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Final report

project

Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam province, Indonesia

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1 Acknowledgments

We wish to thank Peter Slavich, Malem McLeod, Gavin Tinning, Rebecca Lines-Kelly and other New South Wales Department of Primary Industries staff for their good collaboration and help with initiating and implementing our project.

Our project built upon work which was conducted in the eastern Aceh coastal districts in Project LWR/2005/004, “Management of Soil Fertility for Restoring Cropping in Tsunami-affected Areas of Nanggroe Aceh Darussalam Province, Indonesia”, which was led by NSW Department of Primary Industries.

A follow-up project, “Restoration of Annual Cropping in Tsunami-affected Areas of NAD Province, Indonesia” (LWR/2005/118), also led by NSW DPI, provided our project support and collaboration which was very helpful.

Equipment and tools purchased by LWR/2005/118 and LWR/2005/004 were shared with our project and were instrumental for conducting the soil assessments and farmer-participatory research trials. For all of the above we are grateful.

2 Executive summary

Indonesia suffered the most damage and loss of life of all the countries hit by the 2004 tsunami. In response to the disaster, a consortium led by AVRDC - The World Vegetable Center conducted a vegetable research and development project in tsunami-affected areas of Aceh province during 2007-2009. The aim of the project was to restore and enhance food security, nutrition and livelihoods, through rehabilitation of vegetable production. The specific objectives were: (1) To identify constraints to the re-establishment of vegetable production on tsunami-affected soils and discover sustainable methods for overcoming these constraints; (2) To build technical capacity among researchers, extension specialists and farmers in integrated soil and crop management of vegetables; and (3) To monitor and evaluate the above activities.

All of the outputs in the Project Document were achieved. Over 95% of the milestones were met and the remaining ones are mostly publications in progress. Field activities were initiated in March 2007 by conducting a participatory assessment (PA) of soil and other crop management constraints to vegetable production in five tsunami-affected districts of Aceh. A Soil Survey/Assessment covering 23 sites was also conducted in 2007. Compost, animal manures, lime and inorganic fertilizers were identified for soil remediation and were tested in farmer-participatory research trials for rehabilitation of vegetable production in tsunami-affected areas. Twelve trials were completed with chilli pepper, cucumber and amaranth in farmers' fields. Ten of these tested soil amendments while two tested starter solution technology (SST) developed at AVRDC. A Soil Research Methods Workshop (23 attendees) and a Statistics and Experimental Design Workshop (21 attendees) were held in 2007. A baseline survey was conducted with 240 farmers sampled.

A Training of Trainers (ToT) and Vegetable Integrated Crop Management (ICM) Workshop was held in 2008 with 35 attendees, including 20 Farmer Field School (FFS) facilitators. This activity focused on chilli pepper ICM and led into the FFS; 1648 farmers subsequently completed training in 77 adapted FFS in 2009. Two participants from Aceh completed the Regional Training Course at AVRDC-Asian Regional Center in Thailand. Two farmer field days were held. Extension publications were published on natural enemies, how to make compost, starter solution technology, and chilli pepper cultivation. These were distributed to 77 farmers groups in 43 villages across 20 subdistricts in five districts of Aceh. The adapted FFS were evaluated, and costs and benefits of various crop management strategies were analysed. The Final Workshop, held in November 2009, was attended by ~90 people, most of them Indonesian research and extension staff.

The FFS evaluations showed favourable results. At the individual level, the farmers' overall knowledgebase on chilli farming has been greatly enhanced from participating in FFS. On average, farmers who attended the FFS stated that their overall knowledge on chilli cultivation increased by over 70%. Farmers' knowledge of pests, diseases and natural enemies also increased considerably. FFS farmers could also differentiate between pests and diseases, as well as between insect pests and beneficial insects. FFS participants have become aware that pesticides can affect human health, kill natural enemies and other beneficial organisms, contaminate soil and the environment in general, and bring about pest and disease resistance. With their enhanced knowledge, farmers are confident that in the future they will be able to increase yields of chilli by 30% while reducing use of chemical pesticides by 33%. This is a clear indicator of good performance for these FFS.

For the most part, the vegetable yields in Aceh are very low, cultivation is not very intensive, and the input base system is low. This means there is a huge potential for improvement in vegetable production and productivity levels in Aceh. Many farmers are interested in expanding vegetable farming, but they need more technical support and infrastructure, especially for managing soil fertility, pests/diseases and water constraints.

3 Background

Indonesia suffered the most damage and loss of life of all the countries hit by the 26 December 2004 tsunami. Up to 92,000 farms and small enterprises were partially or completely destroyed. These enterprises provided employment for roughly 160,000 people before this catastrophic event. The tsunami affected nearly 40,000 hectares of agricultural land. It is estimated that over 600,000 men and women lost their livelihoods due to this disaster (FAO 2005a). An effort to rehabilitate and increase vegetable production was determined to potentially have a large positive impact.

In response to the disaster, AVRDC - The World Vegetable Center proposed to conduct a vegetable research and development project in these tsunami-affected areas. Capacity building of researchers and extension agents, to enable them to better serve the public, was determined to be a priority.

Vegetables are essential for healthy diets and productive communities. Vegetables are rich sources of a myriad of essential micronutrients, including vitamins C and K, folate, thiamine, carotenes, several minerals, and dietary fibre. Vegetables are also a good source of health-promoting phytochemicals such as antioxidants; these play an integral role in reducing the risks of a number of chronic diseases (AVRDC 2002). Vegetable production creates more jobs per hectare than cereal production (Weinberger and Lumpkin 2005; Midmore and Jansen 2003). It is therefore very important to improve food security, as well as promote diversification of diets and incomes, by supporting development of vegetable production.

Soil sodicity and fertility, along with structural degradation arising from the tsunami, were identified as major constraints to crop production in Aceh (Project LWR/2005/004). Knowledge gained from LWR/2005/004 was integral to the formulation of this project (SMCN/2005/075).

In many tsunami-affected areas, for several years after the tsunami, vegetable crops were grown by women, those left behind in the villages as the male agricultural labourers were mainly involved in tsunami reconstruction. This vegetable project was therefore deemed to be especially able to benefit women in these villages.

In a preliminary appraisal conducted on 8-14 February 2006 in tsunami-affected areas of the Nanggroe Aceh Darussalam (NAD) Districts of Aceh Besar, Pidie, Bireuen and Aceh Utara, chilli pepper emerged as the most important vegetable, with shallot and tomato close behind. Amaranth, kangkong, pak choy, cucumber, yard-long bean and eggplant were also determined to be important. In addition, farmers and extension agents expressed interest in planting more cauliflower, because of its strong marketing potential. Overall, farmers said that marketing of vegetables is easy with very few obstacles. Pests and diseases were mentioned as a major production constraint by every farmer interviewed. In general, stresses imposed upon plants, such as those associated with tsunami-affected soils, will make plants more vulnerable to pests and diseases.

Vegetables with medium to high salt tolerance are likely to have an advantage in tsunami-affected soils; tomato, cucumber and cauliflower fall into this category (FAO 2005b). Tomato and bell pepper have exhibited tolerance to certain levels of saline water without significant reductions in growth; tomato was tolerant to 40% sea water at the seedling stage and 20% at the reproductive stage, while bell pepper was tolerant to 20% sea water at the seedling stage and 40% at the reproductive stage (Kowalski and Palada 1994).

Further literature review was conducted on salt tolerances of the vegetables shown to be important in our appraisal (Bresler *et al*. 1982; Maas 1990; Maynard and Hochmuth 1997). Tomato, cucumber and cauliflower were among the more saline-soil-tolerant vegetables. Amaranth has also displayed good tolerance to salinity (Omami 2005).

Due to the above appraisal results and salinity data, it was decided that this project would focus on chilli pepper, cucumber, tomato and amaranth.

Integrated Crop Management (ICM) principles were deemed to be useful and appropriate to address the aforementioned problems. ICM strategies proposed for this project included: (1) crop selection for salt tolerance; (2) leaching away of salts in soils; (3) localized soil amendments in root zones, with emphasis on increasing water and nutrient buffer capacity; (4) special cultural practices, such as establishing permanent areas for vegetable crop production, forming sloping beds, installing frequent sprinkle or drip irrigation, and applying surface mulches; and (5) appropriate integrated pest management (IPM) for the management of major pests and diseases.

Application of organic manures is an effective low-input agro-technological approach to address problems with salinized and/or sodic soils. Addition of organic matter to saline and/or sodic soils can accelerate leaching of Na+, decrease the exchangeable sodium percentage (ESP) and the electrical conductivity (EC), increase water infiltration, water-holding capacity and aggregate stability (Lax *et al.* 1994; Robbins 1986; El-Shakweer *et al.* 1998; Wahid *et al.* 1998; Qadir *et al.* 2001). Many studies have demonstrated that application of decomposed straw or farmyard manure significantly increased the yields of crops grown on saline and/or sodic soils (Tahir *et al.* 1991; Gaffar *et al*. 1992; Liang *et al.* 2003). A pot study showed that incorporation of organic amendments (a poultry manure and a compost) increased the cation exchange capacity of the soil and the concentrations of exchangeable K+ and Mg2+. Addition of manure significantly increased shoot growth for two Brassica species (Walker *et al*. 2004). Therefore, one major approach for addressing problems with tsunami-caused saline and sodic soils in this project was the application of organic amendments.

This project built upon work which was conducted in the eastern coastal districts of Aceh in Project LWR/2005/004, “Management of Soil Fertility for Restoring Cropping in Tsunami-affected Areas of Nanggroe Aceh Darussalam Province, Indonesia”, which was led by New South Wales Department of Primary Industries. LWR/2005/004 collected soil and plant samples from cropping soils which had varying degrees of tsunami damage (high, medium and low) to identify the extent of salinity and related or non-related nutritional disorders in approximately 20 sites. Results indicated that inundation with saline sea water altered the balance of exchangeable cations in the soil and led to potassium and calcium deficiencies in some sites. Phosphorus was determined to have a potential role in restoring these soils, and phosphate fertilizers were therefore utilized in this project.

Implementation of our project benefited substantially from the groundwork laid by LWR/2005/004, in terms of: (1) research results, particularly in the area of appropriate technologies to prepare tsunami-affected soils for viable agricultural production; (2) capacity building in Assessment Institute for Agricultural Technology (AIAT or BPTP)), Food Crops and Agricultural Services (FCAS) of NAD and other institutions that are also partners on our project, which enabled our project to move forward at a higher technical level.

Our project collaborated with the follow-up project to LWR/2005/004, “Restoration of Annual Cropping in Tsunami-affected Areas of NAD Province, Indonesia” (LWR/2005/118) to exchange information and ensure that efforts were not duplicated. The synergies with LWR/2005/118 also enhanced our project in the areas of research, capacity building and information dissemination. Our project exchanged information freely with LWR/2005/004 and LWR/2005/118 and scheduled some trips to Aceh to synchronize with their project staff.

Our project also collaborated with CP/2004/048, “Integrated Disease Management (IDM) for Anthracnose, Phytophthora Blight, and Whitefly Transmitted Geminiviruses in Chilli Pepper in Indonesia”, which is led by AVRDC and has four AVRDC staff (P. Gniffke, G.C. Luther, M. Bhattarai and M. Palada) common to both projects. This collaboration strengthened our project considerably since chilli pepper is a very important vegetable in Aceh.

The project training curriculum was based on ICM and Agroecology (Altieri 2001; UNDP 1995), which are holistic approaches to agriculture that incorporate crop production and nutrition, agronomy/horticulture, soil and water management, IPM, marketing, and sociological factors. The AVRDC-led consortium promoted sustainable agroecosystem management throughout this project (Norton *et al*. 2005; Altieri and Nicholls 2004).

For most of the training activities, a Farmer Field School (FFS) approach was planned due to the extensive benefits that it provides to stakeholders (Luther *et al.* 2005; Pontius *et al.* 2002). A synthesis of 25 impact evaluations of FFS showed “substantial and consistent reductions in pesticide use attributable to the effect of training” (van den Berg 2004). In addition, a considerable increase in yield was demonstrated in many instances. Many developmental impacts were also documented, among them that FFS motivated continued learning.

With FFS, the trainers travel to farmers’ fields and conduct the training on site. This is a participatory learning process which lasts the entire length of the season for annual crops. While FFS were originally created for IPM training, the methodology has been adapted for many areas of agriculture, forestry and health (CIP-UPWARD 2003). In this project, the FFS emphasized soil issues, IPM technologies, and other ICM strategies. We conducted "adapted FFS" which entailed eight meetings between farmers and trainers, rather than holding weekly meetings the entire length of the season (due to budget constraints).

It was predicted that constraints to adoption of project outputs may be largely economic. This project therefore included an economic analysis of soil remediation and other ICM technologies (Activity 3.3), to help the project team assess which technologies are more likely to be adopted by farmers. Technologies that are economically feasible/profitable were emphasized in the extension activities (although others were also offered to farmers since they may be useful for certain individuals; for example, a farmer who has readily available cheap labour may be able to implement a labour-intensive soil remediation technique). Constraints to adoption may also involve availability of necessary inputs. The project team therefore planned to assess input availability before promoting any technology.

It was also anticipated that other possible constraints to all aspects of project implementation could arise due to a decline in the security situation if the NAD peace accord broke down. Fortunately it held up over our 3-year project period.

The project team together with ACIAR staff decided that this project would focus on the eastern coast of Aceh (mainly Banda Aceh to Aceh Utara District) because farmers were able to return to cropping sooner after the tsunami in this region. Most of the displaced people wished to return to their villages to rebuild their lives, however, resettlement was predicted to take some time, particularly on the western coast where wave damage was most severe (FAO 2005a).

The overall research and development (R&D) strategy for the project was planned as a staged and integrated R&D program involving the following major activities:

1) Assessment

    a) Participatory

    b) Soil survey

2) Farmer-participatory field research

3) Communication

4) Capacity building

4 Objectives

The aim of the project is to restore and enhance food security and nutrition, and also livelihoods, through rehabilitation of vegetable production.

The specific objectives are:

1) To identify constraints to the re-establishment of vegetable production on tsunami-affected soils and discover sustainable methods for overcoming these constraints.

Activity 1. Conduct a participatory assessment (PA) of soil and other crop management constraints to vegetable production.

Activity 2. Conduct farmer-participatory research trials for rehabilitation of vegetable production.

2) To build technical capacity among researchers, extension specialists and farmers in integrated soil and crop management of vegetables.

Activity 1. Build research capacity of staff at BPTP NAD, the Food Crops Agricultural Service and other NAD institutions through:

a. facilitation of farmer-participatory vegetable research trials.

b. a research methods workshop.

Activity 2. Build research and extension capacity of governmental and non-govermental organizations' staff through:

a. a Vegetable ICM Workshop.

b. a Final Workshop.

c. Participation in the AVRDC Asian Regional Center Regional Training Course.

Activity 3. Build extension capacity of governmental and non-govermental organizations' staff through a Training of Trainers (which will partly draw from the Vegetable ICM Workshop).

Activity 4. Build capacity of farmers to successfully grow vegetables through adapted Farmer Field Schools and field days facilitated by the staff trained in Activity 3.

Activity 5. Produce extension publications in Indonesian/Acehnese and distribute to 4000 farmers and extensionists .

Activity 6. Re-establish up to four vegetable visitor demonstration plots at BPTP NAD.

3) To monitor and evaluate the above activities.

Activity 1. Conduct a baseline survey that covers vegetable production and consumption aspects.

Activity 2. Evaluate the adapted FFS (Objective 2, Activity 4).

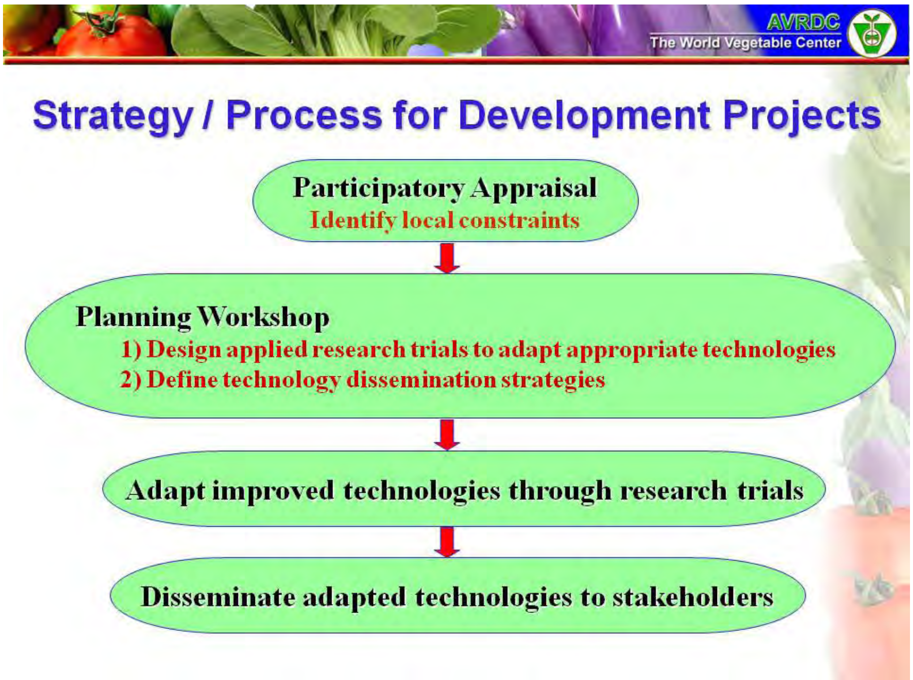
Activity 3. Analyse costs and benefits of various crop management strategies.

5 Methodology

The project was led by AVRDC - The World Vegetable Center, while daily activities in NAD were coordinated by BPTP NAD. IVegRI, NSW DPI and 'ableblue' consultant (Dr. Dorahy) provided substantial input to the project at many interfaces, especially in planning the research trials and contributing to the workshops and Training of Trainers (ToT). The Food Crops Agricultural Service was involved in many extension and research activities, and most of the FFS Facilitators/Trainers were their staff. AUSTCARE and KEUMANG were the main NGOs on the project team and they participated in the PA, research trial coordination and the workshops.

A participatory approach was emphasized throughout this project, from the participatory appraisal/assessment at the beginning through all of the research, training and technology dissemination activities. The project team ensured that both women and men were significantly involved in project activities.

The overall strategy and process used in this project followed the diagram below:



Methods are detailed below under each project objective and activity.

5.1 Objective 1. Identify constraints to the re-establishment of vegetable production on tsunami-affected soils and discover sustainable methods for overcoming these constraints.

5.1.1 Activity 1. Conduct a participatory assessment (PA) of soil and other crop management constraints to vegetable production.

This activity was implemented as a two-part assessment:

Part 1: Participatory Assessment (PA), focused on interviewing farmers and observing their farms;

Part 2: Soil Survey/Assessment, which covered 23 sites.

The project was initiated with a participatory assessment/appraisal (PA) of local needs as defined by farmers and other stakeholders. The PA (Part 1) involved discussions with farmers and other stakeholders regarding vegetable production and consumption needs and obstacles in their communities, their ideas about ways to meet these needs, extent of tsunami inundation on their farms, past history of successes and failures with planting vegetables, pest/disease problems, marketing linkages, and the impact and consequences of the tsunami in their community. Direct observations of vegetable crops, soils, pests, diseases and other factors on farms were also conducted. The PA was conducted by a multi-disciplinary team in the five project Districts (Aceh Besar, Pidie, Pidie Jaya, Bireuen and Aceh Utara). Further details on the team members and methods used (including questionnaires) can be found in the attached PA report.

The Soil Survey/Assessment (Part 2) focused on soil conditions in relation to the performance of vegetable crops that were already established by local farmers. This enabled rapid identification of soil fertility constraints to vegetable production. Biophysical and chemical problems of soils arising from sea water inundation included salinity, sodicity, shifts in the proportions of exchangeable cations, low soil porosity, and acidic deposits.

The Soil Survey/Assessment was coordinated by NSW DPI/ableblue and BPTP staff. It involved:

1) gathering information on the extent of tsunami inundation (e.g. depth and duration) and level of sediment deposition at 23 sites;

2) taking EM38 readings (EMv and EMh) to measure the extent of salinity and relating this to crop condition;

3) undertaking assessments of soil texture and structural conditions using field techniques (e.g. ribbon tests, extent of porosity, presence of root channels, level of aggregation);

4) recording information on crop management practices such as fertiliser history, weed, disease, pest and irrigation management;

5) identifying likely constraints to crop growth/yield (e.g. soil compaction, waterlogging);

6) collecting stratified surface soil samples (0-30cm) and analysing them for a range of chemical parameters (e.g. pH, EC, available P, exchangeable cations, DTPA extracts);

7) collecting plant tissue samples from developing crops and analysing them for macro and micronutrients.

The outcomes from the PA and Soil Survey/Assessment were used to identify the most important constraints to vegetable production in tsunami-affected areas and were integrated into plans for all other project activities. The work plans for all research, training and information exchange activities for the remainder of the project were developed based on PA results.

5.1.2 Activity 2. Conduct farmer-participatory research trials for rehabilitation of vegetable production.

Based on the results of the PA, research was conducted on promising methods to overcome the most important constraints to vegetable production. Areas of investigation were: (1) identification of the role of organic soil amendments (cow manure, compost) and inorganic fertilisers in building up soil organic matter and restoring soil chemical and physical fertility; (2) testing the starter solution technology developed by AVRDC - The World Vegetable Center. The results of this research were used to develop integrated nutrient management strategies for vegetables grown on tsunami-affected soils.

BPTP-NAD, FCAS and KEUMANG staff coordinated the farmer-participatory research trials on site. AVRDC, NSW DPI and IVegRI staff monitored these activities and provided advice regarding the design, establishment and operation of the studies, as required. Specific topics for the research were determined based on the PA and Soil Survey/ Assessment, and results from previous trials.

These experiments were conducted on tsunami-affected sites identified during the PA and subsequent reconnaissance efforts by BPTP staff. Finding farmers who were good collaborators was challenging and in several cases we had to move on to find new collaborators when trials failed due to neglect by the farmers.

The objectives were to develop strategies for overcoming the constraints to productivity identified in the PA.

The research trial sites were located in tsunami-affected areas of Aceh Besar, Pidie, Pidie Jaya and Bireuen Districts, in line with the areas prescribed in the Project Document.

5.2 Objective 2. Build technical capacity among researchers, extension specialists and farmers in integrated soil and crop management of vegetables.

Expertise at AVRDC, IVegRI, BPTP, FCAS, NSW DPI, ableblue, and Austcare was drawn upon to assemble and deliver the training curriculum. These institutions utilized their expertise in soil fertility, crop management and production, IPM, socio-economics, seed production and other topics on a wide range of vegetable species to design appropriate training activities for the situations at hand. Publications from AVRDC, IVegRI, NSW DPI and other informational sources were drawn upon extensively.

5.2.1 Activity 1. Build research capacity of staff at BPTP NAD, FCAS and other NAD institutions through:

Facilitation of farmer-participatory vegetable research trials

Staff from BPTP, FCAS and KEUMANG travelled frequently to research sites and worked with the farmers to conduct the research trials, as described above.

A Research Methods Workshop

The Research Methods Workshop was conducted in two parts:

1) Soils Research Methods Workshop: the NSW DPI Soil Fertility and Plant Nutrition specialist coordinated this workshop and contributed materials on soil research methods;

2) Statistics and Experimental Design Workshop: the AVRDC Biometrician provided a 5-day course on experimental design and statistics.

Methodologies for these are described in more detail below.

Soils Research Methods Workshop (27-28 March 2007)

The Soils Research Methods Workshop served two functions. Firstly, it was used to design 4 field experiments, which are deliverables associated with the first year of the project. Equally, it was used as a way of teaching BPTP-NAD, Food Crops Agricultural Service NAD, and Austcare staff associated with the project new skills in: identifying and prioritising natural resource management problems; establishing project objectives;

designing field experiments to address these issues; and developing a defined plan for implementing the experiments.

The framework used was adapted from facilitated workshop techniques commonly used within the NSW DPI. This was effective in ensuring equal participation in the workshop, shared ownership in the outcomes and collective responsibility for implementing the actions arising from it. The skills and techniques learnt by participants during the workshop will have lasting benefits beyond the life of the current project.

Ableblue facilitated this workshop, which was attended by 23 men and women staff of BPTP-NAD, the Food Crops Agricultural Service NAD, and Austcare. The workshop was held at the BPTP NAD office in Banda Aceh, with a follow-up field activity in Peukan Bada Subdistrict, Aceh Besar on 29 March 2007.

The following framework was used to deliver the soils research methods workshop:

1) The research method – a case study
2) Summary of Participatory Appraisal
3) Problem formulation and identification
4) Establishing experiment objectives
5) Designing an experiment
6) Groups Present designed experiments
7) Implementing the experiments
8) Actions, timelines and responsibilities

Constraints identified during the workshop and strategies proposed for overcoming them:

1) Aceh Utara - the soil is acidic (pH < 5.5) with medium levels of salinity (EC 0.5 dS/m).

a) Lime, P fertiliser and gypsum are recommended to improve soil pH, P status and soil structure, respectively.

2) Pidie Jaya – the soil was also acidic (pH 6).

a) Lime could help raise soil pH.

b) Compost and manure addition could also help build up soil carbon and calcium. Gypsum would also be beneficial if it is locally available.

3) Aceh Besar – The soil was alkaline (pH1:5 H20 7.6) and had low levels of salinity (EC1:5 0.22 dS/m).

a) Application of gypsum is recommended to reduce the impacts of sodicity, whilst P fertiliser and organic matter addition is recommended to build up soil concentrations of P and carbon.

4) Bireuen – Compost, manure and gypsum addition is required to reduce sodicity and improve soil structure.

Statistics and Experimental Design Workshop (21-25 May 2007)

The Statistics and Experimental Design Workshop covered a range of topics, including Basic Concepts and Principles of Experimental Design, Proper blocking, Factorial Treatments, Randomized Complete Block design (RCBD), ANOVA: Statistical Hypothesis, Single-factor and factorial experiments, Comparison of means, Partitioning of Sum of Squares (PSS), and use of IRRISTAT, a statistical software developed at IRRI.

Didit Ledesma, AVRDC Specialist for Statistics and Database Development, facilitated this workshop, which was attended by 21 men and women staff of BPTP-NAD and the Food Crops Agricultural Service NAD.

Each participant received a hard copy of the Training Guide: Experimental Design, Analysis of Variance, IRRISTAT by D.R. Ledesma, which was translated into Indonesian for this workshop. This 94-page guide, in parallel English and Indonesian languages, is expected to be used in future statistical trainings of other projects in Indonesia. An IRRISTAT CD installer with electronic easy-to-follow tutorial manual was also distributed to all participants.

5.2.2 Activity 2. Build research and extension capacity of governmental and non-governmental organizations; staff in vegetable ICM through:

a. Vegetable ICM Workshop.

The Vegetable ICM Workshop was combined with the Training of Trainers (ToT). These included materials from the NSW DPI Soil Fertility and Plant Nutrition Specialist, and from the AVRDC Horticulturist, Chilli Pepper Breeder, IPM/Development Specialist and the Director of the AVRDC Asian Regional Center who has extensive experience with training of trainers and farmers. The Director of BPTP NAD provided materials on economics and marketing. The AVRDC Soil Scientist introduced Starter Solution Technology during this workshop, to explore possible use in Aceh. SST is designed to meet the high nutrient demands that vegetable crops have in a relatively short growth period. AVRDC has developed Starter Solution Technology for enhancing early growth and overall yield of certain vegetable crops (cucumber, tomato, chilli pepper, others). Small amounts of concentrated inorganic fertilizer solution are applied immediately after transplanting which builds up high nutrient gradients in soil solution providing young plants with readily available nutrients before root development, thus, enhancing initial growth. Healthy young plants can be more tolerant to environmental stress and increase their early yields which can increase income to farmers. The inorganic fertilizer solution can also enhance the nutrient release from organic fertilizer and composts. In tsunami-affected areas, fertilizer sources can be constraints to vegetable production. When salts in tsunami-affected soils have been leached to nearly normal levels, application of Starter Solution Technology may enhance vegetable production and save fertilizer inputs. In the short term, it helps plants to develop faster at early stages so they have better chance to overcome the environmental stress afterward. In the long term, it will help to reduce salt accumulation in fields due to over-fertilization. The practices are low input and environmentally-friendly, and are applicable to target areas where fertilizers are especially costly for farmers. Starter Solution Technology is very easy to apply.

b. Final Workshop.

The Final Workshop summarized project results and accomplishments, reviewed lessons learned, and explored future plans and potential follow-up activities.

c. Participation in the AVRDC Asian Regional Center Regional Training Course.

The project also developed human resources capacity by sending two participants (one research and one extension) to the AVRDC Asian Regional Center Regional Training Course, which is a basic management course for both researchers and extension specialists. Besides encouraging collaboration between researchers and extensionists, the course was organised along the lines of a Training of Trainers. The course was 3.5 months long, a season long with close connection to developing farmer field research by farmers. It advocated bringing science to farmers. Moreover, the farmer field research was developed with an FFS alumni group.

5.2.3 Activity 3. Build extension capacity of governmental and non-governmental organizations' staff through a Training of Trainers.

A Training of Trainers was conducted with curriculum derived from a variety of ToT sources, for example, those utilized for FAO programs in the past (Pontius, Dilts and Bartlett 2002). The project consortium built a team of 20 trainers by recruiting candidates from FCAS, BPTP and NGO staff. Candidates who are likely to remain in NAD long-term were prioritized to sustain impact after the project has ended. The ToT was partly drawn from the Vegetable ICM Workshop, i.e., the trainers attended the presentations in the ICM Workshop.

5.2.4 Activity 4. Build capacity of farmers to successfully grow vegetables through adapted Farmer Field Schools facilitated by the staff trained in Activity 3.

Capacity was built among growers through the farmer-participatory research activities and farmer training. Our target was to train at least 1600 farmers through adapted FFS in Years 2-3 of the project. After the ToT was completed, 20 trainers facilitated a total of 77 FFS. Each FFS had 20-25 farmers, a total of 1648 farmers was trained.

Soil remediation techniques, such as soil amendment technologies and low-cost drip irrigation, were taught to farmers through a FFS format. Other aspects of vegetable ICM, such as varietal selection and IPM strategies were integrated into the farmer training programs where appropriate. FFS incorporated some adaptive research activities to enable farmer learning and to answer questions that arise during the project. For example, farmers compared vegetable yields and water use under low-cost drip irrigation versus present irrigation methods. Small-scale research-for-development activities that were directly pertinent to needs of local communities was also conducted.

5.2.5 Activity 5. Produce vegetable ICM extension publications in Indonesian/Acehnese and distribute to 4000 farmers and extensionists.

Booklets and leaflets on vegetable ICM were produced in Indonesian. These were user-friendly with colour photos. These extension publications were distributed to farmers, NGOs and extension agents. Since adult literacy rates in Indonesia are 93% for men and 83% for women, this approach is deemed to have a good chance of producing impact.

5.2.6 Activity 6. Re-establish vegetable visitor demonstration plots at BPTP NAD.

The BPTP-NAD staff re-established demonstration plots that were inundated by the tsunami. School children and other visitors frequently come by the BPTP NAD office, so putting some resources into this is valuable.

AVRDC's expertise in indigenous vegetables was brought to bear in this project, particularly for amaranth, one of our target vegetables. Opportunities arose through these demonstration plots or other activities above to promote the idea that indigenous vegetables contain health properties as a value added component.

5.3 Objective 3. Monitoring and Evaluation

5.3.1 Activity 1. Baseline survey

A quantitative baseline survey was conducted within the first year of the project to gain a better understanding of the current economics of vegetable production in the tsunami affected areas of Aceh. The baseline survey included 240 randomly sampled farmers from 20 sites in eastern Aceh in the targeted areas of this project. A survey schedule was developed to include aspects such as area under vegetable production, yields, prices for vegetables, and costs and benefits of vegetable production. Vegetable consumption aspects was also included. The baseline data generated during this project is useful in the future to study the impact of improved crop management practices on the livelihoods of farmers in the tsunami affected areas. The final survey was not conducted in this project because the time is too short to show impact.

5.3.2 Activity 2. Evaluation of Farmer Field Schools

The impact of the farmer field school approach on farmers' knowledge concerning crop management practices was assessed based on the method developed by Price (2001). Pre- and post-knowledge were compared for a sample of approximately 100 farmers participating in FFS and following normal practices. Qualitative approaches and multiple choice tests was applied.

5.3.3 Activity 3. Cost-Benefit analyses of crop management strategies

Costs benefit analysis was conducted for various crop and nutrient management strategies based on data generated through the participatory research trials. Promising treatments/ amendments was recommended based on the outcomes, and findings was disseminated to key stakeholders including farmers, extension workers, NGOs, and donor agencies.

6 Achievements against activities and outputs/milestones

Objective 1: To identify constraints to the re-establishment of vegetable production on tsunami-affected soils and discover sustainable methods for overcoming these constraints.

no.	activity	outputs/ milestones	completion date	comments
1.1	Conduct a participatory assessment (PA) of soil and other crop management constraints to vegetable production.	Vegetable and soil assessments for 20 sites	PA report: Oct 2007	PA field activities conducted in March 2007 and report completed in October 2007 (report attached as an appendix)
		Report on PA results, including identification of chemical, physical and biological constraints to vegetable production and guidance on managing them	Soil Survey/ Assessment data collected in 2007; data compilation completed in March 2009; report completed March 2010; journal article writing in progress	The Soil Survey/ Assessment covered 23 sites. The report is inserted below under Section 7.1.1. A journal article is being written.
		Identification of possible soil ameliorants for overcoming constraints from soil samples collected	Ameliorants identified in 2007 and reconfirmed through continuing activities	Compost, animal manures, lime and appropriate use of inorganic fertilizers have been identified for soil remediation and have been tested in farmer-participatory research trials
1.2	Conduct farmer-participatory research trials for rehabilitation of vegetable production.	At least three participatory research trials testing soil amendments and one testing other ICM technologies, for 3 seasons (total of 12 trials)	Twelve trials completed by Dec 2009	Twelve trials were completed between early 2008 and late 2009, six with chili pepper, five with cucumber, and one with amaranth in farmers' fields in Bireuen, Pidie Jaya, Pidie and Aceh Besar Districts. Ten trials tested soil amendments while two tested and demonstrated starter solution technology developed at AVRDC - The World Vegetable Center.
		Establishment of field trials and demonstrations based on research outputs and farmer, PPL (Penyuluh Pertanian Lapangan), and BPTP inputs	All trials were established in 2007-2009 with inputs from stakeholders; all trials had a farmer's practice treatment	All trials included a farmer's practice compared with treatments designed by AVRDC, NSW DPI, BPTP and IVEGRI
		Recommendations for treatments or amendments that are acceptable to farmers	Recommendations already formulated and being further refined	Composts, animal manures, lime and judicious use of inorganic fertilizers were recommended in the Farmer Field Schools (FFS), field days, extension publications and interviews with the media.

PC = partner country, A = Australia

Objective 2: To build technical capacity among researchers, extension specialists and farmers in integrated soil and crop management of vegetables.

no.	activity	outputs/ milestones	completion date	comments
2.1	Build research capacity of staff at BPTP NAD, the Food Crops Agricultural Service and other NAD institutions.	At least 15 Indonesian research staff trained in agricultural research methods, including facilitation of farmer-participatory field trials.	Soil Research Methods Workshop: March 2007 Statistics and Experimental Design Workshop: May 2007 12 field trials completed Dec 2009	Participants of these workshops found them to be beneficial, with capacity built in soils research methods, and statistics and experimental design. The soils workshop was attended by 23 men and women staff of BPTP-NAD, the FCAS NAD, and Austcare. The statistics workshop was attended by 21 men and women staff of BPTP and FCAS NAD. Fifteen staff from BPTP NAD, FCAS and KEUMANG facilitated the farmer-participatory research trials (2007-2009)
2.2	Build research and extension capacity of governmental and non-governmental organizations' staff	At least 15 Indonesian research staff and 20 extensionists participate in the Vegetable ICM Workshop and Final Workshop	Vegetable ICM Workshop: 13-24 Oct 2008 Final Workshop: 17-18 Nov 2009 One participant to AVRDC-ARC Nov 2007 - Jan 2008, and one Nov 2008 - Jan 2009	Vegetable ICM Workshop had 15 research staff and 20 extensionists attend (this was a combined event with the ToT). Final Workshop attended by approx. 90 people, most of them Indonesian research and extension staff Two participants from Aceh successfully completed the Regional Training Course at AVRDC Asian Regional Center in Bangkok. One was BPTP staff and the other was FCAS staff.
2.3	Build extension capacity of governmental and non-governmental organizations' staff through a Training of Trainers (ToT).	At least 20 Indonesian extensionists trained in vegetable ICM and participatory training method-ologies	ToT held on 13-24 October 2008 in Saree, NAD	The ToT focused on chilli integrated crop management (ICM) and had 20 FFS facilitators in attendance. Since these FFS facilitators were already trained and experienced in how to conduct FFS, participatory training methodologies were not emphasized during this ToT.
2.4	Build capacity of farmers to successfully grow vegetables	At least 1600 Indonesian farmers trained in vegetable ICM through adapted FFS Many farmers attend field days to learn about successful treatments	1648 farmers completed FFS training during Dec 2008 - Nov 2009 One field day held in Pidie on 26 Aug 2008; another in Aceh Besar on 20 Aug 2009	77 adapted FFS were conducted across the 5 Districts of Aceh Besar, Pidie, Pidie Jaya, Bireuen, and Aceh Utara One farmer field day held at the site of the chilli trials in Jaja Tunong, Simpang Tiga, Pidie. One held to demonstrate starter solution technology near the completion of this trial in Aceh Besar.

2.5	Produce extension publications in Indonesian/ Acehnese and distribute to 4000 farmers.	Vegetable ICM extension publications produced with colour photos and distributed to 4000 farmers/ extensionists	Written in Aug-Dec 2009; printed in Nov-Dec 2009; distributed in Nov 2009 - March 2010	Four extension publications were published on: (1) natural enemies (1500 copies printed); (2) how to make compost (1000 copies); (3) Starter Solution Technology (1500 copies); (4) chilli pepper cultivation (300 copies). These were distributed to 77 farmers groups in 43 villages across 20 subdistricts in five districts in Aceh.
2.6	Re-establish up to four vegetable visitor demonstration plots at BPTP NAD.	One to four demonstration plots planted with various vegetable crops	Large demonstration plot planted at BPTP NAD Mar-Sep 2008	IVEGRI sent seeds of tomato, chilli, cucumber, eggplant, yard-long bean, and other vegetables to BPTP NAD, which the team planted out. Drip irrigation kits purchased by the project were also demonstrated to a range of visitors to the BPTP NAD office, including schoolchildren.

PC = partner country, A = Australia

Objective 3: To monitor and evaluate the above activities.

no.	activity	outputs/ milestones	completion date	comments
3.1	Conduct a baseline survey that covers vegetable production and consumption aspects.	Baseline survey with at least 240 farmers; report produced	Data collection completed June 2008. Data compilation completed April 2009. Report completed March 2010.	This survey, which will later allow impact analysis to be conducted, was very detailed and has yielded an extensive analysis of the vegetable sector in the five Districts covered by the project. The report is attached as an appendix and 1-2 journal articles from this survey are planned to be completed in 2010.
3.2	Evaluate the adapted FFS (Activity 2.4)	Evaluation of impact of adapted FFS	Data collection completed in 2009, report completed in 2010	Pre-assessments of farmers started in Dec 2008. Post-assessments were conducted June-Sept 2009. The report is attached as an appendix.
3.3	Analyse costs and benefits of various crop management strategies.	Financial feasibility of vegetable production methods assessed; promising treatments/ amendments recom-mended	Cost-benefit analyses completed for ten farmer-participatory research trials in 2008-2010	Cost-benefit tables for 10 farmer-participatory research trials are presented below in Section 7.1.2. Cost-benefit analyses were not conducted for the other two trials since issues with the yield data made the analyses not worthwhile.

PC = partner country, A = Australia

7 Key results and discussion

The key results of the project are detailed and discussed below in line with the Objectives and Activities of the project.

7.1 Objective 1. To identify constraints to the re-establishment of vegetable production on tsunami-affected soils and discover sustainable methods for overcoming these constraints.

7.1.1 Activity 1. Conduct a participatory assessment (PA) of soil and other crop management constraints to vegetable production.

This activity was implemented as a two-part assessment:

Part 1: Participatory Assessment (PA), focused on interviewing farmers and observing their farms.

Part 2: Soil Survey/Assessment, which covered 23 sites.

Summary of Participatory Assessment results

The Participatory Assessment (PA) was conducted to initiate activities for this project "Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia". The PA focused on soil and other crop management constraints to vegetable production and was undertaken on 20-24 March 2007, which is during the beginning of the dry season in Aceh. The PA was conducted in tsunami-affected areas of Aceh Besar, Pidie, Bireuen and Aceh Utara Districts.

The PA was an effective means of identifying the issues vegetable farmers face in returning their land to post-tsunami production. From a soils perspective, many areas visited in Aceh Besar had not yet returned to vegetable production. The effects of salinity were variable whereby it was evident in some areas but not others. Major constraints were damage to drainage and irrigation infrastructure; poor quality (saline) irrigation water; lack of fences to exclude livestock and wild animals; and a lack of equipment and labour to clear and cultivate damaged fields. Contrastingly, many vegetable production areas of Pidie, Bireuen and Aceh Utara are being planted again with vegetable crops, with varying levels of success. The above constraints also continue to hinder vegetable production in the latter three districts.

Nutrient deficiencies (N, P and micronutrients) were common in many of the fields visited. Soil acidity (pH < 4) was common in Aceh Besar District and highlighted the need for lime application to these soils. Most growers had access to NPK fertilizers and manure and applied them to their crops. However, it was difficult to determine whether the rates at which they were applied were effective in meeting crop nutrient requirements.

A serious thrips infestation on chili peppers was observed in Aceh Besar. Significant levels of defoliation on amaranth appear to be caused by two caterpillars, a leafroller (Lepidoptera: Pyralidae) and *Spodoptera* sp. (Lepidoptera: Noctuidae). Farmers mentioned a range of other pests and diseases which seriously damage vegetable crops in NAD. In many of the villages visited, farmers requested training on pest and disease control methods.

. Other crop management factors such as increased pest and disease incidence and weeds were also identified as issues requiring further investigation. Farmers involved with the PA were very supportive of the project and expressed a willingness to participate in its implementation. In particular, they were keen to receive technical information on all aspects of crop production, take part in future training activities and be involved in the participatory research program. Many farmers had been visited by Indonesian and international researchers since the tsunami but had not had any follow-up visits, highlighting the need to maintain the good will exhibited, via regular communication and project updates.

Finally, the results from the PA provide an information base for making all subsequent project decisions. The project team intends to utilize this information to design future activities to fit the needs of the stakeholders in NAD.

The full Participatory Assessment report is attached as an appendix.

Summary of Soil Survey/Assessment results

Tsunami related constraints - salinity and sodicity

Of the 23 sites assessed, three were classified as saline/sodic, six were saline and one was sodic (Figure 1). Twelve of the 23 sites were within acceptable limits for salinity and sodicity indicating that the majority of sites visited were not constrained by these factors.

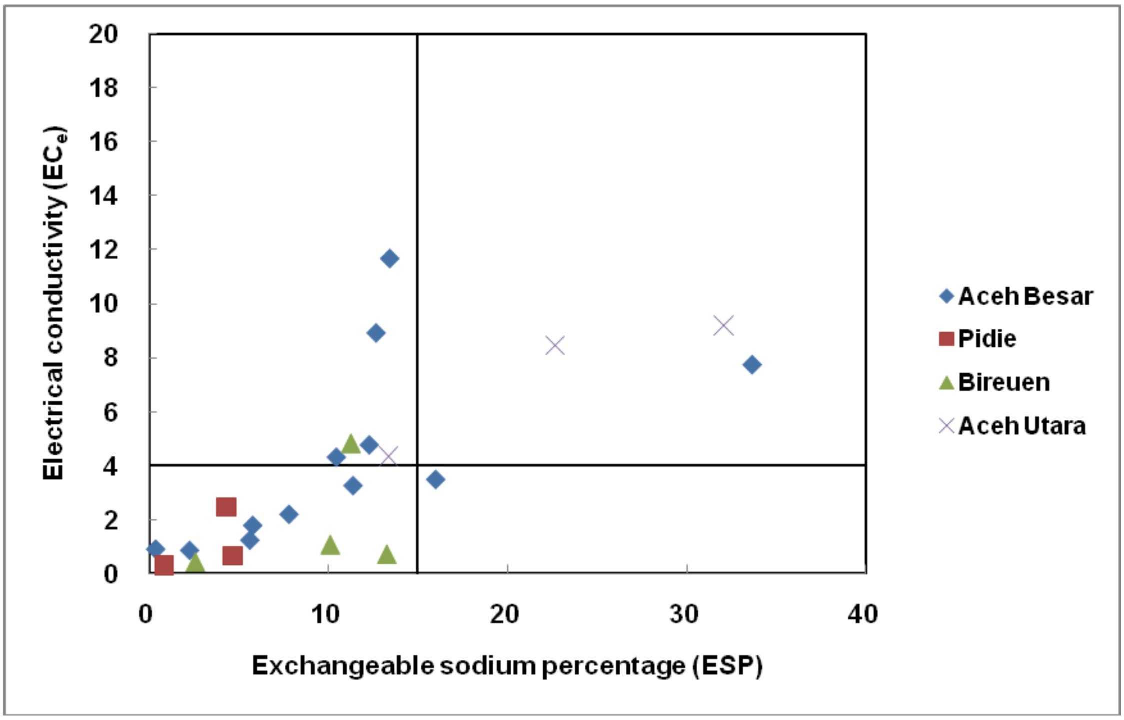


Figure 1. Comparison of exchangeable sodium percentage (ESP) and Electrical Conductivity of 2 vegetable soils affected by the 2004 tsunami.

Tsunami related constraints - drainage

Information on soil physical and chemical properties was used to predict the likelihood of drainage problems occurring as a consequence of sediment deposition in association with the tsunami. The results indicated that 9 out of the 23 sites were likely to have poor drainage and that nearly all of these sites were in Aceh Besar (Table 1). The consequences of poor drainage are that these sites are prone to waterlogging during periods of high rainfall (e.g. wet season), which increases the potential for production and economic losses.

Table 1. Prediction of drainage classes at the soil survey sites based on soil physical (texture) and chemical properties (salinity and sodicity).

District	Drainage class			Total
	Poor	Moderate	Good	
Aceh Besar	8	3	2	13
Aceh Utara	1	1	1	3
Bireuen	0	1	3	4
Pidie	0	1	1	2
Pidie Jaya	0	0	1	1
Total	9	6	8	23

Other constraints - soil fertility

Most areas visited in the Aceh Utara, Pidie and Bireuen Districts appeared to be back to normal production. However, many of the crops which were inspected suffered from nutritional deficiencies, in particular N, P and K, which highlights the need for improved nutrient management on these soils.

Availability of alternative inputs

During the participatory and soil assessments it became apparent that alternative fertiliser inputs were available to farmers, namely compost and poultry litter. However, adoption of these alternatives appears to be limited with the key barriers to adoption being a lack of awareness of the benefits of compost and perceived health risks associated with poultry litter production

Figure 2. A lack of awareness of the benefits of compost has limited the uptake of compost by vegetable farmers in Aceh.

Figure 3. Perceptions regarding the health risks (avian influenza) associated with poultry litter meant that stockpiles were burnt instead of applied to adjacent chilli crops.

Conclusions from the Soil Survey/Assessment

The information gained from the soil assessments has been used to identify the key constraints to vegetable production arising from the tsunami and develop options farmers can use to overcome them. These remediation options were evaluated in a series of experiments which were established in commercial vegetable fields in tsunami-affected areas (see Activity 2 below).

7.1.2 Activity 2. Conduct farmer-participatory research trials for rehabilitation of vegetable production.

Twelve farmer-participatory research trials testing various soil rehabilitation practices were conducted in farmers' fields in four project-targeted districts of NAD: Pidie Jaya, Bireuen, Aceh Besar and Pidie. There were three trials per district. The crops, timing and objectives of the trials are listed below, with trials numbered according to the sequence they were set up.

Based on the participatory assessment report, baseline survey results and the soil assessment data, key soil constraints were identified in project-targeted areas. The treatments of the research trials were planned for overcoming the constraints. The main objectives of these experiments were: (1) to test the ability of soil amendments (compost, cow manure, lime) and inorganic fertilizers to improve soil fertility and vegetable yields on tsunami-affected soils; (2) to introduce starter solution technology for enhancing fertilizer efficiency and vegetable productivity; and (3) to expose farmers to various soil remediation practices for tsunami-affected areas, so they could judge the practices for themselves and efficiently adopt any advantageous ones.

Table 2. List of farmer-participatory research trials

No.	Crop	Location	Time of trial	Objectives and Comments
1	Cucumber	Meue, Trienggadeng, Pidie Jaya	Wet season 2007-2008	To test effects of compost with/without phosphate fertilizer as compared to the farmer's practice. This field flooded during the trial, and due to continual risk of flooding, subsequent trials were conducted in a nearby field.
4	Chilli pepper	Meue, Trienggadeng, Pidie Jaya	June – Oct 2008	To test effects of compost with/without phosphate fertilizer as compared to the farmer's practice. After this trial, the field was planted with rice; the beds were broken down but not plowed heavily like in other rice fields.
10	Cucumber	Meue, Trienggadeng, Pidie Jaya	May – July 2009	To test effects of lime and inorganic fertilizer as compared to the farmer's practice. Conducted in the same field after rice cultivation.
2	Chili pepper	Kreung Juli Barat, Koala, Bireuen	Wet season 2007-2008	To test effects of manures and NPK fertilizers as compared to the farmer's practice. A very successful trial, with pepper yields far above the Aceh and national averages.
7	Cucumber	Kreung Juli Barat, Koala, Bireuen	Aug – Oct 2008	To test effects of manures and NPK fertilizers as compared to the farmer's practice. Conducted with the same plots/beds as the previous trial #2.
9	Amaranth	Kreung Juli Barat, Koala, Bireuen	May – July 2009	To evaluate the effects of residue fertilizers from previous applications in trials #2 & #7. Used plots/beds from previous trials (#2 & 7). Chili pepper and amaranth were also planted on this land between Trials #7 and #9. The chili was fertilized and included as residue fertilizers.
3	Cucumber	Meunasah Baro, Lhoknga, Aceh Besar	April – June 2008	To test effects of manures/composts and P fertilizers as compared to the farmer's practice. Trial completed, but a large part of one block was damaged by wild pigs. Other problems with the data also existed. We finally abandoned the analysis due to multiple problems with the data.
8	Chili pepper	Meunasah Baro, Lhoknga, Aceh Besar	Sep 2008 – Jan 2009	To test effects of manures/composts and inorganic fertilizers as compared to the farmer's practice. Conducted with the same plots/beds as the previous trial #3.
11	Chili pepper	Meunasah Baro,Lhoknga, Aceh Besar	June – October 2009	To test the effects of SST (starter solution technology) against the farmer's practice. Moved to nearby field not yet used for trials. SST trial was conducted.
5	Chili pepper	Jaja Tunong, Simpang Tiga, Pidie	July – Nov 2008 (concurrent with Trial # 6)	To test effects of manures/composts and inorganic fertilizers as compared to the farmer's practice. Disease attacks to the crop were prominent.
6	Cucumber	Jaja Tunong, Simpang Tiga, Pidie	Aug – Nov 2008	To test effects of manures/composts and inorganic fertilizers as compared to the farmer's practice. Trial was conducted concurrently with Trial #5.
12	Chili pepper	Jaja Tunong, Simpang Tiga, Pidie	Aug - Dec 2009	To test the effects of SST (starter solution technology) against the farmer's practice. Used land near Trial #5 site with soil type is good for SST trial.

Location report: Pidie Jaya District, Trials #1, #4 and #10

Three farmer-participatory research trials with cucumber, chili pepper and cucumber were conducted from 2007 through 2009 in Meue village, Trienggading subdistrict, Pidie Jaya district. Results were presented below according to the sequence they were conducted.

Based on participatory appraisal survey, vegetable crops productivity was low compared to potential production of the crops. The major soil constraints identified as the causes of low crop productivity were soil acidity (pH 4.5-6), poor soil fertility, phosphorus deficiency, low organic matter content in the soil and sandy soil texture. The treatments were designed to address the key constraints identified in the soil, including compost and manure addition to build up soil carbon and calcium, liming to raise soil pH, increasing phosphorus and inorganic fertilizers application to improve soil fertility.

Trial #1

A cucumber trial was carried out during the wet season of 2007-2008 in Meue, Trienggadeng, Pidie Jaya. This trial tested three levels of compost treatments alone and with phosphate fertilizer as compared to the farmer's practice. The latter included NPK fertilizer and cow manure. This trial proceeded quite well until the fourth harvest, when it was flooded due to heavy rain and an adjacent farmer opening a floodgate so he could plant rice. There were six harvests total. This farmer cooperator worked well with the research team. Results showed that two treatments (T5 & T7) had significantly higher yields than the farmer's practice (Table 3); these utilized compost and phosphorus fertilizer. These results highlight the benefits of using compost in conjunction with inorganic P fertilizer to increase crop yield.

Cost-benefit analyses for the trial indicated that T7 applied with 5 t/ha of compost plus P fertilizer was the most profitable recommendation for farmers (Table 4).

Table 3. Results from the cucumber trial (Aceh Trial #1) in tsunami-affected Meue Village, Trienggading Subdistrict, Pidie Jaya District (wet season 2007-2008)

Treatment	Yield (t/ha)	Plant Height (cm)
T1-Cow manure 2 t/ha + NPK 400 kg/ha (Farmer's practice)	18.03 b	174.8
T2-Compost 15t/ha	21.79 ab	182.9
T3-Compost 10 t/ha	19.39 ab	160.7
T4-Compost 5 t/ha	19.32 ab	171.6
T5-Compost 15 t/ha + SP-36 417 kg/ha	22.57 a	179.2
T6-Compost 10 t/ha + SP-36 417 kg/ha	20.09 ab	178.8
T7-Compost 5 t/ha + SP-36 417 kg/ha	22.95 a	186.7
Basal fertilizer in T2-T7: Urea 200 kg/ha + KCl 167 kg/ha Randomized completed block design (RCBD) with 4 replications Mean yield separation at $P<0.05$ by LSD No significant differences were found in plant height		

Table 4. Cost-benefit analysis of Trial #1 -- cucumber in Pidie Jaya.

Treatment	Yield (t/ha)	Marginal Cost (US$/ha)	Marginal Return (US$/ha)	Marginal Profit (US$/ha)	Ranking
T1	18.03	--	--	--	2nd
T2	21.79	1279.5	658.0	-621.5	
T3	19.39	779.5	238.0	-541.5	
T4	19.32	279.5	225.8	-53.8	3rd
T5	22.57	1467.2	794.5	-672.7	
T6	20.09	967.2	360.5	-606.7	
T7	22.95	467.2	861.0	393.9	1st

Trial #4

With chili pepper in Pidie Jaya District, the effects of compost and phosphate fertilizer were compared with the farmer collaborator's practice of using manure and NPK fertilizer (Table 5). There were no significant differences among the treatments for all observed parameters. However, the treatment effects on cumulative yields in T5, T6 and T7 treatments were consistently higher than the yields of check T1 treatment. The large within-treatment variations could have been masked the real treatment effects. On the other hand, nutrient releases from composts were slow and it was difficult to achieve the great effect merely by one application of composts. Soil amendment and fertility improvement require long-term efforts. Application of inorganic fertilizer and compost is only one of the options.

While yields did not significantly differ and were comparable among treatments, two of the researcher-designed treatments could be recommended over the farmer's practice because they had reduced input cost. These were T4 (compost 10 t/ha) and T7 (compost 10 t/ha + SP-36 150 kg/ha) as shown in the cost-benefit analysis (Table 6).

Table 5. Results from chili pepper trial (Aceh Trial #4) in tsunami-affected Meue Village, Trienggading Subdistrict, Pidie Jaya District (June – October 2008)

Treatment	Yield (t/ha)	No. of fruits per plant	No. of marketable fruits per plant	% of fruits damaged by pests/diseases
T1- Manure 4 t/ha + NPK 400 kg/ha (farmer's practice)	7.17	88.4	87.6	0.79
T2- Compost 30 t/ha	7.53	99.5	98.7	0.87
T3- Compost 20 t/ha	7.27	93.9	93.4	0.49
T4- Compost 10 t/ha	7.69	98.3	97.8	0.58
T5- Compost 30 t/ha + SP-36 150 kg/ha	8.55	106.3	105.7	0.55
T6- Compost 20 t/ha + SP-36 150 kg/ha	7.54	97.4	96.9	0.46
T7- Compost 10 t/ha + SP-36 150 kg/ha	8.64	110.9	110.1	0.68
Basal fertilizer in T1-T7 : Urea 200 Kg/ha + KCl 100 kg/ha Randomized Complete Block Design (RCBD) with 4 replications. No significant mean differences among treatments.				

