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# IMPACTS OF COMMUNITY BASED TRAINING ON PESTICIDE RISK REDUCTION

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## ABSTRACT

Pesticide risks in terms of hazard and exposure are expected to reduce through community based farmer training. With this regards, a community based training program on pesticide risk reduction (PRR) has been implemented in Vietnam since 2007. With two data sets on 94 pesticide users before and after PRR training in PRR and control communes of Hanoi city and Thai Binh province, this paper shows that: The program has improved farmers' awareness/knowledge and their behaviors in PRR, and enabled farmers to reduce hazards and exposure. Farmers used pesticides permited for vegetables, used more biopesticides and class III and IV pesticides. On the exposure side, positive impacts were more proper pesticide use techniques; use of more protective equipment and better unused pesticides and sprayer management. As a result, the environmental impact quotients were reduced sharply from 20% to 78%.

Keywords: Community-based training, exposure, hazard, pesticides, risk reduction.

## Đánh giá tác động của tập huấn dựa vào cộng đồng về giảm thiểu rui ro thuốc bảo vệ thực vật

## TÓM TẮT

Rủi ro thuốc bảo vệ thực vật (BVTV) có thể được giảm thiểu thông qua tập huấn dựa vào cộng đồng để giảm độc hại và tiếp xúc với thuốc BVTV. Trên phương diện này, chương trình tập huấn dựa vào cộng đồng để giảm thiểu rủi ro thuốc BVTV được thực hiện ở Việt Nam từ năm 2007. Với hai bộ số liệu của 94 hộ dùng thuốc trước và sau khi tập huấn ở 2 xã thực nghiệm và 2 xã đối chứng của Thái Bình và Hà Nội, bài viết này đã chỉ ra rằng: Chương trình tập huấn đã cải thiện được kiến thức và ứng xử của nông dân trong giảm thiểu rủi ro thuốc BVTV làm giảm cả độc hại và nguy cơ tiếp xúc với thuốc. Nông dân đã dụng thuốc trong danh mục, sử dụng nhiều thuốc sinh học, và thuốc thuộc nhóm III và IV hơn, sử dụng bảo hộ lao động và quản lý thuốc thừa sau khi phun tốt hơn so với trước khi tập huấn. Kết quả là chỉ số tác động môi trường giảm được từ 20 đến 78%.

Từ khóa: Độc hại, giảm thiểu rủi ro, tập huấn dựa vào cộng đồng, tiếp xúc.

## 1. INTRODUCTION

Population growth results in high demand for food. In this context, farmers must adopt agricultural intensification to produce enough food. To meeting the increasing demand for food security, more chemical inputs including pesticides and fertilizers are increasingly used in agriculture. The use of these chemical inputs, especially pesticides puts agricultural production at risk. Improper use of pesticides lead to high risks to producers, consumers and environment. Given the challenges to food security and food safety and environmental protection, sustainable agricultural production is much concerned by Vietnamese government. In this context, managing agricultural ecosystems by rational combining intensification of crop production with proper use of pesticides to reduce risk is one of the strategies for agricultural production. In this regard, adopting Integrated Pest Management

(IPM) to reduce both hazards and exposure to pesticides is a strategy of farmer community based pesticide risk reduction (PRR) training. Vietnam Plant Protection Department (PPD) has been implementing PRR training since 2007 (Dung and Long, 2013). With this regards, Vietnam 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 basic principle of community based PRR training is to involve a full participation of farmers, local officials and pesticide dealers to be aware of, changing their behaviors in selection, use and management of pesticides so as to reduce pesticide risks. By December 2013, the community based PRR training program has covered all farming communities in Vietnam with effective participation of more than 10,855 farmers. After 6 years of PRR program implementation, there are some arising questions on PRR training program: Could PRR training program help farmers reduce hazard and exposure, then reduce pesticide risks? To find the answer to this question, the overall objective of this paper was to examine the impacts of the community based PRR training on pesticide risks. To obtain this objective, the research tried to achieve the following specific objectives : 1) Examining how the training affects reduction of hazard; 2) Finding the training effects on pesticide exposure; 3) Measuring the effects of the training on pesticide risks. With thí scope of the paper discusses primarily how the community based PRR training affects environmental impact quotient. Other factors affecting PRR training are beyond the scope of this paper.

