized by local government, followed by technical staff of Plant Protection Departments (both at district and provincial levels), farmer groups, farmers' clubs, other public association and cooperatives. These groups are relatively larger numbers of participants than the other control groups organized by friends, neighbors and relatives together. Both surveys in 2006 and 2009 showed that most of the rats caught were consumed by farmers. Only 13-20 % of rats were sold. Less than 10% was throw out (Table 10).

Table 10. What did farmers do with rat caught?

Allocation of rat caught	2006		2009	
	Percent	Price (VND /rat)	Percent	Price (VND/rat)
Throw out	8		9	
Consume	72		78	
Sell	20	1196	13	2110
Total	100		100	

Rats caused damaged not only on the standing rice in the fields but also in the rice stores. Most of the farmers (95%) mentioned that rat damaged the rice stores. Farmers detected the rat damage in the rice stores by seeing the running rats, rat's voice, rice husks remained (after eating the rice inside, rats left the rice husks in the stores), rice bags were bittern by rats, rat's nest/litter/hole, rat's droppings, rat's urine smell and rat's footmarks. Farmers protected the rice stores by using various measures as traps, rodenticide, raising cats (to

catch rats), covering the stores by plastic/metal material and frequently check. Farmers decided appropriate control methods mostly based on their experience (81%), followed by their partner's experience (as spouse, neighbor) (47%). They also made decision on rat control methods based on extension staff, training, mass media (TV, radio, leaflet) and traders. Less than one-third of the farmers heard about barrier system mainly from technician/ agricultural extension workers. The other source of information was television (only 26% and newspaper (only 8%). Not much prevalent on mass media to farmers and leaflet (14%) in 2006 was observed. In 2009, the percentage of the farmers hearing of trap barrier system was higher than those in 2006 (71%). Most of them said that this method was more benefit as compared with input cost to establish the trap barrier system. Though using trap barrier system was benefit, there were problems in its application as lack of equipment and labour, thief stealing traps, easily broken traps, no synchronized cropping and aroma rice varieties attracting rats.

Community action was familiar to farmer long time ago. The survey in both years 2006 and 2009, majority of the farmers were volunteers to work together to do something for benefit of the community. They mainly participated in charitable organization, road and bridge building, building the house of charity, contribution to public interest and temples, contribution to local and national security and defense, helping victims of flood areas, poor people and foundlings and handicappeds. They also participated in Red Cross, burial service group and reconcile group. Mostly husband or sons of the household participated in community action. Female children also participated. More farmers in 2009 survey than in 2006 survey said that social unity of village/neighborhood was good, and 10-13% of them rated social unity of village/neighborhood was very good. This maybe the improvement of organization and activities of the union in the later year than those in the past year and this improvement can bring benefit to farmers and their community. Farmers also commented that the social unity of village/neighborhood was good solidarity and security. Sibling and neighbors form social unity because they always help each other when farmer member faced to difficulty. Everybody participate and contribute for the common benefit of the social unity. The survey in 2006 indicated that farmers daily talk mostly with neighbours, relatives and siblings. They also talk with friends, fellow trader, local authority / technician / agricultural extension workes, colleagues at lower extent. They mostly talk in the rice fields and coffee shop. The other places were neighbour's house, at home and village's office where they talk together. They usually talked about purchasing of inputs for farm production (what branch and where to buy), marketing of produce (where, when and price to sell the farm products), their business and daily news. Farmers' knowledge in 2009 increased through the access of information on agricultural technologies and markets from government information system than in 2006 such as television, radio, pamphlet (from extension workers), community leaders, Plant Protection department (PPD), and agricultural extension staffs. The other sources of information were relatives, friends, neighbors, newspaper, farmers' cooperative, retailer of fertilizer and pesticide. Farmers expressed that the situation of information access was improved as compared with the previous years. This increased farmers' knowledge and adoption of agricultural technologies. Farmers accessed to information due to availability of village loudspeakers, local radio station, electricity and private televisions, increase of extension activities, workshops, better transportation conditions, knowledge exchange among farmers and guidance from technician/PPD staff.

In year 2006, 38% of the farmers were train on "3 reductions 3 gains" and this was increased to 43% in survey in 2009. There was 42% of the farmers in 2006 and 36% in 2009 attended workshops (organized by various organization and agency including Plant Protection department, farmers' association, research institute, university and

private company…). There was 40% and 47% of the farmers attended the training in rice production in 2006 and 2009, respectively. Few of them attended national defense meeting, private secretary and breeding.

