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IMPACTS OF THE COMMUNITY EDUCATION ON FARMERS' KNOWLEDGE AND BEHAVIOR IN PESTICIDE USE TOWARD PESTICIDE RISK REDUCTION IN VIETNAM: A CASE STUDY IN VEGETABLE PRODUCTION

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ABSTRACT

Farmers' knowledge and their behavior in pesticide use toward pesticide risk reduction (PRR) becomes a key issue in adopting IPM approach. Pesticide risks can possibly be reduced through community farmer education with a fortified IPM training focused on improving pesticide use. A community education program on PRR in safe vegetable production was first implemented in Hanoi city and Thai Binh province of the country in 2008. Two data sets were collected in 2008 and 2010 from 95 local officials, 170 pesticide users and 15 pesticide sellers before and after PRR implementation in 2 experimented and 2 control communes of Hanoi city and Thai Binh province. Findings show that the program has: i) improved knowledge of local officials, pesticide sellers and applicators in PRR; ii) strengthened community actions as well as individual farmers' behavior in PRR; iii) enabled local people to reduce pesticide risks in terms of hazards and exposure, as a result, the environmental impact quotients were reduced sharply from 20% to 78%; and iv) an extraordinary impact in supporting national pest management policy reform. The paper also draws some recommendations for improving PRR training and some legal policy issues for a sustainable vegetable farming.

Keywords: impacts, training, integrated pest management, hazards and exposure, double delta approach

INTRODUCTION

Vietnam started the integrated pest management (IPM) program in crop production in 1992 in order to help farmers acquire knowledge to become rationale decision makers on their own fields. The goal of the program was to empower small-scale farmers to become skillful and better-informed decision makers in managing the rice production system. The IPM program has been extended from rice to vegetable production since 1996 and a few years later to fruit cultivation (FAO, 2008). In order to meet Vietnam's growing demand for safe vegetables, there is an increasing need to adopt IPM to eliminate use of hazardous and persistent agro-chemicals through IPM farmer training in conjunction with better access to alternative pest management options and support for national pest and pesticide management policy reform. After two decades of IPM implementation, pesticide risk reduction (PRR) becomes one of key issues in adopting IPM approach. Pesticide risks can possibly be reduced through community farmer education with a fortified IPM training focused on improving farmers' knowledge and their behaviors in pesticide use toward pesticide risk reduction (McCauley et al. 2002; Gerd, 2007). Studies on the relevance, effectiveness and impacts of training are limited (Sabur and Molla 2001; Damalas and Koutroubas, 2017). Training of smallholder farmers on IPM and good agricultural practices in farmers' field schools (FFS) in better-off countries had positive effects (Wu and Hou 2012; Clausen et al. 2017), but is scarce in most low-income countries (Jørs et al. 2014; Gautam et al.

2017). Some bottlenecks are market dynamics, availability of personal protective equipment, and the lack of alternative means of pest control on the markets that hindered transformation of knowledge into practice (Vaidya et al. 2017).

Vietnam's Plant Protection Department (PPD) has been implementing fortified PRR training through a Community-based Training Program on PRR in Safe Vegetable Production with Vietnam's Good Agricultural Practices Orientation to reduce pesticide risks since 2008 (Vietnam National IPM Program, 2008). The program seeks to involve a full participation of all stakeholders of the community including IPM farmers, local leaders, mass organizations and public health center in pesticide risk reduction by following activities: 1) Conducting PRR training for pesticide applicators, local officials and pesticide sellers; 2) Formation of farmers' interest groups for pesticide risk reduction. The farmer groups were facilitated to form its own action plan, field studies for PRR and its members were trained in PRR-Vietnam's good agricultural practices (VietGAP); 3) Development and enforcement of local regulations on pesticide trade, use and management; 4) Consultation for development of safe vegetable production zone including improving infrastructure (tanks for keeping pesticide containers); 5) PRR information dissemination by mass media, local village meetings. The PRR training programs were first implemented in Hanoi city and Thai Binh province. After two years of PRR program implementation, there arose some questions on PRR training program: 1) Could the PRR education program help the vegetable production community with better knowledge and behaviors in pesticide use toward pesticide risk reduction. To answer this question, this research was carried out to identify impacts of this training program on: 1) local people's knowledge on PRR; 2) people's behaviors and decision making on PRR; 3) pesticide use and pesticide risk reduction 4) draw recommendations for adopting PRR approach to eliminate use of hazardous and persistent agro-chemicals with better access of alternative pest management options