## 2. METHODOLOGY

### 2.1. Community Based Pesticide Risk Reduction (PRR) Training

Pesticide risks are defined as the product of hazard (i.e. chemical property) and exposure (i.e. intensity and duration). Pesticide risk reduction can be achieved by reducing hazard and/or reducing exposure (Walter Echols, 2007).

Risk = Hazard x Exposure

Hazard is reduced by selecting less toxic products while exposure is reduced by using fewer pesticides, better application methods and protective equipment. With this framework, the objective of the community based pesticide risk reduction training in Vietnam is to improve human and environmental knowledge, attitude among farmers and other local stakeholders, make changes in pesticide management practices, reduce pesticide hazard and exposure, and finally, reduce pesticide risks. The program seeks to involve a full participation of all stakeholders of the community through the followings: 1) Conducting PRR season long farmer field school (FFS) training for pesticide applicators, short term training for local officials and pesticide dealers; 2) Formation of farmers' interest groups for pesticide risk reduction; 3) Development and enforcement of local regulations on pesticide trade, use and management; 4) Developing infrastructure (i.e. tanks for keeping pesticide containers..); and 5) PRR information dissemination by mass media, local village meetings. These activities aim at helping farmers to reduce: 1) hazards by selecting least hazard products through understanding pesticides, pesticide labels, effects on human, impacts on non-target organisms and how to select the least hazardous pesticides (bio pesticides, and Pesticide class III and IV by World Health Organization's classification), 2) reducing exposure by using adequate protective equipments, observation of adequate intervals before reentering the field and harvesting the crop, proper storage and disposal of pesticide containers, appropriate application techniques, using non-leaking sprayers and correct timing of pesticide application. The PRR training program has been conducted throughout the country since 2007. By November 2013, 3,128 PRR farm field schools were organized with participation of 10,855 farmers and 540 farmer groups were established throughout Vietnam (Dung and Long, 2013).

### 2.2. Study Design

A "Double Delta Approach" (DDA) was employed to examine the impacts of community-based PRR training. DDA helps estimate differences between success indicators (e.g. changes in pesticide exposure, hazards and risks) before and after 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, the factors other than PRR training, are "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 of 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. Farmers in these selected communes had a commitment that they continued growing the same vegetable at least three years (2008 - 2010). After the base-line survey in 2007, one of these two communes (Dang Xa and Thai Giang) of each location received a PRR training (called PRR commune) in 2008, the others did not receive PRR training until 2010 (called control commune). The training was conducted in Dang xa and Thai iang communes in 2009 with a participation of 62 farmers, 30 local leaders and 10 pestcide sellers in each commune. Farmer field schools were conducted on season-long basis for PRR communes. The second survey was conducted in 2010 cropping year. Cropping seasons in 2008 and 2010 were similar in terms of climatic and pest conditions.

### 2.3. Data Collection

Secondary information including legislative documents on banned, restricted and permitted pesticides for vegetables, permitted pesticide list in Vietnam, pesticide lists for vegetable production were collected from Ministry of Agriculture and Rural Development (MARD, 2009) and other relevant offices. Information on environmental impact quotient (EIQ), EIQ tables were collected from Food and Agriculture Organization (FAO, 2008), New York State Integrated Pest Management Program, FAO-EU IPM program for Cotton in Asia (Rikke Peterson and Gerd Walter-Echols, 2004). A sample of farmers ranging from 33 to 47 in each pair of communes were selected for interviewing, direct observation, and book keeping on pesticide use in both base-line and post PRR training survey (Table 1).