Table 6. Cost-benefit analysis of Trial #4 -- chili pepper in Pidie Jaya.

Treatment	Yield (t/ha)	Marginal Cost (US$/ha)	Marginal Return (US$/ha)	Marginal Profit (US$/ha)	Ranking
T1	7.17	--	--	--	3rd
T2	7.53	2620.0	432.0	-2188.0	
T3	7.27	1620.0	120.0	-1500.0	
T4	7.69	620.0	624.0	4.0	2nd
T5	8.55	2687.5	1656.0	-1031.5	
T6	7.54	1687.5	444.0	-1243.5	
T7	8.64	687.5	1764.0	1076.5	1st

Trial #10

Trials #10 was conducted on the same field as previous trial #4, the residual fertilizer from compost should be counted as part of the treatments in the subsequent trial #10. However, rice was planted in the same field between Trials #4 and #10 and the beds were broken down, although not plowed heavily like in other wet rice fields. The residue fertilizers might have been utilized by rice plants and might be leached away by the rainfall.

Analysis on soil collected after chili pepper cultivation indicated that soil pH at top 10 cm became very acidic (pH 4.4-4.6) within short duration. Thus, this trial evaluated the effects of lime application and previous residuals against the farmer's practice with same amounts of inorganic fertilizer applications. Again, yields did not significantly differ among treatments (Table 7). Application of 1 t/ha lime did not show its effect on cucumber. Cost-benefit analyses for the trial indicated that Treatments T2 and T3 are recommended as the more advantageous treatments for farmers due to their numerically higher yields and higher marginal profits (Table 8).

Table 7. Results from the cucumber trial (Aceh Trial # 10) in Meue village, Trienggadeng Subdistrict, Pidie Jaya District. (May 4 - July 22, 2009)

Treatment	Plant Height (30 DAT) (cm)	Market -able Yield (t/ha)	No. of marketable fruits per plant (No./plant)	No. of total fruits per plant (No./plant)
T1-manure 3 t/ha + NPK-Urea-KCl, 100-50-100 kg/ha (farmer's practice)	223.2	36.2	6.1	6.6
T2-lime 1 t/ha + NPK-Urea-KCl, 100-50-100 kg/ha	208.1	37.4	6.4	6.9
T3-lime 1 t/ha + NPK-Urea-KCl, 100-50-100 kg/ha	224.0	37.4	6.2	6.7
T4-lime 1 t/ha + NPK-Urea-KCl, 100-50-100 kg/ha	213.8	33.3	5.6	6.0
T5-lime 1 t/ha + NPK-Urea-KCl, 100-50-100 kg/ha	221.0	35.1	5.8	6.3
T6-lime 1 t/ha + NPK-Urea-KCl, 100-50-100 kg/ha	211.7	34.3	5.8	6.3
T7-lime 1 t/ha + NPK-Urea-KCl, 100-50-100 kg/ha	228.2	36.4	6.3	6.8

RCBD with 4 replications.

This trial used the same field as previous trial #4; residuals from individual treatment T1 to T7 in Trial #4 were included in the equivalent T1 to T7 treatments of Trial #10.

No significant mean differences among treatments

Table 8. Cost-benefit analysis of Trial #10 -- cucumber in Pidie Jaya.

Treatment	Yield (t/ha)	Marginal Cost (US$/ha)	Marginal Return (US$/ha)	Marginal Profit (US$/ha)	Ranking
T1	36.2	--	--	--	
T2	37.4	0.0	317.7	317.7	1st
T3	37.4	0.0	305.1	305.1	2nd
T4	33.3	0.0	-725.3	-725.3	
T5	35.1	0.0	-266.7	-266.7	
T6	34.3	0.0	-459.6	-459.6	
T7	36.4	0.0	72.0	72.0	3rd

Location report: Bireuen District, Trials #2, #7 and #9

Three farmer-participatory research trials with chili pepper, cucumber and amaranth were conducted from 2007 through 2009 in Krueng Juli Barat village, Koala subdistrict, Bireuen district. Results were presented below according to the sequence they were conducted. The farmer collaborators, Mawardi and Abdul Rachman, were very enthusiastic and attentive to the trial. The trial #2 was very successful, with pepper yields far above the Aceh and national averages.

Based on top-soil analytical data, the soils in trial site is sandy loam texture, low value of cation exchangeable capacity (CEC), with slightly acidity (pH 6.5-6.8), but with medium to high levels of available P and K contents in soil. The high levels and great variations of soil P and K contents might be attributed to farmer's practice in this location by applying large amount of manures (20 t/ha) for each cropping. Results on top-soils collected after chili pepper trial had shown that soil pH became more acidic (pH 5.4-5.8), soil electric conductivity (EC) increased, with medium level of P while high level of K contents. The major soil constraints identified were soil acidity, low soil N and imbalanced soil fertility, and low organic matter content in the soil. The strategies for designing the treatments to address the key soil constraints included compost and manure application to increase soil buffering capacity, better balanced application of manures and inorganic N fertilizer to improve soil N-P-K fertility.

Trial #2

A chili pepper trial was conducted in Kreung Juli Barat, Koala, Bireuen during the wet season of 2007-2008. This trial tested three levels of NPK fertilizer and two levels of manure in a factorial design, compared to the farmer's practice, which had the lowest level of NPK with an intermediate level of manure. Since no agricultural netting for pest control was available in Aceh, a plankton net was adapted for protecting the nursery; this was quite effective in protecting the pepper plants from geminivirus infections and insect pests.

Results showed there were no significant differences among treatments (Table 9). The cost-benefit analysis indicated that Treatment T4 was the most profitable treatment (Table 10). However, since yields did not differ significantly, the treatment with the second lower inputs (T5) is the most advantageous to recommend. T5 reduced manure amounts while increased NPK fertilizers resulted in a more balanced fertilization as compared with farmer's practice.

Table 9. Results from the chili pepper trial (Aceh Trial #2) in tsunami-affected Krueng Juli Barat Village, Koala Subdistrict, Bireuen District (wet season 2007-2008)

Treatment	Yield (t/ha)	No. of Fruits per plant	No. of Marketable fruits per plant
T1- manure 20 t/ha + NPK 250 kg/ha (Farmer's practice)	13.5	185.5	179.3
T2- manure 30 t/ha + NPK 1000 kg/ha	13.2	179.5	171.5
T3- manure 10 t/ha + NPK 1000 kg/ha	11.0	157.2	150.4
T4- manure 30 t/ha + NPK 750 kg/ha	14.7	190.4	180.2
T5- manure 10 t/ha + NPK 750 kg/ha	13.1	178.6	170.3
T6- manure 30 t/ha + NPK 500 kg/ha	12.1	172.5	161.3
T7- manure 10 t/ha + NPK 500 kg/ha	12.5	168.6	161.8
RCBD with 4 replications No significant mean differences among treatments. Less than 2% of fruits were damaged by pests or diseases in all plots			

Table 10. Cost-benefit analysis of Trial #2 -- chili pepper trial in Bireuen.

Treatment	Yield (t/ha)	Marginal Cost (US$/ha)	Marginal Return (US$/ha)	Marginal Profit (US$/ha)	Ranking
T1	13.48	--	--	--	2nd
T2	13.15	762.5	-396.0	-1158.5	
T3	11.04	362.5	-2928.0	-3290.5	
T4	14.70	575.0	1464.0	889.0	1st
T5	13.08	175.0	-480.0	-655.0	
T6	12.14	387.5	-1608.0	-1995.5	
T7	12.50	-12.5	-1176.0	-1163.5	

Trial #7

The effects of different levels of NPK fertilizer and compost/cow manure on cucumber were investigated in Bireuen District in 2008. Again, yields did not significantly differ among treatments, but the treatment means differed greatly (Table 11). The large within-treatment variations had made the treatment effects difficult of being detected as significant. The cost-benefit analysis showed that Treatment T7 was the most profitable treatment (Table 12). However, Treatment T4 is also recommended over the farmer's practice, due to its numerically higher yield (43% higher) and higher marginal benefit.

This trials #7 was conducted on the same field and plots as previous trial #2 for this project location, so residual fertilizer and other soil amendments should be considered as part of the treatments. However, there was nearly half year between the trials #2 and #7, the high decomposed rate of manures and high rainfall might leach away the residue nutrients in the beds. The left-over residue effects from previous treatments of chili trial on cucumber were not significant as compared the pair's data of cucumber treatments (T2 vs.T3, T4 vs. T5, and T6 vs. T7 in Tables 9 & 11).

Table 11. Results from cucumber trial (Aceh Trial #7) in tsunami-affected Krueng Juli Barat Village, Koala Subdistrict, Bireuen District (August – October 2008)

Treatment	Yield (t/ha)	No. of fruits per plant	No. of marketable fruit per plant	% of fruits damaged by pests/diseases
T1-cow manure 20 t/ha + NPK-Urea, 250-100 kg/ha (Farmer's practice)	18.4	3.5	2.9	17.8
T2-cow manure 30 t/ha + NPK-Urea, 170-100 kg/ha	18.9	3.4	2.9	14.7
T3-cow manure 30 t/ha + NPK-Urea, 100-100 kg/ha	19.3	3.5	2.9	17.9
T4-cow manure 10 t/ha + NPK-Urea, 170-100 kg/ha	26.3	4.6	3.9	15.8
T5-cow manure 10 t/ha + NPK-Urea, 100-100 kg/ha	21.8	4.0	3.2	19.5
T6-cow manure 5 t/ha + NPK-Urea, 170-100 kg/ha	18.9	3.5	2.9	16.0
T7-cow manure 5 t/ha + NPK-Urea, 100-100 kg/ha	23.2	4.0	3.3	17.3
RCBD with 4 replications. This trial used the same field and plots as previous trial #2, residuals from individual treatment T1 to T7 in Trial #2 were included in the equivalent T1 to T7 treatments of Trial #7. No significant mean differences among treatments.				

Table 12. Cost-benefit analysis of Trial #7 – cucumber in Bireuen (2008).

Treatment	Yield (t/ha)	Marginal Cost (US$/ha)	Marginal Return (US$/ha)	Marginal Profit (US$/ha)	Ranking
T1	18.36	--	--	--	
T2	18.90	140.0	94.5	-45.5	
T3	19.30	87.5	164.5	77.0	
T4	26.33	540.0	1394.8	854.8	2nd
T5	21.81	487.5	603.8	116.3	3rd
T6	18.88	40.0	91.0	51.0	
T7	23.18	-12.5	843.5	856.0	1st

Trial #9

The beds from previous trials #2 and #7 were intact for the trial #9. The trial area had been planted with chilli pepper and amaranth between Trials #7 and #9. The chilli pepper was fertilized with manure 3.5 t/ha and Urea-SP36-KCl= 833-1042-903 kg/ha in all plots. Due to severe infection of Geminivirus on chili pepper plant, the trial was abandoned, amaranth was planted but no data was collected. Trial #9 was conducted on the same field and plots after trial #7 with the objective to evaluate the residue fertilizer effects from previous applications in trials #2, #7 and from the abandoned chili trial. 2 t/ha of compost and 60 kg/ha of urea were applied to all the plots in Trial #9.

There were no significant mean differences among treatments (Table 13). T7 yielded 54% higher than that in T1 treatment, however, the high variations within-treatment made it difficult to show statistically significant differences among treatment effects. Great amounts of compost/manure applications did not show their residue effects after two years' cultivations (T2, T3 & T4). Treatments T5 and T7 are recommended over the farmer's practice, due to their numerically higher yields and lower inputs for three trials. Results implied that farmers in Bireuen may apply 50-60% less of compost/manures and

20-50% more NPK and urea fertilizers for achieving same or higher yields, better balanced soil NPK fertility and reducing input costs.

Table 13. Results for the amaranth trial (Aceh Trial #9) in tsunami-affected Krueng Juli Barat Village, Koala Subdistrict, Bireuen District (May-July, 2009)

Treatment	Yield (t/ha)	Yield Index
T1-compost 2 t/ha + 60 kg/ha Urea	11.5	100
T2-compost 2 t/ha + 60 kg/ha Urea	13.2	115
T3-compost 2 t/ha + 60 kg/ha Urea	12.9	112
T4-compost 2 t/ha + 60 kg/ha Urea	12.6	110
T5-compost 2 t/ha + 60 kg/ha Urea	16.4	142
T6-compost 2 t/ha + 60 kg/ha Urea	15.3	133
T7-compost 2 t/ha + 60 kg/ha Urea	17.7	154

RCBD with 4 replications

This trial used the same field and plots as previous trials #2 and #7, residuals from individual treatment T1 to T7 in Trial #2 and #7 were included in the equivalent T1 to T7 treatments of Trial #9.

No significant mean differences among treatments (Tukey's test)

Location report: Aceh Besar District, Trials #3, #8 and #11

Three farmer-participatory research trials with cucumber, chili pepper and chili pepper were conducted from 2008 through 2009 in Meunasah Baro Village, Lhoknga Subdistrict, Aceh Besar District. Results were presented below according to the sequence they were conducted.

Based on soil assessment data, the top-soils in Aceh Besar had textures varying from clay to sandy clay loam with alkaline soil pH (pH 7.4-7.8 by soil:water = 1:5 method), medium level of CEC and medium to high levels of total nitrogen and K but very low levels of Bray-P content. The values of EC (EC1:5, 0.4-0.9 dS/m) indicated the soil in Aceh Besar had medium levels of salinity. In this location, farmers applied high amounts of both organic and inorganic fertilizers. Results on top 10cm soils collected after cucumber trial had shown that soil pH became neutral (pH 6.8-7.0), soil EC decreased slightly while available P and K contents increased to high levels due to high amounts of fertilizer application. After chili pepper cultivation in 2009, the soil pH had returned to alkaline condition (pH 7.5-7.6), EC decreased to normal condition, while soil P again decreased to low levels.

The major soil constraints identified were high EC, low soil available P, and imbalanced soil fertility. The strategies for designing the treatments to address the key soil constraints were to test effects of good quality composts against manure application, and better balanced application of manures and inorganic P fertilizer to improve overall soil N-P-K fertility. Application of starter solution was recommended to reduce total fertilizer inputs and to enhance fertilizer efficiency through modification of locally feasible practices.

Trial #3

This trial had been conducted to test effects of compost and P fertilizer application as compared to the farmer's practice in which 40 t/ha of manures and 300-500-500 kg/ha of NPK-SP36-KCl fertilizer were applied to the cucumber plants. The trial had completed, but a large part of one block was damaged by wild pigs. Other problems with the data also existed. We finally abandoned the analysis of results due to multiple problems with the data.

Trial #8

A chilli pepper trial was conducted with various levels of urea, NPK fertilizer and cow manure/compost as compared with farmer's practice. The trial #8 was conducted on the same field and plots as previous trial #3 for this location, so residual fertilizer and other soil amendments were included as part of treatments.

Although T7 yielded 38% higher than the check T1 treatment, however, due to great variations within-treatment, no statistically significant differences on yields among treatments were found (Table 14). High rates of pest and diseases infection had attributed to the low yields of this trial. Despite there being no significant differences among treatments, T3 is recommended for situations where cow manure is more available than compost and T7 is recommended where compost is readily available. Both treatments appear to be superior to the farmer's practice (Table 15).

Table 14. Results from chili pepper trial (Aceh Trial #8) in tsunami-affected Meunasah Baro Village, Lhoknga Subdistrict, Aceh Besar District (Sept. 2008 – Jan. 2009)

Treatment	Yield (t/ha)	No. of fruits per plant	No. of marketable fruits per plant	% of fruits damaged by pests/ diseases
T1-cow manure 20 t/ha + NPK-Urea, 300-300 kg/ha (farmer's practice)	3.71	53.3	40.3	26.4
T2-cow manure 20 t/ha + NPK-Urea, 200-100 kg/ha	3.89	56.2	43.0	29.1
T3-cow manure 20 t/ha + NPK-Urea, 100-200 kg/ha	4.96	77.6	60.6	23.2
T4-cow manure 20 t/ha + NPK-Urea, 0-300 kg/ha	3.45	51.0	37.8	29.6
T5-cow manure 20 t/ha + NPK-Urea, 0-150 kg/ha	4.81	67.6	51.1	25.7
T6- compost 10 t/ha + NPK-Urea, 200-100 kg/ha	3.78	55.6	42.4	23.7
T7- compost 10 t/ha + NPK-Urea, 100-200 kg/ha	5.13	72.7	57.2	24.5
RCBD with 4 replications. This trial used the same field and plots as previous trial #3, residuals from individual treatment T1 to T7 in Trial #3 was included in the equivalent T1 to T7 treatments of Trial #8. No significant mean differences among treatments.				

Table 15. Cost-benefit analysis of Trial #8 -- chili pepper in Aceh Besar.

Treatment	Yield (t/ha)	Marginal Cost (US$/ha)	Marginal Return (US$/ha)	Marginal Profit (US$/ha)	Ranking
T1	3.71	--	--	--	
T2	3.89	-111.0	216.0	327.0	
T3	4.96	-168.0	1500.0	1668.0	1 st
T4	3.45	-225.0	-312.0	-87.0	
T5	4.81	-252.0	1320.0	1572.0	2 nd
T6	3.78	489.0	84.0	-405.0	
T7	5.13	432.0	1704.0	1272.0	3 rd

Trial #11

In all trials #2 to #10, the variations within-treatments were very large; that made the treatment effects difficult to be detected as statistically different. On the other hand, results from these trials implied that fertilizer inputs were not the major yield constraint. Conventional approaches by increasing both organic and inorganic inputs could neither improve yield of vegetables tested nor the fertilizer efficiency. Other advanced technology able to enhance fertilizer efficiency should be adapted for use in the region.

Starter solution technology was adapted in tsunami-affected areas of Indonesia via last two farmer participatory trials, one in Aceh Besar (June–October 2009) and one in Pidie (August–December 2009). Chili pepper was the tested crop. There were five treatments using randomized complete block design with four replications (Table 16). T1 was the farmer's practice with low amounts of basal and side-dress fertilizers. T2 had same fertilizer application amounts, but using starter solution. T3 increased fertilizers to 1.9 fold of that in T1 and applied starter solution twice. T4 served as conventional check against the farmer's practice, but increased fertilizer amounts to 2.8 times. T5 had the same fertilizer applications as T4 except T5 applied by starter solution. Results of the chili trial #11 conducted in Aceh Besar are reported here.

Table 16. Treatments for Starter Solution Technology (SST) trial (Aceh Trial #11) for Chili pepper in Meunasah Baro Village, Lhoknga Subdistrict, Aceh Besar District (June-October 2009)

Treatment	Manure *x* (t/ha)	Basal NPK (kg/ha)	Total inorganic fertilizers *y* (kg/ha)		
			N	P2O5	K2O
T1 - Basal-NPK 50 +Side1 +Side2 +Side3 +Side4 (Farmer's practice)	5	50	38	38	38
T2 - Basal-NPK125 + ST0 + ST1 + ST2 + ST3	5	125	38	34	34
T3 - Basal-NPK200 + ST0 + ST1 +Side3	5	200	70	68	68
T4 - Basal-NPK200 +Side1 +Side2 +Side3 +Side4	5	200	104	104	104
T5 - Basal-NPK200 + ST0 + ST1 +Side2 +Side3 + ST4	5	200	104	101	101

x 5 t/ha of manures were applied to all treatments as basal fertilizer

y Total inorganic fertilizers included basal NPK, starter solution (ST) and solid side-dress fertilizers. One ST application consisted of 25 kg NPK and 5 kg ammonium sulfate (AS) per ha. Side-dress fertilizers were NPK with various rates. Total inorganic fertilizers applied in T1 to T5 were NPK-AS, 250-0, 225-20, 450-10, 690-0 and 675-15 kg/ha, respectively.

At 45 days after transplanting (DAT), in terms of plant canopy and plant height, T3 and T5 appeared to be the best treatments due to applications of first and second starter solutions (ST1 and ST2). Starter solution application significantly enhanced the leaf growth and leaf color in T5 as compared to T4 and other treatments. Total fruit yields of six harvests for T1~T5 were 8.69, 9.14, 9.98, 10.58, 10.59 t/ha; the yield index for T1~T5 treatments were 100, 105, 115, 122, 122, respectively. As compared to T1, yield increased 22% in T4/T5 regardless of the significant differences in initial growth. T3 had 1.9 times higher fertilizer amounts but less number of applications than T1, resulting in a 15% increase in fruit yield. Similarly, total fruit yields of eight harvests in T4/T5 were 19% higher compared with yields in T1 although no significant differences were detected statistically (Table 17). T3 increased fruit yield by 14% with affordable increment of fertilizers and feasible application practices, so T3 could be a more promising recommendation to farmers.

Table 17. Effects of basal, starter solution (SST) and side-dress fertilizer applications on yield of chili pepper, in Lhoknga, Aceh Besar (Aceh Trial #11) (June – October 2009)

Treatment	Yield (t/ha)	No. of fruits per plant	No. of marketable fruits per plant	% of fruits damaged by pests/ diseases
T1 - Basal-NPK 50 +Side1 +Side2 +Side3 +Side4 (Farmer's practice)	10.21	135.2	128.5	4.9
T2 - Basal-NPK125 + ST0 + ST1 + ST2 + ST3	10.49	143.2	136.5	4.7
T3 - Basal-NPK200 + ST0 + ST1 +Side3	11.67	163.2	154.6	5.3
T4 - Basal-NPK200 +Side1 +Side2 +Side3 +Side4	12.14	159.0	151.1	5.0
T5 - Basal-NPK200 + ST0 + ST1 +Side2 +Side3 + ST4	12.18	156.7	148.4	5.3
RCBD with 4 replications. No significant mean differences among treatments (by Tukey test).				

Cost and benefit analysis using marginal cost and return analysis (investment decision) technique for trial #11 was carried out and results were summarized in Table 18. Though the physical yield of treatment T5 was higher than that of other treatments, its rate of marginal economic return on additional capital investment was lower than that of the T3. Hence, treatment T3 was ranked first as the farmer’s best bet, not T4/T5 with higher physical yield. For convenience, the ratio of MR to MC of farmers’ treatment is set to 1, which has important implications in a situation when the ratios (of MR/MC) for other treatments (best bet technologies) would be less than 1.

Table 18. Cost-benefit analysis of Trial #11 -- SST with chili pepper in Aceh Besar.

Treatment	Yield (t/ha)	Marginal Cost (US$/ha)	Marginal Return (US$/ha)	Ratio (MR/MC)	Ranking
T1	10.21	--	--	--	
T2	10.49	-14.8	338.2	-22.93	
T3	11.67	152.0	1750.0	11.51	1 st
T4	12.14	330.0	2323.5	7.04	3 rd
T5	12.18	321.8	2367.7	7.36	2 nd

The results obtained in this trial coincided with those from previous trials conducted at AVRDC Headquarters. The success of this approach provides a model for starter solution technology dissemination. The treatments, application practices, and fertilizer amounts should be adjusted based on locally available fertilizers, affordable inputs for resource-poor farmers, and locally feasible application methods. In this trial, application of manures and inorganic basal fertilizers in central bands of beds was recommended. A local compound fertilizer (15-15-15) was selected for basal, side-dress, and starter fertilizers. To increase the N availability in the starter solution, about 22% of N was replaced by ammonium sulfate. More importantly, furrow irrigation was not available in the trial area, so we modified the starter solution technology by applying the starter solution at the inner side of plants, let the starter solution adsorb on soil particle surfaces at least 30 minutes after application, then irrigated plants from their outer side using a watering can to avoid diluting the starter solution.

The project leader played a key role in communicating (including Indonesian-English interpreting) between Indonesian agricultural research and extension systems and AVRDC scientists. E-mail, PowerPoint presentations and illustrations all enabled on-site understanding of the advanced technology developed at AVRDC headquarters and the successful implementation of the trials in Aceh Besar.

Location report: Pidie District, Trials #5, #6 and #12

Three farmer-participatory research trials with chili pepper, cucumber and chili pepper were conducted from 2008 through 2009 in Jaja Tunong Village, Simpang Tiga Subdistrict, Pidie District. Results were presented below according to the sequence they were conducted.

Based on soil assessment data, the top-soils in Pidie had alkaline soil pH (pH 7.35 by soil:water = 1:5 method) with texture of clay loam, very low values of EC and available P contents, medium levels of T-N and organic matter contents while high level of K content (67 ppm K2O, Morgan method). Results on top 10cm soils collected after chili trial had shown that soil pH became neutral (pH 6.9-7.1), soil EC increased slightly while available P contents remaining in very low levels.

The major soil constraints identified were low soil available P, poor and imbalanced soil fertility. The strategies for designing the treatments to address the key soil constraints included compost and manure addition to build up soil organic carbon, increasing P fertilizers application to overcome P deficiency problem and better balanced application of manures and inorganic fertilizers to improve overall soil fertility. Starter solution technology was also introduced to enhance fertilizer efficiency through modification of locally feasible practices in last trial.

Trial #5

For chili pepper in Pidie District, different levels of manure/compost and inorganic fertilizers were tested against the farmer's practice (Table 19). Diseases attacked the crop were prominent in the trial. Although there was a 1-1.4 t/ha (15-20% higher than T1) yield difference between both T2/T3 and the farmer's practice, the statistical test showed that it was not significant. This could be due to large within-treatment variations. Cost-benefit analysis for the trial indicated that T2 applied with only inorganic fertilizers was the most profitable recommendation for farmers (Table 20). However, in this case, the farmer's practice may be as good as T2 treatment, because yields did not significantly differ with T2 and the inputs included little manures to sustain soil organic matters in the system.

Table 19. Results from chili pepper trial (Aceh Trial #5) in tsunami-affected Jaja Tunong Village, Simpang Tiga Subdistrict, Pidie District (July - November 2008)

Treatment	Yield (t/ha)
T1- manure 2.5t/ha + Urea-TSP- NPK, 160-120-160 kg/ha (farmer's practice)	6.98
T2- + Urea-TSP-KCl, 320-200-200 kg/ha	8.03
T3- compost 20 t/ha + Urea-TSP-KCl, 320-200-200 kg/ha	8.41
T4- manure 20 t/ha + Urea-TSP-KCl, 320-200-200 kg/ha	5.73
T5- manure 10 t/ha + Urea-TSP-KCl, 320-200-200 kg/ha	6.67

RCBD with 4 replications.

No significant mean differences among treatments (Tukey's test).

Table 20. Cost-benefit analysis of Trial #5 -- chilli pepper in Pidie.

Treatment	Yield (t/ha)	Marginal Cost (US $/ha)	Marginal Return (US $/ha)	Marginal Profit (US $/ha)	Ranking
T1	6.98	--	--	--	2 nd
T2	8.03	-41.2	1260.0	1301.2	1 st (cost reduction)
T3	8.41	1994.8	1716.0	-278.8	
T4	5.73	394.8	-1500.0	-1894.8	
T5	6.67	194.8	-372.0	-566.8	

Trial #6

Trial #6 was conducted concurrently with Trial #5 in adjacent field. T1 treatment used farmer's practice with highest amounts of manures and inorganic fertilizer application. T2 to T5 with relative to 75%, 50%, 25% and 0% of T1 fertilizers were compared to the farmer's practice. Again, yields did not significantly differ among treatments (Table 21). Cost-benefit analysis for the trial showed that T3 was the most profitable recommendation over farmer's practice (Table 22), due to its numerically similar yield but only half amounts of inputs. Farmers applied high amounts of manure and inorganic N fertilizer in this location. Results of the trial demostrated that inputs could be decreased without great yield reduction.

Table 21. Results from cucumber trial (Aceh Trial #6) in tsunami-affected Jaja Tunong Village, Simpang Tiga Subdistrict, Pidie District (August - November 2008)

Treatment	Yield (t/ha)
T1- Manure 16.7 t/ha + Urea-NPK, 400-48 kg/ha (Farmer's practice)	30.67
T2- Manure 12.5 t/ha + Urea-NPK, 300-36 kg/ha (75% of T1)	28.63
T3- Manure 8.3 t/ha + Urea-NPK, 200-24 kg/ha (50% of T1)	30.10
T4- Manure 4.2 t/ha + Urea-NPK, 100-12 kg/ha (25% of T1)	26.18
T5- No fertilizer (0% of T1)	26.94

RCBD with 4 replications.

No significant mean differences among treatments (Tukey's test).

Table 22. Cost-benefit analysis of Trial #6 -- cucumber in Pidie.

Treatment	Yield (t/ha)	Marginal Cost (US $/ha)	Marginal Return (US $/ha)	Marginal Profit (US $/ha)	Ranking
T1	30.67	--	--	--	
T2	28.63	-110.3	-367.2	-256.9	
T3	30.10	-220.7	-102.6	118.1	1 st
T4	26.18	-331.0	-808.2	-477.2	
T5	26.94	-441.3	-671.4	-230.1	

Trial #12

As trials in Aceh Besar district and other locations, the large variations within-treatment had caused the treatment effects difficult to be tested as statistically different. Therefore, starter solution technology was also adapted in the last farmer participatory trial in Pidie (August–December 2009) for chili pepper crop. Treatments used in Trial #12 were same as those in Trial #11 (Table 16), there were five treatments with randomized complete block design and four replications. T1 was the farmer's practice in Aceh Besar with low amounts of basal and four side-dress fertilizers. T2 had same fertilizer amounts as T1, but using starter solution technology method. T3 increased fertilizers to 1.9 fold of that in T1 and applied starter solution twice and one side-dress. T4 served as conventional check against the farmer's practice, but increased fertilizer amounts to 2.8 times. T5 had the same fertilizer applications as T4 except T5 applied by SST method. Total inorganic fertilizers applied in T1 to T5 were NPK-ammonium sulfate (AS), 250-0, 225-20, 450-10, 690-0 and 675-15 kg/ha, respectively.

No significant mean differences among treatments were found in plant height and plant canopy surveyed at 45 days after transplanting (Table 23). Plants in T2 to T5 appeared slightly taller and greater than plants in T1 check due to applications of starter solutions or increased amounts of fertilizers. However, the variations between replications of the treatments were very high, which might mask the treatment effects. On the other hand, the rainy season in Pidie normally starts in October, but apparently there was already some rain in August, 2009. The rain came before the transplanting time of the trial might also dilute the effects of starter solution application.

Total chili fruit yields of 9 harvests for T1~T5 were 3.99, 4.18, 4.08, 4.13, 4.42 t/ha; the yield index for T1~T5 treatments were 100, 105, 102, 104, 111, respectively. Although the yields of T5 treatment were 11% higher than the T1 check, there were not statistical different among treatments (Table 24). Cumulative fruit yields of seven harvests had shown that yield increased 10% and 19% in T2/T5 as compared to T1, but again no significant differences existed between these treatments. The SST trial in Pidie didn't come out as nicely as trial # 11 conducted in Aceh Besar, the yields in former trial were only one third of the yields in the latter one. The low fertilizer rate adopted in this trial, the rain and other factors caused the low yields might be responsible for the effectiveness of the SST applications. Although cost-effect analysis showed that T5 is most profitable treatment to recommend over farmer's practice, but the marginal benefit for T5 in this trial was only half of the T3 in Aceh Besar SST trial (Table 25 vs. Table 18). The application of SST in Pidie will need to be re-designed based on local farmer's practice with affordable amounts of fertilizers and feasible application practices and be tested in the future.

Table 23. Effects of basal, starter solution (SST) and side-dress fertilizer applications on plant height and canopy diameter of chili pepper plants, in Jaja Tunong, Pidie (Aug. – Dec. 2009) (Aceh Trial # 12)

Treatment	Plant height at 45 DAT (cm)	Index	Diameter of plant's Canopy (cm)	Index
T1 - Basal-NPK 50 +Side1 +Side2 +Side3 +Side4 (Farmer's practice)	66.2	100	69.2 a	100
T2 - Basal-NPK125 + ST0 + ST1 + ST2 + ST3	71.3	108	74.1 a	107
T3 - Basal-NPK200 + ST0 + ST1 +Side3	70.2	106	73.2 a	106
T4 - Basal-NPK200 +Side1 +Side2 +Side3 +Side4	69.7	105	73.4 a	106
T5 - Basal-NPK200 + ST0 + ST1 +Side2 +Side3 + ST4	73.6	111	74.5 a	108

No significant mean differences among treatments (Tukey's test).

Table 24. Effects of basal, starter solution (SST) and side-dress fertilizer applications on yield of chili pepper, in Jaja Tunong, Pidie (Aug. – Dec. 2009) (Trial # 12)

Treatment	Yield (t/ha)	No. of fruits per plant	No. of marketable fruits per plant	% of fruits damaged by pests/ diseases
T1 - Basal-NPK 50+Side1 +Side2 +Side3 +Side4 (Farmer's practice)	3.99	126.9	115.5	8.2
T2 - Basal-NPK125 + ST0 + ST1+ ST2 + ST3	4.18	114.2	106.7	6.5
T3 - Basal-NPK200 + ST0 + ST1+Side3	4.08	115.5	109.0	5.4
T4 - Basal-NPK200+Side1 +Side2 +Side3+Side4	4.13	122.6	116.5	4.9
T5 - Basal-NPK200 + ST0 + ST1+Side2 +Side3 + ST4	4.42	120.7	111.3	7.6

The trial used RCB design with 4 replications.
No significant mean differences among treatments (Tukey's test).

Table 25. Cost-benefit analysis of Trial #12 -- SST with chili pepper in Pidie.

Treatment	Yield (t/ha)	Marginal Cost (US$/ha)	Marginal Return (US$/ha)	Ratio (MR/MC)	Ranking
T1	3.99	--	--	--	
T2	4.18	-18.7	456.9	-24.4	
T3	4.08	150.0	-68.5	-0.5	
T4	4.13	330.0	333.5	1.0	2nd
T5	4.42	318.8	1106.7	3.5	1st

Summary and recommendation for future application

In four project-targeted districts of NAD, none of the soils existed has real salinity problems except the soils in Aceh Besar which had medium levels of salinity. This can be easily overcome by several crop cultivations. Based on the results of twelve farmer-participatory research trials, fertilizer management recommendations to overcome the major soil constraints are summarized as below for future application.

<table>
<tr><th>No.</th><th>Crop /Yield level</th><th>Location/Time of trial</th><th>Major soil constraints & farmer's practice</th><th>Recommendation</th></tr>
<tr><td>1</td><td>Cucumber/
18-23 t/ha</td><td>Meue, Trienggadeng, Pidie Jaya/ Wet season 2007-2008</td><td rowspan="3">- soil acidity (pH 4.5-6)
- poor soil fertility
- P deficiency
- low organic matter content
- sandy soil texture
- farmer applies low amounts of manures (2-4 t/ha) and inorganic fertilizers</td><td rowspan="3">- liming to raise soil pH
- increase inorganic and P fertilizers application to improve soil fertility.
- compost and manure addition to build up soil carbon
- increase manure to 10 t/ha or apply compost 5-10 t/ha, increase application of SP-36 P fertilizer, apply 1-2 t/ha of lime per crop</td></tr>
<tr><td>4</td><td>Chili pepper/
7.2-8.6 t/ha</td><td>Pidie Jaya /June – Oct 2008</td></tr>
<tr><td>10</td><td>Cucumber
33-37 t/ha</td><td>Pidie Jaya/
May– July 2009</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

No.	Crop /Yield level	Location/Time of trial	Major soil constraints & farmer's practice	Recommendation
2	Chili pepper 11.0-14.7 t/ha	Kreung Juli Barat, Koala, Bireuen/ Wet season 2007-2008	- low soil N - imbalanced soil fertility-high P& K in soils - soil acidity - low organic matter content - farmer applies high amounts of manure (20 t/ha) and low amounts of NPK fertilizers	- better balanced application of manures and inorganic N fertilizer to improve soil N-P-K fertility - compost and manure application to increase soil buffering capacity - decrease manure to 10 t/ha or apply compost 5-10 t/ha, increase application of Urea N fertilizer to improve balanced soil fertility, apply 1 t/ha of lime if soil pH <5.5
7	Cucumber 18-26 t/ha	Bireuen/ Aug – Oct 2008		
9	Amaranth 11.5-17.7 t/ha	Bireuen/May – July 2009		
3	Cucumber 17-23 t/ha	Meunasah Baro, Lhoknga, Aceh Besar/ April – June 2008	- alkaline soil pH (pH 7.4-7.8) - High EC (EC1:5, 0.4-0.9 dS/m) - imbalanced soil fertility-high K but low Bray-P content - farmer applies high amounts of both organic and inorganic fertilizers	- pay attention to micro-nutrient deficiency better balanced application of manures and inorganic P fertilizer to improve overall soil N-P-K fertility - decrease manure to 10 t/ha or apply good quality compost 5-10 t/ha, increase application of P fertilizer to improve P fertility - adapt Starter solution technology with medium level of fertilizer, 2-ST +1 side-dress applications
8	Chili pepper/ 3.5-5.1 t/ha	Aceh Besar/ Sep 2008 – Jan 2009		
11	Chili pepper/ 10.2-12.2 t/ha	Aceh Besar/ June – October 2009		
5	Chili pepper/ 5.7-8.4 t/ha	Jaja Tunong, Simpang Tiga, Pidie/ July – Nov 2008	- alkaline soil pH (pH 7.35) - low soil available P - poor and imbalanced soil fertility-low EC, low P but high K contents - farmer applies low amounts of both organic and inorganic fertilizers to chili pepper but high amounts to cucumber	- pay attention to micro-nutrient deficiency better balanced application of manures and - inorganic P fertilizer to improve overall soil N-P-K fertility - apply manure/compost to 10 t/ha and medium level of inorganic fertilizers (N and P) for chili pepper & cucumber - adapt Starter solution technology with higher level of fertilizer, 3-ST +2 side-dress applications
6	Cucumber/ 26-31 t/ha	Pidie/ Aug – Nov 2008		
12	Chili pepper/ 4.0-4.2 t/ha	Pidie/ Aug - Dec 2009		

7.2 Objective 2. To build technical capacity among researchers, extension specialists and farmers in integrated soil and crop management of vegetables.

7.2.1 Activity 1. Build research capacity of staff at BPTP NAD, the Food Crops Agricultural Service and other NAD institutions through:

a. Facilitation of farmer-participatory vegetable research trials.

A total of 15 staff from BPTP NAD (Yatiman, M. Ferizal, Tamrin, M. Ramlan, Yufniati ZA, Basri A. Bakar, Fenty Ferayanti, Fitri, Ahmad, Saufan Daud, Rachman Jaya, Emlan Fauzi), FCAS (Nazir, Marlina) and KEUMANG (Yusri Yusuf) facilitated the twelve farmer-participatory research trials detailed above. They gained much valuable experience from both the successes and failures. More details can be found in the first and second annual reports for this project.

b. A research methods workshop.

The Research Methods Workshop had two parts:

1) Soils Research Methods Workshop (27-28 March 2007)

C. Dorahy facilitated this workshop, which was attended by 23 men and women staff of BPTP-NAD, FCAS NAD, and Austcare. The workshop was held in the BPTP NAD conference room in Banda Aceh, with a follow-up field activity in Peukan Bada Subdistrict, Aceh Besar on 29 March 2007.

The key outcome from the Soils Research Methods Workshop was the development of 4 experiments which were designed to address the key constraints identified in the soil and participatory assessments. The titles of the experiments were:

a) Effects of lime and organic matter amendments on chilli pepper growth and yield in post-tsunami fields of Aceh Besar

b) Effect of Organic and Phosphate fertilizers on growth and yield of chilli pepper in post-Tsunami fields in Pidie District, Aceh.

c) Improving the fertility of tsunami- affected soils in Aceh Utara through the application of gypsum and organic soil amendments.

d) Effect of Stable Manure and NPK Fertilizer Compounds on Chilli Pepper in Bireuen District, Aceh.

2) Statistics and Experimental Design Workshop (21-25 May 2007)

D.R. Ledesma facilitated this workshop, which was attended by 21 men and women staff of BPTP-NAD and the FCAS NAD. Feedback from the attendees was very positive and the workshop met key capacity building needs at these institutions.

7.2.2 Activity 2. Build research and extension capacity of governmental and non-governmental organizations' staff through:

a. A Vegetable ICM Workshop.

The Vegetable ICM Workshop was combined with the Training of Trainers (ToT); fifteen Indonesian research staff were considered to be Workshop participants and twenty trainers (FFS Facilitators) were considered to be ToT participants. This activity focused on chili pepper ICM and was held at the Agricultural Extension Training Center (BLPP), Saree, Aceh on 13-24 Oct 2008. Thirty-five people (25 men and 10 women) were trained by 14 resource persons in a range of topics, including: IPM - Bio-control and farmers' perspectives (given by Peter Ooi, AVRDC); IPM - Differentiating between pests, natural enemies and neutral species (Greg Luther, AVRDC); IPM - Disease management and producing bio-control agents (Rakhmat Sutarya, IVEGRI); Communications (Basri Bakar and Nazariah, BPTP NAD); Farm record keeping (M. Ferizal, BPTP NAD); Bio-control agents (Aiyub, FCAS NAD); Chili pepper agriculture (Subhan, IVEGRI); Chili pepper seed production and handling (Paul Gniffke, AVRDC); Drip irrigation (Manuel Palada, AVRDC); Starter Solution Technology (Chin-Hua Ma and M. Palada, AVRDC); Nutrient deficiency diagnosis, soil analysis and how to make compost (Chris Dorahy, NSW DPI, and Chin-Hua Ma, AVRDC); Soil salinity (Irhas Gita, BPTP NAD). Rachman Jaya of BPTP NAD was the main organizer of the event.

Participants came from BPTP NAD, the FCAS NAD and Austcare; twenty of them (15 men and 5 women) went on to facilitate FFS in our project. Support for this event by a range of institutions was indicated by the fact that the Head of the FCAS (Extension Service) for Aceh Province, the Director of BPTP NAD, and the Regional Director of the

Asian Regional Center of AVRDC opened the event. The full report of the ToT and Vegetable ICM Workshop is attached as an appendix to this report.

b. A Final Workshop.

The Final Workshop for this project was held on 17-18 November 2009 in the BPTP NAD conference room (in Banda Aceh) with approximately 90 people attending. Participants came from BPTP NAD, FCAS NAD, IVEGRI, ACIAR, AVRDC, NSW DPI, ableblue, Syiah Kuala University, Mercy Corps, Austcare, World Vision, Red Cross and Aceh farming communities. The main purposes of the workshop were to report on all major accomplishments, disseminate information from the project more widely, discuss lessons learned and future directions, and obtain feedback from the ACIAR Research Program Manager. The workshop accomplished all of these. The workshop program with a list of participants is attached as an appendix.

c. Participation in the AVRDC-Asian Regional Center Regional Training Course.

The project sent two participants to the Regional Training Course conducted by AVRDC Asian Regional Center in Bangkok, Thailand. Saufan Daud, Agronomist at BPTP NAD attended the course on ‘Managing Vegetable Production and Marketing’, which was held from 5 Nov 2007 to 31 Jan 2008. This provided an excellent opportunity to build technical capacity within BPTP and enabled Mr. Daud to establish professional networks and linkages with other course participants.

Diana Samira of the Rice, Horticulture and Secondary Food Crop Production staff at the Food Crops Agricultural Service NAD participated in the 3-month Regional Training Course from 3 Nov 2008 to 30 Jan 2009. The course encompassed three modules: (1) From land preparation to planting; (2) Good Agricultural Practice (GAP) - Planting a healthy crop; (3) Harvest to market. After returning to Aceh, Ms. Samira gave a seminar at BPTP NAD on 15 May 2009 about her experiences and knowledge gained from the Regional Training Course.

7.2.3 Activity 3. Build extension capacity of governmental and non-governmental organizations' staff through a Training of Trainers (which will partly draw from the Vegetable ICM Workshop).

The Training of Trainers was combined with the Vegetable ICM Workshop and these are described in Section 7.2.2.a above. The full report of the Training of Trainers and Vegetable ICM Workshop is attached as an appendix to this report.

7.2.4 Activity 4. Build capacity of farmers to successfully grow vegetables through adapted Farmer Field Schools and field days facilitated by the staff trained in Activity 3.

Farmer Field Schools

From December 2008 to October 2009, 1648 farmers were trained in 77 adapted Farmer Field Schools in five tsunami-affected districts of Aceh. The districts were Aceh Besar, Pidie, Pidie Jaya, Bireuen and Aceh Utara. The FFS focused on chili pepper integrated crop management. Technologies disseminated during the FFS included: biological control concepts; distinguishing between pests, natural enemies and “neutral” species; bio-pesticides (neem, for example); mulching (plastic, rice straw, others); seed production and handling; drip irrigation; starter solution; soil fertility concepts; soil assessments/tests; how to make compost; soil salinity issues and remediation. Technologies that farmers are most interested in adopting include: composting/bokashi preparation, pest and disease identification, application of botanical pesticides, proper methods of pesticide use, netting to protect seedlings from pests and diseases. The twenty trainers who facilitated these FFS are staff of FCAS NAD and BPTP NAD (15 men and 5 women), who were trained in our project's Training of Trainers. Evaluations of these FFS are reported under Activity 3.2 below.

Field Days

A Farmer Field Day was conducted in Jaja Tunong Village, Simpang Tiga Sub-district, Pidie District on 26 August 2008 to disseminate findings from several vegetable research activities. This Field Day was held near the end of the dry season, which is the main vegetable planting season in our project area. Participants were mostly vegetable farmers from Jaja Tunong and surrounding villages such as Pulo Blang, Pulo Raya, Curocok Barat and Meue (the latter in Tringgadeng Sub-District, Pidie Jaya District). In total, 48 people participated. In addition to farmers, extensionists, researchers, and NGO staff were also involved. Participants were 55% men and 45% women.

A second Farmer Field Day was conducted in Meunasah Baro Village, Lhoknga Sub-district, Aceh Besar District on 20 August 2009. The main purpose of this field day was to disseminate starter solution technology to farmers, focusing on its use for chilli pepper. Participants were vegetable farmers from Meunasah Baro and surrounding villages, such as Meunasah Mon Cut and Lamgiriek. In total, 25 people participated. Extension agents, researchers and NGO staff attended in addition to farmers. Participants were 55% men and 45% women.

7.2.5 Activity 5. Produce extension publications in Indonesian/Acehnese and distribute to 4000 farmers and extensionists (NGOs, GOI).

In 2009, after most of the project's results had been obtained, the project team wrote four extension publications based on what had been learned from the project and other previous research and experience. The four publications produced in Indonesian are:

1) Luther GC with photos from Mangan J, Ooi PAC. 2009. Natural Enemies Help Farmers Control Pests. Extension brochure. Assessment Institute for Agricultural Technology, Indonesia and AVRDC – The World Vegetable Center. 6 p. *1500 copies printed.*

2) Ma CH, Ramlan M, Luther GC, Palada MC. 2009. Starter Solution Technology: Growth Stimulation Liquid Fertilizer Technology. Extension publication. Assessment Institute for Agricultural Technology, Indonesia and AVRDC – The World Vegetable Center. 2 p. *1500 copies printed.*

3) Ramlan M, Dorahy C, Luther GC, Ferayanti F. 2009. How to Make Compost. Extension brochure. Assessment Institute for Agricultural Technology, Indonesia and AVRDC – The World Vegetable Center. 6 p. *1000 copies printed.*

4) Fitriana N, Luther GC, Iskandar T, Ferizal M, Jaya R, Ramlan M, Yatiman, Tamrin, Daud S, Ferayanti F. 2009. Red Chilli Pepper Cultivation. Extension booklet. Assessment Institute for Agricultural Technology, Indonesia. 30 p. *300 copies printed.*

These were distributed to farmers and extension specialists in the Districts of Aceh Besar, Pidie, Pidie Jaya, Bireuen and Aceh Utara via BPTP, FCAS and NGO staff. Dissemination was widespread to increase the impact. The publications were distributed to:

1) Aceh Besar: 30 farmer groups in 13 villages of 3 subdistricts;

2) Pidie: 13 farmer groups in 6 villages of 4 subdistricts;

3) Pidie Jaya: 17 farmer groups in 12 villages of 5 subdistricts;

4) Bireuen: 5 farmer groups in 4 villages of 2 subdistricts;

5) Aceh Utara: 12 farmer groups in 8 villages of 6 subdistricts.

7.2.6 Activity 6. Re-establish up to four vegetable visitor demonstration plots at BPTP NAD.

IVEGRI sent seeds of tomato, chilli pepper, cucumber, eggplant, yard-long bean, *caisim* and kangkong to BPTP NAD, which the team planted out in a visitor demonstration plot at the BPTP NAD office during March - September 2008. IVEGRI's varieties were compared with vegetable varieties normally planted in Aceh. Broccoli was also planted for demonstration purposes. Drip irrigation kits purchased by the project were also demonstrated to a range of visitors. BPTP NAD receives visitors from local schools and other organizations, so these plots were viewed by Indonesians from a variety of groups.

7.3 Objective 3. To monitor and evaluate the above activities.

7.3.1 Activity 1. Conduct a baseline survey that covers vegetable production and consumption aspects.

Summary and findings of the baseline report

After conducting a Participatory Appraisal (PA) of local needs and concerns in vegetable farming in early 2007, a more rigorous baseline survey covering over 240 households from eight tsunami-affected communities spread over 5 districts of the NAD province (Aceh) was carried out in 2008. The overall objective of this baseline survey was to analyse and document production characteristics of vegetables in general, and individual household level constraints and opportunities for vegetable farming in these tsunami-affected communities. It also provided background information for implementing other components of the project. In addition, it discusses policy strategies for strengthening vegetable farming in those disaster-hit areas of Aceh, with potential for application in other places as well.

Out of 240 surveyed households, farming was the main occupation for more than 95% of these households. Rice was mostly cultivated as a rain-fed crop in the survey sites, and it was grown more in Aceh Besar and Pidie than in the Northeast survey region. On average, rice harvested from the farmer's own land was sufficient to meet 8-9 months of annual consumption needs of an average household surveyed. The main reasons for rice insufficiency were small size of farm land, low yields due to low inputs, and infertile land due to the tsunami.

Over 90% of the households surveyed were growing vegetables on some plot parcel: large numbers of them were home garden type cultivators. About 12% of the total respondents were women, which indicates that women also play an important role in vegetable farming in Aceh and they were able to provide information on agricultural practices, and information related to economic activities of households, in general.

Many of the farmers were not growing vegetables in a large plot area due to constraints such as land damage by the tsunami, lack of support for cultivation of cash crops, high pest and disease incidence, highly fluctuating market prices, and so on. Among vegetables, chilli was a very popular crop in the surveyed communities, with all of the farmers growing chilli at least on a small plot of their land. After chilli, other important vegetables cultivated in the area were: tomato, cucumber, eggplant, yard long bean, amaranth, shallot, kangkong, pak choy, cabbage, and several other indigenous vegetables. Average farmers hold about 0.6 ha of farm land for cultivation.

An average vegetable grower (chilli grower), out of the sample of farmers already growing chilli, devoted about 0.26 ha of land for chilli cultivation in 2007/08, and produced about 2500kg of chilli. Out of that, over 95% was for market sale. The average household consumed around 2.7 kg of vegetables (a mix of vegetables) per week, and with monetary value at about Rp 19,000 (AUD 2.3). Despite the fact that chilli had higher price fluctuations than other vegetables, about 43% of the surveyed farmers grew chilli in their backyard (or for market sale plot); many other farmers also wanted to grow chilli at least on a small parcel of land for market sale, if they could get timely technical and other infrastructural support. Tub-wells were the main sources of water for irrigation of vegetable fields.

Among the various reasons for growing vegetables in Aceh, the most important reasons were availability of suitable land with the household, past experience with growing vegetables, easy input availability (through NGO support in many places), and more income even from lesser land areas. The major constraints for growing vegetables are pest and disease occurence, high fluctuation of prices, and unavailability of irrigation infrastructure.

Among the surveyed households, only 13% of farmers had participated in any type of training on cultivation of vegetables. Farmers learnt vegetable cultivation practices largely from older members of the households or from neighbouring farmers. The roles of women and men vary by the specific operation of the vegetable production practices. About 70% of decisions for acreage allocation of vegetable areas were made by females; the larger role of women household members for acreage allocation is also reasonable due to the fact that male members from these communities formerly worked as temporary wage labourers (construction work) in the nearby urban areas.

Using the household level information, we have also done economic analysis for cultivation of chilli in Aceh. The level of input application inputs (fertilizers, pesticides and other materials) on chilli largely varies across the three regions surveyed. Even among farmers within a community, the level of input use varies substantially, indicating that each farmer has a different level of adoption of chilli production technology. Labour use in chilli farming in the survey sites was low (only 220 days per ha) compared to the level reported in other intensive chilli production pockets in Aceh and in Indonesia. The variation in labour use across the sites (and across households within a site) was also very high.

Shares of labour cost and input material cost for chilli production were 70% and 30%, respectively. Out of the total labour cost, nearly 60% was an opportunity cost of family labour forces for cultivating the crop. Thus, benefits of employment generation from vegetables production are substantially high, creating one of the motivations of the household to farm vegetables. The profit from chili crops, i.e., share in terms of return to management factor, was very high in Northeast Aceh compared to Pidie and Aceh Besar. Vegetable farming is relatively more intensive in Northeast Aceh, due to better market access to the market in nearby North Sumatra province.

In general he vegetable yield in Aceh is very low, cultivation is not very intensive, and the input base system is low. This means there is a huge potential for improvement in vegetable production and productivity levels in Aceh. Rehabilitation of vegetable production through soil and crop management is feasible. Among the different vegetables grown, chilli dominates cash crop cultivation and chilli growers are obtaining substantial economic returns, thus many other farmers are interested in growing chilli or expanding chilli farming, if they can obtain adequate technical support and infrastructure. These include support from public agencies to reduce risks with vegetable production, particularly in managing pests and diseases, the need to strengthen vegetable specific extension services like Farmer Field Schools, institutionalization of vegetable-specific issues in the province, and the need to increase access to compost in the rural areas for managing soil fertility and rehabilitation of the land damaged by the tsunami.

There is an urgent need to strengthen the technical and institutional capacities of local public and private sector agencies (input suppliers, credit systems) currently providing agricultural services in Aceh. Due to the catastrophic event of the tsunami, the human resources, institutional, and infrastructural base of Aceh's research and extension services has nearly collapsed and needs to be revived, more so for the province's vegetable sector than for other sub-sectors of agriculture, as vegetables require intensive and specialized extension services.

7.3.2 Activity 2. Evaluate the adapted FFS (Objective 2, Activity 4).

Evaluation and Impact Assessment of Farmer Field Schools (FFS) on Integrated Soil and Pest Management in Tsunami-affected Areas of Aceh, Indonesia

Farmer Field Schools (FFS) are one of the effective ways to disseminate knowledge-intensive technologies to farmers. Modified and adapted FFS for integrated soil and pest management in vegetables, as conducted in Aceh under this project, were expected to have positive impacts on farming practices, farmers' knowledge of vegetable production, and soil and pest management in general. The project was implemented through adapted Farmer Field Schools (FFS) on vegetables in 77 villages, which entailed training 1648 farmers within a year's time. Immediately after completion of the FFS, we evaluated the process involved and some of the perceived impacts of the FFS on the farmers' knowledgebase and their farming practices in general. The real impact of FFS will be achieved only after a few years when the farmer participants apply the knowledge gained at the FFS, conduct field research on their own farm and obtain increased crop yields and income. Nevertheless, it is important to document these perceived impacts immediately after the training, and within the project period, so that the farmers' perspectives on the project activities can be ascertained in time for improved decision-making.

For this purpose, two survey methods were used: (1) individual household survey of over 270 farmers participating in the training, and (2) participatory group survey for 27 farmers' groups (at 27 FFS sites) who attended the FFS training in Aceh. The project evaluation framework as well as ex ante impact assessment methodology were adopted to document the ex-ante impacts of the FFS. Farmers were asked to provide their expectation and perceived effects of FFS on a range of issues pertaining to vegetable (chilli) farming, and soil and pest management. Thus, conceptually, we followed a “before and after” comparison method for evaluating impacts of FFS, i.e., the impacts in this case means what the farmers' “perceived impacts” were from attending FFS and the participatory managed field trials. The survey was conducted within 2-3 months after completion of FFS, and the results derived in this paper are from both group discussions at 27 FFS sites and individual interviews of 270 farmers, spread across three regions of Aceh.