METHODOLOGY

Study design. A "Double Delta Approach" (DDA) was employed to examine the impacts of PRR training. The use of DDA are to estimate differences between success indicators (e.g. changes in knowledge of and behaviors in pesticide risk management) before and after the PRR training for both PRR participants and non PRR-participants (control group) and then comparing the difference between the two groups. Hence, the effect of factors affecting the success indicators of both groups, other than PRR training, is "differenced out". With this design, two typical communes, namely Dang Xa and Le Chi (Hanoi city), Thai Giang and Thuy Son (Thai Binh province) were selected for an in-depth study for baseline and post PRR training surveys. Farmers in Hanoi's communes planted cabbages while those in Thai Binh produced melon. These vegetables are potential for consumer risks. These paired communes are similar and representative for the province in terms of pesticide risks, agro-ecological conditions, and vegetable production and IPM FFS activities. Farmers in these selected communes had a commitment that they continued grow the same vegetable at least three years (2008-2010). After the base-line survey, one of these two communes received a PRR training (called PRR commune) in 2008, the other did not get PRR training until 2010 (called control commune). Differences between PRR and control commune in terms of knowledge, decision making behaviors of farmers, pesticide dealers and local community officials and community actions, situation of hazards and exposures before and after PRR training are considered as impacts of the PRR training on farm and community levels (Table 1).

Table 1. Communes under study by provinces and study crops

Province	PRR commune	Control commune	Study Crops
Hanoi city	Dang Xa (Gia Lam district)	Le Chi (Gia Lam district)	Winter Cabbage (Nov to Jan)
Thai Binh	Thai Giang	Thuy Son	Spring Melon

province (Thai Thuy district) (Thai Thuy district) (Apr to mid Jun)

Data collection. Secondary information including legislative documents on banned, restricted and permitted pesticides for vegetables and Vietnam's good agricultural practices (VietGAP), permitted pesticide list in Vietnam, pesticide lists for vegetable production were collected from Ministry of Agriculture and Rural Development (MARD, 2009), PPD and Provincial PPD, district plant protection departments and other relevant offices.

The PRR impact assessment comprises of a baseline data collection before the PRR activities and a post-survey data collection period one year later, during the same crop calendar as the baseline survey. The baseline survey was carried out in 2008 on three types of respondents, namely, community officials, pesticide applicators with the sample sizes of 95, 70 and 15 respondents, respectively. In 2009, the PRR program was implemented Dang Xa (Hanoi) and Thai Giang (Thai Binh) communes. PRR farmers in Dang Xa and Thai Giang communes continued cultivating their crops in 2010. Cropping seasons in 2008 and 2010 were similar in terms of climate, pest and disease conditions. Thus, the post-PRR training survey for impact assessment was conducted in 2010 in Hanoi city and Thai Binh province using repeated sampling (Table 2).

Table 2. Sample size by type of communes and type of respondents for the base-line and post PRR training surveys

	All			Hanoi city			Thai Binh province		
Type of Respondent	**PRR commune**	**Control commune**	**Sub total**	**PRR commune**	**Control commune**	**Sub total**	**PRR commune**	**Control Commune**	**Sub total**
Community officials	47	48	95	25	20	45	22	28	50
Pesticide Applicators	89	81	170	33	33	66	56	48	104
Pesticide sellers	8	7	15	5	4	9	3	3	6

Information on pesticides given by farmers were clarified in terms of World Health Organization's classification. Information on pesticide exposures were gathered by direct observation and interviews.