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.

### 2.4. Measurement of Pesticide Risks

Pesticide risk reduction can be measured in terms of changes in hazards and exposure. The improvement in hazards were measured in a changes in pesticide types used (chemical by WHO's classification, bio-pesticides, those in or outside the list for selected crop), frequency of pesticide applications, dosage rate and wrong pesticide cocktails. The progress in exposure

**Table 1. Sample Sizes used for Calculating Field Use EIQ Value before and after PRR program Implementation**

| Type of Respondent | Hanoi city | | | Thai Binh province | | |
|---|---|---|---|---|---|---|
| | PRR commune (Dang xa) | Control commune (Le Chi) | Sub total | PRR commune (Thaigiang) | Control Commune (Thuy Son) | Sub total |
| Pesticide Applicators | 33 | 33 | 66 | 47 | 47 | 94 |

reduction was measured in terms of percentages of applicators who used protective equipment, safe sprayer, and pesticide good container management and pre-harvest interval.

The reduction of pesticide risk is measured by Environmental Impact Quotient (EIQ). EIQ is a rating system to assess the environmental impact of pesticides that was developed at Cornell University, USA, in 1992 (FAO, 2008). It generalizes a wide range of potential impacts on farm workers, consumers and the environment based on toxicological data, chemical properties and physical behavior. The EIQ can provide useful additional information when assessing the impact of PRR training program on pesticide risk reduction because it reflects both quantitative and qualitative improvements in pesticide selection and use. There are two types of EIQs, namely "EIQ value" and the "Field Use EIQ". The former refers to the hazard of active ingredients, while the latter is an indicator of risk of specific pesticide applications.

***The EIQ value*** for a particular active ingredient was calculated according to a formula that includes parameters such as toxicity (dermal, chronic, bird, bee, fish, beneficial arthropod), half-life in soil, systemicity, leaching potential, and half-life on leaf surface (Table 2).

Each of these parameters was given a score of 1, 3 or 5 to reflect its potential to cause harm. Six of these ratings were based on measured or known properties and five others on general judgments according to low, moderate or severe impact. These eleven parameters were used to calculate eight environmental impact (EI) indicators by using algebraic equations that combine the numerical ratings with relative weights assigned to each of these effects: effect to applicators, harvester / pickers, consumers, ground water, fish, birds, honey bees and beneficial arthropods (Table 3). These scores were then further aggregated to express the environmental impact on the three main compartments: farm worker, consumer and environment. The final composite EIQ score was taken as the average of the three scores. The maximum possible EIQ score for an active ingredient is 210, while the minimum is 6.7. These scores, however, express potential hazards, not actual hazards. A list of EIQ value

**Table 2. The parameters and rating system used to calculate the EIQ value for specific active ingredients (Kovach et al., 1992)**

| Parameter | Symbol | Score 1 | Score 3 | Score 5 |
|---|---|---|---|---|
| 1. Long-term health effects | C | Little-none | Possible | Definite |
| 2. Dermal toxicity (Rat $LD_{50}$) | DT | >2000 mg/kg | 200-2000 mg/kg | 0-200 mg/kg |
| 3. Bird toxicity (8 day $LC_{50}$) | D | >1000 ppm | 100-1000 ppm | 1-100 ppm |
| 4. Bee toxicity | Z | Non-toxic | Moderately toxic | Highly toxic |
| 5. Beneficial arthropod toxicity | B | Low impact | Moderate | Severe impact |
| 6. Fish toxicity (96 hr $LC_{50}$) | F | >10 ppm | 1-10 ppm | <1 ppm |
| 7. Half-live on leaf surface | P | 1-2 weeks<br>Pre-emerg. Herbic. | 2-4 weeks<br>Post-emerg. herbic. | >4 weeks |
| 8. Half-live in soil (TI/2) | S | <30 days | 30-100 days | >100 days |
| 9. Mode of action | SY | Non-systemic;<br>all herbicides | Systemic | |
| 10. Leaching potential | L | Small | Medium | Large |
| 11. Surface runoff potential | R | Small | Medium | Large |