At the individual level, the farmers' overall knowledgebase on chilli farming has been greatly enhanced from participating in FFS. On average, farmers who attended the FFS stated that their overall knowledge on chilli cultivation has been enhanced by over 70%. After attending the FFS, farmers' knowledge of pests, diseases and natural enemies has increased considerably. The farmers' level of knowledge of pests and diseases doubled, and every farmer could mention at least one natural enemy of insect pests. After attending the FFS, farmers could also differentiate between pests and diseases, as well as between insect pests and beneficial insects. Farmers are also now capable of ranking insect pests in terms of how damaging they are; they can also observe which insect pests are more important than others. Knowledge on kinds of pesticides has been enhanced, as well as on adverse impacts of pesticides. From the FFS, farmers have become aware that pesticides can affect human health, kill natural enemies and other beneficial organisms, contaminate soil and the environment in general, as well as bring about pest and disease resistance.

With their enhanced knowledge, farmers are confident that in the forthcoming season, they will be able to increase yields of chilli with reduced use of chemical pesticides. After attending the FFS, on average, farmers expect that yields will increase by 30% and pesticide use could be diminished by 33%. This is a clear indicator of good performance for the FFS carried out in Aceh. Farmers' perception of impact is also important since they have already participated in the crop-season-long school and all of the technology components involved in growing chilli and managing soil health, insects and diseases on the crop. Higher performance level of FFS, as perceived by the farmers have direct linked on the higher level of its real impacts in the subsequent days, as and when farmers grow crop on their individual farm with the improved technologies that they have learnt and practiced at the FFS.

At the group level, the impacts confirmed those at the individual level. The group level impacts of FFS were evaluated using the framework of livelihood asset, i.e., the FFS impacts were analysed on each component of livelihood assets. FFS helped in enhancing human capital related to development of knowledge on vegetable farming overall, and specially on improving knowledge on plant-protection and crop management related issues.

In terms of impact on financial asset, the FFS participating farmers expected to reduce agro-chemicals use by 20-25 percent; which means reduced costs for fertilizers and pesticides, ranges from 15 per cent to 25 per cent reduced production cost of chilli farming. They also expect to increase productivity of chilli by 10-25; and eventually, more efficient use of agrochemicals and increased productivity, all of them means also a more farm income and profit from per unit of land.

After attending the FFS, the farmer participants believed that social relationship among farmers within group as well as between groups has become more coherent and strong. This is the most noticeable impact on social cohesiveness (i.e., increased social asset). After the FFS training, the level of communication among farmers has also become more frequent and with more effective information in the community. In addition, now, these farmers no longer hesitate to consult agricultural officers if they found any problem on farming and other issues. These unquantifiable impacts on social capital are strong aspects of FFS than that of other kinds of formal training of agricultural extension services.

As the topics of FFS were on soil, pest and disease management, noticeable positive impacts of FFS on natural capital were achieved such as improvement on soil fertility, biodiversity, and human health. Farmers also learnt techniques on reducing synthetic pesticides use, which helped in avoiding possible contamination to local agro-ecosystem and risk of pesticide poisoning. All of them contributed to positive impacts on human health and natural capital in the area.

In terms of adequacy of FFS, farmers were mostly satisfied with the implementation of FFS. Training facilities were adequate and the quality of trainer/facilitator was high. However, some constraints have been identified and reported by farmer participants as well. Some of them were such as time of training did not match the planting season, several training materials were not available in local market, size of trial plot was too small, and germination of seed was not satisfactory in many places.

To sum up, FFSs have successfully delivered the message containing packages of technologies as farmers learnt directly during one-crop season long of practical training. Training materials delivered through FFS were understandable and acceptable to farmers. Noticeable impacts on farmers' livelihood have been identified. Likewise, among others farmers were also trained on more advanced knowledge of chilli farming practices such as pest and disease management, pesticides, natural enemies, soil fertility; and stronger social relationship between farmers. Considering the total financial resources spent for implementation of the FFS, a direct access to 1648 farmers and to train them on improved practices of chilli farming and other component of farming would certainly give a long term impacts in these communities, and some of these benefits would last much more years in the future.

A draft paper manuscript out of the evaluation of FFS in Aceh has been developed for submission to a peer review journal (attached as an appendix). A brief overview on methods used and key findings of the evaluation and impact assessment of FFS has been presented here.

7.3.3 Activity 3. Analyse costs and benefits of various crop management strategies.

The cost-benefit analyses of the various crop management strategies utilized in the farmer-participatory research trials are incorporated above in Section 7.1.2 to facilitate the analysis of those trial results.

8 Impacts

8.1 Scientific impacts – now and in 5 years

Results from twelve farmer-participatory research trials have been compiled and eleven were statistically analysed (one was deemed not worth analysing due to problems with the data). Through the implementation process, BPTP and FCAS personnel have become much more capable at facilitating these trials over the past three years.

The Soil Survey/Assessment data was collected by BPTP NAD staff, which provided an excellent learning experience. Guidance was provided by C. Dorahy of 'ableblue'.

Techniques learned in the Soils Research Methods Workshop are being applied by BPTP NAD staff in their daily work. These include soil sampling techniques and research trial planning.

BPTP and FCAS staff expanded their knowledge greatly during the Statistics and Experimental Design Workshop, and these new skills are being applied in a range of governmental- and donor-funded projects. Knowledge gained by the 21 participants has improved the methods they use to design field and laboratory experiments, collect and store data, and conduct statistical analyses of data. During the Workshop, 20 copies of IRRISTAT were distributed to participants and they were instructed how to use the program through a participatory process. Impacts of this workshop are now being seen in other projects in Aceh.

Our project hosted Endeavour Executive Award winner Dr. Nilantha Hulugalle, Soil Physicist, NSW DPI, during June-August 2007 at the BPTP NAD office in Banda Aceh. During this time, Hulugalle conducted research on physical characteristics of tsunami-affected soils, focusing on SMCN/2005/075 project sites. An article on Hulugalle's experience in Aceh can be found in Endeavour Alert Issue 1 (http://www.endeavour.dest.gov.au/newsletter/Edition_1.htm). Scientific impacts are occurring through Hulugalle's research papers, presentations, and interactions with project staff in Aceh. The BPTP staff mentioned that Hulugalle's tenure with them was particularly useful because they learned much about a new subject matter for them, i.e. soil physics. They are applying their new skills in their daily work.

All of the above scientific impacts are expected to multiply over the coming 5 years.

8.2 Capacity impacts – now and in 5 years

Capacity building was a major theme of this project, with Farmer Field Schools (FFS), farmer-participatory research trials, a Training of Trainers (ToT) combined with a Vegetable ICM Workshop, and a two-part Research Methods Workshop being conducted.

The two training workshops, "Soils Research Methods" and "Statistics and Experimental Design", were very successful in building technical capacity of staff at BPTP NAD, the FCAS and other NAD institutions. The skills gained during these workshops are being applied as described in the above section. These training activities will have lasting impacts because they have equipped Partner Country project team members with new skills and techniques for identifying, prioritising and addressing future natural resource management and agricultural production issues.

Dr. Nilantha Hulugalle trained the BPTP soil scientist, Ir. Irhas, and other BPTP staff on a range of soil science techniques during his Endeavour Executive Award program funded by the Australian Government. Hulugalle travelled extensively to field sites and advised farmers on their soil problems.

Ir. Saufan Daud, Horticulture Technician, BPTP NAD, attended the Regional Training Course at AVRDC Asian Regional Center, located at Kasetsart University, Thailand, from Nov 2007 to Jan 2008. The Course, entitled "Managing Vegetable Production and Marketing", contained three modules: (1) From land preparation to planting; (2) Good Agriculture Practices (GAP) – Growing a healthy crop; (3) Harvest to market.

Ir. Diana Samira, Rice, Horticulture and Secondary Food Crop Production Technician at FCAS NAD, attended the same course the following year (Nov 2008 - Jan 2009).

S. Daud and D. Samira have given seminars on their experiences after returning to Aceh. They are applying the knowledge they gained from the Regional Training Course in their present work, and it is anticipated this will have multiple impacts on scientific and community development activities in Aceh in the future.

Details about participants and subject matters for the Training of Trainers and Vegetable ICM Workshop are provided in above sections. The participants of the ToT and Vegetable ICM Workshop indicated in their evaluations that these activities were valuable. When asked to rank the usefulness of the subject matter from 1 (not useful) to 10 (very useful), their responses averaged 9.06; when asked how much their knowledge and understanding of vegetable production had improved due to the ToT and Workshop, the mean response was 57% improvement. The full report of the ToT and Workshop includes evaluation results for this activity; this report is attached in an appendix.

The twenty trainers who facilitated the FFS are staff of FCAS NAD and BPTP NAD (15 men and 5 women), and since they hold permanent positions with these government agencies, they can easily continue to impact farming communities in Aceh with the knowledge they gained from this project.

Five years from now we expect that capacity building impacts from this project will be felt extensively in Aceh through the work of BPTP, FCAS and NGO staff who participated in the many capacity building activities in this project.

8.3 Community impacts – now and in 5 years

Community impacts have already been realized in some areas (see below) and are anticipated on a much larger scale over the coming five years since 1648 farmers have completed FFS training and extension publications have been distributed. Adoption of new technologies and techniques (composting, starter solution, IPM methods and more) from this project is expected to show significant impacts in target communities.

8.3.1 Economic impacts

Farmers and other members of project-targeted communities have become more aware of the economic importance of, and opportunities provided by, vegetable production. Baseline survey results showed that, among the project-targeted vegetables in Aceh, chilli production provided better income and employment to the farmers because chilli generated more income and more employment per unit of cropland than other crops. On the basis of unit of land, net income from chilli was 1.5 times higher than tomato, 5 times higher than cucumber, and 10 times higher than paddy rice. Higher chilli prices in Indonesia in recent years was also among the major reasons for high income from chilli production. Improvement of crop management practices for chilli production through the project interventions is expected to improve chilli productivity in Aceh further and enhance farm returns and rural livelihoods. Over 800 labour days of employment were generated by one hectare of chilli crop in a season (5 months), which is almost three times that of paddy rice. The study shows that an average market-oriented chilli farmer in Aceh obtained net return of about US$3500 per hectare of chilli cultivation; for this the farmer needed to invest (i.e. the production cost) about US$3700 per hectare, which is more than three times that of paddy rice cultivation. The baseline survey and focus group discussions on costs and benefits of crop production in Aceh also improved farmers' understanding on major components of costs and benefits of vegetable production. Likewise, on-farm trial results on various practices of soil fertility rehabilitation also led to increased farmer awareness about alternative cost-effective practices for vegetable cultivation, leading to better crop management and increased profitability.

Due to the high profitability of chilli, this crop received much attention from farmer co-operators and neighbouring farmers where the trials were carried out. Since many farmers in the project area had a very high interest in growing chilli, all 77 FFS focused on chilli. Through the project's FFS sessions, 1648 farmers have directly benefited in terms of improving their knowledge and skills on efficient use of input resources and other aspects of crop management for chilli production.

From the twelve on-farm research trials and their results, cooperating farmers as well as neighbouring farmers improved their understanding on cost-effectiveness and comparative advantages of using compost and animal manures in vegetable farming. They also learnt about the efficient use of pesticides and other chemicals, and IPM practices, leading to cost-effective production of vegetables.

8.3.2 Social impacts

Empowerment of farmers is a social impact very often associated with FFS participation. This is also expected from the FFS in this project, as farmers learn more technologies and methods for managing their chilli production agro-ecosystems. With greater knowledge of natural enemies and other biologically-based pest control methods, composting and other environmentally-favourable soil fertility management techniques, and drip irrigation options to greatly increase water use efficiency, farmers in this project will have many more choices for overcoming agricultural challenges.

Through on-farm trials and FFS participation, farmers’ awareness of vegetable ICM increased and so changes in their management practices followed. Vegetables create more employment opportunities than many other crops (see Section 3.3.1). Thus, through increased employment security and year-round job creation, this project has created significant social benefits and rural livelihood improvements in target communities.

8.3.3 Environmental impacts

Whitefly and geminivirus control methods practiced by farmers in Bireuen have improved due to this project. The use of netting over the chilli seedling bed was introduced in the farmer-participatory research trial in Kreung Juli Barat Village, Koala Subdistrict, Bireuen District, and neighbouring farmers were convinced of its effectiveness after seeing the high chilli yields in the trial. Subsequently, several farmers have borrowed the netting from the collaborating farmer, Pak Mawardi, for their chilli nurseries. Further netting was purchased by the project and distributed among the farmers in the area. Use of the netting is likely to reduce pesticide use because it controls whiteflies and other insect pests during the entire nursery period.

The project has promoted the use of compost and animal manures in the FFS, the farmer-participatory research trials, and the ToT/ICM Workshop. One anticipated impact is a much needed increase in organic matter in the soils of Aceh. When the project started, the compost operation at the NGO, Y'Dua, was having trouble selling all of the compost it produced, whereas now the demand for compost has increased to a level that Y'Dua cannot meet. While many factors have probably contributed to this increased demand, it is likely that the project has been one of them.

8.4 Communication and dissemination activities

Publicity to a wider audience than just project participants was strong in this project. At the time of the ToT and ICM Workshop, Aceh TV broadcasted interviews with Teuku Iskandar (Director, BPTP-NAD), Greg Luther and Chris Dorahy. Radio Republic Indonesia also interviewed T. Iskandar and G. Luther. An Aceh TV cameraman accompanied project team members on a day-long field trip on 14 May 2009, interviewing Pak Mawardi, Pak Bahani (FFS Facilitator, Pidie Jaya) and Greg Luther.

Greg Luther was also interviewed by the BBC World Service regarding some broader topics but was able to include discussion about this project in the interview (July 2008).

Farmer Field Schools were one of the largest dissemination activities of this project. A total of 1648 farmers completed their participation in adapted FFS; more details are found above in Section 7. The evaluation of the FFS indicated that these were successfully conducted (see Section 7.3.2).

Several project team members participated in the International Workshop on Post-Tsunami Soil and Crop Management in Bogor, Indonesia, on 1-2 July 2008. Four posters were presented from this project:

1) Rachman Jaya, M. Ferizal, Basri A.B., Tamrin, F. Ferayanti, Yatiman, Yufniati ZA, S. Daud, R. Sutarya, Subhan, A. Silmi, J.S. Apolita, B. Han, Yusri Yusuf, G.C. Luther, C. Dorahy, M.C. Palada, M. Bhattarai, D. Ledesma, N. Hulugalle, P.A.C. Ooi, C.H. Ma, A. Azis, and N.N. Rayyan (2008). An Overview of the Aceh Vegetables Project: Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia.

2) Yatiman, Rachman Jaya, M. Nazir, Marlina, M. Ferizal, Subhan, Saufan Daud, Tamrin, Yusri Yusuf, Yufniati Z.A., Basri A.B., Fenty Ferayanti, Rakhmat Sutarya, Julie S. Apolita, A. Silmi, Chris Dorahy, Greg Luther, Manuel C. Palada, Chin-Hua Ma, and D. Ledesma (2008). Farmer-participatory Research Trials to Test Soil Rehabilitation Practices in Bireuen and Pidie Jaya, NAD.

3) Madhusudan Bhattarai, M. Ferizal, R. Jaya, G. C. Luther, and M. Palada (2008). Socioeconomic and local institutional factors affecting vegetable production and restoration of soil fertility in Aceh, Indonesia.

4) M. Ferizal and Madhusudan Bhattarai (2008). Costs and returns for production of major vegetables and rice in Aceh, Indonesia.

One refereed journal article was produced: Hulugalle, N.R., R. Jaya, G.C. Luther, M. Ferizal, S. Daud, Yatiman, Irhas, Z.A. Yufniati, F. Feriyanti, Tamrin and B. Han (2009). Physical properties of tsunami-affected soils in Aceh, Indonesia: 2½ years after the tsunami. *Catena* 77 (2009) 224–231.

One Proceedings publication was produced: Bhattarai, M., M. Ferizal, G.C. Luther and R. Jaya (2008). Socio-Institutional and Economic Analysis of Vegetable Farming in Tsunami-affected Communities in Aceh, Indonesia. In: Perner H, George A, Zaitun, and Syahabuddin (Eds.). 2008. Proceedings International Symposium on Land Use after the Tsunami: Supporting Education, Research and Development in the Aceh Region, November 4-6, 2008. Syiah Kuala University, Banda Aceh, Indonesia. Agriculture Project-the EU Asia Link Programme and ReGrIn Project-the EU Asia Pro Eco IIB Programme. ISBN 978-979-25-7401-2

Pertanian Pasca Tsunami – Agriculture after the tsunami newsletter

Several articles have been published in the joint ACIAR/ NSW DPI/ BPTP newsletter on various activities being undertaken in this project, including the launch of the project, the

Soils Research Methods Workshop and linkages between the compost industries in Aceh and Australia.

“Soil management for rebuilding agriculture in tsunami-affected areas in Nanggroe Aceh Darussalam Province” Training workshop – BPTP, Banda Aceh – 23-24 January 2007

Many project team members participated in this workshop, which was coordinated by team members from project LWR/2005/118. This provided an opportunity to learn about work which had already been done on rebuilding agriculture in tsunami-affected areas and inform some of the activities conducted in this project.

Cross project Communications Forum – Saree, NAD - 8 August 2007

The Cross project (LWR 2005/004, LWR 2005/118 and SMCN 2005/075) Communications Forum was an excellent opportunity to learn about progress on other tsunami-related projects and interact with project partners, Dinas Pertanian/PPL extension staff and NGO staff from NAD and other provinces in Indonesia.

Rachman Jaya, presented a poster entitled “Integrated soil and crop management for rehabilitation of vegetable production in tsunami affected areas of NAD” on key activities undertaken in this project since it commenced in January 2007, whilst Chris Dorahy presented a poster paper on linkages between the compost industries in Australia and Aceh.

Inaugural Compost Ball – Leichhardt, NSW 11 May 2007

Chris Dorahy gave a presentation on the Acehnese compost industry at the Inaugural Compost Ball which was held as part of international Compost Awareness Week (ICAW). Funds raised from the Ball was directed to a project(s) in Aceh where Australia, through AUSTCARE, is partnering with a number of local groups and businesses who are working with compost manufacture and use. The Ball was attended by about 150 people and is a good news story about how collaborative projects create linkages which extend beyond individual projects and have broader benefits to communities and organisations in Indonesia and Australia.

An article on the Compost Ball was published in the Daily Telegraph:

- Howden, S. (2007). Compost ball heaps of fun. The Daily Telegraph. 12/5/2007. News Limited, Sydney. (http://www.news.com.au/dailytelegraph/story/0,22049,21714338-5001031,00.html)

Two Farmer Field Days were conducted to disseminate findings from vegetable research activities; one in Jaja Tunong Village, Simpang Tiga Sub-district, Pidie District on 26 August 2008 and another in Meunasah Baro Village, Lhoknga Sub-district, Aceh Besar District on 20 August 2009. The Field Day in Jaja Tunong was held near the end of the dry season, which is the main vegetable planting season in our project area. Participants were mostly vegetable farmers from Jaja Tunong and surrounding villages such as Pulo Blang, Pulo Raya, Curocok Barat and Meue (the latter in Tringgadeng Sub-District, Pidie Jaya District). In total, 48 people participated. In addition to farmers, extensionists, researchers, and NGO staff were also involved. Participants were 55% men and 45% women.

During the event, a profile of vegetable research activities in Aceh Province was presented, focusing on BPTP's role. Another presentation on how to cultivate red chilli in tsunami-affected areas and control pests was also given. One collaborating farmer (Pak Taib) led a discussion with the farmers on the problems they face when farming vegetables. The major problems were: wrinkled leaves (likely caused by viruses), yellowing leaves, spots on leaves, and rotting fruits (one cause is fruit fly); for all of these, no pesticide has been found that solves these problems. To overcome them, BPTP NAD researchers suggested that cropping systems be improved, adequate irrigation be ensured, and insecticides and fungicides be sprayed using correct rates and timing. Circulation of large amounts of seeds falsely purporting to be from a reputable seed producer is also a problem. All of this information was incorporated into planning the Training of Trainers (to prepare them to facilitate FFS), Vegetable ICM Workshop, and Farmer Field Schools.

The second Farmer Field Day's main purpose was to disseminate starter solution technology to farmers, focusing on its use for chilli pepper. Participants were vegetable farmers from Meunasah Baro and surrounding villages, such as Meunasah Mon Cut and Lamgiriek. In total, 25 people participated. Extension agents, researchers and NGO staff attended in addition to farmers. Participants were 55% men and 45% women.

The project team wrote four extension publications based on what had been learned from the project and other previous research and experience. Efforts were made to write at the level that farmers could read the material relatively easily and utilize it. The four publications produced in Indonesian are:

1) Luther GC with photos from Mangan J, Ooi PAC. 2009. Natural Enemies Help Farmers Control Pests. Extension brochure. Assessment Institute for Agricultural Technology, Indonesia and AVRDC – The World Vegetable Center. 6 p. (in Indonesian). *1500 copies printed.*

2) Ma CH, Ramlan M, Luther GC, Palada MC. 2009. Starter Solution Technology: Growth Stimulation Liquid Fertiliser Technology. Extension publication. Assessment Institute for Agricultural Technology, Indonesia and AVRDC – The World Vegetable Center. 2 p. (in Indonesian). *1500 copies printed.*

3) Ramlan M, Dorahy C, Luther GC, Ferayanti F. 2009. How to Make Compost. Extension brochure. Assessment Institute for Agricultural Technology, Indonesia and AVRDC – The World Vegetable Center. 6 p. (in Indonesian). *1000 copies printed.*

4) Fitriana N, Luther GC, Iskandar T, Ferizal M, Jaya R, Ramlan M, Yatiman, Tamrin, Daud S, Ferayanti F. 2009. Red Chilli Pepper Cultivation. Extension booklet. Assessment Institute for Agricultural Technology, Indonesia. 30 p. (in Indonesian). *300 copies printed.*

Impact from these extension publications is expected to be high due to wide distribution and tailoring the material to farmers' needs. These publications were distributed to farmers via BPTP, FACAS and NGO staff to the following:

1) Aceh Besar: 30 farmer groups in 13 villages of 3 subdistricts;

2) Pidie: 13 farmer groups in 6 villages of 4 subdistricts;

3) Pidie Jaya: 17 farmer groups in 12 villages of 5 subdistricts;

4) Bireuen: 5 farmer groups in 4 villages of 2 subdistricts;

5) Aceh Utara: 12 farmer groups in 8 villages of 6 subdistricts.

9 Conclusions and recommendations

A range of conclusions and recommendations arose from this project; these are detailed below.

9.1 Conclusions

As detailed above, Farmer Field Schools (FFS) on vegetables were conducted in 77 villages, which entailed training 1648 farmers within a year's time.

At the individual level, the farmers' overall knowledgebase on chilli farming has been greatly enhanced from participating in FFS. On average, farmers who attended the FFS stated that their overall knowledge on chilli cultivation has been enhanced by over 70%. After attending the FFS, farmers' knowledge of pests, diseases and natural enemies has increased considerably. The farmers' level of knowledge of pests and diseases doubled, and every farmer could mention at least one natural enemy of insect pests. After attending the FFS, farmers could also differentiate between pests and diseases, as well as between insect pests and beneficial insects. Farmers are also now capable of ranking insect pests in terms of how damaging the pests are; they can also observe which insect pests are more important than others. Knowledge on kinds of pesticides has been enhanced, as well as on adverse impacts of pesticides. From the FFS, farmers have become aware that pesticides can affect human health, kill natural enemies and other beneficial organisms, contaminate soil and the environment in general, as well as bring about pest and disease resistance.

With their enhanced knowledge, farmers are confident that in the forthcoming season, they will be able to increase yields of chilli with reduced use of chemical pesticides. After attending the FFS, on average, farmers expect that yields will increase by 30% and pesticide use could be diminished by 33%. This is a clear indicator of good performance for the FFS carried out in Aceh.

During the PA, the team found that water constraints are a major limiting factor for vegetable production for many farmers. Greater access to low-cost drip irrigation equipment could facilitate a large increase in area planted to vegetables in Aceh.

In general the vegetable yield in Aceh is very low, cultivation is not very intensive, and the input base system is low. This means there is a huge potential for improvement in vegetable production and productivity levels in Aceh. Among the different vegetables grown, chilli dominates cash crop cultivation and chilli growers are obtaining substantial economic returns, thus many other farmers are interested in growing chilli or expanding chilli farming if they can obtain adequate technical support and infrastructure. These include support from public agencies to reduce risks with vegetable production, particularly in managing pests and diseases, the need to strengthen vegetable specific extension services like FFS, institutionalization of vegetable-specific issues in the province, and the need to strengthen the access to compost in the rural areas for managing soil fertility and rehabilitation of the land damaged by the tsunami.

Rehabilitation of vegetable production through soil and crop management is feasible.

9.2 Recommendations

9.2.1 Areas for future research and development activities

A wide range of research and development activities emerged as priorities for Aceh; some of these are listed below.

1) Integration of organic and inorganic fertilisers to improve soil quality for vegetable production systems in Aceh.

2) Options for improving drainage of soils used for vegetable production.

3) On-going education and extension campaigns and training packages to disseminate existing information to growers. Adequate technical support is integral to future development of the vegetable farming sector in Aceh.

4) While this project focused on tsunami-affected areas of five coastal districts in Aceh, these areas are not the primary vegetable production regions of the province. The highland districts of Bener Meriah and Aceh Tengah constitute the primary vegetable farming area of Aceh, and it would be quite pertinent to conduct a follow-on project to enhance vegetable production in this area.

9.2.2 Other recommendations

Circulation of large amounts of seeds falsely purporting to be from a reputable seed producer is a large problem in Aceh. More government enforcement in this area could help farmers to increase their productivity and efficiency.

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10.2 Acronyms

BPTP = Balai Pengkajian Teknologi Pertanian (Assessment Institute for Agricultural Technology, AIAT)

FCAS = Food Crops Agricultural Service (Dinas Pertanian)

FFS = Farmer Field School(s)

GOI = Government of Indonesia

ICM = Integrated Crop Management

IPM = Integrated Pest Management

IVegRI = Indonesian Vegetable Research Institute

NAD = Nanggroe Aceh Darussalam

NGO = Non-governmental organization

NSW DPI = New South Wales Department of Primary Industries

PA = Participatory assessment

10.3 List of publications produced by project

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11 Appendixes

11.1 Appendix 1: Participatory Assessment report

PARTICIPATORY ASSESSMENT

Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia

ACIAR project CP/2005/075

Australian Government
Australian Centre for International Agricultural Research

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Yusri Yusuf, KEUMANG

AVRDC The World Vegetable Center
NSW DEPARTMENT OF PRIMARY INDUSTRIES
Austcare World Humanitarian Aid

Assessment Institute for Agricultural Technology – NAD (AIAT-NAD)
Austcare
AVRDC - The World Vegetable Center
Food and Horticultural Crops Agricultural Service NAD (FHCAS NAD)
Indonesian Vegetable Research Institute (IVEGRI)
KEUMANG
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EXECUTIVE SUMMARY

A Participatory Assessment (PA) was conducted to initiate activities for the contracted ACIAR project CP/2005/075, "Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia". The PA focused on soil and other crop management constraints to vegetable production and was undertaken on 20-24 March 2007, which is during the beginning of the dry season in Aceh. The PA was conducted in tsunami-affected areas of Aceh Besar, Pidie, Bireuen and Aceh Utara Districts.

From a soils perspective, many areas visited in Aceh Besar had not yet returned to vegetable production. The effects of salinity were variable whereby it was evident in some areas but not others. Major constraints were damage to drainage and irrigation infrastructure; poor quality (saline) irrigation water; lack of fences to exclude livestock and wild animals; and a lack of equipment and labour to cultivate fields. Contrastingly, many vegetable production areas of Pidie, Bireuen and Aceh Utara are being planted again with vegetable crops, with varying levels of success. The above constraints also continue to hinder vegetable production in the latter three districts.

Nutrient deficiencies (N, P and micronutrients) were common in many of the fields visited. Soil acidity (pH < 4) was common in Aceh Besar District and highlighted the need for lime application to these soils. Most growers had access to NPK fertilizers and manure and applied them to their crops. However, it was difficult to determine whether the rates at which they were applied were effective in meeting crop nutrient requirements.

A serious thrips infestation on chili peppers was observed in Aceh Besar. Significant levels of defoliation on amaranth appear to be caused by two caterpillars, a leafroller (Lepidoptera: Pyralidae) and *Spodoptera* sp. (Lepidoptera: Noctuidae). Farmers mentioned a range of other pests and diseases which seriously damage vegetable crops in NAD. In many of the villages visited, farmers requested training on pest and disease control methods.

The PA was an effective means of identifying the issues vegetable farmers face in returning their land to post-tsunami production. These issues include damage to drainage and irrigation infrastructure, poor quality (saline) irrigation water, lack of fences to exclude livestock, and a shortage of equipment and labour to clear and cultivate damaged fields. Other crop management factors such as increased pest and disease incidence and weeds were also identified as issues requiring further investigation. Farmers involved with the PA were very supportive of the project and expressed a willingness to participate in its implementation. In particular, they were keen to receive technical information on all aspects of crop production, take part in future training activities and be involved in the participatory research program. Many farmers had been visited by Indonesian and international researchers since the tsunami but had not had any follow-up visits, highlighting the need to maintain the good will exhibited, via regular communication and project updates.

Finally, the results from the PA provide an information base for making all subsequent project decisions. The project team intends to utilize this information to design future activities to fit the needs of the stakeholders in NAD.

INTRODUCTION

The Indonesian province of *Nanggroe Aceh Darussalam* (NAD) is rich in natural resources, including a range of agricultural resources. These agricultural resources can be divided into several subsectors, including food and horticultural crops, estate crops, livestock and fisheries. Due to this richness, it is advisable to take an agricultural development strategy that is based on local resources, empowers the local people, and optimizes local potential.

Vegetables have high development potential in NAD because production and consumption are currently low. Many vegetable production areas were damaged by the tsunami of 26 December 2007; problems such as soil sodicity, salinity, and nutrient loss are still serious two years later, in addition to social problems that influence farmer productivity. To respond to this situation, the Australian Centre for International Agricultural Research (ACIAR) has funded the project, "Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia" (CP/2005/075), which focuses on four vegetable commodities: chilli pepper, tomato, cucumber and amaranth. The project was initiated with a Participatory Assessment (PA) to appraise the needs of vegetable farmers and other stakeholders in the project region (Aceh Besar, Pidie, Bireuen and Aceh Utara Districts). The PA was conducted on 20-24 March 2007; many photographs of PA activities can be found in Appendix 1. This PA was shorter than many (e.g., see Luther *et al*. 1999) due to the fact that two "scoping trips" had already been taken by project scientists during proposal preparation in 2006.

The aim of this project is to enable rehabilitation of vegetable production to help restore and enhance food security, nutrition and livelihoods. The specific objectives are to:

1. Identify constraints to the re-establishment of vegetable production on tsunami-affected soils and discover sustainable methods for overcoming these constraints.
2. Build technical capacity among researchers, extension specialists and farmers in integrated soil and crop management of vegetables.
3. Monitor and evaluate the above activities.

This report provides the results of Part 1 of the PA as defined in the Project Document (CP/2005/075), i.e., discussions with stakeholders and direct observations of vegetable crops by a multidisciplinary team. The results from Part 2, a soil/crop assessment of 20 sites, will be reported in a separate document.

METHODS

The PA was conducted through two major methods: (a) Informal interviews with farmers, agricultural research/extension staff of the Indonesian Government, and local marketing agents, using prepared questionnaires (see Appendix 3); (b) Direct observations by the PA team of vegetables and soil in farmers' fields and homegardens. To set up the interview sessions and PA locations, a pre-survey was conducted on 13-15 March 2007. A planning meeting to familiarize the team with PA procedures and finalize the questionnaires was held at the BPTP-NAD office on 20 March 2007. Field activities were carried out on 21-23 March 2007 in four districts (*Kabupaten*) of *Nanggroe Aceh Darussalam* Province, i.e., Aceh Besar, Pidie, Bireuen and Aceh Utara. In Aceh Besar, the PA was conducted in five subdistricts (*Kecamatan*): Peukan Bada, Lhoknga, Darussalam, Baitussalam and Mesjid Raya. In Pidie the subdistricts represented were Simpang Tiga and Tringgadeng. In Bireuen the PA was undertaken in Kuala Subdistrict, while in Aceh Utara it was conducted in Samudra Subdistrict. The total number of people interviewed per village ranged from 10-25; these were mostly farmers but some middlemen were also involved. To some extent people came and went during the course of the interviews due to other commitments, but the gender breakdown was approximately 85% men and 15% women.

The PA teams by district were as follows:

1. Aceh Besar: Basri A. Bakar, Yufniati ZA, Manuel Palada, Gregory Luther, Chris Dorahy, Fenti Ferayanti, Tamrin, Yatiman, Peter Ooi and Novita Rayyan.
2. Pidie, Bireuen and Aceh Utara: Rachman Jaya, Burlis Han, M. Ferizal, Saufan Daud, Abdul Azis, Subhan, Rakhmat Sutarya, Yusri Yusuf, Ariyati Silmi and Julie S. Avolita.

A wrap-up meeting was held on 24 March 2007 during which each team reported major results to the other and discussed specific and overall conclusions.

RESULTS

Responses from Informal Interviews

Vegetable crops cultivated in the project area include chilli pepper, tomato, cucumber, amaranth, shallot, yard-long bean, watermelon and kangkong. Each location shows chili pepper to be a major vegetable, but there are differences in other vegetables cultivated (Table 1). In Kotakrueng, for example, the farmers do not grow tomato but they grow other vegetables such as yard-long bean, cucumber and amaranth.

Table 1. General conditions of vegetable cultivation in four locations of northeastern Aceh.

District/Subdistrict	Location (Village)	Number of farmers	Farm area (ha)	Years of experience with vegetable cultivation	Kinds of vegetables	Source of seed
Pidie/Simpang Tiga	Meunasah Lhee	4	< 0,5	15-20	Ch, To, Cu, Am, Sh	Shop
Pidie/Trieng Gading	Meue	3	< 0,5	15-20	Ch, To, Cu, Am, Wm, Ka	Shop
North Aceh/ Samudra	Kotakrueng	3	0,5- 1.0	15-20	Ch, Cu, Am, Yb, Wm	Shop
Bireuen/ Koala	Ujung Belang Mesjid	3	< 0.5	> 15	Ch, Cu, Am, To, Sh	Shop

Note: Ch= Chilli, To= tomato; Cu= cucumber; Am= Amaranth; Wm= watermelon; Sh= shallot; Yb= yard-long bean; Ka= kangkong.

Farmers generally cultivate vegetables in the ricefields after they harvest rice planted in the rainy season (Table 2). They usually plant vegetables in April or June/July. However, in Kota Krueng, the farmers plant vegetables anytime in the dry land, and they do not plant vegetables in ricefields. Therefore, they can plant rice twice in a year.

Tractors are mainly used for initial land preparation, thereafter manual (men and women) labor is used to construct beds. The bed width is usually 60-80cm with a height of 10-15cm. They use silver plastic mulch for chilli and tomato. Chilli and tomato seeds are first sowed in plastic bags before planting in the field. In Meunasah Lhee, cucumber seeds are sowed in plastic bags before planting, but in other locations the cucumber seeds are sowed directly on the prepared bed (Table 2). To control pests and diseases the farmer sprays pesticides as much as 2-3 times per week for chilli and tomato, once per week for cucumber and 0-1 times per season for amaranth. Other measures to control pests and diseases are never used by the farmers; the only method they know for preventing pest damage to vegetables is the application of pesticides. They harvest vegetables several times, i.e., 4-10 times per season, and their produce is sold directly to the traditional market or middleman.

Table 2. Management of vegetable cultivation in four locations of northeastern Aceh.

Activities	Village			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Crop rotation	Rice - vegetable	Rice- vegetable	Veg- veg (dry land) Rice – rice (field rice)	Rice- vegetable
Irrigation	Well	Well	Well	Well
Planting time of vegetable	June/July	April	Any time (dry land)	June/July
Land preparation	Tractor	Tractor	Tractor	Tractor
Planting system - Chilli & tomato - Cucumber & amaranth	 Bed+ mulch Bed	 Bed+mulch Bed	 Bed+mulch Bed	 Bed+mulch Bed
Nursery: - Chilli & Tomato - Cucumber - Amaranth	 Plastic bag Plastic bag Sowing	 Plastic bag Direct Sowing	 Plastic bag Direct Sowing	 Plastic bag Direct Sowing
Weeding	Traditional	Traditional	Traditional	Traditional
Spraying : - Chilli & tomato - Cucumber - Amaranth	 2-3 times/wk 1 time/ wk 0-1 time/season	 2-3 times/wk 1 time/ wk 1 time/season	 2-3 times/ wk 1 time/wk 1 time/season	 2-3 times/wk 1 time/wk none
Other pest control	none	none	none	none
Harvesting	4-8 times	5-6 times	4-8 times	5-10 times
Marketing	Market/middle man	Market	Market/middle man	Market/ middle man

Farmers are using three kinds of fertilizers for vegetable cultivation: NPK, Urea and KCl (Table 3). Chilli pepper and tomato crops usually use all three fertilizers. Cucumber is fertilized with NPK, urea or both. Urea is the only fertilizer applied for amaranth cultivation. Cow manure is used with all four vegetables at all locations in different dosages. Gypsum and lime are never applied by farmers to improve soil fertility.

Table 3. Fertilizers used for vegetable crops in four locations of northeastern Aceh.

Fertilization Usage	Village			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
History of fertilization:				
- Chilli	NPK, Urea, KCl	NPK, Urea, KCl	NPK, Urea	NPK, Urea, KCl
- Tomato	NPK, Urea, KCl	NPK, Urea, KCl	-	NPK, Urea, KCl
- Cucumber	NPK	NPK, Urea	NPK	Urea
- Amaranth	Urea	Urea	Urea	Urea
Stable manure usage:				
- Chilli	Yes	Yes	Yes	Yes
- Tomato	Yes	Yes	-	Yes
- Cucumber	Yes	Yes	Yes	Yes
- Amaranth	Yes	Yes	Yes	Yes
Nutritional deficiency:				
- Chilli	P & K deficiency	P deficiency	-	-
- Tomato	P & K deficiency	-	-	-
- Cucumber	-	-	-	-
- Amaranth	-	-	N deficiency	-
Gypsum or lime usage:	No	No	No	No

In most cases, farmers only know that "worms" attack vegetables, and they rarely distinguish other pests and diseases from these (Table 4). Farmers' knowledge of pests and especially diseases is still poor and they do not differentiate clearly among the wide range of organisms attacking vegetables in Aceh. The insect pests attacking chilli are thrips, *Spodoptera* sp., and aphids, while diseases of chilli are anthracnose, leaf malformation, virus and wilt. Yield reduction caused by pests and diseases on chilli is 20%-50%. The main pest of tomato is *Helicoverpa* sp., while diseases are wilt and virus. Yield reduction caused by pests and diseases on tomato ranges from 30% to 50%.

Cucumber is attacked by worms and aphids. Symptoms of diseases on cucumber plants seem to indicate wilt and leaf yellowing. Amaranth is sometimes attacked by worms and white blister on the leaves. Pesticides are used by farmers to control pests and diseases on vegetables. Farmers buy them from pesticide shops, where they also get some information on how to control pests and diseases on vegetables, but most farmers do not remember the names of pesticides they used.

Table 5 provides Aceh Besar farmers' responses regarding the most damaging pests and diseases on the four priority vegetable crops for this project.

Table 4. Pests and diseases infesting chilli, tomato, cucumber and amaranth in four locations of northeastern Aceh.

Village	**Commodities**			
	Chilli pepper	**Tomato**	**Cucumber**	**Amaranth**
Meunasah Lhee:				
- Pest / disease	Sp, Th/ Vr, An	Ha, Wf/ Wl, Vr	Be, Aph/ ly	Wo/Al
- Yield reduction	20%	50%	30%	20%
- Control measure	2-3 times/wk	3 times/wk	1 time/wk	1 time/season
- Control successful?	Successful	Not successful	Successful	Successful
Meue:				
- Pest & disease	Sp, Th/ mfl, wl, An	Ha/ Wl, Vr	Wo, Aph/Ly	Wo/
- Yield reduction	40%	30%	20%	20%
- Control measure	2-3 times/wk	2-3 times/wk	0-1 time/wk	-
- Control successful?	Not successful	Not successful	Successful	Successful
Kota Krueng				
- Pest & disease	Wo, Th, Aph/ An, Mlf, Wl	-	Wo, Aph/ Ly, wl	
- Yield reduction	50%		10%	
- Control measure	2-3 times/ wk		1 time/ wk	
- Control successful?	Not successful		Successful	
Ujung Belang Mesjid:		-		
- Pest & disease	Th, Aph/ An, Lmf		Wo,Wf/ Ly	Wo/Al
- Yield reduction	20-50%		20-30%	50-70%
- Control measure	2-3 times/wk		1 time/ wk	1 time/wk
- Control successful?	Not successful		Successful	Not successful

Note: Wo= worm; Th= Thrips; Sp= *Spodoptera* sp.; Wf= Whitefly; Be= Beetles; Aph= Aphids; An= Anthracnose; Mlf= leaf malformation; Vr= virus; Al= Albugo disease; Wl= wilt; Ly= Leaf yellowing.

Table 5. Farmers' responses in Aceh Besar regarding the most damaging pests and diseases on chili pepper, tomato, cucumber and amaranth.

Location (Village, Subdistrict)	Chili pepper	Tomato	Cucumber	Amaranth
Braden, Peukan Bada	Grasshoppers, caterpillars, wild boars, leaf curl virus	Whiteflies, leafhoppers	*Kutu* (aphids?), red flying beetle, dark green flying beetle	Amaranth not planted much here because not easy to sell
Miruek Taman, Darussalam	Whiteflies, fungus on roots, leaf curl virus (geminivirus)	White fungus on roots makes plants wilt; caterpillars feed on leaves and fruits; whiteflies; wrinkled leaves (virus?)	Caterpillars feed on shoots and leaves; foggy weather makes plants die; small moth lays eggs that hatch into caterpillars	Caterpillars can damage up to 100% of crop
Kling Cot Arun, Baitussalam	Whiteflies, wrinkled leaves (virus?), crickets, grasshoppers, cutworms, white grubs (scarab larvae), rotting fruits (anthracnose and/or Ca deficiency?), fungi	Fruit borer which also feeds on leaves; whiteflies; grasshoppers; crickets; wilt which causes a rotten stem	Powdery mildew (when fog comes in, leaves get white on edges)	Caterpillars; whiteflies; mealybugs
Ladong, Masjid Raya	Wild boars; monkeys; wrinkled leaves (virus?); fruit rotting from the bottom up (Ca deficiency?); fruit drop; fungus on roots	Roots rot at time of fruiting; fruit borer; young plants wilt	Sucking insect on fruit; defoliator with red luminescence that comes out at night	Amaranth not grown in this area

Inundation of agricultural fields by the tsunami is quite different at each location but it ranges from about 1.5 to 10 hours depending on each location's topography (Table 6). The maximum depths of inundation are 2.0, 1.0, 1.5 and 1.5 meters, respectively, for Meunasah Lhee, Meue, Kota Krueng and Ujung Belang Mesjid.

Table 6. Tsunami-related issues in four locations of northeastern Aceh.

Characteristic or issue	Village			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Field inundated (hr)	10	6	1.5	6
Inundation depth (m)	2	1	1.5	1.5
Sedimentation depth (cm)	10	10	15	10
Other material deposited	Yes	Yes	Yes	Yes
Vegetable cultivation after tsunami (mth)	18	8	24	5
Crop yield after tsunami	Good	Good	Good	Good

The tsunami deposited 10 – 15 cm of soil and sediment in farmers' fields in PA locations of Pidie, Bireuen and Aceh Utara. The tsunami also deposited other materials such as trees, remnants of houses, etc. and these farmers removed these materials from their fields. They did not compost the organic materials, however. Vegetable cultivation after the tsunami was recommenced by different farmers at different times. Farmers in Meunasah Lhee, Meue, Kota Krueng and Ujung Belang Mesjid started vegetable cultivation again at 18, 8, 24 and 5 months, respectively, after tsunami incidence. Crop yields after the tsunami commonly have shown good results in these areas of Pidie, Bireuen and Aceh Utara.

Soil fertility is poor in Meunasah Lhee, but in Meue, Kota Krueng and Ujung Belang Mesjid it is better (Table 7). These locations have top soil that is 20 – 30 cm deep. Water drainage is good in Meue, Kota Krueng and Ujung Belang Mesjid; however, it is poor in Meunasah Lhee.

Table 7. Characteristics of soil and soil management in four locations of northeastern Aceh.

Soil Characteristic	**Village**			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Soil fertility	Poor	Good	Good	Good
Top soil depth (cm)	20	25-30	25-30	25-30
Water drainage	Poor	Good	Good	Good
Soil structural problems	Yes	No	No	No
Soil salinity	Yes	Yes	Yes	Yes

For the most part, farmers make their own decisions to grow a particular vegetable crop (Table 8). They sometimes sell their produce directly at the market, but they also sell to middlemen sometimes. The farmer does not have access to any information to obtain better prices.

Table 8. Marketing of vegetables in four locations of northeastern Aceh.

Activities	**Village**			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Decision to grow a particular vegetable	Self	Self	Self	Self
Where farmers sell vegetable produce	Market/middle man	Market	Market/middle man	Market/ middle man
Facilities to get good price	No	No	No	No

Water pumps are needed by farmers to pump irrigation water from wells (Table 9). Information to increase farmer knowledge in the area of pest and disease control is very urgent for the farmers in all locations. Farmers are hoping for better availability of fertilizers and pesticides, and this is especially true for poor farmers.

Table 9. Needs and requests of farmers for future activities of vegetable cultivation in four locations of northeastern Aceh.

Needs and requests	Village			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Equipment	Water pump	Water pump	Water pump	Water pump
Information	Training on pests and diseases	Training on pests and diseases	Training on pests and diseases	Training on pests and diseases
Resources	Fertilizer and pesticide	Fertilizer and pesticide	Fertilizer and pesticide	Fertilizer and pesticide

Responses to the questionnaires are summarized below, for farmers in Table 10, for Government of Indonesia (GoI) research and extension staff in Table 11, and for marketing agents in Table 12.

Table 10. Summary of farmer responses (numbers correspond to questions in the questionnaire in Appendix 3).

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
1.	Location	Ladong Village, Mesjid Raya Subdistrict Kleng Cot Aroun Village, Baitussalam Subdistrict Nusa Village, Lhoknga Subdistrict Beuraden Village, Peukan Bada Subdistrict	Meunasah Lhee Village, Simpang Tiga Subdistrict Jaja Tunong Village, Simpang Tiga Subdistrict Meue Village, Tringgadeng Subdistrict	Ujong Blang Mesjid Village, Kuala Subdistrict	Kuta Krueng Village, Samudera Subdistrict
2.	Farmers' names	Available on request	Available on request	Available on request	Available on request
3.	Farm size	< 0.5 - 1 ha	< 0.5 - 1 ha	< 0.5 - 1 ha	< 0.5 - 1 ha
4.	Land tenure	Tenant	Tenant	Tenant	Tenant
5.	Major occupation	Farmer	Farmer	Farmer	Farmer
6.	Length of time farming	> 20 years	> 10 years	> 20 years	> 20 years
7.	Length of time vegetable farm in production	5 - 40 years	3 - 30 years	4 - 30 years	4 - 30 years
8.	Vegetables grown	Chilli pepper, tomato, cucumber, Chinese cabbage, maize, watermelon, cassava, and groundnut	Chilli pepper, tomato, cucumber, amaranth, yard-long bean, and shallot	Chilli pepper, tomato, cucumber, amaranth, yard-long bean, and Chinese cabbage	Chilli pepper, tomato, cucumber, amaranth, yard-long bean, shallot, cassava, and Chinese cabbage
9.	Source of seeds or seedlings	Stores/kiosks in Pasar Aceh and Lambaro	Stores/kiosks in subdistrict capitals and Sigli	Stores/kiosks in the city of Bireuen	Stores/kiosks in Geudong
10.	Hybrids or traditional varieties of vegetables	Hybrids	Hybrids	Hybrids	Hybrids
11.	Names of varieties planted	Chili pepper: TM 99 and TM 88 Tomato: Dona, Intan	Taiwan brand	Taiwan brand	Taiwan brand
12.	Crop management practices for 4 priority vegetables	Covered in other parts of this report	Covered in other parts of this report	Covered in other parts of this report	Covered in other parts of this report
13.	Kinds of irrigation	Rainfed	Rainfed	Rainfed	Rainfed

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
14.	Seasonal calendar	See Appendix 3	See Appendix 3	See Appendix 3	See Appendix 3
15.	Yields for 4 priority vegetable crops	Chili pepper: 1 kg/ plant	Chili pepper: 2t/ha Tomato: 6 t/ha Cucumber: 4 t/ha Amaranth: 1600 - 2000 bunches/ha	Chili pepper: 1 Kg/plant Tomato: 3 - 5 kg/plant Cucumber: 5 - 6 Kg/plant Amaranth: 5000 – 10,000 bunches/ha	Chili pepper: 1 Kg/plant Tomato: 3 - 4 kg/plant Cucumber: 5 - 6 Kg/plant Amaranth: 5000 – 10,000 bunches/ha
16.	Crop rotation	Some farmers rotate with other crops, some do not	Some farmers rotate with other crops, some do not	Some farmers rotate with other crops, some do not	Some farmers rotate with other crops, some do not
17.	Effects from tsunami	Damaged farmland, increased pest/disease problems	Damaged farmland, increased pest/disease problems	Damaged farmland, increased pest/disease problems	Damaged farmland, increased pest/disease problems
18.	Fields inundated how long	5 minutes - 2 months	1 hour - 1 day	2 hours - 1 day	1 hour
19.	Maximum depth of inundation	1 - 5 meters	30 cm - 1 meter	40 cm - 1 meter	50 cm - 1 meter
20.	Depth of sediment left by tsunami	1 - 60 cm	Approx. 10 cm	Approx. 10 cm	Approx. 10 cm
21.	Other materials left by tsunami	Parts of trees, boats, houses, etc.	Parts of trees, boats, houses, etc.	Parts of trees, boats, houses, etc.	Parts of trees, boats, houses, etc.
22.	How soon after tsunami can grow vegetables successfully	Some farmers as soon as 1 month, others longer, but many still cannot grow vegetables successfully	1 month to 1 year	1-5 months	1-5 months
23.	Affected fields planted after tsunami	Planted 1-3 times, results unsatisfactory in most areas, but satisfactory in Nusa	Planted 2 times; first time unsatisfactory, second time relatively good	Planted 3 times, with good results	Planted 2 times, with good results
24.	Vegetable crop yields since the tsunami	Chili pepper: 1 kg/ plant	Chili pepper: 2t/ha Tomato: 6 t/ha Cucumber: 4 t/ha Amaranth: 1600 - 2000 bunches/ha	Chili pepper: 1 Kg/plant Tomato: 3 - 5 kg/plant Cucumber: 5 - 6 Kg/plant Amaranth: 5000 – 10,000 bunches/ha	Chili pepper: 1 Kg/plant Tomato: 3 - 4 kg/plant Cucumber: 5 - 6 Kg/plant Amaranth: 5000 – 10,000 bunches/ha

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
25.	Reasons for reduced crop productivity	Fields are not fertile enough; pest and disease attacks	Fields are not fertile enough; pest and disease attacks	Fields are not fertile enough; pest and disease attacks	Fields are not fertile enough; pest and disease attacks
26.	Fertility of soil	Not fertile enough	Not fertile enough	Not fertile enough	Not fertile enough
27.	Depth of topsoil	20 - 50 cm	10 - 30 cm	10- 20 cm	10- 20 cm
28.	Drainage of water after rain/irrigation	Drains quickly	Drains quickly	Drains quickly	Drains quickly
29.	Soil tests on farmer's land	Conducted by BPTP NAD and ACIAR Australia	Conducted by a Japanese organization, but farmers never heard the results	Never conducted	Never conducted
30.	Fertilizer used on vegetable fields	Urea, KCl, SP-36, NPK and manure	Urea: 100 kg/ ha KCl: 80 kg/ ha NPK: 50 kg/ha Manure: 50 kg/ha	Urea, KCl, SP-36, NPK and manure	Urea, KCl, SP-36, NPK and manure
31.	Source and cost of fertilizer	From ag kiosk. Prices are: Urea: Rp.1750/kg KCl: Rp. 2000/kg NPK: Rp. 4500/kg Manure is not purchased	From ag kiosk. Prices are: Urea: Rp.1750/kg KCl: Rp. 2000/kg NPK: Rp. 4500/kg Manure is not purchased	From ag kiosk. Prices are: Urea: Rp.1750/kg KCl: Rp. 2000/kg NPK: Rp. 4500/kg Manure is not purchased	From ag kiosk. Prices are: Urea: Rp.1750/kg KCl: Rp. 2000/kg NPK: Rp. 4500/kg Manure is not purchased
32.	Use of animal manures or compost	Yes	Yes	Yes	Yes
33.	Use of gypsum or lime	No	No	No	No
34.	Difficulty of obtaining fertilizers	Manures not difficult Inorganic fertilizers not difficult Have only heard of gypsum	Manures not difficult Inorganic fertilizers not difficult Never heard of gypsum	Manures not difficult Inorganic fertilizers not difficult Never heard of gypsum	Manures not difficult Inorganic fertilizers not difficult Never heard of gypsum
35.	Nutritional deficiencies in vegetable crops	Some show deficiencies but some are fine	Some show deficiencies but some are fine	Some show deficiencies but some are fine	Some show deficiencies but some are fine
36.	Diagnoses of crop problems by ag officers	Diagnoses were made by officers, who gave suggestions for solving the problems	Diagnoses were made by officers, who gave suggestions for solving the problems	Diagnoses were made by officers, who gave suggestions for solving the problems	Diagnoses were made by officers, who gave suggestions for solving the problems

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
37.	Soil salinity problems since the tsunami	Salinity has been a problem, but land is back to normal in some areas	Salinity has been a problem. Farmers try to wash away salts by watering; rainfall also helps.	Soils have been somewhat saline. Farmers try to wash away salts by watering; rainfall also helps.	Soils have been somewhat saline. Farmers try to wash away salts by watering; rainfall also helps.
38.	Soil cultivation methods	Manually	Manually	Manually	Manually
39.	Bed preparation and use of plastic mulch	Soil is overturned with a large hoe, plowed, and beds and furrows are made. Plastic mulch is used.	Soil is overturned with a large hoe, plowed, and beds and furrows are made. Plastic mulch is used.	Soil is overturned with a large hoe, plowed, and beds and furrows are made. Plastic mulch is used.	Soil is overturned with a large hoe, plowed, and beds and furrows are made. Plastic mulch is used.
40.	Permanent beds used for vegetables?	Usually not	Usually not	Usually not, but there are some that are permanent	Usually not
41.	Field drainage methods	Through furrows	Through furrows	Through furrows	Through furrows
42.	Soil structural problems	Problems are present	Problems are present: poor root growth	Problems are present	Problems are present
43.	Crop residue management	Pulled up and burned	Pulled up and burned	Pulled up and burned	Pulled up and burned
44.	[no question]	-	-	-	-
45.	Most damaging pests and diseases	See Table 5	See Table 4	See Table 4	See Table 4
46.	Pest and disease damage since the tsunami	Increased	No change	Increased	Increased
47.	Source of pest and disease control information	BPTP NAD, the Food Crops Agricultural Service (*Dinas*) and extension agents (*PPL*)	Food Crops Agricultural Service (*Dinas*), Pidie District	Food Crops Agricultural Service (*Dinas*), Bireuen District	Food Crops Agricultural Service (*Dinas*), Aceh Utara District
48.	Traditional pest control methods	None used	None used	None used	None used
49.	Had training in pest/disease control	No	Only one farmer interviewed had training	No	No
50.	Natural enemies on vegetables	Farmers are aware these are present	Farmers are aware these are present	Farmers are aware these are present	Farmers are aware these are present

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
51.	Actions that affect natural enemies	Some farmers aware that pesticides kill natural enemies	Some farmers aware that pesticides kill natural enemies	Some farmers aware that pesticides kill natural enemies	Some farmers aware that pesticides kill natural enemies
52.	Monitor pests/diseases before spraying pesticides?	Yes	Yes	Yes	Yes
53.	Factors influencing decision to grow which vegetable crop	High prices	High prices	High prices	High prices
54.	Vegetables sold immediately after harvest?	Yes	Yes	Yes	Yes
55.	How vegetables are sold	Some farmers sell directly at the market, others sell to a middleman	Some farmers sell directly at the market, others sell to a middleman	Some farmers sell directly at the market, others sell to a middleman	Some farmers sell directly at the market, others sell to a middleman
56.	Role of farmers' group or organization	Farmers are members, but the group does not have any role in deciding prices	Farmers are members, but the group does not function effectively	Farmers are members, but the group is not useful	Farmers are members, but the group cannot help improve prices for selling vegetables
57.	Greatest needs to overcome impacts from tsunami	Capital for hiring labor; Water pumps; Technological aid; Agricultural inputs; If trainings are held, farmers request to be included.	Capital for hiring labor; Water pumps; Technological aid; Agricultural inputs; If trainings are held, farmers request to be included.	Capital for hiring labor; Water pumps; Technological aid; Agricultural inputs; If trainings are held, farmers request to be included.	Capital for hiring labor; Water pumps; Technological aid; Agricultural inputs; If trainings are held, farmers request to be included.
58.	Information needed	On all topics	On all topics	On all topics	On all topics

Table 11. Summary of responses from staff at AIAT-NAD and the Food and Horticultural Crops Agricultural Service NAD (numbers correspond to questions in the questionnaire in Appendix 3).