Methods of analysis. *Descriptive statistical methods* such as means, standard deviation, frequencies and cross tabulation were employed to describe changes in knowledge and behaviors of the respondents in the PRR and control communes before and after the PRR training program. Comparisons using DDA between two pairs of data sets before and after PRR training were analyzed. DDA= Δ_E-Δ_C *(Where* Δ_E *= Success indicator in 2010 (after PRR-Training) – Success indicator in 2008 (Before PRR Training) in a PRR commune) and* Δ_C *= Success indicator in 2010 (after PRR training) – Success indicator in 2008 (Before PRR training) in a control commune). Pesticide risk reduction* was measured in terms of reduction in hazards and exposure, i.e. the reduction in the number of pesticide types used in the whole community, number of sprays per farm and pesticide dose used per hectare; and percentages of applicators who used protective equipment, safe sprayer, and pesticide good container management and pre-harvest interval, respectively.

RESULTS AND DISCUSSIONS

Impacts on people's knowledge on pesticide risk reduction

Impacts on community officials' knowledge on pesticide risk reduction. If a person who is aware of four policy issues, namely, safe vegetable regulation, pesticide list for vegetables, regulation on pesticide trading and use, good agricultural practices for vegetable production (VietGAP) is considered to be those who completely know key government policies on pesticide risk management. PRR training has increased awareness of community officials on pesticide risk management policies

about 10% in Hanoi and 20% in Thai Binh (Table 3). PRR training enabled local community officials to be aware of VietGAP and safe vegetable standards. The impacts in Thai Binh were found to be better than those in Hanoi (Table 3). The differences in terms of training curriculum and implementation of PRR program in two studied communes lead to a significant change in training impacts.

Table 3. Impacts on community officials' knowledge on pesticide risk management and regulation.

Impact indicator	PRR Commune		Control Commune		Impact= Δ_E-Δ_C
	2010	Δ_E	2010	Δ_C	
HANOI CITY					
1. Awareness of government policies on pesticide managements	92.0	+13.2	70.0	+3.3	+9.9
2. Knowing 3 policies	40.0	+40.0	0	0	+40.0
3. Remembering VietGAP contents	60.9	+60.9	21.4	+21.4	+39.5
4. Remembering safe vegetable standards *	77.1	+10.5	60.0	-1.9	+13.5
THAI BINH PROVINCE					
1. Awareness of government policies on pesticide managements	90.9	+24.2	67.9	+4.9	+20.0
2. Knowing 3 policies	59.1	+53.5	0	0	+53.5
3. Remembering VietGAP contents	90.0	+90.0	0	0	+90.0
4. Remembering safe vegetable standards *	77.3	+44.4	35.7	+2.4	+42.0

*Percentages of respondents reporting a particular knowledge they perceived in total interviewed respondents

Impacts on sellers' knowledge on pesticide risk reduction. Sellers were asked to express their views on whether their shops meet required standards, reasons for note meeting requirements and their awareness of local regulation on PRR in both pre- and post-PRR training (Table 4).

Table 4. Impacts on pesticide sellers' knowledge on pesticide risk management and regulation.

Impact indicator	PRR Commune		Control Commune		Impact= Δ_E-Δ_C
	2010	Δ_E	2010	Δ_C	
1. Wrong perception of good pesticide shop requirements	50.0	-12.5	66.7	+11.1	-23.6
2. Awareness of local regulation on PRR*	50.0	+50.0	0	0	+50.0

* Percentages of sellers reporting a particular issue they perceived in total sellers;

After PRR training, sellers had a better understanding of requirements for running a pesticide shop. There were less sellers in PRR communes who wrongly perceived of good pesticide shop requirements than those in control communes. It implies that sellers had better knowledge on shop requirements. PRR training enabled 50% of sellers to be aware of local regulation on PRR such as only trading permitted pesticides, opening the shop with a registered license and general requirements for selling pesticides.