**Table 3. EIQ Components and Formula**

| Component | Group | EIQ |
|---|---|---|
| EI Applicator: C x (DT x 5)<br>EI Picker: C x (DT x P) | **EI Farm Worker =**<br>EI Sprayer + EI Picker | **EIQ**<br>(EI Farm Worker + EI Consumer +<br>EI Ecology) /3 |
| EI Consumer: C x ((S + P)/2) x SY<br>EI Ground Water: L | **EI Consumer =**<br>EI Consumer + EI Ground Water | |
| EI Fish: F x R<br>EI Bird: D x ((S + P)/2) x 3<br>EI Honey Bee: Z x P x 3<br>EI Natural Enemies: B x P x 5 | **EI Ecology =**<br>EI Fish + EI Bird + EI Honey Bee + EI Natural Enemies | |
| Full Formula:<br>EIQ={C[(DT*5)+(DT*P)]+[(C*((S+P)/2)*SY)+(L)]+[(F*R)+(D*((S+P)/2)*3)+(Z*P*3)+(B*P*5)]}/3 | | |

was updated regularly in Website of Cornell University (USA)[1]

***Field use EIQ*** is an indicator of risk of specific pesticide applications in crop production. This indicator was employed to estimate the hazard of the product concerned and to provide an indication of potential pesticide risk. Field use EIQ was calculated by multiplying the table EIQ value for a specific active ingredient by the percent active ingredient in the formulation and its dosage rate per hectare used (in liter or kilogram of formulated product).

Field Use EIQ = EIQ value x% Active Ingredient x Dosage Rate

Different pest management regimes before and after PRR training were compared by adding up the Field Use EIQs for all applications throughout the cropping season prior to and after PRR training. These values represent the total seasonal environmental impact of the PRR training program. In order to calculate the field use EIQ for an entire cropping season, each pesticide application was recorded separately. The field use EIQs were calculated for every farmer in the whole cropping seasons in 2008 and 2010 for all PRR or non-PRR farmer groups by adding up all field use EIQs in the sample. Field use EIQs were calculated for two groups namely PRR and non-PRR farmers reflecting pesticide risks to human (EI Applicators, EI Picker, EI Farm worker and EI Consumer) and pesticide risk to ecology (EI Fish, EI bird, EI Bee and EI Natural enemies). Thus, pesticide risk reduction was measured by Environmental Impact Quotient (EIQ). All measures were statistically tested for significance and correlation.

## 2.5. Method of Analysis

*Descriptive statistical methods* were employed to exmine impacts of training on pesticide risk reduction. Comparisons using DDA between two pairs of data sets before and after PRR training were analyzed. DDA= $\Delta_E$-$\Delta_C$ *(Where $\Delta_E$ = Performance in 2010 (after PRR-Training) – Performance in 2008 (Before PRR Training) in a PRR commune) and $\Delta_C$ = Performance in 2010 (after PRR training) – Performance in 2008 (Before PRR training in a control commune). Pesticide risk reduction* was measured in terms of changes in hazards and exposure. *Pesticide risk reduction* was measured by Environmental Impact Quotient (EIQ).

[1] Network State's Integrated Pest Management Program, 2010, A Methods to Measure the Environmental Impact of Pesticides, Table 2, List of Pesticides on http://nysipm.cornell.edu/nysipm/publications/eiq/files/EIQ_values_2010.pdf downloaded on 20 July 2010

## 3. RESULTS AND DISCUSSIONS

### 3.1. Impacts on Reduction of Hazards

Risks to applicators may depend on types of pesticide use. By WHO's 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 class III and IV 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, averaged 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 4).