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
1.	Changes in market for vegetables over past 5 years	Increase, especially for chili pepper and tomato; does not differ by season.	Increase in production, especially during the rainy season	Increase in production, especially during the rainy season	Increase in production, especially during the rainy season
2.	How farmers decide which vegetables to grow	Primarily those which are marketable and farmers know production technologies for	Primarily those which are marketable and farmers know production technologies for	Primarily those which are marketable and farmers know production technologies for	Primarily those which are marketable and farmers know production technologies for
3.	Information requested since tsunami	Field improvement; pest and disease control	Field improvement; pest and disease control	Field improvement; pest and disease control	Field improvement; pest and disease control
4.	Assisting farmers with soil/plant testing	Have done so, but no results yet	Have done so, but no results yet	Never	Never
5.	Assisting farmers with fertilizer decisions	Yes, regarding types, application rates and timing	Yes, regarding types, application rates and timing	Yes, regarding types, application rates and timing	Yes, regarding types, application rates and timing
6.	# of farmers per Extension Agent	6000 farmers / Ag Extension Agent	5800 farmers / Ag Extension Agent	6000 farmers / Ag Extension Agent	5000 farmers / Ag Extension Agent
7.	Vegetable storage facilities provided by Dept. of Agriculture	None at present	None at present	None at present	None at present
8.	Post-harvest technologies promoted by Dept. of Agriculture	Tomato ketchup production	Tomato ketchup production	Tomato ketchup production	Tomato ketchup production
9.	Major pests and diseases of vegetable crops. Severity increased since tsunami?	Wrinkled leaves (virus) on chili pepper; Fusarium wilt; wrinkled leaves (virus) on tomato; thrips on cucumber; grasshoppers on amaranth. Pest and disease levels tend to be higher since tsunami.	Wrinkled leaves (virus) on chili pepper; Fusarium wilt; wrinkled leaves (virus) on tomato; thrips on cucumber. Pest and disease levels are higher since tsunami.	Wrinkled leaves (virus) on chili pepper; Fusarium wilt; wrinkled leaves (virus) on tomato; thrips on cucumber. Pest and disease levels tend to be higher since tsunami.	Wrinkled leaves (virus) on chili pepper; Fusarium wilt; wrinkled leaves (virus) on tomato; thrips on cucumber. Pest and disease levels tend to be higher since tsunami.
10.	Soil fertility and plant nutrition issues for vegetables. Severity increased since tsunami?	Lack of soil fertility. Very serious.	Lack of soil fertility. Very serious.	Lack of soil fertility. Very serious.	Lack of soil fertility. Very serious.
11.	Other issues regarding vegetable crops	None	None	None	None

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
12.	Research done on vegetables	Field fertility	Field fertility	None	None
13.	Research needs on vegetables	Pest/disease control, new superior varieties, correct fertilizer rates	Pest/disease control, new superior varieties, correct fertilizer rates	Pest/disease control, new superior varieties, correct fertilizer rates	Pest/disease control, new superior varieties, correct fertilizer rates
14.	How research results have been extended	Through media such as bulletins, leaflets and brochures, and by direct demonstration	Through media such as bulletins, leaflets and brochures, and by direct demonstration	Through media such as bulletins, leaflets and brochures, and by direct demonstration	Through media such as bulletins, leaflets and brochures, and by direct demonstration
15.	Successful and unsuccessful technology adoption experiences	Successes: use of inorganic fertilizer, mulch and manure. Failures: mistakes in predicting seasons.	Successes: use of inorganic fertilizer, mulch and manure. Failures: mistakes in predicting seasons.	Successes: use of inorganic fertilizer, mulch and manure. Failures: mistakes in predicting seasons.	Successes: use of inorganic fertilizer, mulch and manure. Failures: mistakes in predicting seasons, false seeds, lack of manure.

Table 12. Summary of responses from marketing agents (numbers correspond to questions in the questionnaire in Appendix 3).

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
1.	Product quality	Very important and there are price differences based on quality	Very important and there are price differences based on quality	Very important and there are price differences based on quality	Very important and there are price differences based on quality
2.	Lowest and highest prices for 4 vegetables	Chilli: Rp 35,000/kg-1500/kg Tomato: Rp 12,000/kg-750/kg Cucumber: Rp 2,500/kg-200/kg Amaranth: Rp 500-150/bunch	Chilli: Rp 30,000/kg-1500/kg Tomato: Rp 12,000/kg-750/kg Cucumber: Rp 2,500/kg-200/kg Amaranth: Rp 350-150/bunch	Chilli: Rp 35,000/kg-1500/kg Tomato: Rp 12,000/kg-750/kg Cucumber: Rp 2,500/kg-200/kg Amaranth: Rp 350-150/bunch	Chilli: Rp 35,000/kg-1500/kg Tomato: Rp 12,000/kg-750/kg Cucumber: Rp 2,500/kg-200/kg Amaranth: Rp 350-150/bunch
3.	Where they buy vegetables	Directly from farmers	Directly from farmers	Directly from farmers	Directly from farmers
4.	Vegetables exported?	No	No	No	No
5.	Middlemen have binding agreements with farmers so farmers can’t sell vegetables freely?	No	No	No	No
6.	Price difference between farmer and market levels	Chilli: Rp 5000/kg Tomato: Rp 1000/kg Cucumber: Rp 500-700/kg Amaranth: 50%	Chilli: 4000-5000/kg Tomato: Rp 1000-1250/kg Cucumber: Rp 500-700/kg Amaranth: 50%	Chilli: Rp 5000/kg Tomato: Rp 1000/kg Cucumber: Rp 500-700/kg Amaranth: 50%	Chilli: Rp 4000/kg Tomato: Rp 1000/kg Cucumber: Rp 500-700/kg Amaranth: 50%

Direct Observations by the PA Team

This section highlights the PA team's direct observations of the farms and surrounding environment. However, some related feedback from farmers is intermixed to clarify details.

Soil Issues

Nusa, Lhoknga, Aceh Besar: This village was not as badly affected as many other areas within Aceh. Sediment deposits were in the order of 20-30cm, although they were up to 50cm in some fields. Much of the vegetable farming is back to normal; many of the farmers interviewed had recommenced farming a couple of months after the tsunami. There were some problems with salinity, although most farmers reported that the land is fairly well back to normal in most areas.

Braden, Peukan Bada, Aceh Besar: This area was much more severely affected than Nusa village. Here the fields were inundated for up to 1 week. The depth of inundation was around 4-5m and the depth of sediment (mud) deposits was around 50cm. Rice yields continue to be around 50% of those pre-tsunami. Vegetables were previously grown in rotation with rice but most farmers have not recommenced vegetable production since the tsunami. A preliminary soil assessment was undertaken in one of the farmer's fields (Fig. 1). Tsunami deposits, salt, crusting and dispersion were evident on the soil surface in a neighboring field (Fig. 2).

Figure 1. Aceh Besar PA team taking soil samples in farmer's field near Braden Village, Peukan Bada Sub-district, Aceh Besar District.

Figure 2. Evidence of tsunami deposits, salt, crusting and dispersion on the soil surface of a farmer's field near Braden Village, Peukan Bada Sub-district, Aceh Besar District.

Miruek Taman, Darussalam, Aceh Besar: The depth of inundation was up to 4m in some areas, although the sea water receded after 1 day in most areas and left up to 15cm of sediment deposits. The lowland rice and vegetable growing areas remain severely affected and farmers have not attempted to grow vegetables again after repeated crop failures. One of the main issues in lowland areas is damage to drainage and irrigation infrastructure, meaning that it is difficult to drain water from the fields (Fig. 3). Many lowland rice and vegetable fields have been abandoned and remain under water (Fig. 3). Irrigation and drinking water is also saline. Many farmers grow turf in their home gardens as their sole form of income. The main needs of the farmers include fences, tractors for cultivating the fields, seeds and fertilizers as well as training in new farming practices.

Figure 3. The tsunami damaged irrigation and drainage infrastructure (top) making it difficult to deliver irrigation water and drain lowland rice and vegetable fields, which remain derelict (bottom).

A preliminary soil assessment was undertaken in an upland field of amaranth near the village. The soil was not saline although it was very acidic (pH < 4). The amaranth exhibited symptoms of nitrogen and micro-nutrient (Fe) deficiency (Fig. 4). The soil was not saline, although sub-surface soil adjacent to some tomato plants had increased salinity (EC 0.7 dS/m) as a consequence of being irrigated with saline well water (EC 3.26 dS/m).

Figure 4. Soil acidity (pH<4) is likely to have contributed to micro-nutrient deficiency in an upland crop of amaranth growing near Miruek Taman Village, Darussalam Sub-district, Aceh Besar District. Nitrogen deficiency is also suspected.

Kling Cot Arun, Baitussalam, Aceh Besar: Some of the fields in this village have 50-60cm of sediments and many lowland rice and vegetable fields have become swamps because of inadequate drainage. Many farmers now concentrate on growing vegetables in home gardens and have had to bring in soil from elsewhere to establish vegetable beds. The key challenges faced by farmers with upland fields include the lack of fences to enable rehabilitation of fields and the need for labour to clear debris from the fields. Many of the wells have also become saline and so it is difficult to source good quality irrigation water.

An assessment of a derelict upland vegetable field, previously used to grow chilies, tomatoes, cucumbers and amaranth, was undertaken. The soil was not saline but much debris (e.g. Car tyre rims, bricks, cement and other building material) has made it difficult to cultivate and resulted in weed invasion (viz. *Ipomoea* spp.) (Fig. 5). The soil did not exhibit evidence of dispersion although the surface was hard-setting and was acidic (pH 4.8 surface to 3.1 at 10 cm). It also had poor infiltration (Fig. 6).

Figure 5. Sediment, debris, weed invasion and a lack of fences to exclude livestock has made it difficult for the farmer of this field near Kling Cot Arun village in Baitussalam Sub-district, Aceh Besar District, to recommence vegetable production.

Figure 6. Poor water infiltration was observed in a derelict vegetable field near Kling Cot Arun village in Baitussalam Sub-district, Aceh Besar District.

Ladong, Masjid Raya, Aceh Besar: This village is on the coast and the tsunami came in and out very quickly with 2 inundations, 10 minutes apart. The level of inundation was high (2m) although the water receded after only 5 minutes. Typically, only 1-2 cm of sandy sediment was deposited on farmers' fields. However, many growers reported crop failures since the tsunami as a consequence of pests and diseases. They also expressed a need for fencing to exclude pigs and wild animals, as well as tractors to overcome labour shortages in aging farming populations. They were also keen to receive training in how to grow the 4 priority crops in the project.

Soil samples from all four districts: Soil samples were taken at several locations in vegetable farmers' fields affected by the tsunami in the districts of Pidie, Bireuen, Aceh Utara and Aceh Besar; subdistricts and villages are listed below in Table 13. These samples were taken on land presently planted with vegetables, land where vegetables had recently been harvested, and land normally used for growing vegetables (chilli pepper, tomato, amaranth and cucumber). Nutrient deficiencies were observed in certain locations, such as P and K deficiency symptoms on tomato (Meunasah Lhee), P deficiency symptoms on chilli (Meue) and N deficiency symptoms on amaranth (Kota Krueng). A more detailed evaluation and analysis is provided in Table 14.

Table 13. Soil sampling areas.

District	Subdistrict	Village	Vegetables Planted at Present	Vegetables Harvested	Vegetables Normally Grown on this Land
Pidie	Simpang Tiga	Meunasah Lhee Jaja Tunong	Tomato (P, K deficiency) Tomato (N, K deficiency)	- -	Chilli, Tomato and Amaranth Chilli, Tomato and Amaranth
Pidie	Tringgadeng	Meue	Chilli (P deficiency)	Cucumber, Amaranth	Chilli, Tomato and Amaranth
Bireuen	Kuala	Ujong Blang Mesjid	-	Amaranth	Cucumber, Chilli and Kangkung
Aceh Utara	Samudra	Kuta Krueng	Amaranth (N deficiency) Kangkung (N deficiency)	Tomato	Chilli
Aceh Besar	Darussalam	Miruek Taman	Amaranth (N and micronutrient deficiency); Cassava (P deficiency)	Amaranth, tomato, cassava, watermelon	Amaranth, tomato, cassava, watermelon. Farmers keen to grow chili again.

Table 14. Evaluation of Soil Characteristics.

District	Sub District	Village	Soil Properties
Pidie	Simpang Tiga	Meunasah Lhee	Low land Root architecture : Several restricted Depth of water table (m) : 0.01 m pH (soil pH field kit) : 5.8 EC : V = 0.79 dS/m H : 0.59 dS/m Soil structure: Fine lumps Soil texture : A = Sandy loam, B = Sandy loam, C = Clay Soil type : Loamy soil with clay sub soil
		Jaja Tunong	Low land Root architecture : Several restricted Depth of water table (m) : 0.02 m pH (soil pH field kit) : 5.6 EC : V = 0.65 ds/m H : 0.61 ds/m Soil structure: Sealed Soil texture : A = Sandy, B = Sandy loam, C = Clay Soil type : Loamy soil with clay sub soil
	Tringgadeng	Meue	Low land Root architecture : Several restricted Depth of water table (m) : 2 m pH (soil pH field kit) : 6.2 EC : V = 0.28 ds/m H : 0.18 ds/m Soil structure: Fine lumps Soil texture : A = Sandy loam, B = Clay loam, C = Clay Soil type: sand Soil type : Loamy soil with clay sub soil
Bireuen	Kuala	Ujong Blang Mesjid	Low land Root architecture : Severely restricted Depth of water table (m) : 1.2 m pH (soil pH field kit) : 6.2 EC : V = 0.92 dS/m H : 0.91 dS/m Soil structure: Single grains Soil texture: A = Sandy, B = Sandy, C = Sandy loam Soil type: Sand
Aceh Utara	Samudra	Kuta Krueng	Low land Root architecture : Severely restricted Depth of water table (m) : 2.3 m pH (soil pH field kit) : 6.4 EC : V = 0.84 dS/m H : 0.51 dS/m Soil structure: Single grains Soil texture : A = Sandy, B = Sandy, C = Sandy Soil type : Sand
Aceh Besar	Peukan Bada	Beuraden (Site 1) GPS coordinates: N: 05^{o}30.537 E: 95^{o}16.028	Land being prepared for chili crop. Low land Elevation: 6m Root architecture : N/A – fallow land Depth of water table (m) : 2.0 m pH (soil pH field kit) : 5.2-5.9 EC : Medium (EMh 58.7-62.6 mS/m) ECw: 2.30 dS/m (Very high salinity class) Soil structure: Well structured with fine aggregates Soil texture : A = Sandy Loam, B = Clay loam, C = Light Clay Soil type: Duplex soil

Aceh Besar	Peukan Bada	Beuraden (Site 2)	Land being prepared for chili crop. Elevation: 6m Low land Root architecture : N/A – fallow land Depth of water table (m) : 2.0 m pH (soil pH field kit) : 5.2-5.9 EC : High (EMh 86.2 mS/m) Soil structure: Very poor – obvious sediment deposits, salt on surface, dispersion and crusting evident Soil texture : A = Sandy Loam, B = Clay loam, C = Light Clay Soil type: Duplex soil
Aceh Besar	Darussalam	Miruek Taman GPS coordinates: N: 05^{o}0.670 E: 95^{o}23.590	Amaranth and Tomatoes. Elevation: 11m Upland Root architecture : Medium Depth of water table (m) : pH (soil pH field kit) : 4.1-4.5 (Very acidic) EC : Low (EMh 32.0 mS/m) ECw: 3.26 dS/m (Very high salinity class) Soil structure: Moderate Soil texture : A = Sandy Loam, B = Sandy Loam, C = Sandy Loam Soil type: Sandy Loam soil Comments Amaranth crop showed signs of N and micronutrient deficiency. Soil salinity OK but irrigation water very saline and contributing to increased salinity in adjacent tomato crops.
Aceh Besar	Baitussalam	Kling Cot Arun N: 05^{o}35.917 E: 95^{o}23.470	Previously a chili growing field Elevation: 28m Upland Root architecture : N/A – derelict field Depth of water table (m) : 1.5 pH (soil pH field kit) : 4.8 at surface, 3.2 at 5-10cm EC : Low (EMh 32.0 mS/m) ECw: Well 1 - 2.2 dS/m (Very high salinity class); Well 2 0.57 dS/m – low salinity class Soil structure: Poor – hardsetting surface soil with low rates of infiltration. Soil texture : A = Fine Sand, B = Sandy Loam, C = Sandy Soil type: Sandy Loam soil Comments: Field presents a good opportunity for a demonstration site to redevelop an agricultural field using integrated crop management practices.
Aceh Besar	Mesjid Raya	Ladong N: 05^{o}38.671 E: 95^{o}27.668	Mixed vegetable field with young watermelons planted Elevation: 20m Upland Root architecture : Moderate Depth of water table (m) : 4 pH (soil pH field kit) : 6.2 EC : Very Low (EMh 8.3 mS/m) ECw: 2.19 dS/m (Very high salinity class); Soil structure: Moderate Soil texture : A = Sand, B = Sand, C = Sand Soil type: Sandy Comments: Very poor weed control on plots.

Note: A = Texture at 0 -10 cm depth; B = Texture at 10 – 30 cm depth; C = Texture at 30 – 50 cm depth.

Beds used for vegetable production in the ricefields were observed to be 50-60cm high and 80cm wide.

Pest and Disease Issues

In most sites that the PA team visited in Aceh Besar, vegetables were only planted on a very small scale or not at all due to tsunami damage; therefore the opportunities to observe pests and diseases on vegetable crops were quite limited. The team was taken to a chili pepper field in Nusa, Lhoknga (which we later learned was not affected by the tsunami) which had a heavy infestation of thrips (Fig. 7). Very likely, chili peppers in tsunami-affected areas are also experiencing major problems with this insect.

Figure 7. Thrips infestation on chili pepper leaf from Nusa, Lhoknga, Aceh Besar.

Amaranth observed in Miruek Taman, Darussalam, Aceh Besar was partially defoliated by a leafroller caterpillar that appears to be a pyralid (Order Lepidoptera)(Fig. 8). Another caterpillar, *Spodoptera* sp. (Lepidoptera: Noctuidae) is also contributing to this defoliation.

Less than 100m from the ocean, cucumber was growing relatively well in Ladong, Mesjid Raya, Aceh Besar. There was a leafminer infestation, but it may not have been serious enough to cause yield loss.

Five chili pepper leaf and shoot samples from Ujung Pancu, Peukan Bada, Aceh Besar were tested in the AVRDC Virology Laboratory for CMV, PVY, ToMV, CVMV, PMMV and geminivirus. The samples were negative except for one sample, which was infected with geminivirus.

Virus infestations on chili pepper were observed to be serious in Aceh Utara. These are likely to be geminivirus.

Figure 8. Leafroller caterpillars caused significant defoliation of amaranth in Miruek Taman, Darussalam, Aceh Besar.

CONCLUSIONS

Several conclusions arise from the results of the PA:

1. In Aceh Besar, from a soils perspective, many areas visited had not yet returned to vegetable production. The effects of salinity were variable whereby it was evident in some areas but not others. Major constraints were damage to drainage and irrigation infrastructure; poor quality (saline) irrigation water; lack of fences to exclude livestock and wild animals; and a lack of equipment and labour to cultivate fields.
2. Nutrient deficiencies (N, P and micronutrients) were common in many of the fields visited. Soil acidity ($pH < 4$) was common in Aceh Besar District and highlighted the need for lime application to these soils. Most growers had access to NPK fertilizers and manure and applied them to their crops. However, it was difficult to determine the rates at which they were applied. A summary of the soils issues and research opportunities arising from them are found in Table 15.

Table 15. Summary of soil and crop issues identified during preliminary soils assessments and research opportunities arising from them.

Location	Issue	Research Opportunity
Aceh Besar Baitussalam Sub-district Masjid Raya Village	Soil Acidity Nutrient deficiencies	Examine the effects of lime, compost and nutrients on soil fertility
Aceh Besar Baitussalam Sub-district Kling Cot Arun Village	Acidity, Rehabilitation	Using site to demonstrate the use of integrated crop and soil management to bring farming system back into production
Aceh Besar Baitussalam Sub-district Miruek Taman Village	Soil Acidity	Examine the effects of lime, compost and nutrients on soil fertility
Aceh Besar Peukan Bada Sub-district Braden Village	Soil sodicity (crusting and dispersion); Sub-soil compaction, soil salinity	Use of gypsum, compost and nutrients to restore soil fertility
Aceh Utara, Pidie and Bireuen Districts.	Crop nutrient disorders (N, P, K).	Utilisation of manure and inorganic fertilizers to improve soil fertility and crop nutrition

3. Part of the tsunami-affected area can be successfully planted to vegetables now (chilli, tomato, amaranth, cucumber and others). However, other parts are damaged severely and will require rehabilitation efforts beyond the scope of this project, for example, major repairs of irrigation infrastructure. Other areas may be completely lost to vegetable production because they are now low lying (due to tsunami damage) and affected by tidal waters; with rising ocean levels, the prospects of these areas to become viable for vegetable production are very low.
4. Tables 10-12 indicate that many characteristics are similar in the tsunami-affected areas of the four districts that were appraised. This is reasonable since these districts are contiguous along the northeastern coast of Aceh. However, Aceh Besar shows some differences relative to the other three districts, which is also logical since it was heaviest hit by the tsunami.
5. The PA was an effective means of identifying the issues vegetable farmers face in returning their land to post-tsunami production. These issues include damage to drainage and irrigation infrastructure, poor quality (saline) irrigation water, lack of fences to exclude livestock, and a shortage of equipment and labour to clear and cultivate damaged fields. Other crop management factors such as increased pest and disease incidence and weeds were also identified as issues requiring further investigation. Farmers involved with the PA were very supportive of the project and expressed a willingness to be involved in it. In particular, they were keen to receive technical information on all aspects of crop production, participate in future training activities and be involved in the participatory research program. Many farmers had been visited by Indonesian and international researchers since the tsunami but had not had any follow-up visits, highlighting the need to maintain the good will exhibited, via regular communication and project updates.
6. The preliminary soil assessments made during field inspections revealed variable effects of the tsunami. Most areas visited in the Aceh Utara, Pidie and Bireuen Districts appeared to be back to normal production. However, many of the crops inspected suffered from nutritional deficiencies, in particular N, P and K, which highlights the need for improved nutrient management on these soils. Tsunami damage was much more evident in Aceh

Besar, with many fields derelict and/ or abandoned. The main soil constraints to these fields appear to be salinity, sodicity, poor drainage and sediment deposits. Soil acidity is also an issue in this district.

RECOMMENDATIONS

1. A key recommendation arising from this visit is to ensure farmer groups are kept informed of progress and given regular updates on results as they arise. As outlined in the detailed project plan, this will be achieved by working closely with key farmers in conducting the field experiments and demonstrations associated with the project, disseminating outcomes through education and extension publications and involving them in Farmer Field Schools.
2. This project focuses on rehabilitating vegetable production in the tsunami affected areas of NAD Province, through integrated soil and crop management. Strategies for achieving this have been developed in the project plan. However, there is a clear need for new irrigation and drainage infrastructure and provision of fences and equipment to restore tsunami-affected agricultural land in Aceh. Likewise, the practice of slash and burn agriculture observed on the foothills in Peukan Bada sub-district requires immediate attention. Whilst these broader issues are beyond the scope of the current project, the project partners can play a role in highlighting these issues and creating linkages between stakeholders for addressing them (e.g., Bureau of Rehabilitation and Reconstruction NAD-Nias, NGOs and Governments). The cross-project (LWR 2005/004, LWR 2005/118, CP/2005/075) Communications Workshop held in Saree, NAD on August 8, 2007, is one way of achieving this.
3. Since tsunami-related damage is highest in Aceh Besar, more extensive efforts will be required to return this district to vegetable production, compared to the other three.
4. Training in the use of compost is recommended.
5. In general, farmers use less than optimum amounts of manure. Utilization of stable manure is recommended at a rate of 30 ton/ha or 1 kg/plant in general; however, exact rates should be based on soil tests and the specific vegetable crop(s) to be planted.
6. Adequate use of inorganic fertilizers is important for optimizing vegetable production; rates of 200 kg N/ha, 100 kg P_2O_5/Ha and 100 kg K_2O/Ha are recommended by the team, but exact rates should be based on soil tests and the specific vegetable crop(s) to be planted.
7. Activities and publications to raise farmer knowledge of integrated pest management (IPM) methods on vegetables are recommended, since farmers in many PA locations expressed this need.

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Appendix 1. Photographs of the PA Activities.

PA Discussion in Aceh Besar District

PA Discussion in Aceh Utara District

PA Discussion in Bireuen District

PA Discussion in Pidie District

Chili pepper field owned by the farmer in Kuta Krueng Village, Aceh Utara

Amaranth field owned by the farmer in Ujong Blang Mesjid Village, Bireuen

Most of the ACIAR Vegetables project team members who were involved in the Participatory Assessment held in Aceh during March 2007.

Appendix 2. Seasonal Calendar for Aceh Besar, Pidie, Bireuen and Aceh Utara Districts, NAD, Indonesia.

CROPS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Chili pepper *Note*: If irrigation is available, farmers may plant anytime year-round.	Harvest and sell imme-diately	Harvest and sell imme-diately	Harvest and sell imme-diately				Cultivate the land	Sow in nursery, add manure to fields, and transplant	Add manure to fields and transplant	Crop matures	Harvest and sell imme-diately	Harvest and sell imme-diately
Tomato *Note*: If irrigation is available, farmers may plant anytime year-round.							Cultivate the land	Sow in nursery, add manure to fields, and transplant	Add manure to fields and transplant	Crop matures	Harvest and sell imme-diately	
Cucumber *Note*: If irrigation is available, farmers may plant anytime year-round. Farmers also time their planting so that they can harvest during Ramadan, when prices are high. In this case, they plant ~40 days before the start of Ramadan.							Cultivate the land	Add manure to fields and sow directly	Harvest and sell imme-diately		Add manure to fields and sow directly	Harvest and sell imme-diately
Amaranth *Note:* Farmers plant year-round; harvesting ~22 days after planting is common, although longer seasons are also common.												
Wet and dry seasons	Wet	Wet/dry	Dry	Dry	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet

Appendix 3. Questionnaires.

INTEGRATED CROP MANAGEMENT FOR VEGETABLE PRODUCTION ON TSUNAMI-AFFECTED SOILS
PARTICIPATORY APPRAISAL QUESTIONS
NAD PROVINCE, INDONESIA, 20-25 MARCH 2007

Objectives
The objective of this participatory assessment (PA) is to identify constraints / issues in vegetable agro ecosystems on tsunami-affected soils. The PA is structured around the following potential constraints, although others may become evident during the PA:

- Salinity/ sodicity
- Nutritional disorders (P, K, Ca)
- Soil structural degradation (e.g. poor infiltration).
- Pests and Diseases

It is also an important mechanism for gathering information about the various vegetable production systems in NAD Province. **The PA will focus on the project's priority crops – chili pepper, tomato, cucumber and amaranth** – but may also investigate other vegetable crops to a lesser extent.

***Informasi Petani/* Farmer Information**

1. *Desa* / Village:___________ *Kecamatan*/ Subdistrict:__________ *Kabupaten*/District:________

2. *Nama & Jenis kelamin petani*/ Farmers' names, genders: ________________________________

3. *Luas lahan* / Sizes of farms: <0.5 ha_______; 0.5-1 ha________; >1 ha__________

4. *Kepemilikan lahan*/ Land tenure (Owner, tenant, share farmer, other):

5. *Pekerjaan Utama*/ Major occupation(s):

6. *Sudah berapa lama Bpk/Ibu bertani?/* How long have you been farming?

***Pengelolaan Pertanian/* Management Practices**

7. *Sudah berapa lama lahan sayur Bpk/Ibu diusahakan*?/ How long has your vegetable farm been in production?

8. *Jenis tanaman sayuran apa saja yang ditanam*? / What vegetables do you grow?

9. *Sumber bibit atau benih*: / Source of seeds:

10. Apakah Bpk/Ibu menanam jenis sayur tradisional atau hibrida? /Are you growing hybrids or traditional varieties?

11. Nama jenis hibrida/tradisional yang ditanam? Names of hybrids/traditional varieties:

12.Tolong ceritakan mengenai cara mengelola tanaman sayuran (cara budidaya, bertanam, pengendalian tanaman pengganggu/hama/penyakit, panen). / Can you please describe your typical crop management practices (Bed preparation, cultivation, planting, weed/ pest and disease control, harvest)?

	***Cabai* / Chili pepper**	***Tomat* / Tomato**	***Timun* / Cucumber**	***Bayam* / Amaranth**	***Lain* / Other**
Cara persiapan lahan/ Land preparation					
Persemaian/ Nursery activities					
Penanaman/ Planting					
Pengairan/ Irrigation					
Penyiangan/ Weeding					
Penyemprotan / Spraying					
Cara lain pengendalain hama / Other pest control measures					
Pemanenan/ Harvesting					
Pemasaran/ Marketing					

13. Apakah tanaman sayuran Ibu/Bpk ada pengairan atau tergantung hujan? Jika ada pengairan, sistem pengairan jenis apa? Darimana sumber airnya? (*digenangi*) / Are your crops irrigated or rainfed? If irrigated, can you please describe the irrigation system? Where do you get your water from and how is it applied?

14. Tolong jelaskan kegiatan bulan per bulan untuk menanam cabai, tomat, timun dan bayam.(Lampiran 1) / Can you please describe your typical calendar of operations for chili pepper, tomato, cucumber and amaranth? (Appendix 1)

15. Berapa rata-rata hasil yang diperoleh untuk 4 tanaman sayuran tersebut? / What yields do you usually get for these 4 crops?

16. Apakah tanaman sayuran dirotasi dengan tanaman lain? Tanaman apa dalam musim apa? / Do you grow your vegetable crops in rotation with any crops (e.g. Rice, legumes, others)? Which crops in which seasons?

17. Isu berkaitan dengan tsunami / Tsunami-related issues
Apakah lahan sayur bapak/ibu terkena dampak tsunami? / Was your farm affected by the tsunami?

18. Berapa lama masing-masing lahan tergenang air tsunami? (*jam, hari*) / How long was each field inundated?

19. Berapa genangan tertinggi yang terjadi di lahan Bpk/Ibu? /(centimeter) What was the maximum depth of inundation?

20. Apakah tsunami meninggalkan tanah atau endapan di lahan Bpk/Ibu? Jika ya, berapa ketinggian endapan tersebut? Bagaimana Bpk/Ibu mengatasinya (misalnya, diambil, dicampur dengan tanah, dibiarkan)? Did the tsunami deposit soil or sediment in your fields? If so, how deep were the sediment deposits? How were the sediment deposits managed (eg. removed, mixed with soil, left on the surface)?

21. Apakah tsunami meninggalkan bahan lain di lahan Bpk/Ibu (materi dari laut, pohon, dll)? Jika ya, bagaimana bahan tersebut dibersihkan? Apakah ada bahan organic yang dikomposkan? Did the tsunami deposit other material on your fields (eg. Flotsam and jetsam, trees, other)? If so, how were these removed and disposed of? Was any of the organic material composted?

22. Berapa lama setelah tsunami terjadi Bpk/Ibu mengusahakan kembali lahan sayuran tersebut dengan *berhasil*? How soon after tsunami were you able to grow vegetables again successfully?

23. Apakah Ibu/Bpk sudah pernah menanami lahan yang kena tsunami tersebut? Jika ya, berapa kali tanam dan bagaimana hasil dari tanamannya (baik sekali, baik, rata-rata, jelek, jelek sekali)? Have you grown crops on the fields which were affected by the tsunami? If so, how many and how have they performed (Very good, good, average, poor, very poor)?

24. Berapa hasil tanaman sayur-sayuran tersebut sejak tsunami? What have been your crop yields since the tsunami?

25. Jika pertumbuhan/hasil tanaman berkurang, apa sebabnya, menurut Bpk/Ibu? If crop growth/ productivity has been reduced, what do you think are the reasons for reduced productivity?

26. Pengelolaan tanah / Soil management
Tipe tanah / Soil type
Menurut Bpk/Ibu lahan sayuran subur atau tidak? / Can you please describe how fertile your soil is?

27. Berapa dalamnya topsoil? How deep is the topsoil?

28. Setelah hujan atau irrigasi, apakah airnya cepat menggenang atau menetap lama di permukaan tanah? / Does the water drain away quickly or does it sit on the soil surface after rain or irrigation?

29. Apakah tanah dari lahan Bpk/Ibu pernah dianalisis di laboratorium? Jika ya, bagaimana hasilnya? Have you ever had a soil test done? If so, do you have any historical soil test results?

30. Unsur hara / Nutrients

Pupuk apa yang digunakan di lahan sayur pada musim ini (jenis pupuk, dosis, tanggal dipakai)? Can you please describe the fertilizer history of each of your vegetable fields this season (eg. Fertilizer type, rate of application, dates of application)?

31. Dari mana Ibu/Bpk mendapatkan pupuk dan berapa harganya? Where do you get your fertilizers from and how much do they cost?

32. Apakah Bpk/Ibu menggunakan kompos atau pupuk kandang? Jika ya, didapat dari mana, atau dibuat sendiri? Berapa banyak dosis yang digunakan? Berapa harganya jika dibuat atau dibeli? Do you use composts or animal manures? If so where do you get these from or do you make them? How much do they cost to make or buy?

33. Apakah Bpk/Ibu memakai gipsum atau kapur pada tanahnya? Do you use gypsum or lime in your soils?

34. Apakah ada kesulitan mendapatkan pupuk buatan, kompos, kapur atau gipsum di daerah ini? Is it difficult to obtain inorganic fertilizers, composts, lime or gypsum in this area?

35. Sejak tsunami, apakah Bpk/Ibu melihat tanaman sayur kurang subur? Have you observed any nutritional deficiencies in your vegetable crops since the tsunami?

36. Apakah masalah tanaman sayur tersebut diketahui/diagnosis oleh petugas BPTP/PPL/Dinas? Have you had any nutrient/ crop disorders diagnosed by soil testing or a BPTP/ Dinas Pertanian officer?

37. Salinitas /Salinity

Apakah ada masalah kegaraman pada tanah setelah tsunami?

Have you had any soil salinity problems since the tsunami?

38. Persiapan dan pengelolaan guludan / Bed preparation and management

Bagaimana Bpk/Ibu melakukan pengolahan tanah?

Can you please describe how the soil is cultivated on your farm?

39. Jika memakai guludan untuk tanaman sayur, bagaimana cara penyiapannya? Apakah memakai mulsa plastic atau bahan lainnya?

If you use beds for your vegetable crops, how are they prepared? Do you use plastic mulching or else?

40. *Apakah guludan tersebut tetap dipakai atau dihancurkan jika pada lahan tersebut Bpk/Ibu menanam padi/tanaman lain pada musim selanjutnya?*
Do you use permanent beds for vegetables?

41. *Bagaimana cara pembuangan air di lahan sayuran tersebut?* How do you drain your fields?

42. *Apakah Bpk/Ibu melihat adanya masalah struktur tanah sejak tsunami (dispersi/ sodik, tanah jenuh dgn air, air sulit masuk tanah, pertumbuhan akar jelek*)? Have you noticed any soil structural problems since the tsunami (eg. Dispersion/ sodicity, waterlogging, poor infiltration and root growth)?

43. *Apakah yang Bpk/Ibu lakukan dengan sisa tanaman setelah panen (dibakar, dimasukkan ke dalam tanah, diambil, dibuat kompos)?* How do you manage crop residues (burning, incorporation, removal, composting)?

***44. Hama dan Penyakit /* Pests and Diseases**

45. *Hama dan penyakit apa paling merusak tanaman cabai, tomat, timun dan bayam?*
What are the most damaging pests and diseases on chili pepper, tomato, cucumber and amaranth?

Tanaman sayur / Vegetable	*Hama/penyakit yg paling merusak* / Most damaging pests/diseases	*Besarnya pengurangan hasil* / Amount of yield reduction	*Cara pengendalian (jika pestisida, berapa kali digunakan per musim*) / Control measures used (if pesticides, # times used per season)	*Cara pengendalian berhasil*? Control measures successful?
Cabai / Chili pepper				
Tomat/ Tomato				
Timun / Cucumber				
Bayam/ Amaranth				

46. *Sejak tsunami, apakah kerusakan akibat hama/penyakit pada tanaman sayur bertambah atau menurun? Hama/penyakit apa dan terhadap tanaman apa?*

Has disease/ pest damage increased or decreased since the tsunami? If so, which ones?

47. *Sumber informasi/rekomendasi mengenai pengendalian hama dan penyakit:*
Source of pest and disease control information/recommendations:

48. *Apakah Bpk/Ibu memakai cara pengendalian hama secara tradisional? Jika ya, cara apa?*
Do you use any traditional methods of pest control? If yes, what are they?

49. *Apakah anda pernah mengikuti pelatihan pengendalian hama dan penyakit ? Jika Ya, pelatihan apa? Siapa yang menyelenggarakan ?*
Have you undergone any training in pest/disease control? If yes, what training? Who rganized it?

50. *Apakah ada serangga dan laba-laba (musuh alami) untuk membantu pengendalian hama dan penyakit pada sayur?*Are there beneficial insects/spiders (natural enemies) that help control pests on vegetables?

51. *Apakah anda berbuat sesuatu yang mempengaruhi keberadaan musuh alami ?*
Do you do anything that affects these beneficial insects/spiders?

52. *Apakah anda mengamati/memonitor hama penyakit sebelum penyemprotan pestisida ?*
Do you monitor for pests/diseases before spraying pesticides?

Pemasaran Sayur / **Marketing of Vegetables**

53. *Apa mempengaruhi keputusan anda untuk menanam sayur tertentu?*
What influences your decision to grow a particular vegetable crop?

54. *Apakah anda menjual sayur segera setelah panen ?*
Do you sell vegetables immediately after harvest?

55. *Bagaimana anda menjual sayur setelah panen ?* How do you sell vegetables after harvesting?
Sell by contract / *Menjual secara kontrak* ______
Sell to middle man / *Menjual kepada tengkulak/bandar*_____
Sell directly to the market / *Menjual langsung ke pasar*_______
Others / Lainnya ___________________________

56. *Apakah anda anggota kelompok tani? Kelompok tersebut membantu mendapat harga yang lebih baik?*
Are you a member of farmers' group or organization? Does it help you obtain better prices?

Pertanyaan Kesimpulan / **Concluding questions**

57. *Kebutuhan apa yang paling mendesak untuk mengatasi dampak tsunami*? /What are your greatest needs to overcome impacts from the tsunami?

58. *Informasi lain apa yang Bpk/Ibu perlukan*? What other information do you need?
Sarana produksi apa yang Bpk/Ibu perlukan? (tenaga kerja, pupuk, pestisida, sarana produk lain, alat-alat)? What resources do you need? (labor, fertilizers, chemicals, other inputs, equipment)?

Lampiran 1: Kalendar Musim untuk Desa _________, Kabupaten __________, NAD, Indonesia

Appendix 1: Seasonal Calendar for ___________ village, ________ District, NAD, Indonesia

Tanaman / Crops	JAN	FEB	MAR	APR	MEI	JUN	JUL	AGU	SEP	OKT	NOV	DES
Cabai / Chili pepper												
Tomat / Tomato												
Timun / Cucumber												
Bayam / Amaranth												
Musim hujan dan kemarau / Wet and dry seasons												

INTEGRATED CROP MANAGEMENT FOR VEGETABLE PRODUCTION ON TSUNAMI AFFECTED SOILS – PARTICIPATORY APPRAISAL QUESTIONS NANGGROE ACEH DARUSSALAM, INDONESIA, 20-25 MARCH 2007

Pertanyaan untuk PPL, Dinas Pertanian dan BPTP / **Questions for Agricultural Officers**

1. *Perubahan apa yang terjadi dalam 5 tahun terakhir mengenai pemasaran sayur di NAD? Ada perbedaan di antara musim*? What changes have occurred in the market for vegetables in NAD over the past five years and how does it differ by season?

2. *Bagaimana petani di NAD memutuskan jenis tanaman sayuran diusahakan?*
   How do farmers decide which vegetable crops to grow?

3. *Informasi tentang apa yang banyak ditanyakan sehubungan dengan tsunami?*
   What are the key areas where you have been asked for information since the tsunami?

4. *Apakah anda membantu petani dalam pengujian tanah dan tanaman, serta menterjemahkan hasilnya?*
   Do you assist farmers with soil and plant testing and interpretation of results?

5. *Apakah anda membantu petani dalam memutuskan penggunaan pupuk (jenis, dosis, waktu, dll)?*
   Do you assist farmers make fertilizer decisions (type, application rate, timing etc)?

6. *Jumlah petani per PPL di kabupaten ini:*
   Number of farmers per Agricultural Extension Agent in this District:

7. *Fasilitas penyimpanan hasil sayur apa yang disediakan oleh Departemen Pertanian untuk petani miskin?*
   What storage facilities for vegetables are provided by the Department of Agriculture for resource-poor farmers?

8. *Teknologi pasca-panen apa yang telah diperkenalkan oleh Departemen Pertanian (Dinas Pertanian, BPTP-NAD, Unsyiah) untuk meningkatkan nilai tambah produk (pengalengan, fermentasi, pengepakan, dll)?*
   What post-harvest technologies are promoted by the Department of Agriculture for value addition of vegetables (canning, pickling, processing, etc.)?

9. *Hama dan penyakit apa yang paling merusak tanaman sayur di NAD? Apakah hama dan penyakit tersebut menjadi lebih serius sejak tsunami*? What are the major insect pests and diseases of vegetable crops in NAD? Have the incidence and severity of these increased since the tsunami?

10. *Isu apa yang penting mengenai kesuburan tanah dan nutrisi tanaman untuk tanaman sayur di NAD? Apakah isu tersebut menjadi lebih serius sejak tsunami?*
    What are the key soil fertility and plant nutrition issues for vegetable crops in NAD? Have the incidence and severity of these increased since the tsunami?

11. *Isu lain apa yang penting untuk tanaman sayur di NAD? Apakah isu tersebut menjadi lebih serius sejak tsunami?*
    What other issues are important for vegetable crops in NAD? Have the incidence and severity of these increased since the tsunami?

12. *Penelitian apa sudah dilakukan di daerah ini mengenai sayur?*
    What research has been done in this area on vegetables?

13. *Penelitian apa diperlukan sekarang mengenai sayur?*
    What do you see as research needs on vegetables?

14. *Bagaimana hasil penelitian disampaikan ke petani supaya diterapkan?*
    How have you tried to encourage adoption of research outcomes?

15. *Tolong ceritakan tentang pengalaman penerapan teknologi oleh petani yang berhasil dan tidak berhasil.*
    What are some successful and unsuccessful adoption experiences?

Pertanyaan untuk Agen Pemasaran /* Questions for Marketing Agents*:

1. *Apakah kualitas produk penting diperhatikan? Apakah ada perbedaan harga untuk kualitas produk yang berbeda?*
   Is product quality a concern? What are the price differences for different product qualities?

2. *Berapa harga terendah dan tertinggi untuk masing-masing sayuran?*
   What are the lowest and highest prices for these vegetables?
   Cabai Chili pepper:
   Tomat Tomato:
   Timun Cucumber:
   Bayam Amaranth:

3. *Di mana anda membeli dan menjual sayuran tersebut?*
   Where do you buy and sell vegetables?

4. *Apakah sayuran tersebut diekspor ke luar negeri?*
   Does the crop move into the export market?

5. *Apa ada keterikatan petani oleh Bandar sehingga petani tidak bisa menjual hasil sayuran secara bebas?*
   Does the middleman have a binding agreement with the farmer so the farmer cannot sell his/her vegetables freely?

6. *Berapa perbedaan harga dari petani dengan harga sayuran di pasar?*
   What are the price differences between vegetables bought from the farmer and those sold in the market?

11.2 Appendix 2: Training of Trainers and Vegetable Integrated Crop Management Workshop report

PARTICIPATORY ASSESSMENT

Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia

ACIAR project CP/2005/075

Australian Government
Australian Centre for International Agricultural Research

PA team (alphabetical):

Abdul Azis, AIAT-NAD
Aryati Silmi, FHCAS NAD
Basri A. Bakar, AIAT-NAD
Burlis Han, AIAT-NAD
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Saufan Daud, AIAT-NAD
Subhan, IVEGRI
Tamrin, AIAT-NAD
Yatiman, AIAT-NAD
Yufniati ZA, AIAT-NAD
Yusri Yusuf, KEUMANG

AVRDC The World Vegetable Center
NSW DEPARTMENT OF PRIMARY INDUSTRIES
Austcare World Humanitarian Aid

Assessment Institute for Agricultural Technology – NAD (AIAT-NAD)
Austcare
AVRDC - The World Vegetable Center
Food and Horticultural Crops Agricultural Service NAD (FHCAS NAD)
Indonesian Vegetable Research Institute (IVEGRI)
KEUMANG
New South Wales Department of Primary Industries (NSW DPI)

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EXECUTIVE SUMMARY

A Participatory Assessment (PA) was conducted to initiate activities for the contracted ACIAR project CP/2005/075, "Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia". The PA focused on soil and other crop management constraints to vegetable production and was undertaken on 20-24 March 2007, which is during the beginning of the dry season in Aceh. The PA was conducted in tsunami-affected areas of Aceh Besar, Pidie, Bireuen and Aceh Utara Districts.

From a soils perspective, many areas visited in Aceh Besar had not yet returned to vegetable production. The effects of salinity were variable whereby it was evident in some areas but not others. Major constraints were damage to drainage and irrigation infrastructure; poor quality (saline) irrigation water; lack of fences to exclude livestock and wild animals; and a lack of equipment and labour to cultivate fields. Contrastingly, many vegetable production areas of Pidie, Bireuen and Aceh Utara are being planted again with vegetable crops, with varying levels of success. The above constraints also continue to hinder vegetable production in the latter three districts.

Nutrient deficiencies (N, P and micronutrients) were common in many of the fields visited. Soil acidity (pH < 4) was common in Aceh Besar District and highlighted the need for lime application to these soils. Most growers had access to NPK fertilizers and manure and applied them to their crops. However, it was difficult to determine whether the rates at which they were applied were effective in meeting crop nutrient requirements.

A serious thrips infestation on chili peppers was observed in Aceh Besar. Significant levels of defoliation on amaranth appear to be caused by two caterpillars, a leafroller (Lepidoptera: Pyralidae) and *Spodoptera* sp. (Lepidoptera: Noctuidae). Farmers mentioned a range of other pests and diseases which seriously damage vegetable crops in NAD. In many of the villages visited, farmers requested training on pest and disease control methods.

The PA was an effective means of identifying the issues vegetable farmers face in returning their land to post-tsunami production. These issues include damage to drainage and irrigation infrastructure, poor quality (saline) irrigation water, lack of fences to exclude livestock, and a shortage of equipment and labour to clear and cultivate damaged fields. Other crop management factors such as increased pest and disease incidence and weeds were also identified as issues requiring further investigation. Farmers involved with the PA were very supportive of the project and expressed a willingness to participate in its implementation. In particular, they were keen to receive technical information on all aspects of crop production, take part in future training activities and be involved in the participatory research program. Many farmers had been visited by Indonesian and international researchers since the tsunami but had not had any follow-up visits, highlighting the need to maintain the good will exhibited, via regular communication and project updates.

Finally, the results from the PA provide an information base for making all subsequent project decisions. The project team intends to utilize this information to design future activities to fit the needs of the stakeholders in NAD.

INTRODUCTION

The Indonesian province of *Nanggroe Aceh Darussalam* (NAD) is rich in natural resources, including a range of agricultural resources. These agricultural resources can be divided into several subsectors, including food and horticultural crops, estate crops, livestock and fisheries. Due to this richness, it is advisable to take an agricultural development strategy that is based on local resources, empowers the local people, and optimizes local potential.

Vegetables have high development potential in NAD because production and consumption are currently low. Many vegetable production areas were damaged by the tsunami of 26 December 2007; problems such as soil sodicity, salinity, and nutrient loss are still serious two years later, in addition to social problems that influence farmer productivity. To respond to this situation, the Australian Centre for International Agricultural Research (ACIAR) has funded the project, "Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia" (CP/2005/075), which focuses on four vegetable commodities: chilli pepper, tomato, cucumber and amaranth. The project was initiated with a Participatory Assessment (PA) to appraise the needs of vegetable farmers and other stakeholders in the project region (Aceh Besar, Pidie, Bireuen and Aceh Utara Districts). The PA was conducted on 20-24 March 2007; many photographs of PA activities can be found in Appendix 1. This PA was shorter than many (e.g., see Luther *et al*. 1999) due to the fact that two "scoping trips" had already been taken by project scientists during proposal preparation in 2006.

The aim of this project is to enable rehabilitation of vegetable production to help restore and enhance food security, nutrition and livelihoods. The specific objectives are to:

1. Identify constraints to the re-establishment of vegetable production on tsunami-affected soils and discover sustainable methods for overcoming these constraints.
2. Build technical capacity among researchers, extension specialists and farmers in integrated soil and crop management of vegetables.
3. Monitor and evaluate the above activities.

This report provides the results of Part 1 of the PA as defined in the Project Document (CP/2005/075), i.e., discussions with stakeholders and direct observations of vegetable crops by a multidisciplinary team. The results from Part 2, a soil/crop assessment of 20 sites, will be reported in a separate document.

METHODS

The PA was conducted through two major methods: (a) Informal interviews with farmers, agricultural research/extension staff of the Indonesian Government, and local marketing agents, using prepared questionnaires (see Appendix 3); (b) Direct observations by the PA team of vegetables and soil in farmers' fields and homegardens. To set up the interview sessions and PA locations, a pre-survey was conducted on 13-15 March 2007. A planning meeting to familiarize the team with PA procedures and finalize the questionnaires was held at the BPTP-NAD office on 20 March 2007. Field activities were carried out on 21-23 March 2007 in four districts (*Kabupaten*) of *Nanggroe Aceh Darussalam* Province, i.e., Aceh Besar, Pidie, Bireuen and Aceh Utara. In Aceh Besar, the PA was conducted in five subdistricts (*Kecamatan*): Peukan Bada, Lhoknga, Darussalam, Baitussalam and Mesjid Raya. In Pidie the subdistricts represented were Simpang Tiga and Tringgadeng. In Bireuen the PA was undertaken in Kuala Subdistrict, while in Aceh Utara it was conducted in Samudra Subdistrict. The total number of people interviewed per village ranged from 10-25; these were mostly farmers but some middlemen were also involved. To some extent people came and went during the course of the interviews due to other commitments, but the gender breakdown was approximately 85% men and 15% women.

The PA teams by district were as follows:

1. Aceh Besar: Basri A. Bakar, Yufniati ZA, Manuel Palada, Gregory Luther, Chris Dorahy, Fenti Ferayanti, Tamrin, Yatiman, Peter Ooi and Novita Rayyan.
2. Pidie, Bireuen and Aceh Utara: Rachman Jaya, Burlis Han, M. Ferizal, Saufan Daud, Abdul Azis, Subhan, Rakhmat Sutarya, Yusri Yusuf, Ariyati Silmi and Julie S. Avolita.

A wrap-up meeting was held on 24 March 2007 during which each team reported major results to the other and discussed specific and overall conclusions.

RESULTS

Responses from Informal Interviews

Vegetable crops cultivated in the project area include chilli pepper, tomato, cucumber, amaranth, shallot, yard-long bean, watermelon and kangkong. Each location shows chili pepper to be a major vegetable, but there are differences in other vegetables cultivated (Table 1). In Kotakrueng, for example, the farmers do not grow tomato but they grow other vegetables such as yard-long bean, cucumber and amaranth.

Table 1. General conditions of vegetable cultivation in four locations of northeastern Aceh.

District/Subdistrict	Location (Village)	Number of farmers	Farm area (ha)	Years of experience with vegetable cultivation	Kinds of vegetables	Source of seed
Pidie/Simpang Tiga	Meunasah Lhee	4	< 0,5	15-20	Ch, To, Cu, Am, Sh	Shop
Pidie/Trieng Gading	Meue	3	< 0,5	15-20	Ch, To, Cu, Am, Wm, Ka	Shop
North Aceh/ Samudra	Kotakrueng	3	0,5- 1.0	15-20	Ch, Cu, Am, Yb, Wm	Shop
Bireuen/ Koala	Ujung Belang Mesjid	3	< 0.5	> 15	Ch, Cu, Am, To, Sh	Shop

Note: Ch= Chilli, To= tomato; Cu= cucumber; Am= Amaranth; Wm= watermelon; Sh= shallot; Yb= yard-long bean; Ka= kangkong.

Farmers generally cultivate vegetables in the ricefields after they harvest rice planted in the rainy season (Table 2). They usually plant vegetables in April or June/July. However, in Kota Krueng, the farmers plant vegetables anytime in the dry land, and they do not plant vegetables in ricefields. Therefore, they can plant rice twice in a year.

Tractors are mainly used for initial land preparation, thereafter manual (men and women) labor is used to construct beds. The bed width is usually 60-80cm with a height of 10-15cm. They use silver plastic mulch for chilli and tomato. Chilli and tomato seeds are first sowed in plastic bags before planting in the field. In Meunasah Lhee, cucumber seeds are sowed in plastic bags before planting, but in other locations the cucumber seeds are sowed directly on the prepared bed (Table 2). To control pests and diseases the farmer sprays pesticides as much as 2-3 times per week for chilli and tomato, once per week for cucumber and 0-1 times per season for amaranth. Other measures to control pests and diseases are never used by the farmers; the only method they know for preventing pest damage to vegetables is the application of pesticides. They harvest vegetables several times, i.e., 4-10 times per season, and their produce is sold directly to the traditional market or middleman.

Table 2. Management of vegetable cultivation in four locations of northeastern Aceh.

Activities	Village			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Crop rotation	Rice - vegetable	Rice- vegetable	Veg- veg (dry land) Rice – rice (field rice)	Rice- vegetable
Irrigation	Well	Well	Well	Well
Planting time of vegetable	June/July	April	Any time (dry land)	June/July
Land preparation	Tractor	Tractor	Tractor	Tractor
Planting system - Chilli & tomato - Cucumber & amaranth	 Bed+ mulch Bed	 Bed+mulch Bed	 Bed+mulch Bed	 Bed+mulch Bed
Nursery: - Chilli & Tomato - Cucumber - Amaranth	 Plastic bag Plastic bag Sowing	 Plastic bag Direct Sowing	 Plastic bag Direct Sowing	 Plastic bag Direct Sowing
Weeding	Traditional	Traditional	Traditional	Traditional
Spraying : - Chilli & tomato - Cucumber - Amaranth	 2-3 times/wk 1 time/ wk 0-1 time/season	 2-3 times/wk 1 time/ wk 1 time/season	 2-3 times/ wk 1 time/wk 1 time/season	 2-3 times/wk 1 time/wk none
Other pest control	none	none	none	none
Harvesting	4-8 times	5-6 times	4-8 times	5-10 times
Marketing	Market/middle man	Market	Market/middle man	Market/ middle man

Farmers are using three kinds of fertilizers for vegetable cultivation: NPK, Urea and KCl (Table 3). Chilli pepper and tomato crops usually use all three fertilizers. Cucumber is fertilized with NPK, urea or both. Urea is the only fertilizer applied for amaranth cultivation. Cow manure is used with all four vegetables at all locations in different dosages. Gypsum and lime are never applied by farmers to improve soil fertility.