The topic covered in training on rice production technologies, pesticide and fertilizer use in both investigation in 2006 and 2009. In both years, some of them were trained on the topics livestock raising and techniques of vegetables and other crop production. More topics covered in field of rice breeding and rats in 2009 than in 2006. The training related to rice as "3 reductions 3 gains", "training on rice production" in both years 2006 and 2009 was from 22 – 49 days. Short-term training on "rice breeding" was 5 days duration in 2006 and 30 days in 2009. The longer days of training in rice breeding maybe better for farmers to absorb the knowledge to practice.

CONCLUSION

Farmers involved in community trap barrier system (CTBS) together with community action (CA) in Tinh Bien and Tri Ton districts (An Giang Province) are mostly members of farmers' association. Farmers obtained land from inheritance and purchase. The land for rice cultivation was less than 3 ha. The livestock enterprise is only at household level (small scale). The existence of farming machines is limited and farmers accessed these from other services from other villages or districts. There is limitation of storage area at household level to store rice products after harvest. The rice yields in 2009 is higher than 2006, with the average of 6.25 t/ha and 5.55 t/ha, respectively. Most of rice amounts are sold after harvest due to lack of capital. Farmers mostly use their own seeds in previous season for the following crops. The frequency of fertilizer use in 2009 is lower than those of 2006. The trends of insecticide, fungicide and molluscide use are not different in 2006 and 2009. The seed rates are reduced in 2009 as compared with the year 2006 significantly. The male and female labor investment in 2009 is lower than 2006. Rice production, rice income and net return from rice in 2009 are higher than those of 2006.

The problem in rice production in both year 2006 and 2009 is insect and disease. Rat problem in 2009 was at less extent as compared with 2006. The community action taken by the local government and by the state to reduce rat. High rat population is affected by low flooding water level, rats migrating from Cambodia. Highly reproductive rats is considered as their nature, high density of grasses in the bunds, triple –rice system. Rats appeared in rice field, rice store, earth mound and bushes. The important stages to control rats were land preparation, tillering, booting and harvesting stage. Most of the farmers use rats as food. Farmers apply various rat control methods aside from CTBS and made decision on what method to use based on experience to ensure rice production. In 2009, more farmers applied non-chemical measures than in 2006 and control by community actions organized by local government/association, cooperatives, farmer groups of clubs, and technical staffs from plant protection. The effective rat control methods included trap barrier system, digging, digging + hunting, plastic fence, net rounding and synchronized cropping. Farmers prefer the control methods which are easy to do, less cost and labors. Trap barrier system is effective in rat control. However, farmers faced problem in application due to high cost, lack of equipment and labour, thief stealing traps, easily broken traps, no synchronized cropping and planting aroma rice varieties though social unity of village/neighborhood. The communication system and oral communication among farmers are good. Farmers can also access to agriculture and market information from various to increase the knowledge. Farmers' knowledge related to rats control in 2009 is higher than those in 2006. Thus, there is the need of well arrangement in activities of the social unities and raising funds with the assistance of appropriate policy from the government.

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ĐÁNH GIÁ KIẾN THỨC VÀ THỰC HÀNH BẪY CÂY TRỒNG CỦA NÔNG DÂN AN GIANG TRONG PHÒNG TRỪ CHUỘT HẠI LÚA

Đánh giá kiến thức và thực hành bẫy cây trồng của nông dân An Giang trong phòng trừ chuột hại lúa bằng cách điều tra trước (năm 2006) và sau khi áp dụng bẫy cây trồng (năm 2009) cho thấy kiến thức trồng lúa và phòng trừ chuột của nông dân gia tăng. Nông dân giảm đầu tư (giảm lượng hạt giống, giảm số lần bón phân và giảm công lao động) trong năm 2009 so với năm 2006. Năng suất lúa trong năm 2009 cao hơn năm 2006. Sản lượng lúa, thu nhập và lợi nhuận từ lúa trong năm 2009 cao hơn năm 2006. Bẫy cây trồng được thành lập dựa vào hoạt động cộng đồng đã có từ trước và được tổ chức dưới sự hỗ trợ của chính quyền địa phương và tính đồng thuận xã hội của cộng đồng mạnh mẽ. Bẫy cây trồng phòng trừ chuột có hiệu quả và mang lại lợi ích cho cộng đồng. Tuy nhiên, chi phí bẫy cây trồng cao và khó duy trì bởi nông dân nếu họ không có cách gây quỹ và chính sách phù hợp từ Nhà nước.