### 3.2. Impacts on Reduction of Exposure

One of the most important factors to reduce pesticide risk exposure is to use protective equipments when spraying. This issue was examined by direct observations, interviewing applicators and re-checked by group discussion in both pre and post PRR training surveys. After PRR training more farmers used protective equipment for spraying, used better sprayers and practiced rightly pre-harvest interval (Table 5). Farmers in the PRR commune were observed having better pesticide container management practices. Four to 7 tanks were built in Thai Giang and Dang Xa communes for farmers to dispose pesticide containers during the course of PRR implementation. PRR Farmers had put their pesticide containers and wastes in the tanks located in the fields. Aside from this activity, Thai Giang farmers had collected pesticide containers 2 times monthly in other fields. As a result, the fields in the PRR commune 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 4. Changes in pesticide use after PRR program implementation**

| | PRR Commune | | Control Commune | | Impact= |
|---|---|---|---|---|---|
| | 2010 | $\Delta_E$ | 2010 | $\Delta_C$ | $\Delta_E$-$\Delta_C$ |
| HANOI CITY | | | | | |
| 1. Number of pesticide types used (type) | 11 | -7 | 24 | +6 | -7 |
| 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. Averaged number of sprays per farm (spray) | 3.9 | -2.8 | 7.0* | -0.7 | -2.1 |
| 3. Pesticide used per ha (kg/ha) | 2.17 | -0.38 | 7.91* | +4.55 | -0.38 |
| 4. Wrongly mixed applications in all mixes (%) | 0.0 | -54.0 | 58.3 | -0.3 | -53.7 |
| THAI BINH PROVINCE | | | | | |
| 1. Number of pesticide types used for crop (%) | 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 | 0 |
| Class III Pesticides (%) | 50.0 | +22.2 | 37.5 | -21.5 | +22.2 |
| Class IV Pesticides (%) | 8.4 | +8.4 | 31.2 | +31.2 | 0 |
| 2. Averaged number of sprays per farm (spray) | 3.9* | -6.5 | 6.5* | -3.9 | -2.6 |
| 3. Pesticide used per ha (kg /ha) | 6.35* | -4.42 | 4.40* | -0.13 | -4.29 |
| 4. Wrongly mixed applications in all mix(%) | 20.0 | -54.0 | 36.9 | -38.1 | -15.9 |

*Note: %Percentages of a particular pesticide group in total pesticide types used in the whole community*
**Significant at 1% level.*

**Table 5. Changes in using protective equipments when spraying**

| | PRR Commune | | Control Commune | | Impact= $\Delta_E$-$\Delta_C$ |
|---|---|---|---|---|---|
| | 2010 | $\Delta_E$ | 2010 | $\Delta_C$ | |
| HANOI | | | | | |
| 1. Applicators always used protective tools | 100 | +77.6 | 48.5 | +23.5 | +54.1 |
| 2. Applicators used poor sprayer | 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 | | | | | |
| 1. Applicators always used protective tools | 85.7 | +66.2 | 35.4 | +9.1 | +57.2 |
| 2. Applicators used poor sprayer | 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 |

*Note: Figures in Table are percentages of respondents no used or used particular protective equipment in total respondents*

### 3.3. Impacts on Reduction of Environmental Impact Quotient (EIQ)

As a positive consequence of impacts discussed in the previous section. a significant reduction of hazards and exposure has resulted to sharp improvement in averaged values of EIQ presented in Table 6. This implies that PRR training program had positive impacts in reducing possibility to pesticide risks to human and environment. While in Hanoi City, the field use EIQ values of farmers in control commune in 2010 continued to increase up to 214.5% compared with those 2008, those values of farmers in the PRR commune reduced by 78.1% (Table 6). This reveals the fact that without PRR training implementation, a possibility for pesticide risks increases as farmers use more pesticides for vegetable production.