Table 3. Fertilizers used for vegetable crops in four locations of northeastern Aceh.

Fertilization Usage	**Village**			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
History of fertilization:				
- Chilli	NPK, Urea, KCl	NPK, Urea, KCl	NPK, Urea	NPK, Urea, KCl
- Tomato	NPK, Urea, KCl	NPK, Urea, KCl	-	NPK, Urea, KCl
- Cucumber	NPK	NPK, Urea	NPK	Urea
- Amaranth	Urea	Urea	Urea	Urea
Stable manure usage:				
- Chilli	Yes	Yes	Yes	Yes
- Tomato	Yes	Yes	-	Yes
- Cucumber	Yes	Yes	Yes	Yes
- Amaranth	Yes	Yes	Yes	Yes
Nutritional deficiency:				
- Chilli	P & K deficiency	P deficiency	-	-
- Tomato	P & K deficiency	-	-	-
- Cucumber	-	-	-	-
- Amaranth	-	-	N deficiency	-
Gypsum or lime usage:	No	No	No	No

In most cases, farmers only know that "worms" attack vegetables, and they rarely distinguish other pests and diseases from these (Table 4). Farmers' knowledge of pests and especially diseases is still poor and they do not differentiate clearly among the wide range of organisms attacking vegetables in Aceh. The insect pests attacking chilli are thrips, *Spodoptera* sp., and aphids, while diseases of chilli are anthracnose, leaf malformation, virus and wilt. Yield reduction caused by pests and diseases on chilli is 20%-50%. The main pest of tomato is *Helicoverpa* sp., while diseases are wilt and virus. Yield reduction caused by pests and diseases on tomato ranges from 30% to 50%.

Cucumber is attacked by worms and aphids. Symptoms of diseases on cucumber plants seem to indicate wilt and leaf yellowing. Amaranth is sometimes attacked by worms and white blister on the leaves. Pesticides are used by farmers to control pests and diseases on vegetables. Farmers buy them from pesticide shops, where they also get some information on how to control pests and diseases on vegetables, but most farmers do not remember the names of pesticides they used.

Table 5 provides Aceh Besar farmers' responses regarding the most damaging pests and diseases on the four priority vegetable crops for this project.

Table 4. Pests and diseases infesting chilli, tomato, cucumber and amaranth in four locations of northeastern Aceh.

Village	Commodities			
	Chilli pepper	**Tomato**	**Cucumber**	**Amaranth**
Meunasah Lhee:				
- Pest / disease	Sp, Th/ Vr, An	Ha, Wf/ Wl, Vr	Be, Aph/ ly	Wo/Al
- Yield reduction	20%	50%	30%	20%
- Control measure	2-3 times/wk	3 times/wk	1 time/wk	1 time/season
- Control successful?	Successful	Not successful	Successful	Successful
Meue:				
- Pest & disease	Sp, Th/ mfl, wl, An	Ha/ Wl, Vr	Wo, Aph/Ly	Wo/
- Yield reduction	40%	30%	20%	20%
- Control measure	2-3 times/wk	2-3 times/wk	0-1 time/wk	-
- Control successful?	Not successful	Not successful	Successful	Successful
Kota Krueng				
- Pest & disease	Wo, Th, Aph/ An, Mlf, Wl	-	Wo, Aph/ Ly, wl	
- Yield reduction	50%		10%	
- Control measure	2-3 times/ wk		1 time/ wk	
- Control successful?	Not successful		Successful	
Ujung Belang Mesjid:		-		
- Pest & disease	Th, Aph/ An, Lmf		Wo,Wf/ Ly	Wo/Al
- Yield reduction	20-50%		20-30%	50-70%
- Control measure	2-3 times/wk		1 time/ wk	1 time/wk
- Control successful?	Not successful		Successful	Not successful

Note: Wo= worm; Th= Thrips; Sp= *Spodoptera* sp.; Wf= Whitefly; Be= Beetles; Aph= Aphids; An= Anthracnose; Mlf= leaf malformation; Vr= virus; Al= Albugo disease; Wl= wilt; Ly= Leaf yellowing.

Table 5. Farmers' responses in Aceh Besar regarding the most damaging pests and diseases on chili pepper, tomato, cucumber and amaranth.

Location (Village, Subdistrict)	**Chili pepper**	**Tomato**	**Cucumber**	**Amaranth**
Braden, Peukan Bada	Grasshoppers, caterpillars, wild boars, leaf curl virus	Whiteflies, leafhoppers	*Kutu* (aphids?), red flying beetle, dark green flying beetle	Amaranth not planted much here because not easy to sell
Miruek Taman, Darussalam	Whiteflies, fungus on roots, leaf curl virus (geminivirus)	White fungus on roots makes plants wilt; caterpillars feed on leaves and fruits; whiteflies; wrinkled leaves (virus?)	Caterpillars feed on shoots and leaves; foggy weather makes plants die; small moth lays eggs that hatch into caterpillars	Caterpillars can damage up to 100% of crop
Kling Cot Arun, Baitussalam	Whiteflies, wrinkled leaves (virus?), crickets, grasshoppers, cutworms, white grubs (scarab larvae), rotting fruits (anthracnose and/or Ca deficiency?), fungi	Fruit borer which also feeds on leaves; whiteflies; grasshoppers; crickets; wilt which causes a rotten stem	Powdery mildew (when fog comes in, leaves get white on edges)	Caterpillars; whiteflies; mealybugs
Ladong, Masjid Raya	Wild boars; monkeys; wrinkled leaves (virus?); fruit rotting from the bottom up (Ca deficiency?); fruit drop; fungus on roots	Roots rot at time of fruiting; fruit borer; young plants wilt	Sucking insect on fruit; defoliator with red luminescence that comes out at night	Amaranth not grown in this area

Inundation of agricultural fields by the tsunami is quite different at each location but it ranges from about 1.5 to 10 hours depending on each location's topography (Table 6). The maximum depths of inundation are 2.0, 1.0, 1.5 and 1.5 meters, respectively, for Meunasah Lhee, Meue, Kota Krueng and Ujung Belang Mesjid.

Table 6. Tsunami-related issues in four locations of northeastern Aceh.

Characteristic or issue	**Village**			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Field inundated (hr)	10	6	1.5	6
Inundation depth (m)	2	1	1.5	1.5
Sedimentation depth (cm)	10	10	15	10
Other material deposited	Yes	Yes	Yes	Yes
Vegetable cultivation after tsunami (mth)	18	8	24	5
Crop yield after tsunami	Good	Good	Good	Good

The tsunami deposited 10 – 15 cm of soil and sediment in farmers' fields in PA locations of Pidie, Bireuen and Aceh Utara. The tsunami also deposited other materials such as trees, remnants of houses, etc. and these farmers removed these materials from their fields. They did not compost the organic materials, however. Vegetable cultivation after the tsunami was recommenced by different farmers at different times. Farmers in Meunasah Lhee, Meue, Kota Krueng and Ujung Belang Mesjid started vegetable cultivation again at 18, 8, 24 and 5 months, respectively, after tsunami incidence. Crop yields after the tsunami commonly have shown good results in these areas of Pidie, Bireuen and Aceh Utara.

Soil fertility is poor in Meunasah Lhee, but in Meue, Kota Krueng and Ujung Belang Mesjid it is better (Table 7). These locations have top soil that is 20 – 30 cm deep. Water drainage is good in Meue, Kota Krueng and Ujung Belang Mesjid; however, it is poor in Meunasah Lhee.

Table 7. Characteristics of soil and soil management in four locations of northeastern Aceh.

Soil Characteristic	**Village**			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Soil fertility	Poor	Good	Good	Good
Top soil depth (cm)	20	25-30	25-30	25-30
Water drainage	Poor	Good	Good	Good
Soil structural problems	Yes	No	No	No
Soil salinity	Yes	Yes	Yes	Yes

For the most part, farmers make their own decisions to grow a particular vegetable crop (Table 8). They sometimes sell their produce directly at the market, but they also sell to middlemen sometimes. The farmer does not have access to any information to obtain better prices.

Table 8. Marketing of vegetables in four locations of northeastern Aceh.

Activities	**Village**			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Decision to grow a particular vegetable	Self	Self	Self	Self
Where farmers sell vegetable produce	Market/middle man	Market	Market/middle man	Market/ middle man
Facilities to get good price	No	No	No	No

Water pumps are needed by farmers to pump irrigation water from wells (Table 9). Information to increase farmer knowledge in the area of pest and disease control is very urgent for the farmers in all locations. Farmers are hoping for better availability of fertilizers and pesticides, and this is especially true for poor farmers.

Table 9. Needs and requests of farmers for future activities of vegetable cultivation in four locations of northeastern Aceh.

Needs and requests	**Village**			
	Meunasah Lhee	**Meue**	**Kota Krueng**	**Ujung Belang Mesjid**
Equipment	Water pump	Water pump	Water pump	Water pump
Information	Training on pests and diseases	Training on pests and diseases	Training on pests and diseases	Training on pests and diseases
Resources	Fertilizer and pesticide	Fertilizer and pesticide	Fertilizer and pesticide	Fertilizer and pesticide

Responses to the questionnaires are summarized below, for farmers in Table 10, for Government of Indonesia (GoI) research and extension staff in Table 11, and for marketing agents in Table 12.

Table 10. Summary of farmer responses (numbers correspond to questions in the questionnaire in Appendix 3).

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
1.	Location	Ladong Village, Mesjid Raya Subdistrict Kleng Cot Aroun Village, Baitussalam Subdistrict Nusa Village, Lhoknga Subdistrict Beuraden Village, Peukan Bada Subdistrict	Meunasah Lhee Village, Simpang Tiga Subdistrict Jaja Tunong Village, Simpang Tiga Subdistrict Meue Village, Tringgadeng Subdistrict	Ujong Blang Mesjid Village, Kuala Subdistrict	Kuta Krueng Village, Samudera Subdistrict
2.	Farmers' names	Available on request	Available on request	Available on request	Available on request
3.	Farm size	< 0.5 - 1 ha	< 0.5 - 1 ha	< 0.5 - 1 ha	< 0.5 - 1 ha
4.	Land tenure	Tenant	Tenant	Tenant	Tenant
5.	Major occupation	Farmer	Farmer	Farmer	Farmer
6.	Length of time farming	> 20 years	> 10 years	> 20 years	> 20 years
7.	Length of time vegetable farm in production	5 - 40 years	3 - 30 years	4 - 30 years	4 - 30 years
8.	Vegetables grown	Chilli pepper, tomato, cucumber, Chinese cabbage, maize, watermelon, cassava, and groundnut	Chilli pepper, tomato, cucumber, amaranth, yard-long bean, and shallot	Chilli pepper, tomato, cucumber, amaranth, yard-long bean, and Chinese cabbage	Chilli pepper, tomato, cucumber, amaranth, yard-long bean, shallot, cassava, and Chinese cabbage
9.	Source of seeds or seedlings	Stores/kiosks in Pasar Aceh and Lambaro	Stores/kiosks in subdistrict capitals and Sigli	Stores/kiosks in the city of Bireuen	Stores/kiosks in Geudong
10.	Hybrids or traditional varieties of vegetables	Hybrids	Hybrids	Hybrids	Hybrids
11.	Names of varieties planted	Chili pepper: TM 99 and TM 88 Tomato: Dona, Intan	Taiwan brand	Taiwan brand	Taiwan brand
12.	Crop management practices for 4 priority vegetables	Covered in other parts of this report	Covered in other parts of this report	Covered in other parts of this report	Covered in other parts of this report
13.	Kinds of irrigation	Rainfed	Rainfed	Rainfed	Rainfed

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
14.	Seasonal calendar	See Appendix 3	See Appendix 3	See Appendix 3	See Appendix 3
15.	Yields for 4 priority vegetable crops	Chili pepper: 1 kg/ plant	Chili pepper: 2t/ha Tomato: 6 t/ha Cucumber: 4 t/ha Amaranth: 1600 - 2000 bunches/ha	Chili pepper: 1 Kg/plant Tomato: 3 - 5 kg/plant Cucumber: 5 - 6 Kg/plant Amaranth: 5000 – 10,000 bunches/ha	Chili pepper: 1 Kg/plant Tomato: 3 - 4 kg/plant Cucumber: 5 - 6 Kg/plant Amaranth: 5000 – 10,000 bunches/ha
16.	Crop rotation	Some farmers rotate with other crops, some do not	Some farmers rotate with other crops, some do not	Some farmers rotate with other crops, some do not	Some farmers rotate with other crops, some do not
17.	Effects from tsunami	Damaged farmland, increased pest/disease problems	Damaged farmland, increased pest/disease problems	Damaged farmland, increased pest/disease problems	Damaged farmland, increased pest/disease problems
18.	Fields inundated how long	5 minutes - 2 months	1 hour - 1 day	2 hours - 1 day	1 hour
19.	Maximum depth of inundation	1 - 5 meters	30 cm - 1 meter	40 cm - 1 meter	50 cm - 1 meter
20.	Depth of sediment left by tsunami	1 - 60 cm	Approx. 10 cm	Approx. 10 cm	Approx. 10 cm
21.	Other materials left by tsunami	Parts of trees, boats, houses, etc.	Parts of trees, boats, houses, etc.	Parts of trees, boats, houses, etc.	Parts of trees, boats, houses, etc.
22.	How soon after tsunami can grow vegetables successfully	Some farmers as soon as 1 month, others longer, but many still cannot grow vegetables successfully	1 month to 1 year	1-5 months	1-5 months
23.	Affected fields planted after tsunami	Planted 1-3 times, results unsatisfactory in most areas, but satisfactory in Nusa	Planted 2 times; first time unsatisfactory, second time relatively good	Planted 3 times, with good results	Planted 2 times, with good results
24.	Vegetable crop yields since the tsunami	Chili pepper: 1 kg/ plant	Chili pepper: 2t/ha Tomato: 6 t/ha Cucumber: 4 t/ha Amaranth: 1600 - 2000 bunches/ha	Chili pepper: 1 Kg/plant Tomato: 3 - 5 kg/plant Cucumber: 5 - 6 Kg/plant Amaranth: 5000 – 10,000 bunches/ha	Chili pepper: 1 Kg/plant Tomato: 3 - 4 kg/plant Cucumber: 5 - 6 Kg/plant Amaranth: 5000 – 10,000 bunches/ha

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
25.	Reasons for reduced crop productivity	Fields are not fertile enough; pest and disease attacks	Fields are not fertile enough; pest and disease attacks	Fields are not fertile enough; pest and disease attacks	Fields are not fertile enough; pest and disease attacks
26.	Fertility of soil	Not fertile enough	Not fertile enough	Not fertile enough	Not fertile enough
27.	Depth of topsoil	20 - 50 cm	10 - 30 cm	10- 20 cm	10- 20 cm
28.	Drainage of water after rain/irrigation	Drains quickly	Drains quickly	Drains quickly	Drains quickly
29.	Soil tests on farmer's land	Conducted by BPTP NAD and ACIAR Australia	Conducted by a Japanese organization, but farmers never heard the results	Never conducted	Never conducted
30.	Fertilizer used on vegetable fields	Urea, KCl, SP-36, NPK and manure	Urea: 100 kg/ ha KCl: 80 kg/ ha NPK: 50 kg/ha Manure: 50 kg/ha	Urea, KCl, SP-36, NPK and manure	Urea, KCl, SP-36, NPK and manure
31.	Source and cost of fertilizer	From ag kiosk. Prices are: Urea: Rp.1750/kg KCl: Rp. 2000/kg NPK: Rp. 4500/kg Manure is not purchased	From ag kiosk. Prices are: Urea: Rp.1750/kg KCl: Rp. 2000/kg NPK: Rp. 4500/kg Manure is not purchased	From ag kiosk. Prices are: Urea: Rp.1750/kg KCl: Rp. 2000/kg NPK: Rp. 4500/kg Manure is not purchased	From ag kiosk. Prices are: Urea: Rp.1750/kg KCl: Rp. 2000/kg NPK: Rp. 4500/kg Manure is not purchased
32.	Use of animal manures or compost	Yes	Yes	Yes	Yes
33.	Use of gypsum or lime	No	No	No	No
34.	Difficulty of obtaining fertilizers	Manures not difficult Inorganic fertilizers not difficult Have only heard of gypsum	Manures not difficult Inorganic fertilizers not difficult Never heard of gypsum	Manures not difficult Inorganic fertilizers not difficult Never heard of gypsum	Manures not difficult Inorganic fertilizers not difficult Never heard of gypsum
35.	Nutritional deficiencies in vegetable crops	Some show deficiencies but some are fine	Some show deficiencies but some are fine	Some show deficiencies but some are fine	Some show deficiencies but some are fine
36.	Diagnoses of crop problems by ag officers	Diagnoses were made by officers, who gave suggestions for solving the problems	Diagnoses were made by officers, who gave suggestions for solving the problems	Diagnoses were made by officers, who gave suggestions for solving the problems	Diagnoses were made by officers, who gave suggestions for solving the problems

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
37.	Soil salinity problems since the tsunami	Salinity has been a problem, but land is back to normal in some areas	Salinity has been a problem. Farmers try to wash away salts by watering; rainfall also helps.	Soils have been somewhat saline. Farmers try to wash away salts by watering; rainfall also helps.	Soils have been somewhat saline. Farmers try to wash away salts by watering; rainfall also helps.
38.	Soil cultivation methods	Manually	Manually	Manually	Manually
39.	Bed preparation and use of plastic mulch	Soil is overturned with a large hoe, plowed, and beds and furrows are made. Plastic mulch is used.	Soil is overturned with a large hoe, plowed, and beds and furrows are made. Plastic mulch is used.	Soil is overturned with a large hoe, plowed, and beds and furrows are made. Plastic mulch is used.	Soil is overturned with a large hoe, plowed, and beds and furrows are made. Plastic mulch is used.
40.	Permanent beds used for vegetables?	Usually not	Usually not	Usually not, but there are some that are permanent	Usually not
41.	Field drainage methods	Through furrows	Through furrows	Through furrows	Through furrows
42.	Soil structural problems	Problems are present	Problems are present: poor root growth	Problems are present	Problems are present
43.	Crop residue management	Pulled up and burned	Pulled up and burned	Pulled up and burned	Pulled up and burned
44.	[no question]	-	-	-	-
45.	Most damaging pests and diseases	See Table 5	See Table 4	See Table 4	See Table 4
46.	Pest and disease damage since the tsunami	Increased	No change	Increased	Increased
47.	Source of pest and disease control information	BPTP NAD, the Food Crops Agricultural Service (*Dinas*) and extension agents (*PPL*)	Food Crops Agricultural Service (*Dinas*), Pidie District	Food Crops Agricultural Service (*Dinas*), Bireuen District	Food Crops Agricultural Service (*Dinas*), Aceh Utara District
48.	Traditional pest control methods	None used	None used	None used	None used
49.	Had training in pest/disease control	No	Only one farmer interviewed had training	No	No
50.	Natural enemies on vegetables	Farmers are aware these are present	Farmers are aware these are present	Farmers are aware these are present	Farmers are aware these are present

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
51.	Actions that affect natural enemies	Some farmers aware that pesticides kill natural enemies	Some farmers aware that pesticides kill natural enemies	Some farmers aware that pesticides kill natural enemies	Some farmers aware that pesticides kill natural enemies
52.	Monitor pests/diseases before spraying pesticides?	Yes	Yes	Yes	Yes
53.	Factors influencing decision to grow which vegetable crop	High prices	High prices	High prices	High prices
54.	Vegetables sold immediately after harvest?	Yes	Yes	Yes	Yes
55.	How vegetables are sold	Some farmers sell directly at the market, others sell to a middleman	Some farmers sell directly at the market, others sell to a middleman	Some farmers sell directly at the market, others sell to a middleman	Some farmers sell directly at the market, others sell to a middleman
56.	Role of farmers' group or organization	Farmers are members, but the group does not have any role in deciding prices	Farmers are members, but the group does not function effectively	Farmers are members, but the group is not useful	Farmers are members, but the group cannot help improve prices for selling vegetables
57.	Greatest needs to overcome impacts from tsunami	Capital for hiring labor; Water pumps; Technological aid; Agricultural inputs; If trainings are held, farmers request to be included.	Capital for hiring labor; Water pumps; Technological aid; Agricultural inputs; If trainings are held, farmers request to be included.	Capital for hiring labor; Water pumps; Technological aid; Agricultural inputs; If trainings are held, farmers request to be included.	Capital for hiring labor; Water pumps; Technological aid; Agricultural inputs; If trainings are held, farmers request to be included.
58.	Information needed	On all topics	On all topics	On all topics	On all topics

Table 11. Summary of responses from staff at AIAT-NAD and the Food and Horticultural Crops Agricultural Service NAD (numbers correspond to questions in the questionnaire in Appendix 3).

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
1.	Changes in market for vegetables over past 5 years	Increase, especially for chili pepper and tomato; does not differ by season.	Increase in production, especially during the rainy season	Increase in production, especially during the rainy season	Increase in production, especially during the rainy season
2.	How farmers decide which vegetables to grow	Primarily those which are marketable and farmers know production technologies for	Primarily those which are marketable and farmers know production technologies for	Primarily those which are marketable and farmers know production technologies for	Primarily those which are marketable and farmers know production technologies for
3.	Information requested since tsunami	Field improvement; pest and disease control	Field improvement; pest and disease control	Field improvement; pest and disease control	Field improvement; pest and disease control
4.	Assisting farmers with soil/plant testing	Have done so, but no results yet	Have done so, but no results yet	Never	Never
5.	Assisting farmers with fertilizer decisions	Yes, regarding types, application rates and timing	Yes, regarding types, application rates and timing	Yes, regarding types, application rates and timing	Yes, regarding types, application rates and timing
6.	# of farmers per Extension Agent	6000 farmers / Ag Extension Agent	5800 farmers / Ag Extension Agent	6000 farmers / Ag Extension Agent	5000 farmers / Ag Extension Agent
7.	Vegetable storage facilities provided by Dept. of Agriculture	None at present	None at present	None at present	None at present
8.	Post-harvest technologies promoted by Dept. of Agriculture	Tomato ketchup production	Tomato ketchup production	Tomato ketchup production	Tomato ketchup production
9.	Major pests and diseases of vegetable crops. Severity increased since tsunami?	Wrinkled leaves (virus) on chili pepper; Fusarium wilt; wrinkled leaves (virus) on tomato; thrips on cucumber; grasshoppers on amaranth. Pest and disease levels tend to be higher since tsunami.	Wrinkled leaves (virus) on chili pepper; Fusarium wilt; wrinkled leaves (virus) on tomato; thrips on cucumber. Pest and disease levels are higher since tsunami.	Wrinkled leaves (virus) on chili pepper; Fusarium wilt; wrinkled leaves (virus) on tomato; thrips on cucumber. Pest and disease levels tend to be higher since tsunami.	Wrinkled leaves (virus) on chili pepper; Fusarium wilt; wrinkled leaves (virus) on tomato; thrips on cucumber. Pest and disease levels tend to be higher since tsunami.
10.	Soil fertility and plant nutrition issues for vegetables. Severity increased since tsunami?	Lack of soil fertility. Very serious.	Lack of soil fertility. Very serious.	Lack of soil fertility. Very serious.	Lack of soil fertility. Very serious.
11.	Other issues regarding vegetable crops	None	None	None	None

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
12.	Research done on vegetables	Field fertility	Field fertility	None	None
13.	Research needs on vegetables	Pest/disease control, new superior varieties, correct fertilizer rates	Pest/disease control, new superior varieties, correct fertilizer rates	Pest/disease control, new superior varieties, correct fertilizer rates	Pest/disease control, new superior varieties, correct fertilizer rates
14.	How research results have been extended	Through media such as bulletins, leaflets and brochures, and by direct demonstration	Through media such as bulletins, leaflets and brochures, and by direct demonstration	Through media such as bulletins, leaflets and brochures, and by direct demonstration	Through media such as bulletins, leaflets and brochures, and by direct demonstration
15.	Successful and unsuccessful technology adoption experiences	Successes: use of inorganic fertilizer, mulch and manure. Failures: mistakes in predicting seasons.	Successes: use of inorganic fertilizer, mulch and manure. Failures: mistakes in predicting seasons.	Successes: use of inorganic fertilizer, mulch and manure. Failures: mistakes in predicting seasons.	Successes: use of inorganic fertilizer, mulch and manure. Failures: mistakes in predicting seasons, false seeds, lack of manure.

Table 12. Summary of responses from marketing agents (numbers correspond to questions in the questionnaire in Appendix 3).

No.	Topic	Aceh Besar (in general)	Pidie (in general)	Bireuen (in general)	Aceh Utara (in general)
1.	Product quality	Very important and there are price differences based on quality	Very important and there are price differences based on quality	Very important and there are price differences based on quality	Very important and there are price differences based on quality
2.	Lowest and highest prices for 4 vegetables	Chilli: Rp 35,000/kg-1500/kg Tomato: Rp 12,000/kg-750/kg Cucumber: Rp 2,500/kg-200/kg Amaranth: Rp 500-150/bunch	Chilli: Rp 30,000/kg-1500/kg Tomato: Rp 12,000/kg-750/kg Cucumber: Rp 2,500/kg-200/kg Amaranth: Rp 350-150/bunch	Chilli: Rp 35,000/kg-1500/kg Tomato: Rp 12,000/kg-750/kg Cucumber: Rp 2,500/kg-200/kg Amaranth: Rp 350-150/bunch	Chilli: Rp 35,000/kg-1500/kg Tomato: Rp 12,000/kg-750/kg Cucumber: Rp 2,500/kg-200/kg Amaranth: Rp 350-150/bunch
3.	Where they buy vegetables	Directly from farmers	Directly from farmers	Directly from farmers	Directly from farmers
4.	Vegetables exported?	No	No	No	No
5.	Middlemen have binding agreements with farmers so farmers can’t sell vegetables freely?	No	No	No	No
6.	Price difference between farmer and market levels	Chilli: Rp 5000/kg Tomato: Rp 1000/kg Cucumber: Rp 500-700/kg Amaranth: 50%	Chilli: 4000-5000/kg Tomato: Rp 1000-1250/kg Cucumber: Rp 500-700/kg Amaranth: 50%	Chilli: Rp 5000/kg Tomato: Rp 1000/kg Cucumber: Rp 500-700/kg Amaranth: 50%	Chilli: Rp 4000/kg Tomato: Rp 1000/kg Cucumber: Rp 500-700/kg Amaranth: 50%

Direct Observations by the PA Team

This section highlights the PA team's direct observations of the farms and surrounding environment. However, some related feedback from farmers is intermixed to clarify details.

Soil Issues

Nusa, Lhoknga, Aceh Besar: This village was not as badly affected as many other areas within Aceh. Sediment deposits were in the order of 20-30cm, although they were up to 50cm in some fields. Much of the vegetable farming is back to normal; many of the farmers interviewed had recommenced farming a couple of months after the tsunami. There were some problems with salinity, although most farmers reported that the land is fairly well back to normal in most areas.

Braden, Peukan Bada, Aceh Besar: This area was much more severely affected than Nusa village. Here the fields were inundated for up to 1 week. The depth of inundation was around 4-5m and the depth of sediment (mud) deposits was around 50cm. Rice yields continue to be around 50% of those pre-tsunami. Vegetables were previously grown in rotation with rice but most farmers have not recommenced vegetable production since the tsunami. A preliminary soil assessment was undertaken in one of the farmer's fields (Fig. 1). Tsunami deposits, salt, crusting and dispersion were evident on the soil surface in a neighboring field (Fig. 2).

Figure 1. Aceh Besar PA team taking soil samples in farmer's field near Braden Village, Peukan Bada Sub-district, Aceh Besar District.

Figure 2. Evidence of tsunami deposits, salt, crusting and dispersion on the soil surface of a farmer's field near Braden Village, Peukan Bada Sub-district, Aceh Besar District.

Miruek Taman, Darussalam, Aceh Besar: The depth of inundation was up to 4m in some areas, although the sea water receded after 1 day in most areas and left up to 15cm of sediment deposits. The lowland rice and vegetable growing areas remain severely affected and farmers have not attempted to grow vegetables again after repeated crop failures. One of the main issues in lowland areas is damage to drainage and irrigation infrastructure, meaning that it is difficult to drain water from the fields (Fig. 3). Many lowland rice and vegetable fields have been abandoned and remain under water (Fig. 3). Irrigation and drinking water is also saline. Many farmers grow turf in their home gardens as their sole form of income. The main needs of the farmers include fences, tractors for cultivating the fields, seeds and fertilizers as well as training in new farming practices.

Figure 3. The tsunami damaged irrigation and drainage infrastructure (top) making it difficult to deliver irrigation water and drain lowland rice and vegetable fields, which remain derelict (bottom).

A preliminary soil assessment was undertaken in an upland field of amaranth near the village. The soil was not saline although it was very acidic (pH < 4). The amaranth exhibited symptoms of nitrogen and micro-nutrient (Fe) deficiency (Fig. 4). The soil was not saline, although sub-surface soil adjacent to some tomato plants had increased salinity (EC 0.7 dS/m) as a consequence of being irrigated with saline well water (EC 3.26 dS/m).

Figure 4. Soil acidity (pH<4) is likely to have contributed to micro-nutrient deficiency in an upland crop of amaranth growing near Miruek Taman Village, Darussalam Sub-district, Aceh Besar District. Nitrogen deficiency is also suspected.

Kling Cot Arun, Baitussalam, Aceh Besar: Some of the fields in this village have 50-60cm of sediments and many lowland rice and vegetable fields have become swamps because of inadequate drainage. Many farmers now concentrate on growing vegetables in home gardens and have had to bring in soil from elsewhere to establish vegetable beds. The key challenges faced by farmers with upland fields include the lack of fences to enable rehabilitation of fields and the need for labour to clear debris from the fields. Many of the wells have also become saline and so it is difficult to source good quality irrigation water.

An assessment of a derelict upland vegetable field, previously used to grow chilies, tomatoes, cucumbers and amaranth, was undertaken. The soil was not saline but much debris (e.g. Car tyre rims, bricks, cement and other building material) has made it difficult to cultivate and resulted in weed invasion (viz. *Ipomoea* spp.) (Fig. 5). The soil did not exhibit evidence of dispersion although the surface was hard-setting and was acidic (pH 4.8 surface to 3.1 at 10 cm). It also had poor infiltration (Fig. 6).

Figure 5. Sediment, debris, weed invasion and a lack of fences to exclude livestock has made it difficult for the farmer of this field near Kling Cot Arun village in Baitussalam Sub-district, Aceh Besar District, to recommence vegetable production.

Figure 6. Poor water infiltration was observed in a derelict vegetable field near Kling Cot Arun village in Baitussalam Sub-district, Aceh Besar District.

Ladong, Masjid Raya, Aceh Besar: This village is on the coast and the tsunami came in and out very quickly with 2 inundations, 10 minutes apart. The level of inundation was high (2m) although the water receded after only 5 minutes. Typically, only 1-2 cm of sandy sediment was deposited on farmers' fields. However, many growers reported crop failures since the tsunami as a consequence of pests and diseases. They also expressed a need for fencing to exclude pigs and wild animals, as well as tractors to overcome labour shortages in aging farming populations. They were also keen to receive training in how to grow the 4 priority crops in the project.

Soil samples from all four districts: Soil samples were taken at several locations in vegetable farmers' fields affected by the tsunami in the districts of Pidie, Bireuen, Aceh Utara and Aceh Besar; subdistricts and villages are listed below in Table 13. These samples were taken on land presently planted with vegetables, land where vegetables had recently been harvested, and land normally used for growing vegetables (chilli pepper, tomato, amaranth and cucumber). Nutrient deficiencies were observed in certain locations, such as P and K deficiency symptoms on tomato (Meunasah Lhee), P deficiency symptoms on chilli (Meue) and N deficiency symptoms on amaranth (Kota Krueng). A more detailed evaluation and analysis is provided in Table 14.

Table 13. Soil sampling areas.

District	Subdistrict	Village	Vegetables Planted at Present	Vegetables Harvested	Vegetables Normally Grown on this Land
Pidie	Simpang Tiga	Meunasah Lhee Jaja Tunong	Tomato (P, K deficiency) Tomato (N, K deficiency)	- -	Chilli, Tomato and Amaranth Chilli, Tomato and Amaranth
Pidie	Tringgadeng	Meue	Chilli (P deficiency)	Cucumber, Amaranth	Chilli, Tomato and Amaranth
Bireuen	Kuala	Ujong Blang Mesjid	-	Amaranth	Cucumber, Chilli and Kangkung
Aceh Utara	Samudra	Kuta Krueng	Amaranth (N deficiency) Kangkung (N deficiency)	Tomato	Chilli
Aceh Besar	Darussalam	Miruek Taman	Amaranth (N and micronutrient deficiency); Cassava (P deficiency)	Amaranth, tomato, cassava, watermelon	Amaranth, tomato, cassava, watermelon. Farmers keen to grow chili again.

Table 14. Evaluation of Soil Characteristics.

District	Sub District	Village	Soil Properties
Pidie	Simpang Tiga	Meunasah Lhee	Low land Root architecture : Several restricted Depth of water table (m) : 0.01 m pH (soil pH field kit) : 5.8 EC : V = 0.79 dS/m H : 0.59 dS/m Soil structure: Fine lumps Soil texture : A = Sandy loam, B = Sandy loam, C = Clay Soil type : Loamy soil with clay sub soil
		Jaja Tunong	Low land Root architecture : Several restricted Depth of water table (m) : 0.02 m pH (soil pH field kit) : 5.6 EC : V = 0.65 ds/m H : 0.61 ds/m Soil structure: Sealed Soil texture : A = Sandy, B = Sandy loam, C = Clay Soil type : Loamy soil with clay sub soil
	Tringgadeng	Meue	Low land Root architecture : Several restricted Depth of water table (m) : 2 m pH (soil pH field kit) : 6.2 EC : V = 0.28 ds/m H : 0.18 ds/m Soil structure: Fine lumps Soil texture : A = Sandy loam, B = Clay loam, C = Clay Soil type: sand Soil type : Loamy soil with clay sub soil
Bireuen	Kuala	Ujong Blang Mesjid	Low land Root architecture : Severely restricted Depth of water table (m) : 1.2 m pH (soil pH field kit) : 6.2 EC : V = 0.92 dS/m H : 0.91 dS/m Soil structure: Single grains Soil texture: A = Sandy, B = Sandy, C = Sandy loam Soil type: Sand
Aceh Utara	Samudra	Kuta Krueng	Low land Root architecture : Severely restricted Depth of water table (m) : 2.3 m pH (soil pH field kit) : 6.4 EC : V = 0.84 dS/m H : 0.51 dS/m Soil structure: Single grains Soil texture : A = Sandy, B = Sandy, C = Sandy Soil type : Sand
Aceh Besar	Peukan Bada	Beuraden (Site 1) GPS coordinates: N: 05^{o}30.537 E: 95^{o}16.028	Land being prepared for chili crop. Low land Elevation: 6m Root architecture : N/A – fallow land Depth of water table (m) : 2.0 m pH (soil pH field kit) : 5.2-5.9 EC : Medium (EMh 58.7-62.6 mS/m) ECw: 2.30 dS/m (Very high salinity class) Soil structure: Well structured with fine aggregates Soil texture : A = Sandy Loam, B = Clay loam, C = Light Clay Soil type: Duplex soil

Aceh Besar	Peukan Bada	Beuraden (Site 2)	Land being prepared for chili crop. Elevation: 6m Low land Root architecture : N/A – fallow land Depth of water table (m) : 2.0 m pH (soil pH field kit) : 5.2-5.9 EC : High (EMh 86.2 mS/m) Soil structure: Very poor – obvious sediment deposits, salt on surface, dispersion and crusting evident Soil texture : A = Sandy Loam, B = Clay loam, C = Light Clay Soil type: Duplex soil
Aceh Besar	Darussalam	Miruek Taman GPS coordinates: N: 05°0.670 E: 95°23.590	Amaranth and Tomatoes. Elevation: 11m Upland Root architecture : Medium Depth of water table (m) : pH (soil pH field kit) : 4.1-4.5 (Very acidic) EC : Low (EMh 32.0 mS/m) ECw: 3.26 dS/m (Very high salinity class) Soil structure: Moderate Soil texture : A = Sandy Loam, B = Sandy Loam, C = Sandy Loam Soil type: Sandy Loam soil Comments Amaranth crop showed signs of N and micronutrient deficiency. Soil salinity OK but irrigation water very saline and contributing to increased salinity in adjacent tomato crops.
Aceh Besar	Baitussalam	Kling Cot Arun N: 05°35.917 E: 95°23.470	Previously a chili growing field Elevation: 28m Upland Root architecture : N/A – derelict field Depth of water table (m) : 1.5 pH (soil pH field kit) : 4.8 at surface, 3.2 at 5-10cm EC : Low (EMh 32.0 mS/m) ECw: Well 1 - 2.2 dS/m (Very high salinity class); Well 2 0.57 dS/m – low salinity class Soil structure: Poor – hardsetting surface soil with low rates of infiltration. Soil texture : A = Fine Sand, B = Sandy Loam, C = Sandy Soil type: Sandy Loam soil Comments: Field presents a good opportunity for a demonstration site to redevelop an agricultural field using integrated crop management practices.
Aceh Besar	Mesjid Raya	Ladong N: 05°38.671 E: 95°27.668	Mixed vegetable field with young watermelons planted Elevation: 20m Upland Root architecture : Moderate Depth of water table (m) : 4 pH (soil pH field kit) : 6.2 EC : Very Low (EMh 8.3 mS/m) ECw: 2.19 dS/m (Very high salinity class); Soil structure: Moderate Soil texture : A = Sand, B = Sand, C = Sand Soil type: Sandy Comments: Very poor weed control on plots.

Note: A = Texture at 0 -10 cm depth; B = Texture at 10 – 30 cm depth; C = Texture at 30 – 50 cm depth.

Beds used for vegetable production in the ricefields were observed to be 50-60cm high and 80cm wide.

Pest and Disease Issues

In most sites that the PA team visited in Aceh Besar, vegetables were only planted on a very small scale or not at all due to tsunami damage; therefore the opportunities to observe pests and diseases on vegetable crops were quite limited. The team was taken to a chili pepper field in Nusa, Lhoknga (which we later learned was not affected by the tsunami) which had a heavy infestation of thrips (Fig. 7). Very likely, chili peppers in tsunami-affected areas are also experiencing major problems with this insect.

Figure 7. Thrips infestation on chili pepper leaf from Nusa, Lhoknga, Aceh Besar.

Amaranth observed in Miruek Taman, Darussalam, Aceh Besar was partially defoliated by a leafroller caterpillar that appears to be a pyralid (Order Lepidoptera)(Fig. 8). Another caterpillar, *Spodoptera* sp. (Lepidoptera: Noctuidae) is also contributing to this defoliation.

Less than 100m from the ocean, cucumber was growing relatively well in Ladong, Mesjid Raya, Aceh Besar. There was a leafminer infestation, but it may not have been serious enough to cause yield loss.

Five chili pepper leaf and shoot samples from Ujung Pancu, Peukan Bada, Aceh Besar were tested in the AVRDC Virology Laboratory for CMV, PVY, ToMV, CVMV, PMMV and geminivirus. The samples were negative except for one sample, which was infected with geminivirus.

Virus infestations on chili pepper were observed to be serious in Aceh Utara. These are likely to be geminivirus.

Figure 8. Leafroller caterpillars caused significant defoliation of amaranth in Miruek Taman, Darussalam, Aceh Besar.

CONCLUSIONS

Several conclusions arise from the results of the PA:

1. In Aceh Besar, from a soils perspective, many areas visited had not yet returned to vegetable production. The effects of salinity were variable whereby it was evident in some areas but not others. Major constraints were damage to drainage and irrigation infrastructure; poor quality (saline) irrigation water; lack of fences to exclude livestock and wild animals; and a lack of equipment and labour to cultivate fields.
2. Nutrient deficiencies (N, P and micronutrients) were common in many of the fields visited. Soil acidity (pH < 4) was common in Aceh Besar District and highlighted the need for lime application to these soils. Most growers had access to NPK fertilizers and manure and applied them to their crops. However, it was difficult to determine the rates at which they were applied. A summary of the soils issues and research opportunities arising from them are found in Table 15.

Table 15. Summary of soil and crop issues identified during preliminary soils assessments and research opportunities arising from them.

Location	Issue	Research Opportunity
Aceh Besar Baitussalam Sub-district Masjid Raya Village	Soil Acidity Nutrient deficiencies	Examine the effects of lime, compost and nutrients on soil fertility
Aceh Besar Baitussalam Sub-district Kling Cot Arun Village	Acidity, Rehabilitation	Using site to demonstrate the use of integrated crop and soil management to bring farming system back into production
Aceh Besar Baitussalam Sub-district Miruek Taman Village	Soil Acidity	Examine the effects of lime, compost and nutrients on soil fertility
Aceh Besar Peukan Bada Sub-district Braden Village	Soil sodicity (crusting and dispersion); Sub-soil compaction, soil salinity	Use of gypsum, compost and nutrients to restore soil fertility
Aceh Utara, Pidie and Bireuen Districts.	Crop nutrient disorders (N, P, K).	Utilisation of manure and inorganic fertilizers to improve soil fertility and crop nutrition

3. Part of the tsunami-affected area can be successfully planted to vegetables now (chilli, tomato, amaranth, cucumber and others). However, other parts are damaged severely and will require rehabilitation efforts beyond the scope of this project, for example, major repairs of irrigation infrastructure. Other areas may be completely lost to vegetable production because they are now low lying (due to tsunami damage) and affected by tidal waters; with rising ocean levels, the prospects of these areas to become viable for vegetable production are very low.
4. Tables 10-12 indicate that many characteristics are similar in the tsunami-affected areas of the four districts that were appraised. This is reasonable since these districts are contiguous along the northeastern coast of Aceh. However, Aceh Besar shows some differences relative to the other three districts, which is also logical since it was heaviest hit by the tsunami.
5. The PA was an effective means of identifying the issues vegetable farmers face in returning their land to post-tsunami production. These issues include damage to drainage and irrigation infrastructure, poor quality (saline) irrigation water, lack of fences to exclude livestock, and a shortage of equipment and labour to clear and cultivate damaged fields. Other crop management factors such as increased pest and disease incidence and weeds were also identified as issues requiring further investigation. Farmers involved with the PA were very supportive of the project and expressed a willingness to be involved in it. In particular, they were keen to receive technical information on all aspects of crop production, participate in future training activities and be involved in the participatory research program. Many farmers had been visited by Indonesian and international researchers since the tsunami but had not had any follow-up visits, highlighting the need to maintain the good will exhibited, via regular communication and project updates.
6. The preliminary soil assessments made during field inspections revealed variable effects of the tsunami. Most areas visited in the Aceh Utara, Pidie and Bireuen Districts appeared to be back to normal production. However, many of the crops inspected suffered from nutritional deficiencies, in particular N, P and K, which highlights the need for improved nutrient management on these soils. Tsunami damage was much more evident in Aceh

Besar, with many fields derelict and/ or abandoned. The main soil constraints to these fields appear to be salinity, sodicity, poor drainage and sediment deposits. Soil acidity is also an issue in this district.

RECOMMENDATIONS

1. A key recommendation arising from this visit is to ensure farmer groups are kept informed of progress and given regular updates on results as they arise. As outlined in the detailed project plan, this will be achieved by working closely with key farmers in conducting the field experiments and demonstrations associated with the project, disseminating outcomes through education and extension publications and involving them in Farmer Field Schools.
2. This project focuses on rehabilitating vegetable production in the tsunami affected areas of NAD Province, through integrated soil and crop management. Strategies for achieving this have been developed in the project plan. However, there is a clear need for new irrigation and drainage infrastructure and provision of fences and equipment to restore tsunami-affected agricultural land in Aceh. Likewise, the practice of slash and burn agriculture observed on the foothills in Peukan Bada sub-district requires immediate attention. Whilst these broader issues are beyond the scope of the current project, the project partners can play a role in highlighting these issues and creating linkages between stakeholders for addressing them (e.g., Bureau of Rehabilitation and Reconstruction NAD-Nias, NGOs and Governments). The cross-project (LWR 2005/004, LWR 2005/118, CP/2005/075) Communications Workshop held in Saree, NAD on August 8, 2007, is one way of achieving this.
3. Since tsunami-related damage is highest in Aceh Besar, more extensive efforts will be required to return this district to vegetable production, compared to the other three.
4. Training in the use of compost is recommended.
5. In general, farmers use less than optimum amounts of manure. Utilization of stable manure is recommended at a rate of 30 ton/ha or 1 kg/plant in general; however, exact rates should be based on soil tests and the specific vegetable crop(s) to be planted.
6. Adequate use of inorganic fertilizers is important for optimizing vegetable production; rates of 200 kg N/ha, 100 kg P_2O_5/Ha and 100 kg K_2O/Ha are recommended by the team, but exact rates should be based on soil tests and the specific vegetable crop(s) to be planted.
7. Activities and publications to raise farmer knowledge of integrated pest management (IPM) methods on vegetables are recommended, since farmers in many PA locations expressed this need.

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Appendix 1. Photographs of the PA Activities.

PA Discussion in Aceh Besar District

PA Discussion in Aceh Utara District

PA Discussion in Bireuen District

PA Discussion in Pidie District

Chili pepper field owned by the farmer in Kuta Krueng Village, Aceh Utara

Amaranth field owned by the farmer in Ujong Blang Mesjid Village, Bireuen

Most of the ACIAR Vegetables project team members who were involved in the Participatory Assessment held in Aceh during March 2007.

Appendix 2. Seasonal Calendar for Aceh Besar, Pidie, Bireuen and Aceh Utara Districts, NAD, Indonesia.

CROPS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Chili pepper *Note*: If irrigation is available, farmers may plant anytime year-round.	Harvest and sell imme-diately	Harvest and sell imme-diately	Harvest and sell imme-diately				Cultivate the land	Sow in nursery, add manure to fields, and transplant	Add manure to fields and transplant	Crop matures	Harvest and sell imme-diately	Harvest and sell imme-diately
Tomato *Note*: If irrigation is available, farmers may plant anytime year-round.							Cultivate the land	Sow in nursery, add manure to fields, and transplant	Add manure to fields and transplant	Crop matures	Harvest and sell imme-diately	
Cucumber *Note*: If irrigation is available, farmers may plant anytime year-round. Farmers also time their planting so that they can harvest during Ramadan, when prices are high. In this case, they plant ~40 days before the start of Ramadan.							Cultivate the land	Add manure to fields and sow directly	Harvest and sell imme-diately		Add manure to fields and sow directly	Harvest and sell imme-diately
Amaranth *Note:* Farmers plant year-round; harvesting ~22 days after planting is common, although longer seasons are also common.												
Wet and dry seasons	Wet	Wet/dry	Dry	Dry	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet

Appendix 3. Questionnaires.

INTEGRATED CROP MANAGEMENT FOR VEGETABLE PRODUCTION ON TSUNAMI-AFFECTED SOILS
PARTICIPATORY APPRAISAL QUESTIONS
NAD PROVINCE, INDONESIA, 20-25 MARCH 2007

<u>Objectives</u>

The objective of this participatory assessment (PA) is to identify constraints / issues in vegetable agro ecosystems on tsunami-affected soils. The PA is structured around the following potential constraints, although others may become evident during the PA:

- Salinity/ sodicity
- Nutritional disorders (P, K, Ca)
- Soil structural degradation (e.g. poor infiltration).
- Pests and Diseases

It is also an important mechanism for gathering information about the various vegetable production systems in NAD Province. **The PA will focus on the project's priority crops – chili pepper, tomato, cucumber and amaranth** – but may also investigate other vegetable crops to a lesser extent.

Informasi Petani/ Farmer Information

1. *Desa* / Village:___________ *Kecamatan*/ Subdistrict:__________ *Kabupaten*/District:________

2. *Nama & Jenis kelamin petani*/ Farmers' names, genders: ________________________________

3.*Luas lahan* / Sizes of farms: <0.5 ha_______; 0.5-1 ha________; >1 ha__________

4. *Kepemilikan lahan*/ Land tenure (Owner, tenant, share farmer, other):

5. *Pekerjaan Utama*/ Major occupation(s):

6. *Sudah berapa lama Bpk/Ibu bertani?/* How long have you been farming?

Pengelolaan Pertanian/ Management Practices

7. *Sudah berapa lama lahan sayur Bpk/Ibu diusahakan*?/ How long has your vegetable farm been in production?

8. *Jenis tanaman sayuran apa saja yang ditanam*? / What vegetables do you grow?

9. *Sumber bibit atau benih*: / Source of seeds:

10. *Apakah Bpk/Ibu menanam jenis sayur tradisional atau hibrida*? /Are you growing hybrids or traditional varieties?

11. *Nama jenis hibrida/tradisional yang ditanam*? Names of hybrids/traditional varieties:

12.*Tolong ceritakan mengenai cara mengelola tanaman sayuran (cara budidaya, bertanam, pengendalian tanaman pengganggu/hama/penyakit, panen).* / Can you please describe your typical crop management practices (Bed preparation, cultivation, planting, weed/ pest and disease control, harvest)?

	***Cabai* / Chili pepper**	***Tomat* / Tomato**	***Timun* / Cucumber**	***Bayam* / Amaranth**	***Lain* / Other**
Cara persiapan lahan/ Land preparation					
Persemaian/ Nursery activities					
Penanaman/ Planting					
Pengairan/ Irrigation					
Penyiangan/ Weeding					
Penyemprotan / Spraying					
Cara lain pengendalain hama / Other pest control measures					
Pemanenan/ Harvesting					
Pemasaran/ Marketing					

13. *Apakah tanaman sayuran Ibu/Bpk ada pengairan atau tergantung hujan? Jika ada pengairan, sistem pengairan jenis apa? Darimana sumber airnya*? (*digenangi*) / Are your crops irrigated or rainfed? If irrigated, can you please describe the irrigation system? Where do you get your water from and how is it applied?

14. *Tolong jelaskan kegiatan bulan per bulan untuk menanam cabai, tomat, timun dan bayam.(Lampiran 1)* / Can you please describe your typical calendar of operations for chili pepper, tomato, cucumber and amaranth? (Appendix 1)

15. *Berapa rata-rata hasil yang diperoleh untuk 4 tanaman sayuran tersebut*? / What yields do you usually get for these 4 crops?

16. *Apakah tanaman sayuran dirotasi dengan tanaman lain? Tanaman apa dalam musim apa*? / Do you grow your vegetable crops in rotation with any crops (e.g. Rice, legumes, others)? Which crops in which seasons?

17. *Isu berkaitan dengan tsunami /* Tsunami-related issues
Apakah lahan sayur bapak/ibu terkena dampak tsunami? / Was your farm affected by the tsunami?

18. *Berapa lama masing-masing lahan tergenang air tsunami*? (*jam, hari*) / How long was each field inundated?

19. *Berapa genangan tertinggi yang terjadi di lahan Bpk/Ibu*? /(centimeter) What was the maximum depth of inundation?

20. *Apakah tsunami meninggalkan tanah atau endapan di lahan Bpk/Ibu? Jika ya, berapa ketinggian endapan tersebut? Bagaimana Bpk/Ibu mengatasinya (misalnya, diambil, dicampur dengan tanah, dibiarkan)?* Did the tsunami deposit soil or sediment in your fields? If so, how deep were the sediment deposits? How were the sediment deposits managed (eg. removed, mixed with soil, left on the surface)?

21. *Apakah tsunami meninggalkan bahan lain di lahan Bpk/Ibu (materi dari laut, pohon, dll)? Jika ya, bagaimana bahan tersebut dibersihkan? Apakah ada bahan organic yang dikomposkan?* Did the tsunami deposit other material on your fields (eg. Flotsam and jetsam, trees, other)? If so, how were these removed and disposed of? Was any of the organic material composted?

22. *Berapa lama* setelah tsunami terjadi Bpk/Ibu mengusahakan kembali lahan sayuran tersebut dengan *berhasil*? How soon after tsunami were you able to grow vegetables again successfully?

23. *Apakah Ibu/Bpk sudah pernah menanami lahan yang kena tsunami tersebut? Jika ya, berapa kali tanam dan bagaimana hasil dari tanamannya (baik sekali, baik, rata-rata, jelek, jelek sekali)?* Have you grown crops on the fields which were affected by the tsunami? If so, how many and how have they performed (Very good, good, average, poor, very poor)?

24. *Berapa hasil tanaman sayur-sayuran tersebut sejak tsunami*? What have been your crop yields since the tsunami?

25. *Jika pertumbuhan/hasil tanaman berkurang, apa sebabnya, menurut Bpk/Ibu*? If crop growth/ productivity has been reduced, what do you think are the reasons for reduced productivity?

26. Pengelolaan tanah / Soil management
Tipe tanah / Soil type
Menurut Bpk/Ibu lahan sayuran subur atau tidak? / Can you please describe how fertile your soil is?

27. Berapa dalamnya topsoil? How deep is the topsoil?

28. Setelah hujan atau irrigasi, apakah airnya cepat menggenang atau menetap lama di permukaan tanah? / Does the water drain away quickly or does it sit on the soil surface after rain or irrigation?

29. Apakah tanah dari lahan Bpk/Ibu pernah dianalisis di laboratorium? Jika ya, bagaimana hasilnya? Have you ever had a soil test done? If so, do you have any historical soil test results?

<u>*30. Unsur hara* / Nutrients</u>

Pupuk apa yang digunakan di lahan sayur pada musim ini (jenis pupuk, dosis, tanggal dipakai)? Can you please describe the fertilizer history of each of your vegetable fields this season (eg. Fertilizer type, rate of application, dates of application)?

31. Dari mana Ibu/Bpk mendapatkan pupuk dan berapa harganya? Where do you get your fertilizers from and how much do they cost?

32. Apakah Bpk/Ibu menggunakan kompos atau pupuk kandang? Jika ya, didapat dari mana, atau dibuat sendiri? Berapa banyak dosis yang digunakan? Berapa harganya jika dibuat atau dibeli? Do you use composts or animal manures? If so where do you get these from or do you make them? How much do they cost to make or buy?

33. Apakah Bpk/Ibu memakai gipsum atau kapur pada tanahnya? Do you use gypsum or lime in your soils?

34. Apakah ada kesulitan mendapatkan pupuk buatan, kompos, kapur atau gipsum di daerah ini? Is it difficult to obtain inorganic fertilizers, composts, lime or gypsum in this area?

35. Sejak tsunami, apakah Bpk/Ibu melihat tanaman sayur kurang subur? Have you observed any nutritional deficiencies in your vegetable crops since the tsunami?

36. Apakah masalah tanaman sayur tersebut diketahui/diagnosis oleh petugas BPTP/PPL/Dinas? Have you had any nutrient/ crop disorders diagnosed by soil testing or a BPTP/ Dinas Pertanian officer?

37. Salinitas /Salinity

Apakah ada masalah kegaraman pada tanah setelah tsunami?

Have you had any soil salinity problems since the tsunami?

38. Persiapan dan pengelolaan guludan / Bed preparation and management

Bagaimana Bpk/Ibu melakukan pengolahan tanah?

Can you please describe how the soil is cultivated on your farm?

39. Jika memakai guludan untuk tanaman sayur, bagaimana cara penyiapannya? Apakah memakai mulsa plastic atau bahan lainnya?

If you use beds for your vegetable crops, how are they prepared? Do you use plastic mulching or else?

40. *Apakah guludan tersebut tetap dipakai atau dihancurkan jika pada lahan tersebut Bpk/Ibu menanam padi/tanaman lain pada musim selanjutnya?*
Do you use permanent beds for vegetables?

41. *Bagaimana cara pembuangan air di lahan sayuran tersebut?* How do you drain your fields?

42. *Apakah Bpk/Ibu melihat adanya masalah struktur tanah sejak tsunami (dispersi/ sodik, tanah jenuh dgn air, air sulit masuk tanah, pertumbuhan akar jelek*)? Have you noticed any soil structural problems since the tsunami (eg. Dispersion/ sodicity, waterlogging, poor infiltration and root growth)?

43. *Apakah yang Bpk/Ibu lakukan dengan sisa tanaman setelah panen (dibakar, dimasukkan ke dalam tanah, diambil, dibuat kompos)?* How do you manage crop residues (burning, incorporation, removal, composting)?

***44. Hama dan Penyakit /* Pests and Diseases**

45. *Hama dan penyakit apa paling merusak tanaman cabai, tomat, timun dan bayam?*
What are the most damaging pests and diseases on chili pepper, tomato, cucumber and amaranth?