Impact on applicators' knowledge on pesticide risk reduction. After training, numbers of farmers who were aware of three important policy regulations, namely safe vegetable standards, basic contents of Vietnam agricultural practices for vegetables and fruits (VietGAP) and internal commune regulations in the PRR communes increased significantly (Tables 5). The program had equipped farmers with a better knowledge in understanding right pre-harvest interval, a pesticide container,

pesticide label, bio and chemical pesticides, permitted pesticide list and basic principle for pesticide use, timing for spraying. As a result, numbers of applicators in the PRR commune who were aware of these issues increased significantly (Table 5).

Table 5. Impacts on applicators' knowledge on pesticide risk management

Impact indicator	Dang Xa (PRR) 2010	Δ_E	Le Chi (control) 2010	Δ_C	Impact = Δ_E-Δ_C
HANOI CITY					
1. Awareness of safe vegetable standards	90.9	+32.7	69.7	+11.4	+21.3
2. Awareness of VietGAP	69.7	+69.7	3.0	+3.0	+66.7
3. Awareness of commune regulations	87.5	+87.5	6.1	+6.1	+81.4
4. Knowing a pre-harvest interval	90.9	+34.2	69.7	+9.7	+24.5
5. Perception of pesticide containers	78.8	+72.8	21.2	+1.2	+71.6
6. Knowing information in a pesticide label	60.6	+39.0	27.2	+12.1	+26.9
7. Knowing bio-pesticides	93.8	+47.0	82.6	+35.3	+12.0
8. Knowing a permitted pesticide list	51.5	+48.5	3.0	0	+48.5
9. Correct awareness of 4-right principle for pesticide use*	51.5	+45.5	6.1	+1.1	+44.4
10. Knowing best time for spraying	97.0	+47.7	51.5	+1.5	+46.2
THAI BINH PROVNCE					
1. Awareness of safe vegetable standards	100	+61.2	33.3	-3.5	+64.7
2. Awareness of VietGAP	98.2	+98.2	0	0	+98.2
3. Awareness of commune regulations	100	+100	2.1	+2.1	+97.9
4. Knowing a pre-harvest interval	91.1	+82.1	37.5	+28.7	+54.0
5. Perception of pesticide containers	85.7	+76.7	2.1	0	+76.7
6. Knowing information from in pesticide label	46.4	+23.0	8.4	-12.5	+35.5
7. Knowing bio-pesticides	100.0	+80.8	15.8	-2.4	+83.2
8. Knowing a permitted pesticide list	80.4	+77.4	0	-1.8	+77.4
9. Correct awareness of 4-right principle for pesticide use*	50.0	+48.2	0	-1.8	+50.0
10. Knowing best time for spraying	82.1	+44.8	37.5	-1.1	+45.9

Percentages of respondents reporting a particular knowledge they perceived or responded in total respondents
* 4-right principle: right vegetable, right amount and ingredient, right time and right spaying method

Impacts on people's behaviors on pesticide risk reduction

Impacts on local community actions toward pesticide risk reduction. The program enabled the local community to realise their responsibility and take collective actions towards PRR (formation of farmer interest groups for vegetable production, construction of pesticide container tanks, formation and enactment of internal PRR regulations, organization of PRR training, dissemination of PRR information, control and inspection of pesticide shops, gathering pesticide containers, constructing

poster, booklets, self-control and PRR information sharing (Table 6). The program has built a self-reliance of local organization toward pesticide risk reduction.

Table 6. Local community actions toward pesticide risk reduction.