The situation of field use EIQ value change in Thai Binh province differed from those in Hanoi city. The situation marked a decrease in EIQ values between two communes ranging from 14.2% to 24.3% (Table 6). This is because the fact that during the course of the study, there was a campaign on bio-pesticide use promoted by chemical companies in Thai Binh.

**Table 6. Changes in Field Use EIQ Value per Farm**

| | PRR Commune | | Control Commune | | Impact= $\Delta_E$-$\Delta_C$ |
|---|---|---|---|---|---|
| | 2010 | $\Delta_E$ | 2010 | $\Delta_C$ | |
| Hanoi city (n=33 / commune) | | | | | |
| 1. Field Use EIQ | 6.6 | -23.6 (-78..1)* | 71.6 | +48.8 (+214.5)* | -23.6 (-78.1) |
| 2. EI Farm worker | 2.2 | -16.3 (-88.3)* | 65.4 | +48.5 (+286.6) | -16.3 (-88.3) |
| 3. EI Consumers | 1.0 | -5.9 (-86.0)* | 27.3 | +20.3 (+288.5)* | -5.9 (-86.0) |
| 4. EI Ecology | 16.7 | -48.5 (-74.4)** | 122.0 | +77.6 (+175.2)* | -48.5 (-74.4) |
| Thai Binh province (n= 46 / commune) | | | | | |
| 1. Field Use EIQ | 33.4 | -204.9 (-86.0)* | 51.0 | -100.8 (-66.4)* | -104.1 (-19.6) |
| 2. EI Farm worker | 20.4 | -159.4 (-88.6)* | 28.2 | -82.2 (-74.5)* | -77.2 (-14.2) |
| 3. EI Consumers | 7.6 | -29.6 (-79.6)* | 11.4 | -14.1 (-55.2)** | -15.5 (-24.3) |
| 4. EI Ecology | 73.5 | -424.4 (-85.2)** | 113.5 | -206.0 (-64.5)* | -218.4 (-20.8) |

*Note: Figures in parentheses are percentages of changes in EIQ value compared with base-line and between PRR and control communes.*
**Significant at 1% level.**Significant at 5% level.*

The campaign covered many districts including studied site. As a result, Thuy Son farmers in the control commune were also affected by this pesticide campaign. However, the field use EIQ values of farmers in PRR commune reduced larger and resulted in significant differences between after and before program implementation. Nevertheless, a reduction in terms of field use EIQ values as well as EI values were attributed to an improvement of pesticide use techniques with a wise pesticide selection and use with right pest, right amount and right time. Thus, the program has contributed to reduction of risk to farmers from 14.2% to 88.3%, reduction of risks to consumers from 24.3% to 86% and those to environment up to 21% to 74%. As a result, this contributed to reduction of EIQ value by about 20% to 78%.

### 3.4. Implications

The above evidences indicate that the community-based PRR training has impressive impacts on reductions of pesticide hazards, exposures and risks. The program enabled community people including pesticide users, sellers as well as local leaders to organize themselves to manage pesticide use in a sustainable way. The training components as well as the contents seemed appropriate and should be maintained throughout Vietnam not only for vegetables but also other crops.

## 4. CONCLUSION AND RECOMMENDATIONS

The PRR training had positive impacts on pesticide risk reduction in terms of hazards and exposure (farmers used pesticides listed for vegetables, used more bio, class III and IV pesticides, better pesticide use techniques; use proper and appropriate protective equipment and better management of unused pesticides, container sprayers). As a result of these impacts, the environmental impact quotients were sharply reduced from 20% to 78%. This contributes to ecological conservation as well as environment protection.

For the sake of strengthening these impacts, following measures are recommended for improvement of the PRR training program: 1) the training should be continued as season-long training (12-14 week course) for applicators; 2) more efforts should be devoted to instruct and consult with local authorities as well as mass organizations to form and operate farmer interest groups, self-control and self-help farm group after training; and 3) a close coordination of cooperative, mass organizations, commune's people committee is important for a success and strengthening the impacts of the training program;

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