Tanaman sayur / Vegetable	*Hama/penyakit yg paling merusak* / Most damaging pests/diseases	*Besarnya pengurangan hasil* / Amount of yield reduction	*Cara pengendalian (jika pestisida, berapa kali digunakan per musim*) / Control measures used (if pesticides, # times used per season)	*Cara pengendalian berhasil*? Control measures successful?
Cabai / Chili pepper				
Tomat/ Tomato				
Timun / Cucumber				
Bayam/ Amaranth				

46. *Sejak tsunami, apakah kerusakan akibat hama/penyakit pada tanaman sayur bertambah atau menurun? Hama/penyakit apa dan terhadap tanaman apa?*

Has disease/ pest damage increased or decreased since the tsunami? If so, which ones?

47. Sumber informasi/rekomendasi mengenai pengendalian hama dan penyakit:
Source of pest and disease control information/recommendations:

48. Apakah Bpk/Ibu memakai cara pengendalian hama secara tradisional? Jika ya, cara apa?
Do you use any traditional methods of pest control? If yes, what are they?

49. Apakah anda pernah mengikuti pelatihan pengendalian hama dan penyakit ? Jika Ya, pelatihan apa? Siapa yang menyelenggarakan ?
Have you undergone any training in pest/disease control? If yes, what training? Who rganized it?

*50. Apakah ada serangga dan laba-laba (musuh alami) untuk membantu pengendalian hama dan penyakit pada sayur?*Are there beneficial insects/spiders (natural enemies) that help control pests on vegetables?

51. Apakah anda berbuat sesuatu yang mempengaruhi keberadaan musuh alami ?
Do you do anything that affects these beneficial insects/spiders?

52. Apakah anda mengamati/memonitor hama penyakit sebelum penyemprotan pestisida ?
Do you monitor for pests/diseases before spraying pesticides?

Pemasaran Sayur / **Marketing of Vegetables**

53. Apa mempengaruhi keputusan anda untuk menanam sayur tertentu?
What influences your decision to grow a particular vegetable crop?

54. Apakah anda menjual sayur segera setelah panen ?
Do you sell vegetables immediately after harvest?

55. Bagaimana anda menjual sayur setelah panen ? How do you sell vegetables after harvesting?
Sell by contract / *Menjual secara kontrak* ______
Sell to middle man / *Menjual kepada tengkulak/bandar*_____
Sell directly to the market / *Menjual langsung ke pasar*_______
Others / Lainnya ___________________________

56. Apakah anda anggota kelompok tani? Kelompok tersebut membantu mendapat harga yang lebih baik?
Are you a member of farmers' group or organization? Does it help you obtain better prices?

Pertanyaan Kesimpulan / **Concluding questions**

57. Kebutuhan apa yang paling mendesak untuk mengatasi dampak tsunami? /What are your greatest needs to overcome impacts from the tsunami?

58. Informasi lain apa yang Bpk/Ibu perlukan? What other information do you need?
Sarana produksi apa yang Bpk/Ibu perlukan? (tenaga kerja, pupuk, pestisida, sarana produk lain, alat-alat)? What resources do you need? (labor, fertilizers, chemicals, other inputs, equipment)?

Lampiran 1: Kalendar Musim untuk Desa _________, Kabupaten __________, NAD, Indonesia

Appendix 1: Seasonal Calendar for ___________ village, ________ District, NAD, Indonesia

Tanaman / Crops	JAN	FEB	MAR	APR	MEI	JUN	JUL	AGU	SEP	OKT	NOV	DES
Cabai / Chili pepper												
Tomat / Tomato												
Timun / Cucumber												
Bayam / Amaranth												
Musim hujan dan kemarau / Wet and dry seasons												

INTEGRATED CROP MANAGEMENT FOR VEGETABLE PRODUCTION ON TSUNAMI AFFECTED SOILS –
PARTICIPATORY APPRAISAL QUESTIONS
NANGGROE ACEH DARUSSALAM, INDONESIA, 20-25 MARCH 2007

Pertanyaan untuk PPL, Dinas Pertanian dan BPTP / Questions for Agricultural Officers

1. *Perubahan apa yang terjadi dalam 5 tahun terakhir mengenai pemasaran sayur di NAD? Ada perbedaan di antara musim*? What changes have occurred in the market for vegetables in NAD over the past five years and how does it differ by season?

2. *Bagaimana petani di NAD memutuskan jenis tanaman sayuran diusahakan?*
   How do farmers decide which vegetable crops to grow?

3. *Informasi tentang apa yang banyak ditanyakan sehubungan dengan tsunami?*
   What are the key areas where you have been asked for information since the tsunami?

4. *Apakah anda membantu petani dalam pengujian tanah dan tanaman, serta menterjemahkan hasilnya?*
   Do you assist farmers with soil and plant testing and interpretation of results?

5. *Apakah anda membantu petani dalam memutuskan penggunaan pupuk (jenis, dosis, waktu, dll)?*
   Do you assist farmers make fertilizer decisions (type, application rate, timing etc)?

6. *Jumlah petani per PPL di kabupaten ini:*
   Number of farmers per Agricultural Extension Agent in this District:

7. *Fasilitas penyimpanan hasil sayur apa yang disediakan oleh Departemen Pertanian untuk petani miskin?*
   What storage facilities for vegetables are provided by the Department of Agriculture for resource-poor farmers?

8. *Teknologi pasca-panen apa yang telah diperkenalkan oleh Departemen Pertanian (Dinas Pertanian, BPTP-NAD, Unsyiah) untuk meningkatkan nilai tambah produk (pengalengan, fermentasi, pengepakan, dll)?*
   What post-harvest technologies are promoted by the Department of Agriculture for value addition of vegetables (canning, pickling, processing, etc.)?

9. *Hama dan penyakit apa yang paling merusak tanaman sayur di NAD? Apakah hama dan penyakit tersebut menjadi lebih serius sejak tsunami*? What are the major insect pests and diseases of vegetable crops in NAD? Have the incidence and severity of these increased since the tsunami?

10. *Isu apa yang penting mengenai kesuburan tanah dan nutrisi tanaman untuk tanaman sayur di NAD? Apakah isu tersebut menjadi lebih serius sejak tsunami?*
    What are the key soil fertility and plant nutrition issues for vegetable crops in NAD? Have the incidence and severity of these increased since the tsunami?

11. *Isu lain apa yang penting untuk tanaman sayur di NAD? Apakah isu tersebut menjadi lebih serius sejak tsunami?*
    What other issues are important for vegetable crops in NAD? Have the incidence and severity of these increased since the tsunami?

12. *Penelitian apa sudah dilakukan di daerah ini mengenai sayur?*
    What research has been done in this area on vegetables?

13. *Penelitian apa diperlukan sekarang mengenai sayur?*
    What do you see as research needs on vegetables?

14. *Bagaimana hasil penelitian disampaikan ke petani supaya diterapkan?*
    How have you tried to encourage adoption of research outcomes?

15. *Tolong ceritakan tentang pengalaman penerapan teknologi oleh petani yang berhasil dan tidak berhasil.*
    What are some successful and unsuccessful adoption experiences?

Pertanyaan untuk Agen Pemasaran* / Questions for Marketing Agents*:

1. *Apakah kualitas produk penting diperhatikan? Apakah ada perbedaan harga untuk kualitas produk yang berbeda?*
   Is product quality a concern? What are the price differences for different product qualities?

2. *Berapa harga terendah dan tertinggi untuk masing-masing sayuran?*
   What are the lowest and highest prices for these vegetables?
   Cabai Chili pepper:
   Tomat Tomato:
   Timun Cucumber:
   Bayam Amaranth:

3. *Di mana anda membeli dan menjual sayuran tersebut?*
   Where do you buy and sell vegetables?

4. *Apakah sayuran tersebut diekspor ke luar negeri?*
   Does the crop move into the export market?

5. *Apa ada keterikatan petani oleh Bandar sehingga petani tidak bisa menjual hasil sayuran secara bebas?*
   Does the middleman have a binding agreement with the farmer so the farmer cannot sell his/her vegetables freely?

6. *Berapa perbedaan harga dari petani dengan harga sayuran di pasar?*
   What are the price differences between vegetables bought from the farmer and those sold in the market?

TRAINING OF TRAINERS
AND
VEGETABLE INTEGRATED CROP MANAGEMENT WORKSHOP
REPORT

13-24 October 2008

Saree, Aceh Besar, Nanggroe Aceh Darussalam, Indonesia

Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia (SMCN/2005/075)

AVRDC
The World Vegetable Center

NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Assessment Institute for Agricultural Technology (*BPTP NAD*)
AVRDC – The World Vegetable Center
Food Crops Agricultural Service (*Dinas Pertanian Tanaman Pangan Provinsi NAD*)
Indonesian Vegetable Research Institute (IVEGRI)
New South Wales Department of Primary Industries (NSW DPI)
BLPP Saree
Austcare

Funded by ACIAR:

Australian Government
Australian Centre for International Agricultural Research

Background: The participatory assessment and baseline survey conducted for this project both determined that chili pepper is the most important vegetable crop in our project area, i.e., tsunami-affected regions of Aceh Besar, Pidie, Pidie Jaya, Bireuen, and Aceh Utara Districts. Furthermore, the baseline survey has confirmed the high income potential that chili pepper has for Aceh farmers and their strong interest in planting it. According to the recent baseline survey results, the major problems with chili pepper at the farmer level are pest and disease attacks, among them anthracnose and thrips. Nutrient deficiencies (N, P and micronutrients) were also common in many of the fields visited.

Objective: To train 20 farmer field school trainers/facilitators and 15 agricultural R&D staff in chili pepper integrated crop management.

Date, Venue and Program: The activities were held at BLPP Saree, Aceh Besar on 13-24 October 2008. All oral presentations were translated/interpreted into Indonesian by Greg Luther, M. Ferizal or Rachman Jaya. This training workshop fell under the project activity "Training of Trainers and Vegetable Integrated Crop Management Workshop" for the ACIAR-funded project, "Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia" (ACIAR Project SMCN 2005/075). Photographs of many of the activities can be found in Appendix 1.

No.	Subject	Presenter	Date
1.	Integrated pest and disease management, focusing on chili pepper	Dr. Gregory Luther Dr. Rakhmat Sutarya Dr. Peter Ooi	13-15 October
2.	Communications	Ir. Basri AB, M.Si Ir. Nazariah, M.Si	16 October
3.	Regional Training Course at AVRDC-ARC and Farmer Field Schools	Saufan Daud, SP	17 October
4.	Organic chili production in North Sumatra	Doan Sianturi	17 October
5.	Farm Record Keeping	Ir. M. Ferizal, M.Sc	17 October
6.	Chili Pepper Agriculture	Ir. Subhan	20 October
7.	Integrated pest and disease management using natural enemies	Ir. Aiyub	20 October
8.	Chili Pepper Seed Production and Handling	Dr. Paul Gniffke	21 October
9.	Drip Irrigation	Dr. Manuel Palada	22 October
10.	Starter solution technology; Soil assessment and how to make compost; Soil salinity; Field practice	Dr. Chris Dorahy Dr. Manuel Palada Dr. Chin-hua Ma Ir. Irhas Gita	23-24 October

Participants: Twenty Farmer Field School trainers/facilitators and 15 agricultural R&D staff were trained in chilli pepper integrated crop management, using a participatory approach for a majority of the time. This prepared the 20 FFS facilitators for training at least 1600 farmers in the coming year. The participants consisted of 26 men and 9 women. The 20 FFS Facilitators are field staff of the Food Crop Protection Agency (*Balai Proteksi Tanaman Pangan*) who are based in various sub-districts in Aceh Province. Lists of the participants are found in Appendix 4.

Publicity: Teuku Iskandar, Director, BPTP NAD; Greg Luther, Project Leader; and Chris Dorahy, Soil Scientist, were all interviewed by Aceh TV. It was broadcasted soon afterwards. Teuku Iskandar and Greg Luther were also interviewed by Radio Republic Indonesia, which broadcasts nationwide.

Evaluation Results: The questionnaire utilized to administer the evaluation can be found in Appendix 2, while the evaluation results are in Appendix 3. To summarize, when the participants were asked to rank the usefulness of the subject matter (1 being "not useful" to 10 being "very useful"), the mean response was 9.06. The participants also responded that, on average, they experienced 57% improvement in their knowledge and understanding of vegetable production as a result of the ToT and Workshop.

Lessons Learned: A major session on lessons learned will be conducted at the Final Workshop for this project in Oct/Nov 2009. At this point the FFS Facilitators/Trainers will have finished two seasons of chili pepper ICM FFS, so they will be able to evaluate the ToT better at that time than they could when it finished on 24 October 2008. At the Final Workshop, they will be asked to reflect on how well the ToT prepared them for the FFS. Therefore, lessons learned from the ToT are not discussed in this report.

Organizers

Directors of activities : Ir. T. Iskandar, M.Si; Dr. Gregory C. Luther
Leader : Rachman Jaya, S.Pi, M.Si
Secretary : Yatiman, SP
Treasurer : Fenti Ferayanti, SP
Materials : Ir. Basri AB, M.Si, Ir. M. Ferizal, M.Sc,
Ceremony : Nazariah, SP, M.Si
Transportation : Zulkifli, Masdi Tansafril, Janusadaruddin
Consumption and accommodation : Ratna Elis Rajab
Documentation : Mahdi
Location Preparation : Ahmad

Materials: At the completion of the ToT and Workshop, a CD was provided to each participant, containing the following materials:

<u>Presentations:</u>
Aiyub. Perbanyakan Agens Hayati Serta Aplikasi Dilapangan.
Basri A. Bakar and Nazariah. Komunikasi Dan Penyuluhan.
Basri A. Bakar. Adopsi Dan Adaptasi Teknologi Baru.
Basri A. Bakar. Jawab Yang Benar Dengan Suara Lantang.
Basri A. Bakar. Kemiskinan petani.
Basri A. Bakar. Puisi petani.
Basri A.Bakar and Nazariah. Strategi Komunikasi Untuk Rehabilitasi Pertanian.
Chin-Hua Ma and Chris Dorahy. Nutrient deficiency diagnosis.
Chin-Hua Ma and Manuel C. Palada. Starter solution technology.

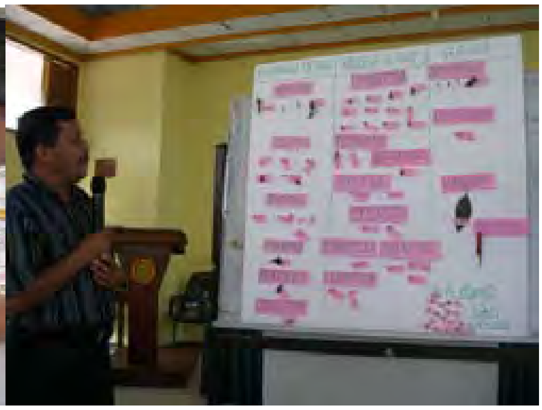
Chris Dorahy. Pengelolaan Kesuburan Tanah pada Usahatani Tanaman Hortikultura. Pengalaman dari Australia, Indonesia dan Philipina.
Greg Luther. Kenapa diadakan pelatihan mengenai musuh alami?
Greg Luther. Training of trainers.
Irhas Gita. Salinitas.
M. Ferizal. Farm record keeping.
Manuel C. Palada. IDE low-cost drip irrigation for vegetable production: A farmer's guide.
Nazariah. Perilaku hewan.
Peter A.C. Ooi. Learning about natural enemies.
Paul Gniffke. Onion seed production.
Paul Gniffke. Pepper seed production.
Paul Gniffke. Production of hybrid tomato seeds.
Paul Gniffke. Vegetable seed production: equipment, methods, and strategies.
Rakhmat Sutarya. Mikroorganisme Sebagai Agens Hayati Untuk Mendukung Pht.
Rakhmat Sutarya. Pengendalian Hama/Penyakit Terpadu Pada Budidaya cabai.
Subhan. Chilli pepper (*Capsicum annuum*) cultivations.

<u>Booklets and bulletins:</u>
Ahmad Muhammad, Dewi Judawi, Djoko Priharyanto, Gregory C. Luther, Gusti N. Rai Purnayasa, James Mangan Maruddin Sianturi, Paul Mundy and Riyatno. *Musuh Alami, Hama Dan Penyakit Tanaman Jambu Mete.*
Dadan Hindayana, Dewi Judawi, Djoko Priharyanto, Gregory C. Luther, James Mangan, Kasumbogo Untung, Maruddin Sianturi, Mujiono Warnodiharjo, Paul Mundy and Riyatno. *Musuh Alami, Hama Dan Penyakit Tanaman Kakao.*
Dadan Hindayana, Dewi Judawi, Djoko Priharyanto, Gregory C. Luther, Gusti N. Rai Purnayasa, James Mangan, Kasumbogo Untung, Maruddin Sianturi, Paul Mundy and Riyatno. *Musuh Alami, Hama Dan Penyakit Tanaman Kopi.*
Dadan Hindayana, Dewi Judawi, Djoko Priharyanto, Gregory C. Luther, James Mangan, Kasumbogo Untung, Maruddin Sianturi, Paul Mundy and Riyatno. *Musuh Alami, Hama Dan Penyakit Tanaman Lada.*
Dadan Hindayana, Dewi Judawi, Djoko Priharyanto, Gregory C. Luther, James Mangan, Kasumbogo Untung, Maruddin Sianturi, Paul Mundy and Riyatno. *Musuh Alami, Hama Dan Penyakit Tanaman Teh.*
Proyek Pengendalian Hama Terpadu Perkebunan Rakyat. *Hama dan serangga bermanfaat pada kapas.*
Shepard B.M., G.R. Carner, A.T. Barrion, P.A.C. Ooi and H. van den Berg. *Insects and their natural enemies associated with vegetables and soybeans in Southeast Asia.*

After the ToT and Workshop, the following FFS curriculum was printed and distributed to each FFS Facilitator:
Pedoman Umum: Sekolah Lapangan Pengendalian Hama Terpadu (SLPHT) Hortikultura (http://ditlin.hortikultura.go.id)

Appendix 1. Photographs of ToT and workshop activities.

Figure 1. The ToT and Workshop was opened by the Head of the agricultural extension service for Aceh Province, the Director of the Assessment Institute for Agricultural Technology (BPTP NAD), the Regional Director of the AVRDC – The World Vegetable Center Asian Regional Center, and the Project Leader.




Training of Trainer &


of Trainer & Workshop

Figure 2. An assortment of photos showing the activities over a two-week period, many of them allowing the participants to gain hands-on experience with the technologies being disseminated.

Appendix 2. Questionnaire for evaluation of the ToT and Workshop.

Note: This English version was translated into Indonesian for the participants to fill out.

Questionnaire for evaluating the TOT in Saree, Aceh

(The purpose of evaluation of the TOT activities should be first explained to the participants. The evaluation should be carried out by one of the participants of the TOT, who can also manage translation of English language, but not by the TOT conducting team/trainers themselves.

Note:
We would appreciate the participants' feedback on the TOT session, which will help us in improving other TOT activities in the future. The individual participants' comments and suggestions/feedback will be kept confidential and will not be circulated to others, except known by a few of the ToT management team. No need to write participants' names on the checklist attached here. (AVRDC Aceh-project team).

Checklist Drafted by:

1. Madhusudan Bhattarai, agricultural economist, AVRDC, Taiwan.
2. Greg Luther, Global Technology Dissemination head, AVRDC, Taiwan.

Evaluation carried out in Saree, Aceh,
Date: 24th October, 2008 Location: Aceh, Indonesia

1. How useful were the ranges of subjects discussed in the TOT for your own work-activities (circle the most appropriate one in index value of 1 to 10)

1 2 3 4 5 6 7 8 9 10

____

(Not useful) Very useful

2. What is your overall impression on presentation of the subject-matters during the TOT?

1 2 3 4 5 6 7

____

(Dull) Very Interesting

3. Among the topics/subjects covered during the TOT, what topics were very beneficial to you (list most beneficial/important as "i" and then less beneficial/important as "ii", and so on.

i. _____________________ iv. ________________________

ii____________________ v. ________________________

iii.____________________ vi. ________________________

4. What topics covered were least beneficial to you (or not beneficial at all)?

i. _____________________ ii. ________________________

iii.________________________ iv. _______________________

5. What topics would you have liked to be emphasized more during the TOT?

i. _______________________ ii_________________________

iii._______________________- iv.________________________

6. Among the topics covered, what topics did you enjoy the most, or you think it was delivered very effectively during the session (i = enjoy most (effective); and iv= enjoy least/not effective)

i. _______________________ ii_________________________

iii._______________________- iv.________________________

7. How much do you think that your knowledge and understanding on vegetable production issues have actually been improved after this TOT training (circle one appropriate to your case)?

10% 20% 30% 40% 50% 60% 70%

____

Lowest improvement Highest improvement

8. To what extent do you think the learning objectives of the TOT course were met?

Not at all 1 2 3 4 5 6 7. **Completely**

9. In terms of improvement on your knowledge, how much do you think your understanding on conducting FFS and the subject-matter have been enhanced after the TOT training (circle one)

1. 2. 3. 4. 5. 6. 7

Lowest improvements Highest improvement.

10. How was the adequacy and quality of the training facilities?

Poor 1 2 3 4 5 6 7. Very good

11. On what subject matters do you need additional training (TOTs types) for implementing FFS?
i…………………………..
ii…………………………….
ii…………………………….

12. Please add any comment that may help to improve the quality of the training session, i.e. making the training more relevant to the needs of your and other colleagues in the future
i.____
ii. ____

13. Please comment on any factors/concerns that might affect your implementing FFS demonstration in the village in the coming days, and while implementing these practices learnt.

i. ____

ii.____

iii.____

Appendix 3. Evaluation results.

SUMMARY OF EVALUATION RESULTS

Training of Trainers and Vegetable ICM Workshop
Saree, Aceh Province, Indonesia

The Training of Trainers (TOT) and Vegetable Integrated Crop Management Workshop activity was attended by 35 participants. The questionnaires were filled in by all 35 participants and this process coordinated by one of the Trainees taking part in the TOT. The questionnaires were distributed on the closing day of the training (24 October 2008).

Results: Perception of the TOT quality as judged by the participants:

1. Usefulness of the subjects to the participants' activities.

	Range										
Index No	1	2	3	4	5	6	7	8	9	10	Total
Frequency	-	-	-	-	1	-	-	6	16	12	35

Note: Index 1 = Not very useful; .... Index 10 : Very useful

2. Impression on presentation of subject matters

	Range							
	1	2	3	4	5	6	7	Total
Frequency	-	-	-	-	2	18	15	35

Note: Index 1 = Not very useful; ....Index 7 : Very useful

3. Most beneficial/important topics/subjects

Subject/Topics		Frequency/Importance				
	A	B	C	D	E	F
1. Drip irrigation	2	2	3	3	2	2
2. Multiplication of Bio-Control Agents	3	3	1	2	-	3
3. Integrated pest and disease management	15	6	3	1	-	-
4. Chili pepper agriculture	6	3	1	4	1	-
5. Communications	2	1	-	-	1	3
6. Soil analysis and how make to compost	3	6	5	6	3	1
7. Seed production and saving seed	2	1	2	2	3	
8. Farm record keeping	-	-	-	-	1	1
9. Starter solution technology	-	1	-	-	-	1
Total						

Note: A: Most beneficial F : Least beneficial

4. Least beneficial/important topics/subjects

Subject/Topics	Frequency
1. No participants said the material was not important	
2.	
3.	
4.	
Total	

5. Topics/subjects that you would like to have more emphasis on in future TOTs

Subject/Topics	Frequency			
	A	B	C	D
1. Drip irrigation	-	-	2	-
2. Multiplication of Bio-Control Agents	5	8	1	1
3. Integrated pest and disease management	14	5	2	1
4. Chili pepper agriculture	3	3	1	-
5. Communications	-	-	1	-
6. Soil analysis and how make to compost	1	2	4	5
7. Seed production and saving seed	4	2	-	-
8. Farm record keeping	-	-	-	-
9. Starter solution technology	3	-	-	-

Note: A : High rank D : Low rank

6. Topics/subjects most enjoyed (effective) by the participants.

Subject/Topics	Frequency (number)			
	A	B	C	D
1. Drip irrigation	1	4	-	1
2. Multiplication of Bio-Control Agents	4	3	2	2
3. Integrated pest and disease management	11	1	2	-
4. Chili pepper agriculture	4	1	2	-
5. Communications	2	1	-	4
6. Soil analysis and how make to compost	3	1	3	2
7. Seed production and saving seed	-	-	1	1
8. Farm record keeping	-	-	-	-
9. Starter solution technology	-	-	-	-

Note: A : Enjoy the most. D: Enjoy the least.

7. Improvement on knowledge and understanding of vegetable production

	Improvement (in %)							
	10	20	30	40	50	60	70	Total
FrequencyNo	-	-	-	-	12	21	2	35

10 : Lowest improvement. 70: Highest improvement

8. Achievement of completed TOT learning objectives

	Range							
	1	2	3	4	5	6	7	Total
Frequency	-	-	-	-	9	19	7	35

Note : 1 : Not all 7 : Completely achieved

9. Improvement on knowledge and understanding of FFS and subject matter.

	Range							
Index	1	2	3	4	5	6	7	Total
Frequency	-	-	-	3	13	15	4	35

Note: 1: Lowest improvement 7 : Highest improvement

10. Adequacy and quality of the training facilities

	Range							
Index	1	2	3	4	5	6	7	Total
Frequency	-	-	-	3	14	13	5	35

1 : Poor 7 : Very good

11. Subject matter needed in additional training (TOTs types) for implementing FFS
    i. How to make biological pesticide
    ii. How to make compost
    iii. Soil analysis

12. Comments on improvement the quality of the training session

    1. The activity should be undertaken one crop season
    2. Trainers have to speak in bahasa Indonesia, at least like Dr. Greg Luther
    3. Guide lines/leaflet should be made easy understood
    4. ....
    5. ....

13. Comments on any factors/concerns that might affect the implementing FFS demonstration in the village and while implementing these practices learnt.

    1. Printed material, tools and equipment should be ready to use as the original.
    2. Hand book of pest and diseases should be available for trainee.
    3. ....

Appendix 4: Lists of participants.

Training of Trainers participants (FFS Facilitators)

No.	Name	Origin	Remark
1.	Abdullah, SP, MP	Aceh Utara	Senior
2.	Rizki Phani Phahlevi	Aceh Utara	Junior
3	Mawardinur	Aceh Utara	Senior
4.	Husniati	Bireuen	Junior
5.	Zulkifli	Bireun	Senior
6.	H. Azhari, SP	Bireun	Senior
7.	Mustafa AG,SP	Pidie Jaya	Junior
8.	Bahani	Pidie Jaya	Senior
9.	Hamdani	Pidie Jaya	Senior
10.	Roslita	Pidie	Junior
11.	Zakaria	Pidie	Senior
12.	Ibrahim Isa	Pidie	Senior
13.	Samsul Bahri,SP	Aceh Besar	Senior
14.	Abd Rahman	Aceh Besar	Senior
15.	Retning Wahyu SP	Aceh Besar	Junior
16.	Sudarti	Aceh Besar	Junior
17.	Ishak	Aceh Besar	Senior
18.	Marlin Heriyani, SP	STAF PROPINSI	Junior
19.	Eka Nasrimaidar, SP, MP	STAF PROPINSI	Junior
20.	M. Yusuf Ali	BPTP NAD	senior

*) senior = experienced with Integrated pest and disease management
*) junior = moderate experience with Integrated pest and disease management

Vegetable ICM Workshop Participants (Agricultural R&D staff)

No.	Name	Origin	Remark
1.	Bintra Meiliana, SP	Distan Prov. NAD	-
2.	Ir. Anwar Budiman	BPTP NAD	-
3	Ir. Marlina	Distan Kab. Bireuen	-
4.	M. Nazir, SP	Distan Kab. Bireuen	-
5.	T. Eka Satria	STPP Saree	-
6.	Said Tarmizi, SP	PPL Kec. Simpang Tiga/BPPKP Kabupaten Pidie	-
7.	Doan Sianturi, STP	Aust-Care Kab. Nias	-
8.	Sudarmi, SP	BDP/BLPP Saree	-
9.	Cut Fitria Lisda	Distan Kab. Bireuen	-
10.	Helliani Krissanti	BPTPH Prov. NAD	-
11.	Fitrial, SP	BDP/BLPP Saree	-
12.	Isnardi	BPTPH Prov. NAD	-
13.	Rahmat Kurniadi, SP	Distan Kab. Aceh Besar	-
14.	Mahzal	BPTPH Kab. Pidie	-
15.	Hamdani, AW	Distanbunnak Kab. Pidie Jaya	-

FINAL WORKSHOP
SEMINAR AKHIR

Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia (SMCN/2005/075)

17-18 November 2009

Banda Aceh, Nanggroe Aceh Darussalam, Indonesia

Australian Government
Australian Centre for International Agricultural Research

AVRDC
The World Vegetable Center

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Austcare
World Humanitarian Aid

ableblue
ENVIRO AGRI BUSINESS

AVRDC – THE WORLD VEGETABLE CENTER
BALAI PENGKAJIAN TEKNOLOGI PERTANIAN ACEH
DINAS PERTANIAN TANAMAN PANGAN & HORTIKULTURA ACEH
INDONESIAN VEGETABLE RESEARCH INSTITUTE
ABLEBLUE
NEW SOUTH WALES DEPARTMENT OF PRIMARY INDUSTRIES
AUSTCARE
KEUMANG
SYIAH KUALA UNIVERSITY

Pendahuluan

Pasca bencana tsunami, banyak lahan pertanian (sayuran) yang rusak terutama menurunnya tingkat kesuburan lahan akibat tertimbun oleh lumpur, sediment dan sampah, hilangnya lapisan olah tanah (top soil), meningkatnya salinitas. Pada awal tahun 2007 sampai dengan sekarang BPTP NAD bersama dengan Pusat Penelitian Tanaman Sayuran Dunia (the world vegetable center), Balai Penelitian Tanaman Sayuran (Balitsa) Lembang telah melakukan berbagai penelitian pada lahan tersebut. . Fokus kegiatan berupa pengkajian tanah, trial penelitian dengan komoditi mentimun, cabai merah, bayam dan tomat. Selain itu dalam proyek ini juga melaksanakan kegiatan training of trainer (TOT) dengan fokus pada manajemen pengendalian hama dan penyakit pada tanaman cabai dan sekolah lapang (SL) penggelolaan tanaman terpadu (PTT) yang dilaksanakan sebanyak 80 site di Kabupaten Aceh Besar, Pidie, Pidie Jaya, Bireuen dan Aceh Utara dengan jumlah petani peserta 1.618 orang petani.

Tujuan

Final workshop (seminar akhir) ini sebagai bentuk pertanggungjawaban terhadap pelaksanaan proyek, dengan tujuan untuk menyampaikan hasil-hasil kegiatan yang telah dilaksanakan dan menerima masukan dari para stakeholder dan beneficiaries untuk kegiatan dimasa yang akan datang.

Tempat dan Waktu

Kegiatan Final workshop/Seminar Akhir dilaksanakan di Aula Balai Pengkajian Teknologi Pertanian (BPTP) Nanggroe Aceh Darussalam. Jl. P. Nyak Makam No. 27 Lampineung - Banda Aceh pada tanggal 17 - 18 Nopember 2009.

Pendanaan

Dana yang ditimbulkan oleh kegiatan ini sepenuhnya berasal dari proyek Integrated Soil And Crop Management For Rehabilitation Of Vegetable Production In The Tsunami-Affected Areas Of NAD Province, Indonesia (CP/2005/075) yang dibiayai oleh ACIAR Australia.

SUSUNAN ACARA

Tanggal 17 November 2009

No.	Subject	Presenter	Time	Moderator
1	Welcome and registration of participants	Event Organizer: BPTP NAD	08.00-08.30	Nazariah,SP, M.Si
2	Holy Alquran reading	Ir. Basri AB, M.Si	08.30-08.40	Nazariah,SP, M.Si
3	Reporting by Organizing Institution (BPTP)	Ir. T. Iskandar, M.Si	08.40-09.00	Nazariah,SP, M.Si
4	Speech of BPTP Aceh Director/BBP2TP	Dr. Muhrizal Syarwani	09.00-09.20	Nazariah,SP, M.Si
5	Opening comments by ACIAR Research Program Manager	Dr. Gamini Keerthisinghe	09.20-09.40	Nazariah,SP, M.Si
6	Project Overview	Dr. Greg Luther	09.40-10.20	Nazariah,SP, M.Si
7	Tea Break	Event Organizer: BPTP NAD	10.20-10.50	
8	Soil Assessment and Research Methods/Planning Workshop	Dr. Chris Dorahy	10.50-11.30	Dr. Joko Mariyono

9	Farmer-Participatory Research: Aceh Besar site	M. Ramlan, SP	11.30-12.00	Dr. Joko Mariyono
10	Farmer- Participatory Research: Pidie site	Ir. Tamrin	12.00-12.30	Dr. Joko Mariyono
11	Farmer-Participatory Research: Pidie Jaya site	Ir. M. Ferizal, M.Sc	12.30-13.00	Dr. Joko Mariyono
12	Break (lunch and praying)	Event Organizer: BPTP NAD	13.00-14.00	
13	Farmer-Participatory Research: Bireuen site	Yatiman, SP	14.00-14.30	Dr. Joko Mariyono
14	Farmers' experiences with conducting farmer-participatory research: all sites	Mawardi, Taib Nasruddin, Surya	14.30-15.00	Ir. M.Ferizal, M.Sc
15	Tea Break	Event Organizer: BPTP NAD	15.00-15.30	
16	Field Days demonstrating Starter Solution Technology and Chilli Pepper Integrated Crop Management	M. Ramlan, SP	15.30-16.00	Ir. M.Ferizal, M.Sc

17	Experience with Training at AVRDC Asian Regional Center in Thailand	Diana Samira, SP	16.00-16.30	Ir. M.Ferizal, M.Sc
18	Demonstration Plot at BPTP	Saufan Daud, SP. DR.Rahmat Sutarya. Ir. Subhan, M.Sc	16.30-17.00	Ir. M.Ferizal, M.Sc

Tanggal 18 November 2009

No.	Subject	Presenter	Time	Moderator
1	Socio-economics of vegetable producti on in Aceh (summa ry of Baseline Survey results)	Ir. M. Ferizal, M.Sc	09.00-09.40	Rachman Jaya, S.Pi,M.Si
2	Training of Trainers and Vegetable ICM Workshop	Ir. Nazariah, M.Si	09.40-10.10	Rachman Jaya, S.Pi,MSi
3	Farmer Field Schools: Facilitators'/Traine rs' Perspectives	Ir. Retning Bahani Abdullah Nazir, SP	10.10-10.55	Rachman Jaya, S.Pi,MSi
4	Tea Break	Event Organizer	10.55-11.15	
5	Farmer Field Schools: Farmers' Perspectives	Ibrahim Ridwan	11.15-11.45	Rachman Jaya, S.Pi,MSi

6	Evaluation of Farmer Field Schools	Dr. Joko Mariyono	11.45-12.15	Rachman Jaya, S.Pi,MSi
7	Extension Materials	Ir. Basri, AB, M.Si	12.15-12.45	Rachman Jaya, S.Pi,MSi
8	Break (lunch and praying)		12.45-14.00	
9	Lessons learned from the project	Rachman Jaya, SPi, M.Si	14.00-14.30	Ir. Basri AB M.Si
10	Possible directions for future projects	Dr. Greg Luther	14.30-15.00	Ir. Basri AB M.Si
11	Tea Break	Event Organizer	15.00-15.20	Ir. Basri AB M.Si
12	Future directions needed in Aceh	Ir. T. Iskandar, M.Si	15.20-15.50	Ir. Basri AB M.Si
13	ACIAR perspective: feedback and reflections	Dr. Gamini Keerthisinghe	15.50-16.30	Ir. Basri AB M.Si
14	Closing	Ir.T.Iskandar, M.Si	16.30-16.45	Ir. Basri AB M.Si

Daftar Peserta Final Workshop/Seminar Akhir

No.	Peserta	Asal
1.	Balai Besar Pengkajian danTeknologi Pertanian	Bogor
2.	Dinas Pertanian Prov. Aceh	Banda Aceh
3.	Balai Sertifikasi Benih Prov. Aceh	Banda Aceh
4.	Badan Ketahanan Pangan Prov. Aceh	Banda Aceh
5.	Balai Proteksi Tanaman Prov. Aceh	Banda Aceh
6.	Dinas Pertanian Kab. Aceh Besar	Kab. Aceh Besar
7.	Lukman Hakim	Unsyiah/Banda Aceh
8.	Nasruddin	Unsyiah/Banda Aceh
9.	Khairunnisa	Unsyiah/Banda Aceh
10.	Zaitun	Unsyiah/Banda Aceh
11.	Aust Care	Banda Aceh
12.	Canada red Cross	Banda Aceh
13.	I O M	Banda Aceh
14.	Mercy Crop	Banda Aceh
15.	Word Vision	Banda Aceh
16.	Gamini Keerthisinghe	ACIAR
17.	T. Iskandar, M.Si	BPTP NAD
18.	Gregory C. Luther	AVRDC Taiwan
19.	Chris Dorahy	NSW-DPI
20.	Gavin Tinning	NSW-DPI
21.	Rakhmat Sutarya	Balitsa Lembang
22.	Subhan	Balitsa Lembang
23.	Joko Mariyono	AVRDC Jawa Tengah
24.	Rachman Jaya	BPTP NAD
25.	M.Ferizal	BPTP NAD
26.	Basri AB	BPTP NAD
27.	M.Ramlan	BPTP NAD
28.	Yufniati ZA	BPTP NAD
29.	Fenty Ferayanti	BPTP NAD
30.	Tamrin	BPTP NAD

31.	Saufan Daud	BPTP NAD
32.	Yatiman	BPTP NAD
33.	Nazariah	BPTP NAD
34.	Diana Samira	Dinas TPH NAD
35.	Jamal Khalid	BPTP NAD
36.	M.Nur HI	BPTP NAD
37.	Syukri Hasan	BPTP NAD
38.	Cut Nina Herlina	BPTP NAD
39.	Nurlaili	BPTP NAD
40.	Assuan	BPTP NAD
41.	Chairunnas	BPTP NAD
42.	Nasir Ali	BPTP NAD
43.	Syarifah Raihanah	BPTP NAD
44.	Elviwirda	BPTP NAD
45.	Idawanni	BPTP NAD
46.	Ahmad	BPTP NAD
47.	Zulkifli Umar	BPTP NAD
48.	Nasir Umar	BPTP NAD
49.	Abdul Aziz	BPTP NAD
50.	Emlan Fauzi	BPTP NAD
51.	Nur Fitriana	BPTP NAD
52.	Ismail	BPTP NAD
53.	Rosita	Kabupaten Pidie
54.	Zakaria	Kabupaten Pidie
55.	Ibrahim Isa	Kabupaten Pidie
56.	Jailani	Kabupaten Pidie
57.	Abdullah abu	Kabupaten Pidie
58.	Bahani	Kabupaten Pidie Jaya
59.	Hamdani	Kabupaten Pidie Jaya
60.	Mustafa, AG	Kabupaten Pidie Jaya
61.	Ridwan	Kabupaten Pidie Jaya

62.	M.Yunus	Kabupaten Pidie Jaya
63.	Ir. Azhari	Kabupaten Bireun
64.	M. Nazir, SP	Kabupaten Bireun
65.	Andali Affan	Kabupaten Bireun
66.	Bukhari	Kabupaten Bireun
67.	Abdullah	Kab. Aceh Utara
68.	Mawardi Nur	Kab. Aceh Utara
69.	Rizki Pahleevi	Kab. Aceh Utara
70.	Asnawi	Kab. Aceh Utara
71.	Muksin	Kab. Aceh Utara
72.	Retning Wahyu	Kab. Aceh Besar
73.	Abdul Rahman	Kab. Aceh Besar
74.	M. Yusuf Ali	Kab. Aceh Besar
75.	Sudarti	Kab. Aceh Besar
76.	Samsul	Kab. Aceh Besar
77.	Ishak	Kab. Aceh Besar
78.	Merlin Hariyani	Kab. Aceh Besar
79.	Eka Nasrimaidar	Kab. Aceh Besar
80.	Idrus	Kab. Aceh Besar
81.	Ibrahim	Kab. Aceh Besar
82.	Surya	Kab. Aceh Besar
83.	Mawardi	Kabupaten Bireun
84.	Nasruddin	Kabupaten Pidie Jaya
85.	M. Taib	Kabupaten Pidie
86.	Tarmizi	Mahasiswa/B.Aceh
87.	Muhdi	Mahasiswa/B.Aceh
88.	Edi Wisra	Mahasiswa/B.Aceh
89.	M.Rafil	Mahasiswa/B.Aceh
90.	Yatul Hidayat	Mahasiswa/B.Aceh
91.	Razali	Mahasiswa/B.Aceh

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		Dr. Gregory C. Luther
Ketua Pelaksana	:	M. Ramlan, SP.
		Ir. M. Ferizal, M.Sc
Sekretaris	:	Nur Fitriana, SP, MP
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		Nazariah, SP, M.Si.
		Emlan, SP
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VEGETABLES FOR RESTORING RURAL LIVELIHOODS IN THE TSUNAMI-AFFECTED AREAS of ACEH, INDONESIA

December 2009

Madhusudan Bhattarai, Nur Fitriana, M. Ferizal, Gregory C. Luther and Joko Mariyono


AVRDC- The World Vegetable Center

Assessment Institute for Agricultural Technology – NAD (AIAT-NAD), Banda Aceh

Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia

(ACIAR SMCN/2005/075)

AVRDC – The World Vegetable Center is the leading international non-profit research organization committed to alleviating poverty and malnutrition and ensuring food security, health, and stronger economies through vegetable research, development, and training.

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Nur Fitriana

Mas Agus Ferizal

Gregory C. Luther

and

Joko Mariyono

Executive summary

After conducting a Participatory Appraisal (PA) of local needs and concerns in vegetable farming in early 2007, a more rigorous baseline survey covering over 240 households from eight tsunami-affected communities spread over 5 districts of the NAD province (Aceh) was carried out in 2008. The overall objective of this baseline survey was to analyse and document production characteristics of vegetables in general, and individual household level constraints and opportunities for vegetable farming in these tsunami-affected communities. It also provided background information for implementing other components of the project. In addition, it discusses policy strategies for strengthening vegetable farming in those disaster-hit areas of Aceh, with potential for application in other places as well.

Out of 240 surveyed households, farming was the main occupation for more than 95% of these households. Paddy was mostly cultivated as a rain-fed crop in the survey sites, and it was grown more in Aceh Besar and Pidie than in the Northeast survey region. On average, rice harvested from the farmer's own land was sufficient to meet 8-9 months of annual consumption needs of an average household surveyed. The main reasons for rice insufficiency were small size of farm land, low paddy yields due to low inputs, and infertile land due to the tsunami.

Over 90% of the households surveyed were growing vegetables on some plot parcel: large numbers of them were home garden type cultivators. About 12% of the total respondents were women, which indicates that women also play an important role in vegetable farming in Aceh and they were able to provide information on agricultural practices, and information related to economic activities of households, in general.

Many of the farmers were not growing vegetables in a large plot area due to constraints such as land damage by the tsunami, lack of support for cultivation of cash crops, high pest and disease incidence, highly fluctuating market prices, and so on. Among vegetables, chilli was a very popular crop in the surveyed communities, with all of the farmers growing chilli at least on a small plot of their land. After chilli, other important vegetables cultivated in the area were: tomato, cucumber, eggplant, yard long bean, amaranth, shallot, kangkong, pak choy, cabbage, and several other indigenous vegetables. Average farmers hold about 0.6 ha of farm land for cultivation.

An average vegetable grower (chilli grower), out of the sample of farmers already growing chilli, devoted about 0.26 ha of land for chilli cultivation in 2007/08, and produced about 2500kg of chilli. Out of that, over 95% was for market sale. The average household consumed around 2.7 kg of vegetables (a mix of vegetables) per week, and with monetary value at about Rp 19,000. Despite the fact that chilli had higher price fluctuations than other vegetables, about 43% of the surveyed farmers grew chilli in their backyard (or for market sale plot); many other farmers also wanted to grow chilli at least on a small parcel of land for market sale, if they could get timely technical and other infrastructural support. Tub-wells were the main sources of water for irrigation of vegetable fields.

Among the various reasons for growing vegetables in Aceh, the most important reasons were availability of suitable land with the household, past experience with growing vegetables, easy input availability (through NGO support in many places), and more income even from lesser land areas. The major constraints for growing vegetables are pest and disease attacks, high fluctuation of prices, and unavailability of irrigation infrastructure.

Among the surveyed households, only 13% of farmers had participated in any type of training on cultivation of vegetables. Farmers learnt vegetable cultivation practices largely from older members of the households or from neighbouring farmers. The roles of women and men vary by the specific operation of the vegetable production practices. About 70% of decisions for acreage allocation of vegetable areas were made by females; the larger role of women household members for acreage allocation is also reasonable due to the fact that male members from these communities formerly worked as temporary wage labourers (construction work) in the nearby urban areas.

Due to the complexity of analysing costs and returns for a range of vegetables, using the household level information, we have also done economic analysis for cultivation of chilli in Aceh. The level of application of material inputs (fertilizers, pesticides and other materials) on chilli largely varies across the three regions surveyed. Even among farmers within a community, the level of use of input materials varies substantially, indicating that each farmer has a different level of adoption of chilli technology. Labour use in chilli farming in the survey sites was low (only 220 days per ha) compared to the level reported in other intensive chilli production pockets in Aceh and in Indonesia, and the variation in labour use across the sites (and across households within a site) was also very high. The villages selected for household surveys are not the main vegetable production pockets in Aceh, but we purposively selected those villages that were most damaged by the 2004 tsunami. Thus, the differences in farming practices and levels of input use across the households are reasonable.

Shares of labour cost and input material cost out of total cost of chilli production were 70% and 30%, respectively. Out of the total labour cost, nearly 60% was just for opportunity cost of family labour forces used for cultivating the crop. Thus, benefits of employment generation from vegetables are substantially high, and this is also one of the motivations of the household to farm vegetables. The profit from chili crops, i.e., share in terms of return to management factor, was very high in Northeast Aceh compared to Pidie and Aceh Besar. Vegetable farming is relatively more intensive in Northeast Aceh also due to better market access to the Medan market in nearby North Sumatra province. The return to management variable is high where farming is also more intensive.

For the most part, the vegetable yield in Aceh is very low, cultivation is not very intensive, and the input base system is low. This means there is a huge potential for improvement in vegetable production and productivity levels in Aceh. Rehabilitation of vegetable production through soil and crop management is feasible. Among the different vegetables grown, chilli dominates cash crop cultivation and chilli growers are obtaining substantial economic returns, thus many other farmers are interested in growing chilli or expanding chilli farming, if they can obtain adequate technical support and infrastructure. These include support from public agencies to reduce risks with vegetable production, particularly in managing pests and diseases, the need to strengthen vegetable specific extension services like Farmer Field Schools (FFS), institutionalization of vegetable-specific issues in the province, and the need to strengthen the access to compost in the rural areas for managing soil fertility and rehabilitation of the land damaged by the tsunami.

There is an urgent need to strengthen the technical and institutional capacities of local public and private sector agencies (input suppliers, credit systems) currently providing agricultural services in Aceh. Due to the catastrophic event of the tsunami, the human resources, institutional, and infrastructural base of Aceh's research and extension services has nearly collapsed and needs to be revived, more so for the province's vegetable sector than for other sub-sectors of agriculture, as vegetables require intensive and specialized extension services.

VEGETABLES FOR RESTORING RURAL LIVELIHOODS IN THE TSUNAMI-AFFECTED AREAS of ACEH, INDONESIA

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Specific symbols and abbreviations used in the report

Rp = Indonesian Rupee (with exchange rate of I USD = Rp 10,000 in 2007).

M^2 = Squared meter of crop area

1. Introduction

1.1. Background

The December 2004 tsunami caused the greatest damage and loss of life in Nanggroe Aceh Darussalam (Aceh) province of Indonesia. About 170,000 people perished, more than 700,000 became homeless, and about 400,000 hectares of agricultural land was destroyed. The economic loss to Indonesia due to infrastructure damage, largely in Aceh, totalled more than US$4 billion; the full range of direct and indirect losses (e.g. employment) was even much more than that (FAO, 2005; various Indonesian government sources). Though, less percentage of vegetable-growing areas were damaged by the 2004 tsunami compared to that of cereal areas, nevertheless, these smaller plots vegetable farming activities are more important for quick income generation, employment creation, and livelihood restoration than that of cereal cultivation. Therefore, with an aim to rehabilitate vegetable production and restore vegetable farmland damaged by the tsunami, AVRDC - The World Vegetable Center, and the center led consortium of partners in Aceh, with funding support from the Australian Centre for International Agricultural Research (ACIAR), initiated a project on “Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province” in 2006**.** The main purpose of the project is to restoration of soil fertility and vegetables land both by on-farm trials and demonstration as well as direct training and capacity building at the farmers and local facilitators and community level extension services.

The other major partners for implementing this AVRDC-led project in Aceh were Assessment Institute for Agricultural Technology (AIAT, or BPTP) Nanggroe Aceh Darussalam, the Indonesian Vegetables Research Institute (IVegRI), Food Crops Agricultural Services (FCAS), Keumang, and Austcare/Indonesia. Likewise, New South Wales-Department of Primary Industry (NSW-DPI) was a major collaborative project partner from Australia. The project contributes to restore farming practices and enhance food security and nutrition, and livelihoods through rehabilitation of vegetable production.

The project began with a Participatory Appraisal (PA) and stakeholder consultations carried out in potential project sites in early 2007. The PA documented local need and constraints on vegetable farming as defined by farmers and other stakeholders. PA findings subsequently also guided development of detailed project work plan and other activities. Then, in early 2008, a more rigorous survey covering over 240 households from eight tsunami affected communities spread over 5 districts of the NAD province (Aceh) was carried out to document farmers level constraints and opportunities for vegetable production in the selected tsunami affected communities, and to provide background information for implementing the project. This technical bulletin is prepared out of the baseline survey. In addition to summarizing major findings of the baseline survey, it also discusses policy strategies for strengthening vegetable farming in those disaster hit areas of Aceh.

The information collected from the field survey were also used by the project team for implementing project activities including conducting farmers field school (FFS) and on-farm research trials. These activities were implemented at the same communities where the socio-economic survey was conducted. The socio-economic information of the households at these communities is critical for designing better targeted agricultural research and extension strategies of government agencies (and NOGs) in implementing the regular agricultural extension activities in those surveyed communities, and also in other communities in Aceh.

Moreover, there are very limited extent of farm level statistics and/or farm household level historical data in NAD province of Indonesia, in general. Before the 2004 December tsunami, a civil war and/or conflict was going in several parts of NAD province for the last few decades; and hence no government statistics available in Aceh that cover detailed farm survey and vegetable production related activities of farm households. Because of the long civil war and conflict in Aceh until 2005, even regular government surveys and census data on farmers' livelihoods and agriculture situation of reliable level are not available of Aceh for the period before 2005. In this context, this report with survey of farmers' activities across 240 households in eight communities from five districts of north Aceh (NAD) can potentially serve a very important refernce data base for local government agencies and other development agencies in NAD for vegetable sector information. The project partners like BPTP, DINAS and other agencies in the Aceh, as well as several other international development agencies (INGOs, and NGOs) working in the disaster hit areas of Aceh and outside can immediately use this report for better targeting their efforts in Aceh.

1.2. Objectives and scope of the study

The overall objective of this study was to document production characterises and individual farming household level constraints and prospectuses of vegetable production in tsunami affected communities Aceh, so that improved vegetable production activities would be implemented and that are targeted to the specific needs and requirements of the disaster hit communities. Thus, the specific objectives of the study were to:

a) document general socioeconomic characteristics of farming households and status of vegetable production practices followed in the project targeted tsunami-affected communities;
b) assess and evaluate socioeconomic and socio-institutional factors and related constraints associated with vegetable production those communities; and
c) evaluate cost-benefit and economic returns of growing targeted vegetables in the selected communities areas.

This is a project focused baseline survey as we selected only those communities for survey where the project had planned some level of activities, hence the assessment and field survey were tailored as per objective and scope of the original project proposal (CP-75/2005), as noted earlier. The issues and scope of the baseline survey focused on already planned project interventions and activities in those communities such as on-farm trials on cultivation of selected vegetables, training to farmers through Farmers Field School (FFS), and so on. This baseline survey was also tailored as per the findings of the Participatory Appraisal (PA) carried out in Aceh in early 2007. The PA study documented largely on qualitative information pertaining to farming situations, and major constraints on vegetable farming at that time. Thus, this baseline study focused more on collection of information pertaining to individual households level, and as much as possible on quantitative term. In addition to study documenting major issues and constraints and opportunities of farming in the selected tsunami affected communities of Aceh, in general, this study also documents on information related to income from different farm activities, crop acreage owned by farmers, issues related to livelihoods and food security, and vegetable production practices followed in specifically. Besides, this study also documents issues related to broad socio-institutional and access to training and related factors affecting vegetable production level in those communities. Cost and benefits of production of project targeted vegetables, more specifically of chili were analyzed in details. These assessments were done in relation to technical interventions such as rehabilitation of land and restoration of soil fertility of the cropland through soil amendments and cultivation of selected vegetables (chili, tomato, cucumber, and amaranths), and farmers field school (FFS) implemented in Aceh in 2008-9.

1.3 Chapter Plan

With this brief background, the second section of this report describes methodology used for the field survey and tools and techniques adopted for data collection, including a brief description of the survey sites/communities in Aceh, sample size of households surveyed in each site, and so on. The third section gives an overview of farming situation and more specifically to vegetable cultivation situation in Aceh province (NAD). The fourth section provides basic characteristics of vegetable farming households in the surveyed sites, and status of the project targeted vegetable production level in the surveyed sites/communities in Aceh. The fifth section summarizes findings related to social, institutional, and infrastructural factors related to vegetable farming in the surveyed sites. The sixth section provides cost and return analysis of chili farming, the most favoured vegetable in Aceh. The last section provides study recommendations in strengthening level of vegetable cultivation in Aceh province.

2. Study Methodology

2.1 Overall methodology and scope of assessment

The study combines information collected from qualitative survey tools (i.e., Participatory Rural Appraisal or PRA) and from quantitative survey tools (i.e., in-depth household survey. The qualitative survey tools of PRA used include Venn diagrams, focus group discussions, key informant surveys, and a structured checklist for key issue of vegetable farming in each site. Using these qualitative survey tools and techniques, we collected information pertaining to community and farmers' group level activities and on vegetable farming related issues in each site. The aim of qualitative survey was to evaluate major socioeconomic concerns, local institutional factors, and other constraints affecting vegetable farming in those communities. Information related to functioning of vegetable farmers' groups in each of site, and community level issues pertaining to several farmers, as well as, issues related to questions on "what", "who", and "how" of vegetables farming are collected through tools and techniques of PRA and qualitative survey.

Likewise, using a structured questionnaire, an in-depth household survey was carried out by individually interviewing 240 households from targeted eight communities in the five districts of Aceh province, i.e., about 30 households were targeted for individual survey at each of the communities surveyed. Geographic location of Aceh province (NAD) is illustrated in Figure 2.1 Unlike the qualitative survey, the household survey emphasized collection of more of issues related to quantitative information of individual households' activities in farming, and individual's resources allocation decision in vegetable farming. The structured questionnaire used for the household survey in Aceh is in appendix A1.

Figure 2.1 The field surveyed sites and geo-political map of Aceh (NAD) province, 2008
Note: Map of Aceh showing the study sites in northern part of Aceh, Indonesia.

The study collected both secondary and primary data. The secondary data pertaining to vegetable production status in Aceh province were collected from Indonesian government statistics (provincial agricultural statistics), and from other related governmental agencies located in each of the district. The field survey focused largely on information pertaining to project-targeted four vegetables such as chili, tomato, cucumber, and amaranth, which were selected as project priority crops for intervention during the Participatory Appraisal meetings and stakeholder consultation process in Aceh in early 2007.