Impact indicator	Dang Xa (PRR)		Le Chi (control)		Impact= Δ_E-Δ_C
	2010	Δ_E	2010	Δ_C	
HANOI					
1. Do nothing, assign to cooperative to do PRR	4.0	-22.0	50.0	+27.8	-49.8
2. Formation of PRR farmer group	64.0	+64.0	0	0	+64.0
Number of PRR farmer groups formed (group)	5	+5	0	0	+5
3. Construction of pesticide container tanks	12.0	+12.0	0	0	+12.0
Pesticide container tanks built (tank)	7	+7	0	0	+7.0
4. Formation of local PRR regulation	28.0	+28.0	0	0	+28.0
5. Organizing PRR training	84.0	+84.0	0	0	+84.0
6. Information dissemination	72.0	+24.2	38.9	+2.0	+22.2
7. Control pesticide shops	56.0	+56.0	0	0	+56.0
Number of unqualified pesticide shop closed	1	+1	0	0	+1
8. Garthering pesticide containers	0	0	0	0	0
9. Development of foster, booklets, VCD	12.0	+12.0	0	0	+12.0
10. Self control and PRR information sharing	12.0	+12.0	0	0	+12.0
11. Pest surveillance and warning	28.0	19.3	16.7	0	+16.7
THAI BINH					
1. Do nothing, assign to cooperative to do PRR	13.6	-13.6	71.4	+55.8	-69.4
2. Formation of PRR farmer group	69.6	+69.6	0	0	+69.6
Number of PRR farmer groups formed (group)	6	+6	0	0	+6
3. Construction of pesticide container tanks	27.3	+27.3	0	0	+27.3
Number of container tanks built (tank)	4	+4	0	0	+4
4. Formation of local PRR regulation	50.0	+50.0	0	0	+50.0
5. Ogranzing PRR training	95.5	+95.5	0	0	+95.5
6. Information dissemination	86.4	+54.6	35.0	+3.2	+50.8
7. Control pesticide shops	72.7	+72.7	0	0	+72.7
Number of unqualified pesticide shop closed	2	+2	0	0	+2
8. Garthering pesticide containers	59.1	+59.1	0	0	+59.1
9. Constructing foster, booklets, VCD	45.5	+45.5	0	0	+45.5
10. Self control and PRR information sharing	31.8	+31.8	0	0	+31.8
11. Pest surveillance and warning	22.7	+13.6	28.6	+28.6	0

* Percentages of respondents reporting a particular community action in total respondents with an exception of numbers of farmer groups formed, tanks built and the closed shops.

Impacts on sellers' behaviors toward pesticide risk reduction. The PRR program enabled the shop keepers to change their practices toward risk reduction such as arranging shop with safe environment, fire controller, used right pesticide store methods (Table 7). Sellers recognized their responsibility in selling pesticides (untrained person selling reduced), used more protective clothing, stopped selling instant foods and drinks together with pesticides and sold more bio-pesticides (Table 7).

Table 7. Impacts on pesticide sellers' behaviors on pesticide risk reduction

Impact indicator	PRR Commune		Control Commune		Impact= Δ_E-Δ_C
	2010	Δ_E	2010	Δ_C	
1. Shop was cool with good airflow	100	+50.0	66.7	+33.3	+16.7
2. Shop was equipped with fire controller	50.0	+50.0	0	0	+50.0
3. Right pesticides store method	100.0	+87.5	11.1	0	+87.5
4. Untrained person selling pesticides	25.0	-25.0	66.7	0	-25.0
5. No use protective equipment (cloths, masks..)	0	-62.5	77.8	-22.2	-48.3
6. Selling other goods	100.0	+12.5	100.0	0	+12.5
Selling instant foods and drink	25.0	-46.4	66.7	0	-46.4
7. Average number of pesticide type/shop (type)	27.0	+2.0	43.4	+14.8	-12.8
8. Bio pesticide type share in total types (%)	19.4	+13.4	6.1	-1.0	+14.4

* Percentages of respondents having a particular behavior in total pesticide sellers with an exception averaged number of pesticides per shop and item No.7

Impacts on applicators' behaviors toward pesticide risk reduction. The training promoted farmer interest group formation, almost all farmers in the PRR communes had joined farmer groups (Table 8). After training, farmers had better confidence in selecting pesticides (based on their owned experiences) than the situation before PRR program enactment. The program enabled farmers used only pesticides in the permitted lists. As a result, it reduced number of pesticide types used in the field. The training increased numbers of farmers who often read the instruction label before pesticide use, placed their sprayers at safe places, rinsing mouth after spraying, while it reduced numbers of applicators who mixed wrongly pesticide cocktails (Table 8).