2.2. Training to survey teams and survey procedures

Before conducting a household survey, in early 2008, a week long of an intensive training was given by AVRDC economist to the research assistants (field enumerators), including lead research staffs of BPTP involved in supervising the field survey in each site. During this interactive training, the draft study methodology was presented, discussed and finalized by all key project staffs, including the project manager/technology dissemination specialist of AVRDC, Greg Luther. At the meeting with the filed staffs and enumerators, the draft questionnaires were discussed and explained by section by section, and the issues were tailored as per the local needs and context as suggested by the project team from BPTP. Then, on 5^{th} and 6^{th} day of the training, the final draft questionnaires was field tested in selected nearby villages in Aceh Besar district. This one week training to the field survey team was critical for better understanding of each item/issues of the survey to the field staffs/survey teams and better articulation of the essence of the household survey and baseline study by each of the filed enumerators/research assistants. To minimize the biases arising from survey enumerator to enumerator, the field tested and finalized questionnaires were then translated into local language (Achean language). The household survey questionnaires form (15 pages) used for the filed survey contains writings on both in local Acehean language as well as in English language (see Appendix A 1).

2.3. Data collection procedures, surveyed communities and households

During January-July 2008, the field survey was carried out in eight communities located in five different districts of Aceh provinces, and each of them were hard hit by the 2004 tsunami. The five districts surveyed were: Aceh Besar, Pidie, Pidie Jaya, Bireuen, and Aceh Utara. The survey study was carried out at the same villages where PA study was also carried in early 2007. From each community surveyed, about 30 farm households growing vegetables were individually surveyed, thus total of 240 households. First, all of the vegetable growers in the community were listed and then from the list about 30 households, who are regularly growing vegetables for market sale, were selected for individual interview with structured questionnaires. Among the list of vegetable growers, households were selected for individual interview from all income categories, small, medium and large-scale farmers, rich and poor households, and including those households who are targeted for further training on vegetable production and Farmers Field School (FFS) related training activities to be carried out by the project in the site in the subsequent days.

A vegetable growing household (a vegetable farmer) was defined as the one with regularly cultivating vegetable on about 100 M^2 of land area (vegetable plot), and also selling occasionally also selling some part of the vegetables produced at the local markets. That is, some of the vegetable farmers selected for the survey were growing vegetable for the market sale. As per the overall objective of the project (CP/2005/075), the scope of data collection task at the project targeted communities with aim of project intervention and specially issues related to cultivation of project targeted four vegetables such as chili, tomato, cucumber, and amaranth. Out of 240 households surveyed, 218 households were identified as vegetable growers and rest as non-vegetable growers (Table 2.1). The villages selected for the survey and project implementation were the ones where farmers used to cultivate vegetable widely before the 2004 December tsunami disaster. In addition, we aimed to include more of he farmers who could be potential candidate for FFS training in the subsequent days, thereby, the proportionate of non-vegetable growing farmers in the sample was small.

Table 2.1 Sample of household survey

No	Particular\surveyed regions	Aceh Besar region	Pidie region	NortheastAceh region	Total Sample
1	Number of districts	1	2	2	4
2	Name of districts	-Aceh Besar	-Pidie -Pidie Jaya	-Bireuen -Aceh Utara	
3	Number of villages surveyed	4	2	2	8
5	Number of households surveyed	120	60	60	240

For convenience in summarizing the survey data from several villages and better illustrating the overall results and findings at aggregate level, these five districts surveyed are again regrouped into three survey sites. They are as listed below.

a. **Aceh Besar prouction region**: This covers four communities in Aceh Besar district,
b. **Pidie site production region**: This is formed by combing the results of surveyed in Pidie and Pidie Jaya districts together, and
c. **NortheastAceh production region:** it covers survey results from one community each from Bireuen and Aceh Utara districts.

The survey findings are compared and contrasted across the three regions (sites) in Aceh, and likewise, an average value for Aceh province is derived by taking average of these three production regions. These production regions of vegetables (or districts) were combined taking into consideration of farming characteristics, agro-ecology, and similar geographical settings. For example, production characteristics of vegetable farming in two districts of Pidie and Pidie Jaya are almost same, and they are also nearby district; thereby, pooling survey data from the two districts would not create any potential biases (or reduce heterogeneity of sites) in the survey results reported and interpreted. In addition, until few years back, both of these districts were same combined district if Pidie. Similar case is there for the two districts of –Bireuen and Aceh Utara in north eastern Aceh (Table 2.1). In case of Aceh Besar, all of the five communities/villages surveyed were from the same district, and hence they are kept under Aceh Besar production region. Other details are in Table 2.1.

2.4. Analytical procedure

The data collected from qualitative survey were analyzed soon after the field survey so that lots of information on qualitative issues of vegetable farming as acquired during the survey are documented properly. The analysis of quantitative survey took little longer time for computer entry of the survey questionnaires and data analysis subsequently.

2.4.1. Data analysis

Out of the information collected from the household surveys, a detailed analysis on several characteristics of the vegetable farming as such and the households producing the vegetables were carried out. The reporting is done here as per scope and key objectives of underlining project (CP 75). This involves analysis of both socio-economic and technical aspects of vegetable production followed in the surveyed communities in Aceh. Major types of data collected from the filed survey are listed below.

- Socio-economics of vegetable farmers and their characteristics
- Overall farming practices followed in the community, and crop types grown
- soil types and land types
- types of vegetables grown and cropping patterns
- role of vegetable in farming livelihoods
- farm management practices, irrigation types, cultural practices followed
- cost and returns of vegetable farming
- institutions and policies affecting vegetable farming
- local capacity and trainings need in small-scale vegetable farming
- vegetable marketing at the local settings

For the purpose of this report, three major types of descriptive data were analyzed and compared across the production sites, sample mean at each site, frequency, preference rank (or weighted preference rank). Collection of data from household survey for economic analysis and to carry out costs and benefits analysis for cultivation practices of four crops selected by the project was outside of scope during the baseline survey process, and also outside of capacity of project partner/survey team in Aceh. Therefore, household level data pertaining to cost and returns of cultivating vegetables were collected and analyzed only for one crop chili - the most popular and demanded vegetable in the surveyed communities in Aceh. Chili is one of the widely cultivated vegetable in Aceh and in Indonesia, in general.

Comparative assessment across the three production areas.

In this study, the final results with key variables of vegetable farming are compared across three main vegetable production regions in Aceh, and also an average parameter of key variables for Aceh is derived by taking average of the three production sites. Selected parameters of basic statistics such as, average sample mean, frequency, and weighted rank (for farmers' opinion, preferences, etc) were derived for interpreting the implication fo the results, and in comparing these parameters/factors across the three survey sites (Table 2.1).

2.5. Limitation of the study/assessment

This study focused in the tsunami-affected areas. In practices, they are costal areas and not necessarily the very predominant vegetable production regions of the Aceh province. High land and central region of Aceh are the intensive vegetables production zones in terms of number of vegetable growers and extent of land coverage used for vegetable farming, and extent of technology and level of external inputs used per unit of cropland. Among those of five districts surveyed, vegetable production took place more intensively in northern districts (Aceh Utara area) than in the Aceh Besar region. Since the aim and scope of the project intervenes were to restore rural livelihoods and soil fertility in tsunami-affected area, the communities surveyed for the study were also from the regions where tsunami related damages were high. Thereby, these communities surveyed in each of the districts are not necessarily the representative vegetable production sites of the respective districts and so the findings of this study do not represent the average vegetable production and farming system practices followed in Aceh province as a whole, but the results would be more representative for the tsunami affected regions of Aceh province (Figure 2.1). To some extent, the information of vegetable farming system compiled at the project targeted areas (tsunami affected areas) would also be applicable to other nearby coastal areas of Aceh and other provinces of Indonesia. Moreover, the information compiled in this study is very useful for understanding dynamics of vegetable production related constraints in several other disaster-hit communities in Indonesia and in other places/countries in the region

3. Overview on vegetable farming in Aceh province

With a total population over 4.5 million, Aceh (or NAD) province is located in Northern most part of Sumatra island (Figure 2.1). In Aceh, agriculture is important for the rural livelihoods and local employment and income for majority of the population. But, for r the state as whole, oil and Gas are sector with the major economic activities, which accounts for the over 43% of the province GDP (RGDP) and over 10 % of the national average GDP of Indonesia.

The NAD province (or Aceh) is rich in natural resources, including agricultural and forestry resources, and fisheries related activities. Within agricultural crops, vegetables grow fast and also provide more income, employment, and nutrient per unit of area, and a faster return, than that of other crops. Thereby, vegetable interventions are critical aspect of the rehabilitation activities of several government and non government organization (NGO) in Aceh after the 2004 December disaster.

3.1 Vegetable production situation in Aceh: status and prospectus

In case of Aceh, before the tsunami disaster in 2004, due to on-going conflict and a civil war like situation in the province for over the last two decades, the national statistics on agriculture sector variables such as crop acreage and production related are not available in Aceh province for a long time series. Thereby, these data have also not authentically recorded in the government statistics. Hence, not only historical data but agriculture sectors data representative to a wider regions production in Aceh are not available, and same case for vegetables sector production practices. Therefore, with paucity of farm level data available in Aceh, this study has attempted to assess and document these issues that would be useful for many partner agencies and rural development national and international agencies working in Aceh at this time.

Among the vegetables, chili is an important and widely grown crop in Aceh, and so in many parts of the Indonesia. Thereby, for a comparison purpose, crop acreage, production and productivity of chili in Aceh province with that of two other provinces and with the national level statistics in Indonesia are provided in Table 3.1. In 2007, crop area of chili in Aceh province was less than 5 percentage of the total chili crop acreage in Indonesia. Likewise, average productivity of chili in Aceh was much about 35% less than that of national level crop productivity, and almost half than that of its average productivity in Sumatra Utara — the province located nearby of Aceh.

Table 3.1 Crop areas, production, and productivity of chili in selected provinces of Indonesia, 2007.

S N	Province	Harvest area (Ha)	Production (Ton)	Yield (Ton/Ha)
1	Nanggroe Aceh Darussalam(Aceh)	**5 616**	26 422	4.70
2	North Sumatra	13 229	112 843	8.53
3	West Jawa	15 447	184 764	11.96
	Indonesia - all	**107 362**	**676 827**	**6.30**

Source : Indonesian government statistics available on web site

Figure 3.1 Chili stock in the wholesale vegetable market in Banda Aceh, 2007

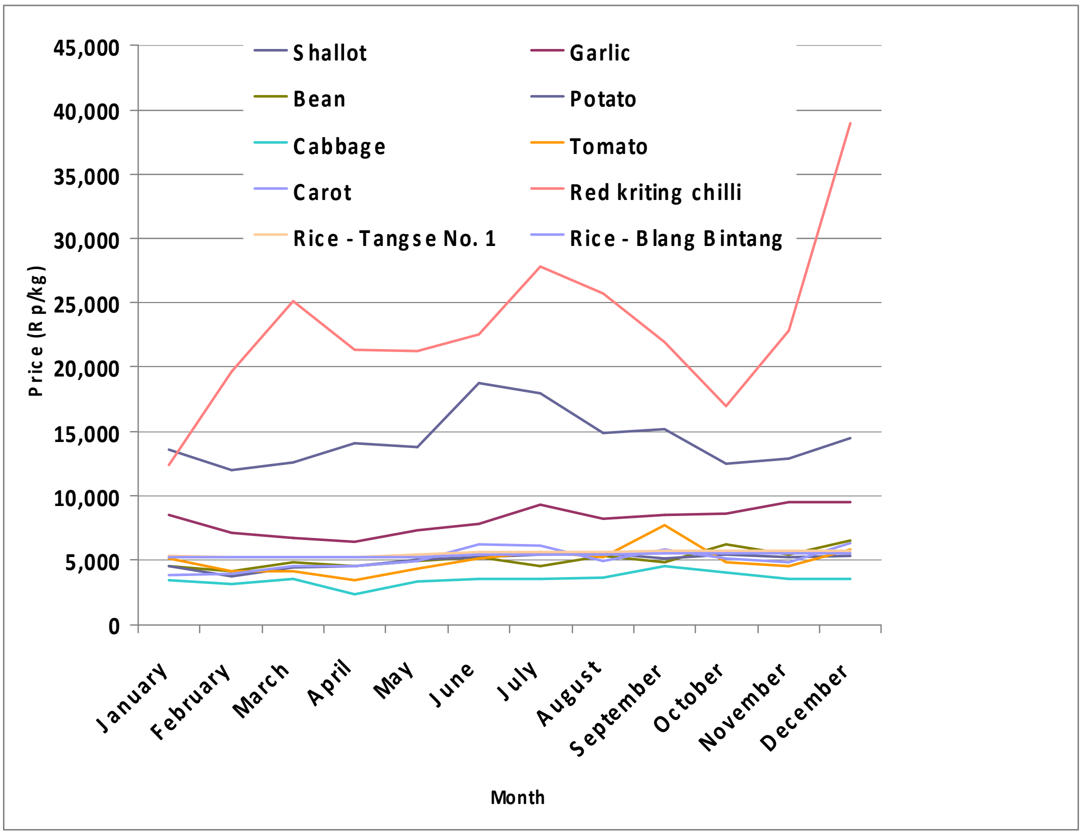
Vegetable crop acreage in Aceh is much less than that of the paddy crop acreage. Some of the major vegetables grown in Aceh, and their crop acreage, production, and productivity (yield) levels for 2006 and 2007 are provided in Table 3.2. In addition to these commonly marketed crops, range of other indigenous vegetables are also cultivated in Aceh. During the first authors visit to the wholesale vegetable markets in Banda Aceh in mid of 2009, over 60 different types of vegetables were recorded at the whole market yard on that day, some of these vegetables were indigenous to Aceh and collected from nearby forest areas. Among the vegetables cultivated in Aceh, whose data are consistently recorded by the government agencies and statistics bureau, in 2007, chili crop acreage was highest among all of the vegetables cultivated in Aceh, which was about 5615 ha and with the average crop productivity of 4.7 t/ha (Table 3.2).

Table 3.2. Crop acreage, production, and productivity of vegetables in Aceh, 2006 and 2007

		2006			2007		
S N	Vegetables	**Crop Area (ha)**	**Production (t)**	**Yield (t/ha)**	**Crop Area (ha)**	**Production (t)**	**Yield (t/ha)**
1	Chili (Big chili)	9,162	43,976	4.80	5,616	26,422	4.70
2	Long bean	3,226	13,216	4.10	3,430	17,030	4.97
3	Small Chili	2,890	14,577	5.04	2,440	11,207	4.59
4	Cucumber	2,890	23,602	8.17	2,402	16,921	7.04
5	Amaranth	1,969	3,571	1.81	1,899	4,023	2.12
6	Kangkoong	1,660	1,257	0.76	1,654	10,606	6.41
7	Egg plant	1,531	9,006	5.88	1,576	10,696	6.79
8	Tomato	1,395	10,307	7.39	1,420	10,642	7.49
9	Shallot	837	7,494	8.95	933	6,222	6.67
10	Potato	827	13,410	16.22	1,181	17,646	14.94
11	Chinese Cabbage	492	2,274	4.62	509	2,539	4.99
12	Red bean	411	1,640	3.99	633	1,118	1.77
13	Green bean	341	2,226	6.53	391	1,931	4.94
14	Squash	297	2,099	7.07	319	1,668	5.23
15	Spring Onion	277	1,766	6.38	336	2,224	6.62
16	Cabbage	239	7,278	30.45	317	6,402	20.20
17	Carrot	186	2,857	15.36	183	2,864	15.65
18	Cauliflower	111	1,594	14.36	100	1,346	13.46
19	Radish	31	102	3.29	13	52	4.00
20	Garlic	12	45	3.75	18	69	3.83
	Sub total	**28,784**			**25,370**		
	Cereal crop						
1	Paddy (rice)	320,789	1,502,748	4.68	360,717	1,533,369	4.25

Source: Provincial agricultural Statistics, Government of Indonesia.
Note. 1. In government published statistics in Indonesia, consistent data series for these vegetables are not available for Aceh for 2005 and earlier period. Therefore, we have provided here only the two years of statistics. .

Price fluctuation patterns of selected vegetables in Banda Aceh are reported in Figure 3.1. It is very obvious that chili prices were the most volatile among the vegetables that prices are recorded by the government agencies in Aceh, which is followed by prices of Shallot, and then Garlic. But, at the same time, average price of fresh chili (Red kriting) was much higher among the crops, then followed by shallot, and Garlic. Compared to other months, chili prices were relatively very during November - December, and during July- August (Figure 3.1).



(Source : Based on daily price data compiled by DINAS Pertanian (government agricultural extension agency), Banda Aceh.)

Figure 3.1. Market price seasonality across selected vegetable crops in Aceh, 2008.

3.2. Districts selected for the intensive survey

As per the intervention strategies of the project, five districts were selected for the detailed socio-economic survey and compiling baseline information at each of the project targeted site. The household survey was also conducted in five districts: Aceh Besar, Pidie, Pidie Jaya, Bireuen, and Aceh Utara, which are merged in to three broad vegetable production regions as reported below. All of these communities/districts selected for survey were hardest hit by the

2004 tsunami. The impact of tsunami on agricultural land in the sample districts/communities, however, also varied by the site. The communities and districts selected for the socio-economic survey (project baseline study) do not necessarily represent the main vegetable production pockets of Aceh province. However, several farmers in the villages selected for the survey used to grow vegetables for the market before the tsunami struck these villages. Nevertheless, the main vegetable production in Aceh province (NAD) is located in central and highland of Aceh, where tsunami effects were minimal. As per the objective and scope of the project activities, and planned project interventions on tsunami affected areas, the household survey were planned at communities/villages targeted for Farmers Field School (FFS) and on-farm research activities by the project. These are also the districts (communities) where participatory assessment was carried out in early 2007, and the project interventions (on-farm research and FFS) were implemented in the subsequent days.

Aceh Besar site

Total of 120 households from four communities were selected from Aceh Besar district for in-depth household survey. The provincial capital, Banda Aceh is also located in this district, hence, compared to other locations; it has got better access to market infrastructure and other service provisions in the province.

Pidie site

Two districts, Pidie and Pidie Jaya, were selected from the central north region of Aceh for in-depth study. The surveyed villages/communities were located about two kms from the nearest permanent road and 10 km from the nearest market town (Sigli City). The surveyed villages are located about 2-4 km from roads of Banda Aceh – Medan, thus are also fairly well linked with the national highway system. Comparison to the production and socio-economic characteristics in the other two locations (Benda Aceh and Northeast Aceh), the farm practices followed in Pidie is considered as more subsistence. This could be due to a little far distance from the provincial market towns.

Northeast Aceh site

Two districts, Bireuen and Aceh Utara, were selected from Northeast Bireuen for the on-farm research and FFS interventions by the project, so this baseline study also selected these two districts for the in-depth socio-economic assessment. These two districts are nearby and so the results from the both districts are combined and created under the heading of Northeast Aceh. Though the farm location is little far from Banda Aceh (over 250 kms), but it is well linked with a road service and connected with Medan -fourth largest city in Indonesia. Thus, the surveyed communities in Northeast Aceh are well connected with Medan, provincial capital of another large province nearby, North Sumatra. Most of the vegetables produced from Northeast Aceh region of Aceh are transported to Medan city, and not to the Banda Aceh. Likewise, farmers and local village level traders there in northeast Aceh also purchase their inputs from products from Medan, but not from Banda Aceh.

4. Vegetable Production characteristics in Aceh

4.1 Study Site

The sample villages and households selected for the survey are summarized in Table 4.1. Four villages were selected in Aceh Besar, and two villages were selected each from Pedie and Northeast Aceh site. Other details feature of the sampling aspect of household survey and name of communities by survey site are summarized in Table 4.1. The surveyed villages in Aceh baser were very near of the provincial capital town, whereas, the sites surveyed in north-eastern region were as far as 250 km away from the provincial town (Banda Aceh).

Table 4.1 Basic characteristics of each site surveyed, Aceh.

No	Description	Aceh Besar	Pidie	NortheastAceh	Total
1	Number of households surveyed	120	60	60	240
2	Total number of farm-household in the village surveyed	458	683	360	1,501
3	Percent of households surveyed in the villages	26	9	17	16
4	Name of villages	-Ladong -Lam Gireuek -Meunasah Baro - Meunasah Moncut	-Jaja Tunong -Meu	-Krueng Juli Barat -Kuta Krueng	
5	Avg. distance of villages from provincial capital (Banda Aceh)	5-10 km	100-120 km	200-250 km	

4.2 General background

Out of 240 surveyed households, 218 households were actively growing vegetable. A vegetable grower is classified here as a farmer who regularly grow vegetables for home consumption as well as for market sale of its surplus. Thus, compared to non-vegetable growing household, a vegetable growing household is one who is

- growing vegetable at least for the last two years
- at least 50% of the produces are sold at the local market, and
- who has dedicated at least 50 squared meter of land for vegetables cultivation

These criteria were used to separate regular vegetable growers from that of others just planting few vegetable plants at the backyard for home consumption.

Majority of the surveyed households were home garden type of cultivators with over 50 squared meters of land area dedicated for the vegetable production. In proportionate term, , more number of households in Aceh Besar and Pidie were classified as vegetable growers compared to the households sample surveyed in Northeast Aceh (Table 4.2). The non-vegetable growing households include fishermen, village shop owner, only rice growing farmers, government service personnel in the village, and others. Chili and paddy are the main crops grown by the sample households surveyed a reflected by very high percentage of the sample surveyed households growing these two crops, which was 91% and 84% for chili and rice, respectively. In fact, paddy growing households also grow chili and vice versa. A chili grower is defined in the study as the farmer/household who has cultivated chili at least one time over the last 3 years. About 12 % of the surveyed respondents were women, which indicates that women also play an important role in Aceh and were able to provide detailed information of household and farm practices followed by the households.

On an average, about 80 percentage of sample surveyed households were growing chili over the last 3-4 years. All household surveyed in Aceh Besar were fallen into the category of chili growing household, as all of then have cultivated chili on over 50 squared meters area over the last 3-4 years. But, in Pidie, only 42% of the surveyed households were growing chili which could be due to its location at a far distance from the vegetable market than other two sites. Even though villages surveyed in northeast region are relatively far from the provincial town in Aceh (i.e., Banda Aceh), but it is located very near to another larger city, Medan city – one of the fourth largest city in Indonesia. Therefore, unlike in Pidie, vegetables produced from Northeast region do not brought to the wholesale markets in Aceh

Besar, but brought at the Medan city, located about 50 kms from the district town of Bireuen, and which is also well connected with the permanent road network (national high way).

Table 4.2 Characteristics of the households surveyed

Description	Aceh Besar	Pidie	Northeast Aceh	Total
Number of vegetable grower surveyed	113	57	48	218
Number of non-vegetable grower surveyed	7	3	12	22
Total number of households surveyed	120	60	60	240
Number of household growing paddy	99	49	53	201
Number of household growing chili	113	25	48	186
Percentage of households survey growing vegetable (in %)	95	95	80	91
Percentage of household surveyed growing paddy (in %)	83	82	89	84
Percentage of household surveyed growing chili (in %)	100	42	80	78
Number and percentage of female respondents interviewed	8 (7 %)	11 (19 %)	9 (15%)	28 (12%)

[a] % in bracket

Basic family profile and household information pertaining to education and vegetable growing experiences are reported in Table 4.3. Overall, the average age of head of households surveyed in all three regions/sites was 40 years old, and average of about five years of education (school year), i.e., even not completed elementary school. However, an average farmer had an farming experience of 18 years, and vegetable farming experience of about 13 years. Farmers in Pidie are the most experienced in farming both in general agriculture (including cultivation of cereal) and of vegetable farming. An average farmer had been trained on vegetable farming related practices for four to five days. On average, four to five family members were there in one farm household.

Table 4.3. Household information and family profile

Description	Unit	Aceh Besar		Pidie		NortheastAceh		Average*	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age of household head	Years	43.03	11.25	41	10.31	44	11.3	42.68	11.05
Education level of household head	Years	5.1	2.19	4.83	2.08	4.23	1.85	4.72	2.1
Farming experience of household head	Years	15.85	11.13	19.60	12.49	18.30	12.71	17.91	11.95
Vegetable growing experience of household head	Years	12.65	10.16	14.59	11.96	10.29	10.13	12.51	10.72
Farmers' training in vegetable cultivation	Day	4.87	5.03	2.91	2.43	6.38	6.82	4.72	4.94
Total family members living in a household	Person s	4.17	1.78	4.4	1.87	4.77	2.01	4.44	1.89

Note: * The average value is taken as arithmetic average of the mean and S D value across the three sites. The numbers in average represent average value of the three sites surveyed instead of overall sample mean. The later would have been then bias towards the sample mean of Aceh Besar, since 50 % of the overall sample survey is from Aceh Besar.

Farming is the main occupation for more than 95% percent of households surveyed (Table 4.4). However, for over 30 % of the surveyed households also had secondary employment as paid labor in the urban market town [1]. Likewise, other important secondary employment sources were civil servant, small trader, operating livestock farming, and other irregular jobs.

Table 4.4. Structures of household head occupation and employment

Description	Aceh Besar	Pidie	NortheastAceh	Overall
Main occupation (%):				
Farming	100	95.0	91.7	96.7
Civil servant	-	1.7	1.7	0.8
Retail shop	-	-	-	-
Local trader	-	-	-	-
Fishermen	-	1.7	-	0.4
Other	-	1.7	6.7	2.1
Secondary occupation (%):				
Farming	-	-	10	2.5
Civil servant	1.7	3.3	1.7	2.1
Retail shop	-	-	-	-
Small trader	4.2	6.7	13.3	7.1
Fishermen	-	18.3	11.7	7.5
Labor	39.2	23.3	21.7	30.8
Big Trade	1.7	-	-	0.8
Livestock	1.7	1.7	1.7	1.7
Other	1.7	11.7	25.0	10.0
Total responded (number)	120	60	60	240

4.2.1. Characteristics and family profile of vegetable growers

Many of the farmers were not growing vegetables in the larger area, or not enough for the home consumption year round and for the market sale, due largely to several constraints. Among them, high pest and disease incidences, and highly fluctuating market prices of produces were the most important factors cited by many of the surveyed households, which is then followed by low vegetable process and high operating cost of growing vegetables than other crops (Table 4.5 and Figure 4.1.).

Table 4.5. Reasons for not growing vegetable by an average household

Description	Aceh Besar		Pidie		NortheastAceh		Overall	
	Rank	Freq	Rank	Freq	Rank	Freq	Rank	Freq
High pest/disease problems	1	112	1	51	1	52	1	215
Fluctuating market prices	2	44	3	30	2	24	2.3	98
Low vegetable price	3	40	2	33	3	19	2.7	92

[1] During 2005-2008, immediately after the disaster, there was a surge on construction and rehabilitation activities in the disaster hit areas of Aceh; hence the labor markets in general was very tight in Aceh during the survey time An average labor wage (per day) for a unskilled labor, including farm labor, in Aceh baser area, in 2008 was about US$5/day; which was almost double than the prevailing labor wage rate in peri-urban areas of Central Java province and other parts of the Indonesia (author's observation in 2007/08).

High operating cost	4	37	5	14	4	16	4.3	67
Difficult in marketing	5	25	4	19	5	12	4.7	56
Land damage by tsunami	6	24	6	10	6	10	6	44
No vegetables experience	7	20	8	7	7	8	7.3	35
Not suitable land	8	15	7	8	8	6	7.7	29

Note: Rank of 1 = highest important factor, and 8 =lowest important factor
Freq => Frequency = Number of households who reported this particular reason with the corresponding rank

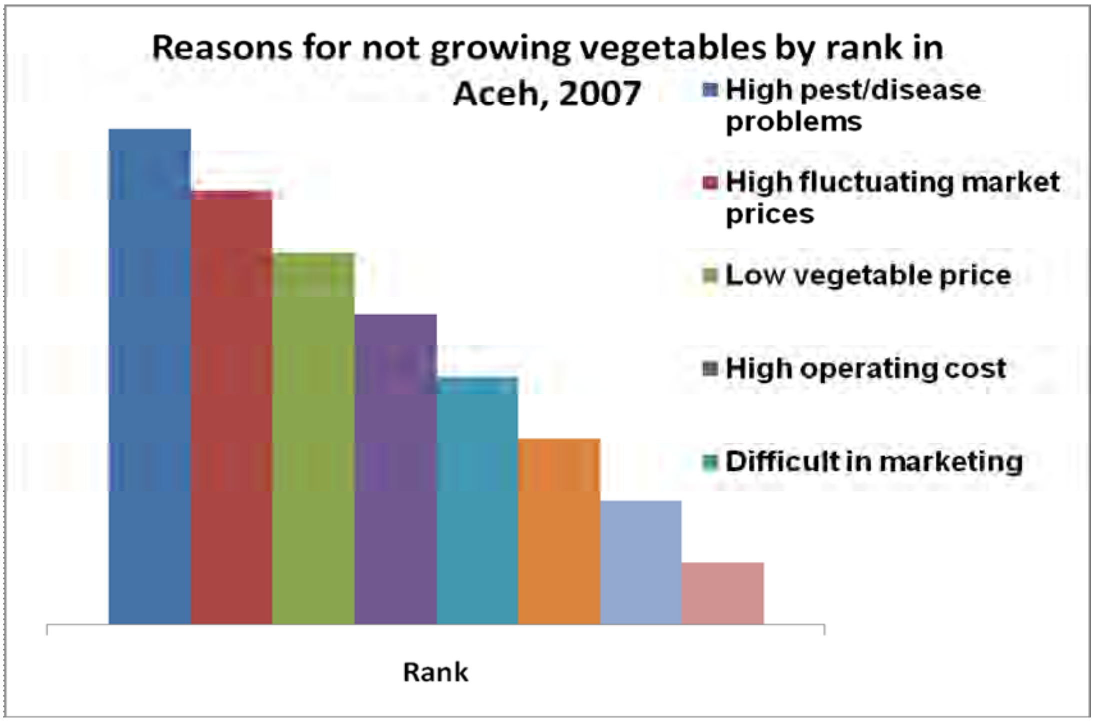


Figure 4.1 Major reasons for an average farmer not being able to cultivate vegetables in Aceh, 2007
Note: The height of the bar reflect the relative important (rank) of a factor as ranked by farmers

4.2.2 Vegetable cultivation areas and farming characteristics

Among the vegetables cultivated in the surveyed sites in Aceh, chili was the more predominant with large number of farmers growing chili at least on small plot of the land. In addition to chili, ranges of other vegetables were also grown on the same plot of the land but in a sequence. At the individual household level survey, many farmers could not recall all of the vegetables cultivated in a year with the exact corresponding land area allocation for individual vegetable crops. Many households were growing several vegetables but just by few plants, except chili, tomato and other few vegetables. Therefore in Table 4.6, we have summarized specific details of only chili cultivation practices. For many of other vegetables (other than chili), crop area per household vary very largely by the households, and by communities/sites selected, and several other factors. Some of the important vegetables grown in the surveyed sites/communities are: chili, tomato, cucumber, eggplant, yard long bean, Amaranth, shallot, Kankong, Pak choy, cabbage, and several other indigenous vegetables as well. Detailed information on the specific types of vegetables cultivation ion each site and their production related issues were compiled in previous project study, using method of participatory appraisal and group discussions (AVRDC Project report, 2007).

Chili production

Farmers could recall exact crop acreage and other details productivity and level of inputs used for chili but not for other vegetable crops like tomato and several other crops. A large number of sample households surveyed were cultivating chili on more than 50 M^2 of areas and also for the market sale, therefore, specific feature of chili farming is reported below.

For an average household, who reported growing chili, had an average chili cultivated land area of 0.26 ha (2600 square meter), with the average production of 2400 kg per household growing chili (Table 4.6.). Because of few number of farmers (marketed oriented producers) only could report details information pertaining to production level, crop areas and inputs uses for specific vegetables, the average productivity of vegetable (chili) of them was naturally higher than that of the average productivity level of chili reported for the Aceh province as a whole. Among the three survey sites, the crop acreage was higher in Aceh Besar and Pidie sites than in Northeast Aceh, but the productivity of chili was higher in later site than the former two production sites. Of the total chili produced by an average farmer, 95 % of the harvest was sold in the market, and only less than 5 % was used for the home consumption by the grower. Because of proximity to a mega city, i.e., Medan city in North Sumatra province, the average price received by farmers in Northeast region was about 25% higher than that of the other two sites (Table 4.6). The total value of chili sold by an average farmer who had grown chili in 2007/08 was around Rp 28 million Rp (or equivalent to US$2,800/household). Despite of relatively low price, the average gross return (value) of marketed sale from chili in Aceh basar was higher than northeast Aceh because of the higher average crop acreage of chili per household basis cultivated in former than later.

Table 4.6. Production and income from chili in Aceh, 2007

Description	Unit	Aceh Besar (mean)	Pidie (mean)	NortheastAceh (mean)	Average of three sites (mean)
a. Avg. crop area	(M^2)	3,872	3,007	1,003	2,625
b. Total production	Kg	3,717	2,400	1,040	2,386
c. Average productivity	Kg/ha	9,600	8,000	10,400	9,340*
c. Production	%	5	5	5	5

distribution	%	95	95	95	95
- Home consumption					
- Sold					
d. Market sale	Kg	3,531	2,280	988	2,266
- Quantity sold	Rp/kg	12,000	11,000	16,000	12,246
- Average price	Rp 000.	42,375	25,080	15,808	27,754
- Value of market sale					

M^2 = Squared meter; Rp = Indonesian Rupees * = Average of the yield from the three survey sites.

Explanatory note
1. An average farmer had cultivated a ranges of vegetables, but in a small plot, and some vegetables were just few number of plants.. Farmers could not report all of the detailed crop area and other production details of other crops but only for chili. Therefore, for comparison across the three sites only the production statistics of chili of average farmers are reported in Table 4.6.
2. Number of chili producing farmers who reported these data in Aceh Besar, Pidie, and Northeast Aceh were 19, 5, and 9, respectively. Farmers who reported production and inputs used data were relatively better off farmers and who have adopted improved cultural practices.
3. The site-specific mean is derived here considering only number of responded households who reported growing chili (frequency) in the survey site. The same procedure was followed while deriving sample mean in other tables reported below as well, unless specifically mentioned in the footnotes of the table.

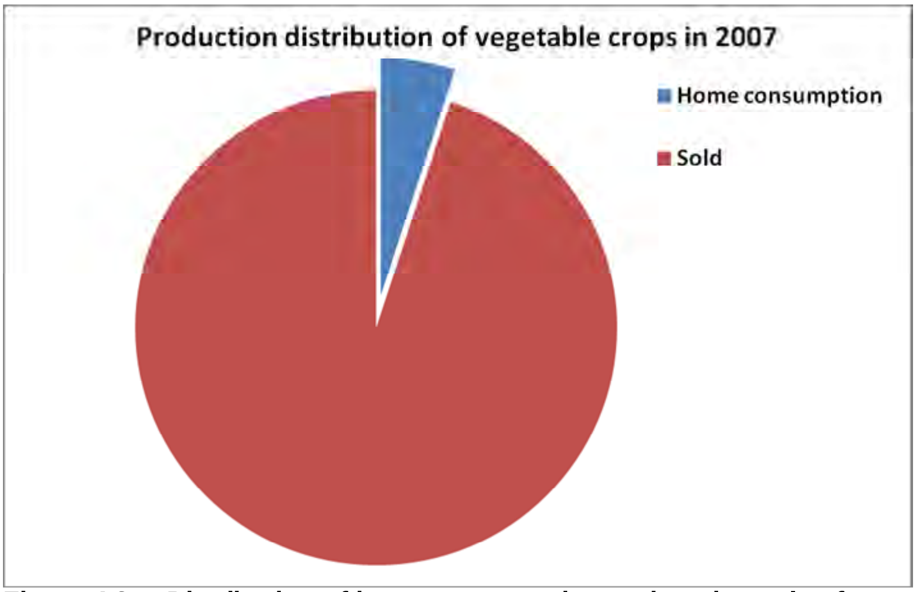


Figure 4.2. Distribution of home consumption and market sale of vegetables among surveyed households.

4.2.3 Land holding, crops grown, and major livelihood characteristics

An average surveyed farmer hold about 0.6 ha of farm land for growing crops (Table 4.7). In addition, about 0.3 ha was rented in (as tenant farming) by borrowing land from neighbour farmer to grow specific crops. Based on the crop-covered land, a typical household had an average of around 0.5 ha of cultivated land in 2007; and of about two parcels of crop land (or fragmented cropland) per household. In fact, land holding related statistics very widely vary across the three sites, and so across the farmers within a survey site, leading to its very high value of standard deviations than that of the other farm characteristics (variables). Because of scarcity of labor, in many places farmers also rented out land or even kept land fallow for after cultivation of paddy. Based on the elevation of crop land, 50% of the crop land per household was lowland (or paddy cultivating land) and remaining 50% was upland (dry land, or slightly elevated land, which is more suitable for vegetable cultivation).

Table 4.7 Agriculture land holding

Description	Unit	Aceh Besar		Pidie		NortheastAceh		Overall	
		Avg	SD	Avg	SD	Avg	SD	Avg	SD
Own crop area	M^2	6,577	12,148	4,876	3,555	5,749	10,915	5,945	8,873
Rented in/shared crop area	M^2	3,013	2,373	2,710	2,075	3,073	2,820	2,952	2,422
Uncultivated land area	M^2	5,888	5,958	2,500	-	3,520	4,041	4,449	3,333
Cultivated area	M^2	6,355	12,097	4,308	3,494	3,534	3,064	5,138	6,218
Number of parcel	No.	1.61	0.68	1.69	1.16	2.25	1.16	1.79	1.00
Lowland area	M^2	3,613	2,210	3,689	2,644	3,726	6,844	3,660	3,899
Dry land/upland area	M^2	4,803	11,895	2,704	2,913	2,326	3,594	3,659	6,134

Note : SD = Standard Deviation . 1. Compared to sample mean, standard deviation of land holding related factors were very high also due to very high variation on these elements across the farmers and across the survey sites. Due to higher value of SD, for many of these variables, the difference of mean across the sample may not be statistical significant (at acceptable level).

Rice is planted by about 85% of the total households surveyed in these eight communities (Table 4.2), but the food security out of the produce cultivated from own land was adequate to only about 66% (2/3rd) of the surveyed households. Rice is grown more in Aceh Besar and Pidie sites than in Northeast site, thereby, the food security level met by paddy cultivated on farmers' own cultivated land was also higher in these two former districts (Table 4.8). The food security during a year is not all met by paddy harvested from own crop land alone, but by different sources (income from labor wage, fishing, etc), and there was around 3.5 months lack of rice from own source. For an average household in the surveyed communities, on an average, rice harvested from own land was sufficient to meet 8-9 months of annual consumption need (food security).

Table 4.8. Household food security level

Description	Aceh Besar	Pidie	NortheastAceh	Overall
Paddy production sufficiency for whole year (%)				
a. Yes	73	75	43	66
b. No	27	25	57	34
Number of months of food insufficient from own production	4	4	3	3.67

The main factors leading to rice insufficiency in the survey sites were small size of farm, pest and disease attack, and infertile land due to tsunami damage (Table 4.9 and Figure 4.3). Low productivity of land was one of the main factors for food insecurity after the 2004 tsunami disaster, as soil salinity level has drastically increased in many places of Aceh now. Moreover, the relative important of these factors were more or less in a same order across the three sites surveyed. Farmers coped with the rice insufficiency by purchasing from local market. Farmers also grew high valued crops including vegetables. Efforts of improving or recovering soil fertility are expected to increase the agricultural productivity, and eventually to improve food security and rural livelihoods.

Table 4.9. Reasons for insufficient rice production in Aceh

Reasons	Ranking of the importance			
	Aceh Besar	Pidie	Northeast Aceh	Overall
Very little land	1	1	1	1
Pest and disease attack	3	2	2	2
Land damaged by tsunami	2	3	3	3
Low land productivity	4	4	5	4
Insufficient capital	5	5	4	5
High salinity due to the tsunami	6	6	6	6
Engaging in fishing activity	7	7	7	7
Large family size	8	8	8	8
Engaging on other labor wage	9	9	9	9

Note: 1 = highest importance rabk, and 9 =lowest importance rank

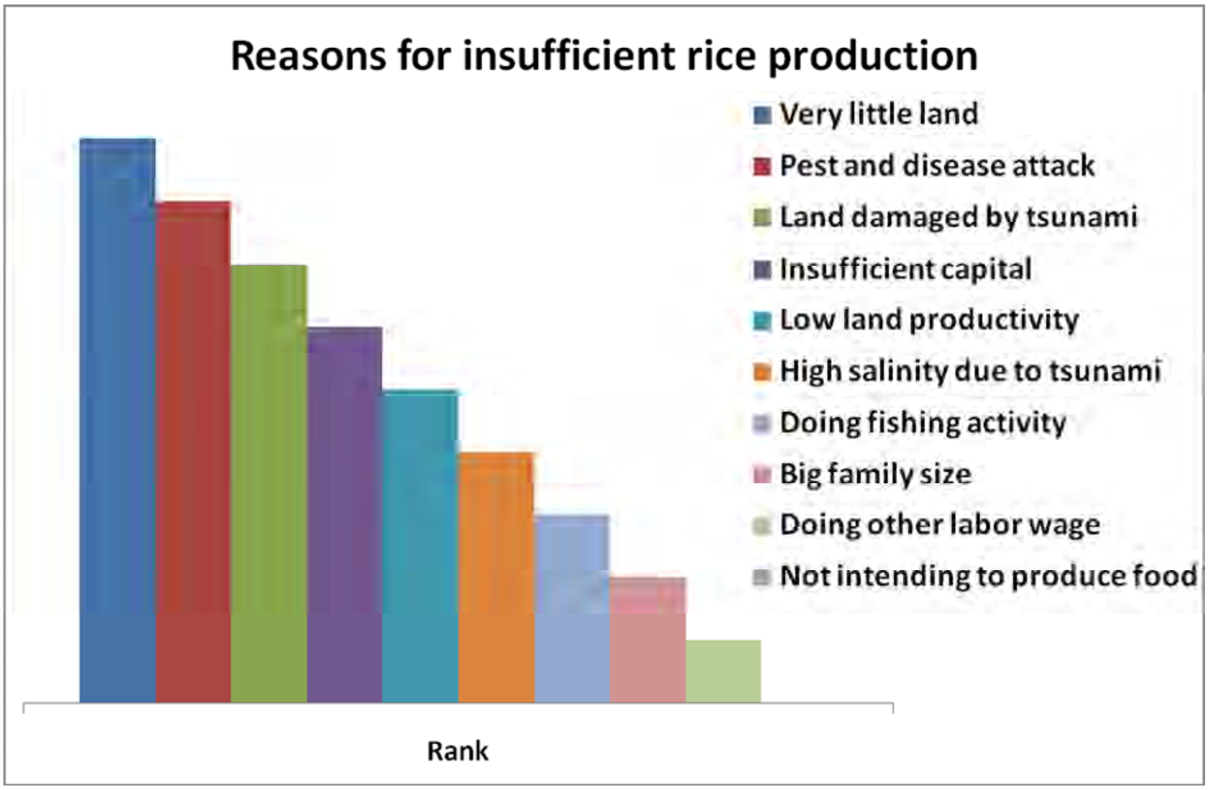


Figure 4.3. Reason for insufficient rice production a surveyed household in Aceh

An average household in the survey sites consumed around 2.7 kg vegetables in dry season, valued at about Rp 19000 (Table 4.10). The level of vegetable consumption in wet season was almost the same as in dry season. The vegetable consumption per household was more in Northeast Aceh than thw tow other study sites. High consumption of vegetable does not necessarily mean wealthier household, because in some parts of Indonesia, particularly in rural and remote areas, vegetables are considered as inferior good, meaning that wealthier household consume less amount of vegetables, and consume more of other food-items such as meat, egg and fresh fish. This is largely due to social, cultural and historical perspectives and not due to any other recently changed incidences or factors.

Table 4.10. Weekly consumption of vegetables by an average family and by seasons

Description	Unit	Aceh Besar	Pidie	NortheastAceh	Average
Dry season (April-July)					
Total quantity of vegetable consumed	Kg/week	1.56	2.79	3.89	2.74
Amount of money spent for vegetable purchase	Rp/week	11,213	22,717	24,842	19,591
Wet season (August-December					
Total quantity of vegetable consumed	Kg/week	1.51	2.76	3.83	2.70
Amount of money spent for vegetable purchase	Rp/week	11,600	22,633	24,633	19,622

4.2.4. Farm land and farm assets holding

Based on the nature of land usages, the land types in the surveyed sites are sorted into home garden, paddy land, vegetable fields and for other crops (Table 4.11 and figure 4.4). Paddy and vegetable farming were the most commonly seen land use types in the surveyed sites, each with about 0.4 ha of land allocation per household basis. Among the communities/districts surveyed, the paddy and vegetable crop acreages/fields were more in Aceh Besar than in other two sites. Very minimum level of land was devoted for production of other crops. After the tsunami, large part of cultivable land has become barren and uncultivable land due to deposition of sand and debris, which is almost 20 percent of total land that an average household holds in the surveyed sites. The uncultivated barren land is more in Aceh Besar than in the other two sites, also indicating severity of the tsunami – in termsof damage to the cultivable land – was more in Aceh Besar than in the other two sites.

Table 4.11. Per family land holdings by land use types and by the types of purposes (unit in squared meter /household)

Description	Aceh Besar			Pidie			Northeast Aceh			Overall		
	Avg	Freq	SD	Avg	Freq	SD	Avg	Freq	SD	Avg	Freq	SD

Home garden	248	70	329	162	25	209	1,062	13	3,094	578	108	
Paddy field	3,327	102	3,330	3,707	53	2,450	2,513	55	1,986	3,209	210	2,589
Vegetable crop land	4,891	95	13,201	3,878	50	3,556	1,003	47	1,213	3,676	192	5,990
Perennial crop land	3,004	11	5,725	1,983	9	1,015	2,278	12	4,098	2,444	32	3,612
Barren/uncultivated land	3,673	15	5,330	430	6	1,014	1,145	13	2,909	2,134	34	3,084

Note: The land area is in square meter (M^2). Avg . = Average

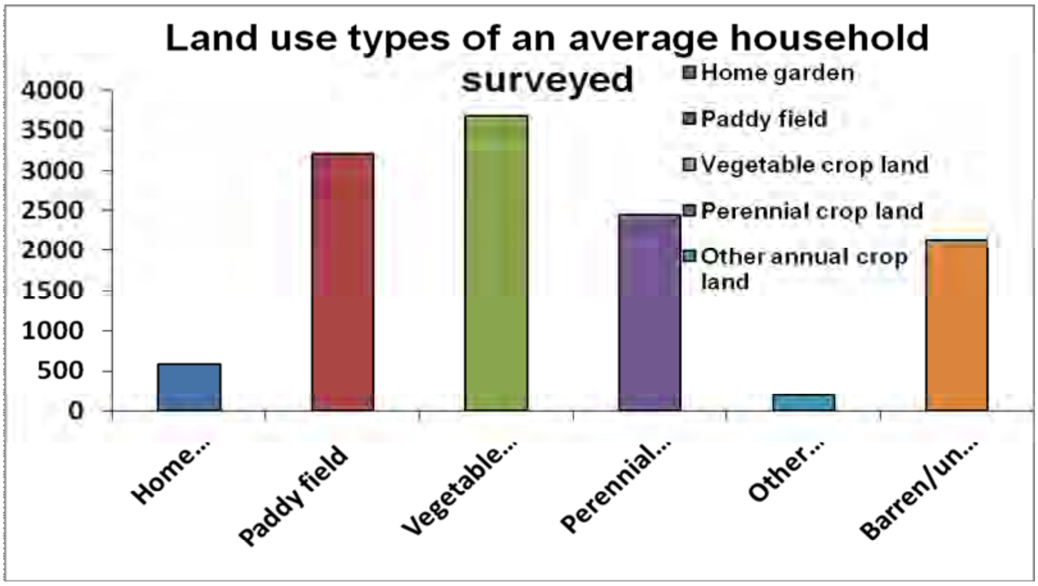


Figure 4.4. Major land use type of an average individual household in surveyed site, Aceh

On average, the distance of paddy land from the nearest water source is 38 meters (Table 4.12), but the distance of an average vegetable plot from water source is only of about 15 meters, indicating that vegetable fields are chosen to be closer to water source than paddy and other crops. Though vegetables need less water (in term of water quantity in absolute term) than paddy but it needs more frequent irrigation than paddy, hence farmers prefer vegetable cultivation close to the water sources for convenience and less drudgery in transferring water.

Table 4.12 Distance to water source (meter) of major land used types

Description	Aceh Besar			Pidie			NortheastAceh			Overall		
	Avg	Freq	SD	Avg	Freq	SD	Avg	Freq	SD	Avg	Freq	SD
Home garden	2.5	16		4.1	14		3.3	19		3.3	49	
Paddy field	0.4	102	1.47	28.1	53	98.26	120.4	53	556.33	38.1	208	218.69
Vegetable crop land	28.7	67	75.54	3.0	50	2.51	9.1	47	11.18	15.2	164	29.74
Perennial crop land	20.8	11	43.7	11.1	9	15.6	9.0	12	9.1	13.7	32	22.78
Barren/uncultivated land	0.3	15	0.7	0.2	6	0.41	0.8	13	1.86	0.5	34	0.99

In terms of types of irrigation, paddy is mostly cultivated as rain-fed crop in Aceh Besar site, but it is largely cultivated on canal irrigated plots in Northeast Aceh and in Pidie. On an average, only less than 50% of the surveyed sample households had cultivated paddy on canal irrigated field (Table 4.13 and figure 4.5). Canal and related farm irrigation infrastructures in Aceh Besar were severely damaged by the tsunami. Clay and sandy clay are the two prominent soil types of paddy field in the surveyed communities, and in fact 35% of the households were cultivating paddy on clay soil types.

Table 4.13. Irrigation sources and soil types of paddy field in the survey sites, Aceh

Description	Aceh Besar	Pidie	NortheastAceh	Overall
	Freq (n=120)	Freq (n=60)	Freq (n=60)	Freq (n=240)
Source of irrigation				
Rain fed	89	20	4	113
Irrigation canal	7	32	36	75
Well		1	3	4
Small pump		-	11	11
River	6	-	1	7
Major soil types				
Clay	49	33	2	84
Sandy	6	9	3	18
Sandy clay	39	11	27	77
Loam	2	-	3	5
River bed	6	-	1	7

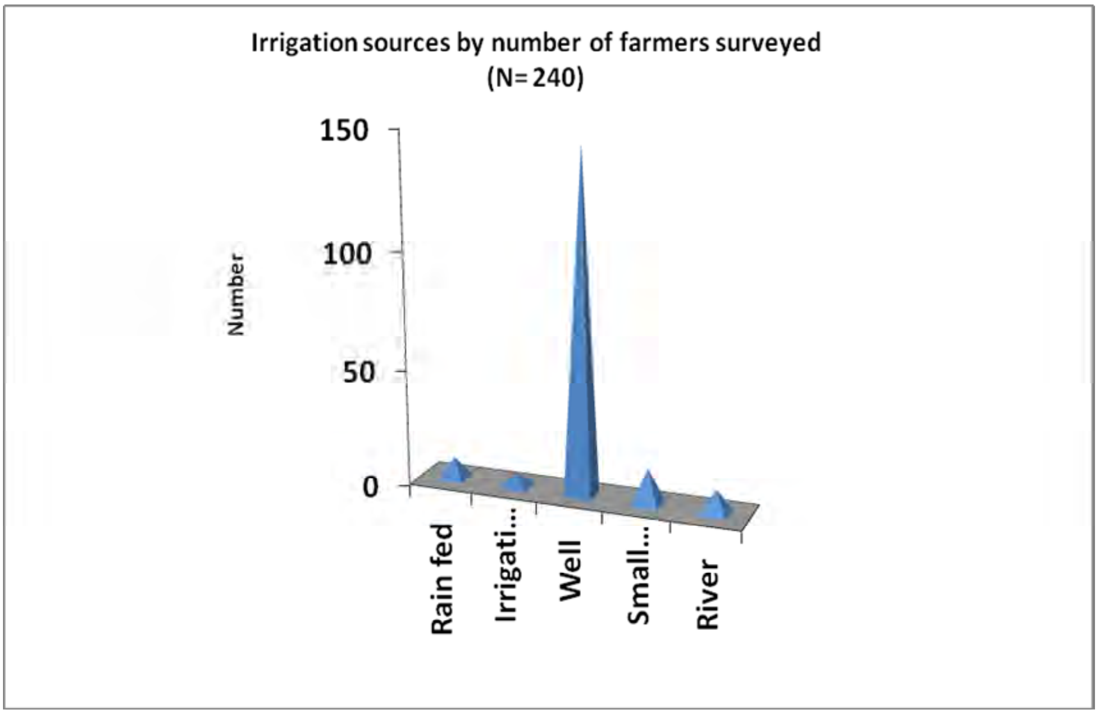


Figure 4.5. Major irrigation source by frequncy (number of farmers), Aceh.

4.2.5 Production practices for the project targeted crops

Chili, tomato, cucumber and shallot are the dominant vegetables cultivated in the surveyed communities (Table 4.14). Tub-well is the main source of water for irrigation of vegetable field in all the surveyed sites. The soil types of vegetable field are similar to that of paddy field, where clay, sandy clay and sandy soil dominate the vegetable field.

Table 4.14. Major Crops planted, irrigation sources and soil types of vegetable land at the surveyed site, Aceh

Description	Aceh Besar	Pidie	Northeast Aceh	Overall
	(No of farmers)	(No of farmers)	(No of farmers)	(No of farmers)
Crop planted				
Chili	64	21	18	103
Tomato	13	5	5	23
Cucumber	6	7	4	17
Eggplant				0
Yardlong bean		3	4	7
Amaranth	3	1	3	7
Shallot	1	11	4	16
Kangkong		1	1	2
Pak Choy	1		3	4
Cabbage		1		1
Other	1			1
Source of irrigation				
Rain fed	6	1	2	9
Irrigation	1	4	1	6
Well	63	45	38	146
Pump	12	-	3	15
River	7	-	3	10
Major soil types				
Clay	17	7	6	30
Sandy	11	21	19	51
Sandy clay	56	22	21	99
Loam	3	-	1	4
River bed	2	-	-	2

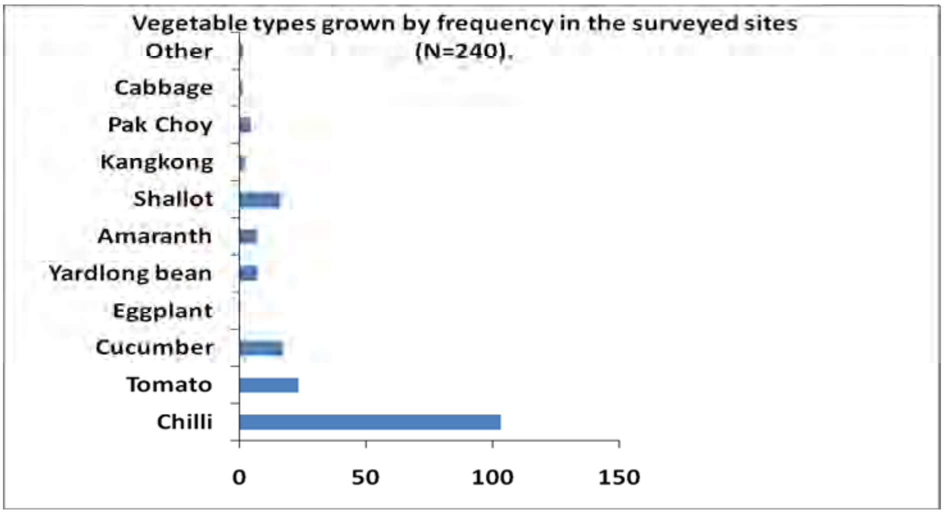


Figure 4.6 Major vegetable types grown by the surveyed households by frequency (number of respondent)

5. Infrastructure and institutional issues

Availability of suitable agricultural infrastructures plays an important role in farmers's decision to grow vegetable, as access to market and road and irrigation factors are critical in this process. Likewise, an institutional factor is as important as that of infrastructural one. They are consider as underlying factors determining extent of farming intensification, farmers' crop choices, and level of inputs used in farming at any place. The 2004 tsunami has destroyed both physical infrastructure as well as institutional infrastructure (including social) in the surveyed sites of Aceh. In this study, the level of infrastructures available is evaluated by analyzing first the major problems and concerns of vegetable farming as revealed by the responded farmers.

5.1. Major constraints and issues on vegetable farming

There are various reasons for growing vegetables, and they largely varied by the surveyed locations in Aceh. In Aceh Besar and Pidie, responded farmers gave suitability and availability of land as the first rank of reason for growing vegetables (Table 5.1 and Figure 5.1). But in Northeast Aceh , the most important reason (determining factor) for growing vegetables by an average household is ease and availability of inputs locally. This makes sense since vegetable farming is input intensive, and Northeast Aceh is located far from the provincial town of Banda Aceh.