Table 8 Impacts on applicators' behaviors on pesticide risk reduction

Impact indicator	Dang Xa (PRR)		Le Chi (control)		Impact= Δ_E-Δ_C
	2010	Δ_E	2010	Δ_C	
HANOI CITY					
1. Joining farmer interest group	90.9	+90.9	0	0	+90.9
2. Information sources for selecting pesticides					
Applicators' experiences of pesticide use	51.5	+9.7	45.5	-2.8	+12.5
Seller's instruction	24.2	-27.3	54.5	+14.5	-41.8
3. Number of pesticide types used	11	-7.0	24	+6.0	-13.0
4. Reading the label before use	97.0	+42.0	57.6	+2.0	+40.0
5. Number of applicators mixed wrongly*	0	-42.5	31.8	-10.3	-32.2
6. Cleaning sprayers wherever convenient	90.9	-3.5	93.9	+10.5	-14.0
7. Keeping sprayers, pesticides at safe places	87.9	+46.0	21.2	-21.2	+67.2
8. Rinsing mouth after spraying	84.8	+72.8	21.2	+10.2	60.6
THAI BINH PROVINCE					
1. Joining farmer interest group	100.0	+100.0	0	0	+100.0
2. Information sources for selecting pesticides					
Applicators' experiences of pesticide use	30.4	+3.5	12.5	+1.5	+2.0
Seller's instructions	57.1	-0.4	70.8	+7.6	-8.0
3. Number of pesticide types used	12	-8	18	-1	-7
4. Reading the label before use	85.7	+40.9	43.8	0	+40.9
5. Number of applicators mixed wrongly*	10.8	-45.5	2.3	-55.5	+10.0
6. Keeping sprayers, pesticides at safe places	78.6	+18.3	68.6	+7.2	+11.1
7. Rinsing mouth after spraying	78.6	+60.6	18.8	+2.8	+57.8

* Percentages of respondents having a particular behavior in total respondents with an exception of the criteria No.3 and those marked with star symbols

Impacts on reduction hazards and exposure

Reduction of hazards. Risks to applicators may depend on types of pesticide use. By World Health Organization's (WHO) toxicity class, pesticides are categorized into four groups. By environmental effects, they are grouped into types including chemical and bio-pesticides. If applicators use more WHO's class III pesticides and bio-pesticides, it implies that they are wise rational applicators. It was found that after the PRR program implementation, the number of pesticide types used in the whole community, average number of sprays per farm in the crop as well as a dose of pesticide used per hectare of cultivated crop and number of wrong cocktailed applications reduced significantly as compared with those before implementation of the PRR program (Table 9).

Table 9. Changes in pesticide use after PRR program implementation

Impact indicator	PRR Commune 2010	Δ_E	Control Commune 2010	Δ_C	Impact= Δ_E-Δ_C
HANOI CITY					
1. Number of pesticide types used (type)	11	-7.0	24	+6.0	-13.0
Bio-pesticides used (%)	45.5	+39.7	20.8	+15.3	+24.4
Class II pesticides (%)	45.5	-21.2	66.7	-3.3	-17.9
Class III Pesticides (%)	54.5	+20.8	33.3	+3.3	+17.5
2. Average number of sprays per farm (spray)	3.9	-2.8	7.0	-0.7	-2.1
3. Pesticide used per ha (kg)	2.17	-0.38	7.91	+4.55	-4.93
4. Number of wrong cocktailed applications in total pesticide cocktailed applications (%)	0.0	-54.0	58.3	-0.3	-53.7
THAI BINH PROVINCE					
1. Number of pesticide types used (type) (%)	12	-8	16	-1	-7
Bio-pesticides used (%)	16.7	+16.7	11.1	+11.1	+5.6
Class II pesticides (%)	41.6	-30.4	31.2	-44.6	+14.5
Class III pesticides (%)	50.0	+22.2	37.5	-21.5	+43.4
2. Average number of sprays per farm (spray)	3.9*	-6.5	6.5*	-3.9	-2.6
3. Pesticide used per ha (kg)	6.35*	-4.42	4.40*	-0.13	-4.29
4. Number of wrong cocktailed applications in total pesticide cocktailed applications (%)	20.0	-54.0	36.9	-38.1	-15.9

% Percentages of a particular pesticide group in total pesticide types used in the whole community

* Significant at 1% level.

Reduction of exposure. After training, the PRR training enabled more farmers to use protective equipment when spraying, use better sprayers and practice rightly pre-harvest interval (Table 10). Farmers in the PRR communes were observed having better pesticide container management practices. Four to seven tanks were built in Thai Giang and Dang Xa communes, respectively for farmers to dispose pesticide containers during the course of PRR implementation. PRR farmers placed their pesticide containers in the tanks located in the fields. As a result, the fields in the PRR communes during cropping season was cleaner and less pesticide containers found in the field compared with the situation before the PRR implementation, whereas, the situation in the control communes seemed unchanged.

Table 10. Changes in using protective equipment when spraying

Impact indicator	PRR Commune		Control Commune		Impact= Δ_E-Δ_C
	2010	Δ_E	2010	Δ_C	
HANOI CITY					
1. Applicators always used protective tools (%)	100	+77.6	48.5	+23.5	+54.1
2. Applicators used defective sprayers (%)	0	-16.0	9.0	-1.0	-15.0
3. Applicators did right pre-harvest interval (%)	100	+46.3	51.5	0	+46.3
THAI BINH PROVINCE					
1. Applicators always used protective tools (%)	85.7	+66.2	35.4	+9.1	+57.2
2. Applicators used defective sprayers (%)	0	-30.4	10.4	-10.8	-19.6
3. Applicators did right pre-harvest interval (%)	100	+53.7	87.5	+38.5	+15.2

CONCLUSION AND RECOMMENDATIONS

The PRR program had positive impacts on: 1) improvement of local people's perception of and behaviors toward pesticide risk reduction; 2) strengthening community actions as well as individual farmers' behaviors in pesticide risk reduction; and 3) reduction of pesticide risks in terms of hazards and exposure. These findings are in line with those of several other studies and indicate that the program has built sustainability for safe vegetable production.

Although the impacts of the program are impressive, for the sake of strengthening these impacts, following measures are recommended: 1) Training contents should focus more on risk reduction and address the applicators' control of pesticide safety, i.e. the applicators should not only be told what they must do to reduce their exposure to pesticides, but why and how these behaviors will reduce their exposure. Furthermore, many organizational, social, and cultural barriers that prevent the applicators from working safely must be factored into the training program; 2) Training should be season-long training (12-14 week course) for applicators and maybe 2 days for local officials and sellers; 3) There should be guidelines on formulation and implementation of internal regulation for the local community; 4) more efforts should be devoted to instruct and consult with local authorities as well as mass organization to form and operate farmer interest groups, self-control and self-help farm groups; 5) to ensure long terms effects, development and implementation of a TOT program for PRR; 6) Further sustained programs that support the principles taught in the community education program are required to effectively decrease pesticide risk for farmworkers; 7) A legal framework and technique for treating the collected containers should be issued. Pesticide companies may be responsible to bear the cost for treating these collected containers

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