Table 5.1. Major reasons for growing vegetable by the surveyed households in Aceh, 2008

Factors\ranking order	Aceh Besar	Pidie	Northeast Aceh	Average
Availability of suitable land	1	1	4	1.67
Past experience	2	5	3	3.3
Can easily sale the harvest to the markets	3	2	3	2.67
Good output prices	4	-	2	2
Short crop cycles than cereal crops	5	3	5	4.3
Easy in crop management	6		-	-
Low-cost protection/operation	7	7	-	-
Easy in availability of inputs	-	4	1	-
Easy in available of water	-	6	-	-
Less land and want more income	-	-	6	-
Good extension services	-	-	7	-

Note: 1 = Highest rank; 8 = Lowest rank

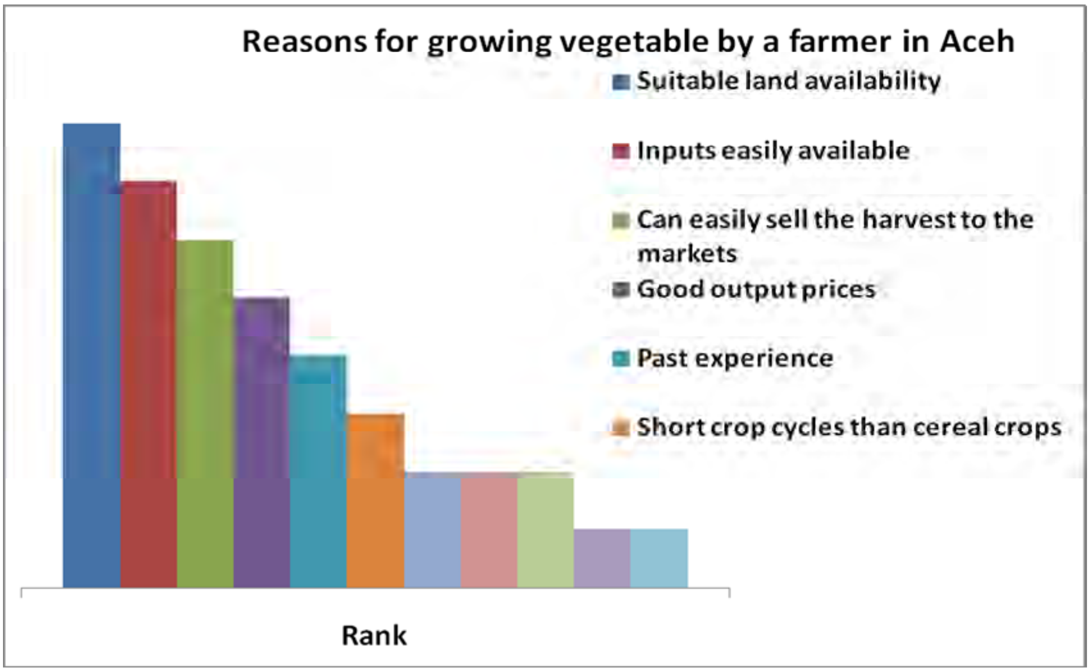


Figure 5.1 major for growing vegetable by a typical farmer in the surveyed localities

In the surveyed communities, pest and disease attack is the most crucial constraint in vegetable farming, followed by high price of fertilizers[2] and other inputs, and then by access to irrigation (Table 5.2 and figure 5.2). The first-three problems are interlinked. Pests and diseases become important because of high price of inputs, including pesticides, as farmers cannot apply needed pesticides and on time. In Aceh, due to more demands for vegetables than supply, therefore, the prices of vegetables were also relatively higher in Aceh than in other parts of Indonesia (central Java).

Table 5.2. Major problem and concern of household for vegetable farming

Major problems/concern/factors	Aceh Besar	Pidie	NortheastAceh	Overall
Pest and disease attack	1	1	1	1
Price of input too expensive	3	3	3	3
Price of fertilizer to high	2	2	2	2
Fluctuation price product	4	4	4	4
Irrigation	5	5	5	5

Note: 1= highest rank; 5 = lowest rank

[2] In 2008, due to fuel crises globally, in many places in Indonesia, process of fertilizer and pesticides increased double fold within a year.

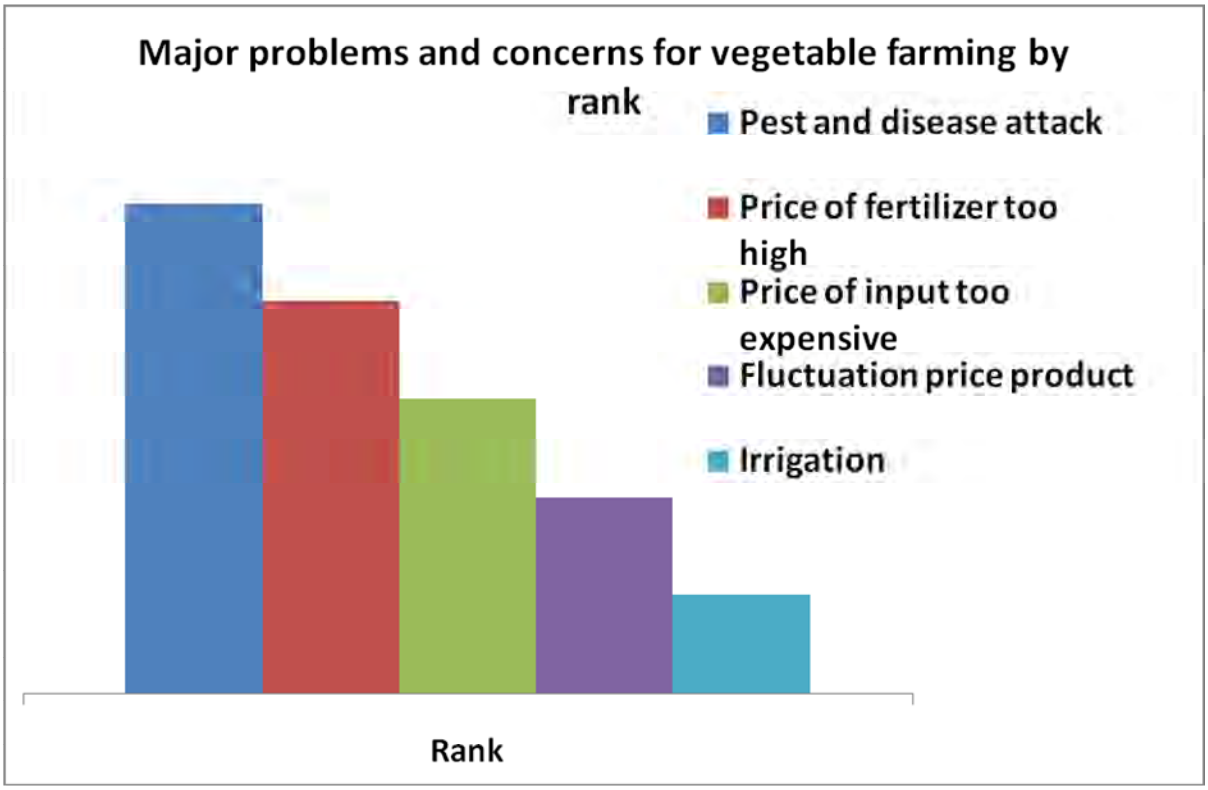


Figure 5.2 Major problems and concerns for vegetable production in the surveyed sites.

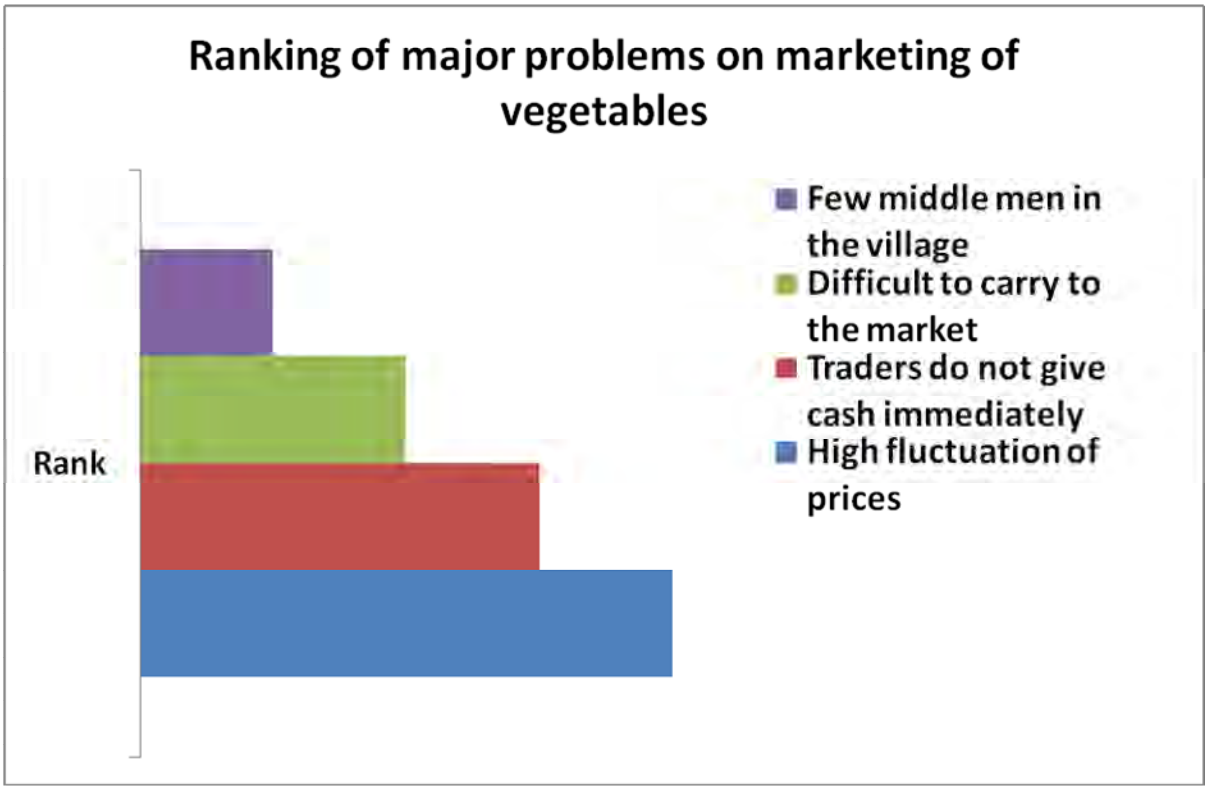
5.2. Marketing of Vegetable produces at the village level

Issues and concerns related to marketing process of vegetables, fluctuating price of vegetable was considered as the key concern in the surveyed sites, except in Pidie, where the farmers inability of getting immediate cash from the trader came as a most important problem (Table 5.3 and Figure 5.3)). Farmers did not consider number of middleman available in the village as a major deciding factor in vegetable farming, because farmers can sell vegetable directly to the market located nearby, and the production of vegetables (supply level) is not so much high in the villages surveyed.

Table 5.3. Major vegetable marketing related problems in the surveyed sites

Type of problems/concern	**Aceh Besar**	**Pidie**	**Northeast Aceh**	**Average**
High fluctuation of prices	1	2	1	1
Few middle men in the village	4	4	4	4
Difficult to carry to the market	3	3	3	3
Traders do not give cash immediately	2	1	2	2

Note: 1 = Highest rank; 4 = Lowest rank



Figre 5.3 Major problem on marketing of vegetables in the surveyd communities

At the surveyed sites, farmers got market information from various sources. Trader was the most important source of market information (Table 5.4), followed by neighbouring farmers. Government extension, radio and village cooperative was not considered as important as trader, meaning that the role of government extension and local government market services in the marketing aspect of vegetable is very minimal. Thereby farmers do not much rely on government sources of information for their produce marketing related decisions and for price negotiation purposes with the traders.

Table 5.4. Ranking of source of information in on-farm marketing of vegetables

Source of information	Aceh Besar	Pidie	Northeast Aceh	Average of all
Trader/collector	1	1	1	1
Neighbor	2	2	2	2
Newspaper	3	3	4	3
Government/Extension	4	4	3	4
Radio	5	5	5	5
Co-operative organization	6	6	6	6

Note: 1 = Highest rank; 6 = Lowest rank.

With respect to market outlets, majority of surveyed households sold their produces at farm site itself. In Aceh, traders and middle men visit to the village and they purchase the produces directly from farmers (Table 5.5 and Figure 5.4) at the field site immediately after harvest. Vegetable vendor and local wholesale market are not so common in Aceh, rather the concept of a wholesale market is gradually evolving in Aceh now[3]. These are typical traditional agricultural markets, where wholesale marketing is not so common, except in Bande Aceh.

Table 5.5. Ranking of market outlets for vegetable produced

Type of middle men	Aceh Besar	Pidie	Northeast Aceh	Average of all
At farm /field	2	2	1	1
Local wholesale market	4	4	4	4
Traders coming to the village	1	1	4	2
Vegetable vendor	5	5	5	5
Carry to the markets	3	3	3	3

Note: 1 = Highest rank; 5 = Lowest rank

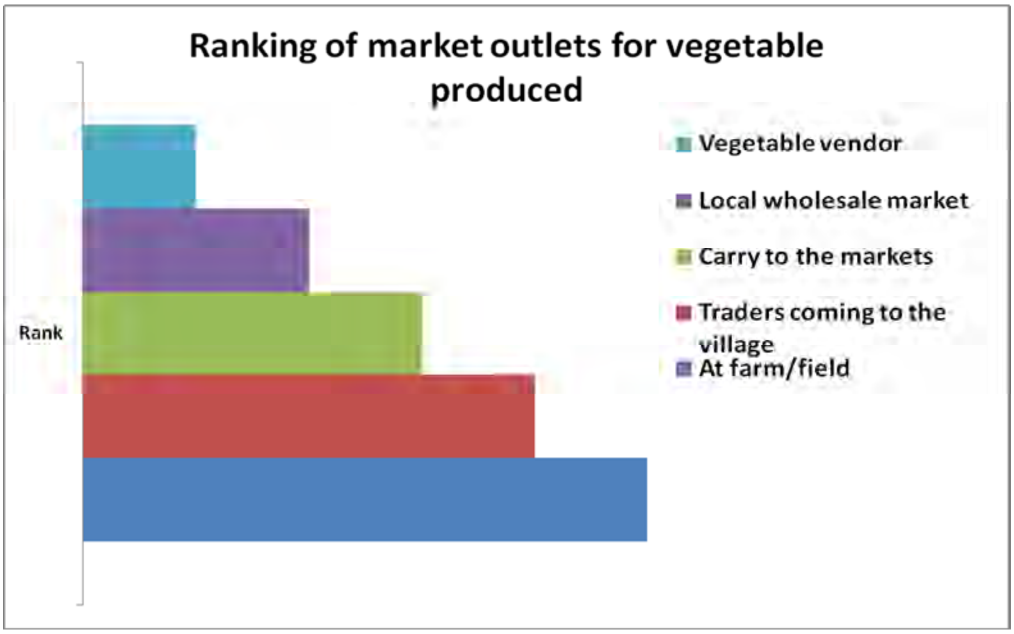


Figure 5.4 Major market outlets of the vegetable produced in the surveyed sites

Despite the traditional practices in marketing of produces, farmers very well know the prevailing price of vegetables in the market, especially for chili, and most of farmers practice fixed trade (Table 5.6). On average, farmers contact more than one trader for knowing prices and selling vegetables before selling to a particular trader. Surprisingly, only a few of farmers get loan from the traders, in spite of almost a fixed trading system followed for marketing of produces in the areas, except in the case Pidie where, over 60% of the farmers surveyed had borrowed fund (mostly in kind) for vegetables cultivation purpose.

Table 5.6. Price information and marketing characteristic

Type of market information	Aceh Besar	Pidie	Northeast Aceh	Overall
Knowledge about prices (%)				

[3] In Bande Aceh, from the support from government of Japan, a central wholesale market has been established just 2-3 years ago, as a part of rehabilitation of basic market infrastructures in the province.

Very well	80	80	75	78.3
Not very well	15	15	20	16.7
Little	5	5	5	5
Whether existence of a fixed trader (%)				
Yes	90	80	75	81.6
No	10	20	25	18.3
Borrow money/inputs from traders (%)				
Yes	30	60	30	40
No	70	40	70	60
Number of traders contacted for sale	3	2	2	2.3

5.3. Irrigation practices followed for vegetables production

Water management and irrigation issues are directly linked to crop production and rehabilitation of field and soil fertility, the major objectives of the project interventions in the surveyed site. Thereby, irrigation and agronomy factors of crop production were assessed across the sites, and separately for chili and other vegetables. Out of the total sample surveyed, about 40 % of the households had cultivated chili in the recent past, and it was about 50% in Aceh Basra site, but 37% and 32% in Pidie and Northeast Aceh, respectively (Table 5.7). About 80 % of the farmers surveyed had cultivated both chili and other vegetables, and they mostly relied well as a source of irrigation (Table 5.7).

Overall all, the farmers surveyed relied more on the well for irrigating chili and other vegetables, but they relied more on canal for irrigating paddy field. Thus, there was a distinct pattern for irrigating paddy and vegetables. About 10 % of the surveyed households were also using pumps for irrigating chili field. In fact, unlike the case of paddy cultivation, only a few of vegetable farmers relied on rain as alternative source of water for irrigation.

Farmers mostly apply manual irrigation for vegetables including chili. Overall, over 70 % of the surveyed farmers manually lifted water from the well located nearby the field for irrigating chili and other vegetables. This was more prevalence in Aceh Besar and Pidie than in Northeast Aceh. Flooding method of irrigation practices was also more common in Northeast Aceh (Aceh Utara and Bireuen), which is due to better access to water from canal. Relative access to water and availability of total quantity of water at a point of time also determine the exact method of irrigation practiced followed. In a place where water is readily available, farmers would usually follow flooding with ridge irrigation practice. Whereas, if the water is a limited factor, then manual irrigation is more widely practiced to save the scarce water resource.

Table 5.7. Irrigation sources and types for vegetable production

	Aceh Besar N=120		Pidie N=60		Northeast Aceh N=60		Overall Sample N=240	
	Chili grower	Other vegetables growers	Chili grower	Other vegetables grower	Chili grower	Other vegetables grower	Chili grower	Other vegetables grower
Number of growers (#)	60	23	22	28	19	30	101	81
% of growers	50	19	37	47	32	50	39.6	38.6
Irrigation source (%)								
Well	76	78	100	82	83	77	86.3	82
Pumps	14	9	0	0	6	7	6.667	5.33
Tank	0	0	0	0	0	0	0	0
Lake	0	0	0	0	0	0	0	0
Rain fed or others	9	13	0	18	11	17	6.67	16
Irrigation type (%)								
Flooding w/o ridges	0	0	0	0	0	0	0	0
Flooding w/ ridges	17	22	18	21	32	7	22.3	16.6
Manual from well	77	78	82	79	53	77	70.6	78
Manual form tank/lake	7	0	0	0	16	17	7.67	5.66

The problems related to irrigation are categorized into major, minor and no problem at all (Table 5.8 and Figure 5.5). Overall, 50% of the surveyed households reported irrigation as a major problem for growing vegetables, but this was more than 70% in case of Aceh Besar and of about 40% in Pidie site. Thus, in general, farmers in Aceh Besar were facing more severe problem of irrigating their vegetables field than that of the other two places. This was also the case for drainage, as it is a more serious problem in Aceh Besar now.

Table 5.8. Severity of problems in irrigation and drainage

Type of problems	Aceh Besar	Pidie	Northeast Aceh	Overall
General irrigation problem (%)				
Major problem	72.3	38	24.5	50
Minor problem	24.1	50	61.2	41.2
No problem	3.6	12	14.3	8.8
Sample size in irrigation problem	83	50	49	182
Drainage problem (%)				
Very serious	44.2	25.0	26.7	35.0
Serious	33.3	41.7	48.3	39.2
Moderate	9.2	23.3	13.3	13.8
Minimal	8.3	8.3	11.7	9.2
No problem	5.0	1.7	0.0	2.9
Total number of responding households for drainage problem	120	60	60	240

Among different types of irrigation problems, farmers believed that unavailability of irrigation as the most critical problem. Other issues related to the irrigation such as drainage, prices of fuel and irrigation tools were also a factor of concerns but not the major problem as that of the damage on-farm irrigation structure by the 2004 tsunami.

Table 5.9. Ranking of irrigation problem on vegetable production recently

Type of problems/concerns	Aceh Besar	Pidie	Northeast Aceh	Overall
No availability of irrigation infrastructures	1	1	2	1.3
Damaged irrigation infrastructures	2	2	1	1.67
Fuel for irrigation machine is too expensive	3	3	3	3
Tools of irrigation are expensive	4	4	4	4

1= highest rank .... 5 = lowest rank

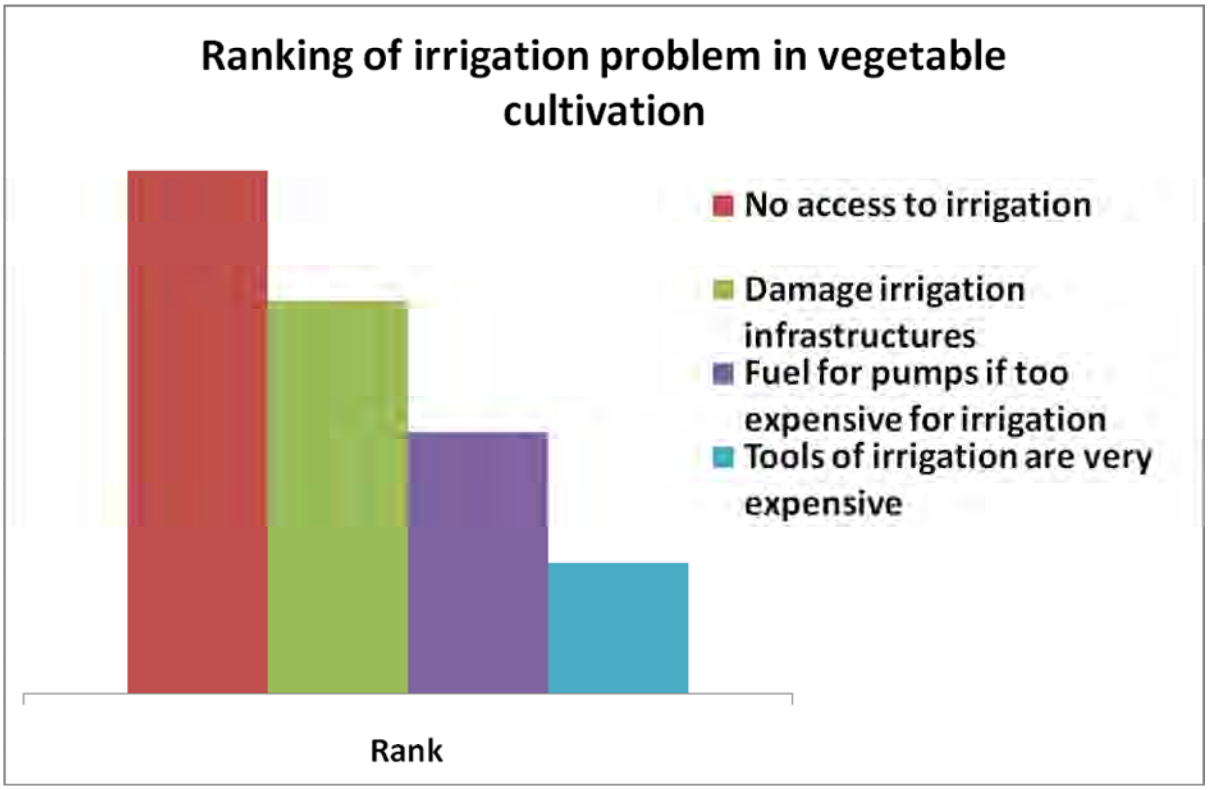


Figure 5.5. Major problem in relation to access to water for vegetable farming

5.4. Access to credit to Vegetable growers

Credit is an important factor for intensive vegetable farming because of high requirement of working capital than growing paddy and other crops. Out of the total of 218 vegetable growers surveyed, only about 42 households (i.e., 19%) had borrowed capital for vegetable cultivation (Table 5.10). In proportionate to the sample surveyed, it was almost equal in all three sites surveyed. The major sources of credit for vegetables were friends and relatives, vegetable collectors, and farm cooperative. At the focus group discussion, we also noticed that, in general, a typical farmers usually also do not want borrow capital from outside source to grow vegetables due to high risk associated in cultivating vegetables. Besides, the cultivation practices followed in Aceh was not so intensive, so vegetables growers usually do not use outside capital but use their own available disposable fund in a household for purchasing inputs for vegetables. To some extent, this is also due to underlying social, cultural, and religious factors, as farmers in the survey site usually do not prefer getting credit from outside of family for cultivation of vegetables and/or other crops, in general;. .

Table 5.10. Credit and related financial issues for vegetable farming

Description	**Aceh Besar**	**Pidie**	**Northeast Aceh**	**Overall**
Households borrowing loan for vegetable cultivation (in 2006/07) (in Number)	20	11	11	42
Households borrowing for vegetables (%)	17	18	18	18
Level of difficulties in getting credit for vegetables cultivation (%):				
Most severe constraint	0	0	0	0
Difficult	0	0	0	0
Little difficult	15	18	18	17
Little problem	75	36	64	58.3
No problem	10	45	18	24.3
Source of credit for farming	Friend Collecto r	Friend	Friend Cooperation organization	Friend Collector Cooperation organization

Difficultly on obtaining credit is strongly related to the time on applying for loan. Timely availability of credit in Pidie and Northern Aceh is more critical than in Aceh besar. On an average, 60 percent of the surveyed households reported not getting credit when one needs, and it was one of the major reasons for not seeking credit from outside sources. Long process of accessing credit from the bank was other major concern in Aceh Besar (Table 5.11). Prevailing high interest rate of the bank loan in rural areas in Aceh also explains why very little number of vegetable growers were obtaining credit from the bank.

Table 5.11. Problem on obtaining credit for vegetable farming

Type of problems/concern	**Aceh Besar**	**Pidie**	**Northeast Aceh**	**Average of three sites**
Problem on obtaining credit (%)				
Not getting credit when one needs it	51	72	62	62
High interest rate	7	2	18	9
Long processing time for bank loan (bureaucracy related problems)	43	27	20	30
Total No. of respondents	120	60	60	

Note : The answers related with credit form bank

The amount borrowed by an average farmer varied from around 1 million Rp to 10 million Rp, which depended on types of credit providers. Compared to the interest rate charge by friends or relatives, credit provided by bank and other financial agency is low, but it also involved of long paper work and complicated regulatory procedures. Commonly, farmers seek credit/loan for farming purpose as well as health services.

5.5. Training and Extension services

Very limited farmers in the surveyed sites had attended formal training, workshop related to vegetable production practices. Out of 240 sample households surveyed, only about 34 farmers had attended at least a vegetable related training in the past, they include 20 farmers from Aceh Besar, 6 from Pidie and 8 from Northeast Aceh (Table 5.12). The organizers of these farmers level trainings and workshops in the past were local and international agencies concerning on the recovery of the tsunami disaster (mostly INGOs). The training participants in these training were equally distributed for male and female, except in Aceh Utara and Birueun, where more proportionate of females attended such training. The training participants in the past were equally from better off and poor farmer types (Table 5.12).

Table 5.12. Training and Extension Services in vegetable farming

Description	**Aceh Besar**	**Pidie**	**Northeast Aceh**	**Total Sample**
Farmers attending training, workshop for vegetable production (Number)	20	6	8	34 (total)
Farmers attending training, workshop for vegetable production (%)	17	10	13	13
Name of organizers providing trainings on vegetable farming in the surveyed sites	Oxfam Lamrine Canada Red Cross Distan Prov.Nad	Distan Prov.Nad BPTP Nad Dafed	Distan Prov.Nad ADB IOM BRR	
Average duration of training (days)	4.87	2.91	6.38	4.72
Who attended training (%):				
Male	50	50	37.5	46
Female	50	50	62.5	54
Farmers/family request first (%):				
Yes	35	33	12.5	27
No	65	67	87.5	73
Perceived benefits from training (%):				
Skill improved	95	100	75	90
Family health improved	5	0	0	-3
Increased cash income	0	0	0	-
Employment generated	0	0	25	-

For whom training and extension activities were targeted (%) • For both better-off and poor • Mainly for well-to-do farmers • Mainly for poor household	 100 0 0	 100 0 0	 100 0 0	 100 0 0

Farmers cited various source for getting information on agricultural practices (Table 5.13). The major types of technology components that they have got training in the past include: general farming (cultivation of cereals and other crops), vegetable production, soil fertility management, pests and diseases control, market information, fertilizer application, agronomical practices, and livestock raising (Table 5.13 and Figures 5.6 and 5.7). In general, own experience was the most important source for farming practices, followed by information from family members in the household, and from neighbouring farmers. Formal institutions like government agencies, farmer organization and news paper were not so much of important source of information for average farmers for cultivating vegetables, which is largely due to inadequacy of such training locally.

Table 5.13. The importance of source of information for agricultural practices in Aceh

Source of information	Rank of information			
	Aceh Besar	Pidie	Northeast Aceh	Overall ranking
General farming				
Own experience	1	2	1	1
Other household members	2	1	2	2
Neighbors/other farmers	4	3	2	3
School/NGO	6			7
Government extension	6	4	3	6
Farmers' organization	3			4
Newspaper/magazine/other print media	5		4	5
Vegetable production				
Own experience	1	2	1	1
Other household members	3	1	2	2
Neighbours/other farmers	2	3	3	3
School/NGO	6			7
Government extension	5		5	5
Input dealers			4	6
Farmers' organization		4	6	6
Newspaper/magazine/other print media	4			4

1= highest rank .... 6 = lowest rank. Overall ranking is derived based on the ranking across the sites and also as per number of reporting in each site.

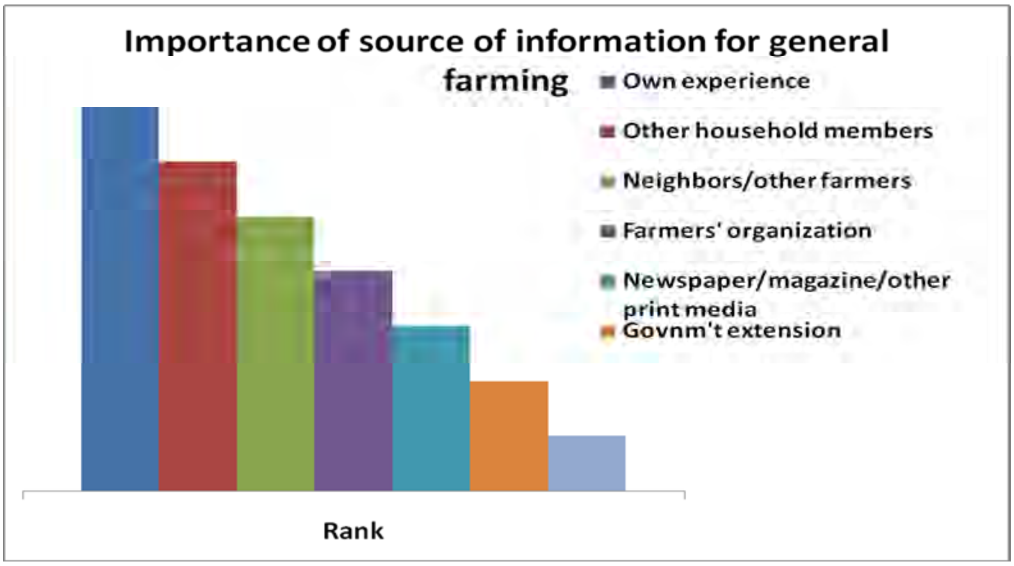


Figure 5.6 Relative importance of source of informaton for vegetable farming

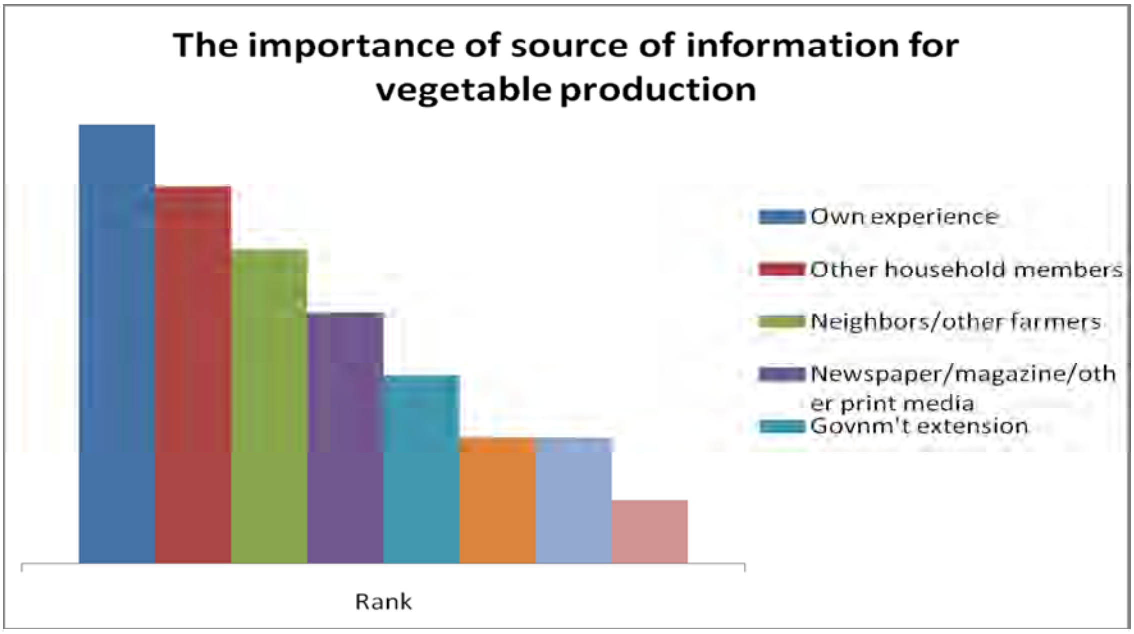


Figure 5.7 Relative importance of source of information for production of vegetables

We also analyze separately on how respondent farmers in each site perceived training providers (service providers) for knowledge specific to management of soil salinity, soil fertility and fertilizer application, and the results are in Table 5.14. These issues also also guided implementing other project-interventions in the sites. For all three categories of information in Table 5.14, farmers perceived their own experience as the most important source of knowledge followed by information sharing across the family members, across neighbouring farmers, and from government extension services. Likewise, importance of source of information for plant protection (pest and diseases management), marketing of agricultural produces, for irrigation and water management issues, livestock raising purpose, were also evaluated by the sites, and the results are in appendix Tables 1 to 4.

Table 5.14. The importance of source of information for soil fertility and fertilizer

Source of information	Rank of information			
	Aceh Besar	**Pidie**	**Northeast Aceh**	**Overall**
Soil salinity management				
Own experience	1	2	1	1
Other household members	3	1	3	2
Neighbors/other farmers	4	3	2	3
School/NGO	6			6
Government extension	2	4	5	4
Farmers' organization	5		4	5
Soil fertility management				
Own experience	1	1	1	1
Other household members	3	2	3	2
Neighbors/other farmers	4	3	2	3
School/NGO	5			6
Government extension	4		4	5
Farmers' organization	2	4	3	4
Newspaper/magazine/other print media			5	7
Fertilizer application				
Own experience	1	1	1	1
Other household members	3	2	2	2
Neighbors/other farmers	4	3	2	3
School/NGO	5			5
Government extension	2		4	4
Input dealers			5	6
Farmers' organization	3		3	4

1= highest rank .... 7 = lowest rank. Overall ranking is derived based on the ranking across the sites and also as per number of reporting in each site.

Framers perceptions upon the agricultural related training provided in the surveyed sites were analyzed, and the results by the surveyed sites are in Table 5.15. About 40 percent of the farmers surveyed reported that they had not attended any of farming related formal training in the past. Nevertheless, about 28 % of the surveyed farmers also reported that they are satisfied with the training what they had received in the past, and the farming related know how what they have got so far. Technical services provisions in Pidie and Northeast Aceh seem to be better in provision of agricultural services (extension services) than in Aceh Besar (Table 5.15 and Figure 5.8), despite the fact that Aceh Besar is located closer to the provincial capital city.

Table 5.15. Farmers' perceptions on adequacy of technical services provided for vegetable farming

Particulars	**Aceh Besar N= 120**		**Pidie N= 60**		**Northeast Aceh N= 60**		**Overall N=240**	
	Freq	%	Freq	%	Freq	%	Freq	%
Not obtained any training	43	35.8	28	46.7	22	36.7	93	38.8
Not good quality	2	1.7	-	-	2	3.3	4	1.7
Moderate/Ok	34	28.3	3	5	7	11.7	44	18.3
Adequate	8	6.7	2	3.3	2	3.3	12	5.0
Very adequate	23	19.2	22	36.7	22	36.7	67	27.9
No data/Not Filled	10	8.3	5	8.3	5	8.3	20	8.3
Total	120	100	60	100	60	100	240	100

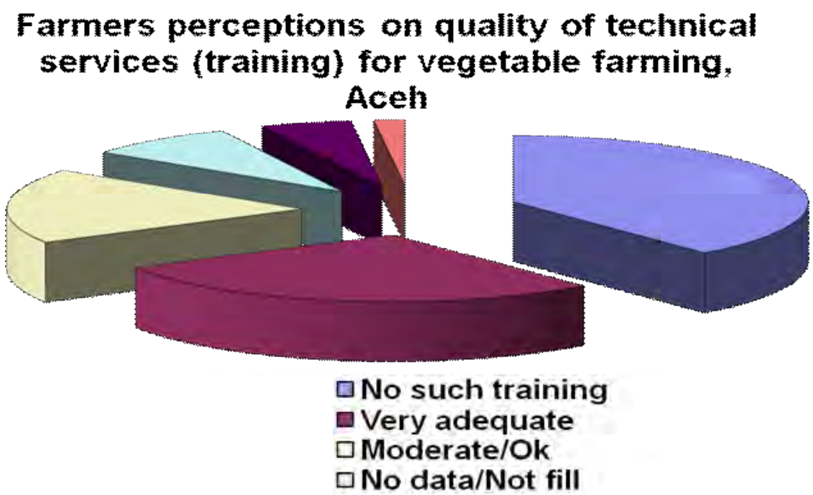


Figure 5.8 Famers perception on quality of technicacl services (training) that they have received for vegetable farming in Aceh

5.6. Gender Issues on vegetable farming

Women play a significant role in vegetable production activities, and hence, gender difference on specific component-activities of vegetable production practices and production decisions were analyzed, and the results are summarized in Table 5.16. In fact, the roles of women and men vary by the specific operation/component of the vegetable production practices. In a typical household surveyed in Aceh, about 70 % of time, the decision of crop acreage allocation for vegetable was decided by female members. Likewise, women members of households also had a major stake in harvesting decision of vegetable produces. Females in Aceh Besar contributed more active role in vegetable farming (production and marketing practices) than that of the other two regions (Table 5.16). Female members of household contributed more on pest and diseases control, purchasing agricultural inputs, marketing the produce and accessing agricultural credit than that of men. These activities are also the most important aspects of vegetable farming.

Table 5.16. Gender and vegetable production

No	Activities and decision in vegetable farming	Aceh Besar		Pidie		Northeast Aceh		Average	
		Male (%)	Fe-male (%)	Male (%)	Fe-male (%)	Male (%)	Fe-male (%)	Male (%)	Fe-male (%)
1	Area of crops to be grown	14	86	44	56	28	72	26	74
2	Seedling preparation	16	84	44	56	26	74	26	74
3	Intercultural operation (weeding, etc)	11	89	43	57	28	72	25	75
4	Fertilizer purchase/ application	5	95	43	57	27	73	23	77
5	Pesticide purchase/application	5	95	34	66	12	88	14	86
6	Harvesting decision	15	85	43	57	28	72	26	74
7	Drying, cleaning, grading of vegetables	15	85	45	55	25	75	26	74
8	Purchasing farm inputs	8	92	42	58	14	86	18	82
9	Selling of the vegetables produce	13	87	36	64	17	83	19	81
10	Working in home garden	59	41	70	30	56	44	60	40
11	Taking a major farming decision	14	86	46	54	29	71	27	73
12	Credit attainment for farming	4	96	39	61	24	76	19	81
13	Participation in village meetings	18	82	47	53	33	67	31	69
14	Participation in Ag. training & extension	25	75	44	56	34	66	34	66
15	Other spending in household needs	30	70	57	43	42	58	41	59

Note: Only about 25% of the households in each sites reported the activities by gender, and this table is based on the average of the figures provided by those households providing to the information on gender implications of the production activities. In addition, for cross-examination, the gender related information was also collected and evaluated at focus group discussions at each of the community surveyed. The information from both approaches was consistent.

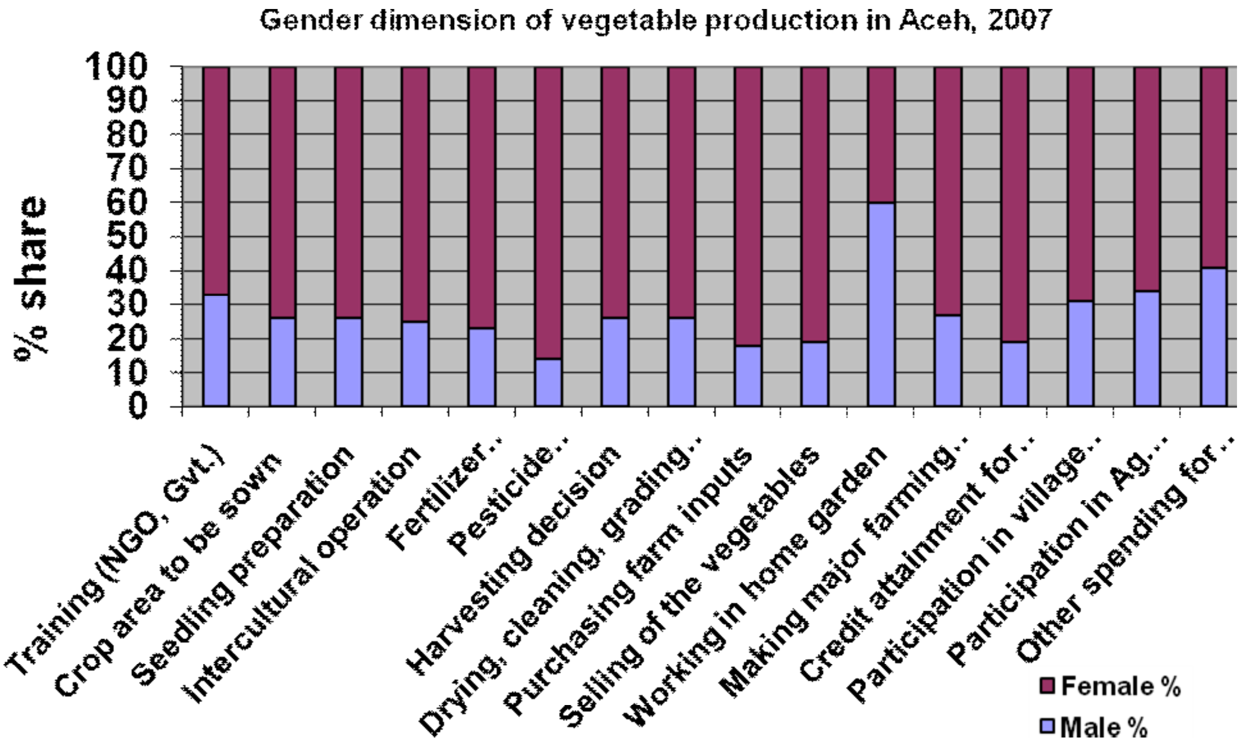


Figure 5.9. Gender dimension of vegetable production in Aceh

Training and extension related to agricultural practices are equally targeted for both male and females (Table 5.17). About 42% of households reported that in the past local level farmers training were given equally for both man and woman members in the community. Moreover, about 50 of the households could not fill any information/data for this specific item in the questionnaires (Table 5.17).

Table 5.17. Gender implications of training and extension activities as perceived by the respondent households, Aceh.

Support of training and extension work	Aceh Besar N=120		Pidie N=		Northeast Aceh		Average	
	Freq	%	Freq	%	Freq	%	Freq	%
Equal for men and women	47	39.2	26	43.3	28	46.7	101	42.1
More for men	19	15.8	1	1.7	5	8.3	25	10.4
More for women	1	0.8	-	-	-	-	1	0.4
No data/Not Fill	53	44.2	33	55	27	45	113	47.1
Total	120	100	60	100	60	100	240	100

Based on the information collected from group discussion and consultation at farming community level, socio-economic and local institutional factors of farming were found to be critical in farmers' decision to grow (or not to grow) vegetables. However, these factors also varied by location and characteristics of the community. Some of the farmers' major concerns for the vegetable production activities in Aceh were:

- Limited availability of land suitable for vegetable cultivation;
- Limited operational capital for purchasing inputs for vegetable farming;
- Limited family labor available to work for vegetable field (4-5 times higher labor need for vegetable than that of paddy cultivation);
- Inadequate access to irrigation facility (infrastructures damaged by tsunami);
- Increasing trend of pest and disease infestations;
- Sharply increased market prices of farm inputs; and
- High fluctuation of seasonal prices vegetables in the local markets.

Using the Venn-diagram tool of Participatory Rural Appraisal (PRA), with groups of farmers in the communities, major institutions/local organizations affecting vegetable farming as identified by the farmers in the surveyed communities was listed. They are:

- Agro-input suppliers,
- Vegetable traders,
- local markets (for sale of outputs),
- Local farmers' groups,
- Local NGOs (for teaching farming practices, materials, and micro-credit),
- Local government, agriculture and extension agencies, and
- Government banks.

The size of circle of a Venn Diagram indicates the importance of an institution, likewise, distance from the center circle reflects the intensisity of the relationship of an agency with teh farming practices. Among these institutions, farmers in Aceh considered that input suppliers, local vegetable traders, and the vegetable markets are very critical determining factors for nature and extent of cultivation of a vegetable crop, and level of vegetable intensification, in a place. Even in these tsunami affected communities, most of the vegetable cultivation was done for the market-sale, and hence, market access and farmers' ability to bear risk on seasonal variation of market prices (inputs and produces both) were found to be critical factors in determining crop choices (vegetable or paddy cultivation), and adoption of a particular technology in a certain location.

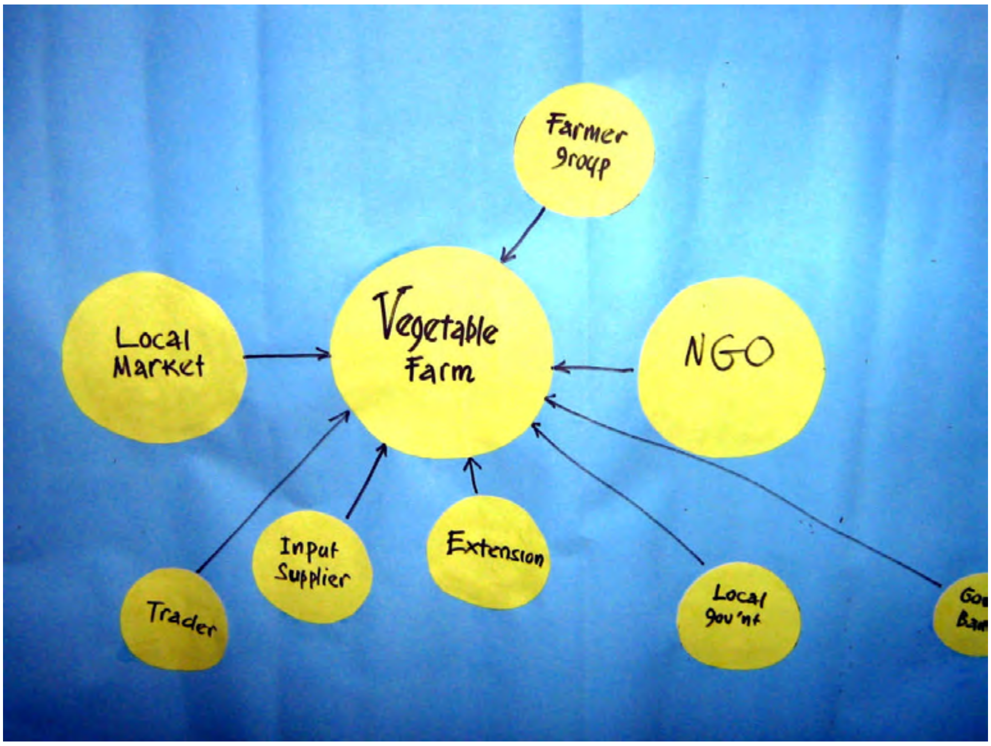


Figure 5.10. Venn Diagram showing major institutions/agencies affecting vegetable farming in Aceh

6. Cost and returns of vegetables production by location

The economic analysis (cost and return analysis) of crop production is done based on a sample plot of a farmer, which was selected by farmers as per their convenience and easy for recalling the past information. In fact, unlike the information related to other household related information, during interview process, many farmers could not provide information pertaining to the cost and return analysis of crop production. To minimize the bias, in this study, the cost and benefit analysis is done by averaging the information pertaining to number of farmers who provided relatively accurate data on the financial aspect of the crop production. Unlike the general category of information, very less numbers of farmers were able to provide accurate information on cost and return of production of a vegetable such as financial information, and inputs level used on crop production activities. Therefore, the economic analysis has been done with information from limited number of farmers and for only one crop, chili ─ also the most widely grown crop in the surveyed sites.

6.1. Cost and return of chili cultivation

In this section, costs and returns of chili production practice have been analyzed using the information household level (individual plot level) information. Out of the total chili-growing households of 186, only about 33 farmers provided detailed information pertaining to costs and benefits of crop production practices. They were 19, 5, and 9 from each of Aceh Besar, Pidie, and Northeast Aceh site. For accurate comparison on inputs use, and convenience to the farmers to recall the detailed information on inputs use by types, the cost and returns related information were obtained only one standard plot (main plot of the farmer) of a surveyed household. Then, data across the sites are reported for 0.1 ha basis (1000 M^2) of farming plot, as illustrated in next section. The costs and return have been evaluated first for materials and labor inputs used for chili cultivation for a plot and then matching with the return from the same plot.

6.1.1 Major material inputs used

A. Nursery

Material inputs used in nursery consist of seed, organic fertilizers, inorganic fertilizers, pesticides, plastic mulch and poly bag, and other equipments for watering (Table 6.1). For crop acreage of 0.1 ha, around of one pack (approximately 10 gram) of seed used for preparing the nursery. In Northeast Aceh, slightly higher quantity of seed was used than in other two regions. Organic fertilizers used in nursery varied from 4 kg in Pidie to 26 kg in Northeast Aceh. The large variation on use of organic matter is also due to variation of moisture content on the materials used (level of dryness of compost). In Northeast Aceh, the use of organic fertilisers was the highest, but the use of inorganic fertilisers on chili was very low, which was less than ¼ kg for the nursery. In Northeast Aceh, where the use of organic material is high, inorganic fertilizers are not used, or if used then at very minimal level. An average of ¼ bottle of insecticides were used in nursery field for nursery plants equivalent to 0.1 ha of main field. The use of insecticides in Northeast Aceh was around ½ bottle[4], and was higher than in other two regions. Fungicides were not applied by the surveyed farmers. Plastic was used for mulching and preparing seedling. The monetary value of such materials varies from Rp 200 to Rp 1,500. But, material cost related to watering in nursery was around Rp 8,500, which was quite high. Among the three sites, the cost of material related to watering (irrigation) was the highest in Pidie (Rp 11,605).

Table 6.1. Material needed for chili nursery (equivalent for 0.1 ha of crop field)

Materials	Quantity							
	Aceh Besar (N=19)		Pidie (N=5)		Northeast Aceh(N=9)		Average[5]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Seed application (pack)	0.80	1.50	0.68	0.50	1.29	0.5	0.692	1.10
Organic fertilizers (kg)	14.48	72.04	4.41	21.67	26.38	66.13	15.09	53.28
Urea (kg)	0.38	1.86	0.08	0.45	0.00		0.15	0.77
SP36 (kg)	0.29	2.33	0.08	0.45	0.00		0.12	0.93
KCl (kg)	0.25	1.40	0.08	0.45	0.00		0.11	0.62
NPK (kg)	0.32	2.54	0.12	0.45	0.00		0.15	0.99
Insecticides (bottle)	0.10	1.16	0.04	0.22	0.62	1.13	0.25	0.84
Fungicides (kg)	0		0		0			
Mulching and polybag (Rp)	518.16	1500	162.48	93.15	1337.30	1153.74	6,72.7	915.6
Watering cost (Rp)	8,005	84,350	11,605	67,082	6,134	16,667	8,5813	560.3
Total cost for material inputs (Rp)	**8,540**		**11,773**		**7,500**		**9,270**	

0 means not using this inputs by any of the sample surveyed households in the location
Exchange rate: Indonesian Rp 10,000 = I USD in 2007

[4] The common volume of a bottle insecticide is 100cc.
[5] In these cost benefits analysis, the average statistics are average of the three sites in the corresponding of the table, and not average of the figures from overall sample size which would be then bias (weighted) more towards mean of the Aceh Besar (50% of the sample).

B. Main filed

Fertilizers used in main field are similar to those used in nursery, but at the different level of doses (Table 6.2). For 0.1 ha of chili acreage, on an average of about 150 kg of organic fertilizer was used, which varies from around 96 kg in Pidie to 250 kg in Aceh besar site. In fact, the level of organic material use in Aceh Besar was double than that in Pidie and Northeast Aceh. About 50 kg of other chemical fertilisers were used on 0.1 ha of chili field, which also varies by sites, it was highest (71 kg) in Northeast and lowest in Pidie (33 kg). The level of use of Urea and other chemicals in Northeast Aceh is much higher than that in Aceh Besar and Pidie. In some of these places, organic material was used for substitution of inorganic fertilizers, particularly in Aceh Besar. In Pidie, the level of both inorganic and organic fertilizers is the lowest so the level of intensification on crop cultivation, and application of other inputs.

Table 6.2. Fertilizers use in chili (0.1 ha of crop field)

	Level of use (kg)							
	Aceh Besar (N=19)		Pidie (N=5)		Northeast Aceh(N=9)		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Organic manures	250.42	785,72	96.71	234.52	99.39	100,75	148.84	295.17
Urea	14.84	28.55	9.13	16.80	23.52	19.23	15.83	21.53
SP36	14.95	31.84	4.80	11.78	16.81	21.34	12.19	21.65
KCl	12.31	30.27	7.89	19.19	16.81	16.75	12.34	22.07
NPK	7.83	31.74	11.22	40.68	13.74	21.54	10.93	31.32
Total chemical fertilizers uses (in kg)	**50.00**		**33.00**		**71.00**		**51.30**	

Pesticides use in the main field consists of insecticides, fungicides and other types (Table 6.3). The level of use of pesticide varies from 1.5 to 2 bottles of formulation, thus much less pesticides were used on chili crop in Aceh than in Central Java and other places of Indonesia (Mariyono and Bhattarai, 2009). The insecticides application in Northeast Aceh was the highest among the three sites, which was around two bottles per reason for 0.1 ha. On an average of 0.75 kg of fungicides were used with a range from 0.5 to 1.7 kg, and. In Pidie, surveyed farmers did not use fungicide on chili crop. In Northeast Aceh, the level of use of fungicides was three folds higher than that of its uses in Aceh Besar. However, the level of uses of other types of pesticides was much less, which was less than 1 kg for 0.1 ha of chili crop acreage.

Table 6.3 Pesticides use in chili (0.1 ha of crop field)

	Level of use							
	Aceh Besar (N=19)		Pidie (N=5)		Noortheast Aceh (N=9)		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Insecticides (small bottle)	1.73	3.87	1.86	3.70	2.09	2.03	1.89	3.20
Fungicides (kg)	0.49	1.24	0.00	0.00	1.72	2.96	0.74	1.40
Others chemicals*	0.25	2.82	0.23	0.89	0.00	0.00	0.16	1.24

*) Others comprise unknown and unnamed pesticides and surfactant

In terms of monetary value of material input in nursery, seed cost was the highest, followed by organic materials and plastic mulching and polybag (Table 6.4). Some farmers do not value many of these materials, as they are not purchased from the market. Compared to Central Java and other provinces of Indonesia, the level (and cost) of inorganic fertilizers and pesticides use on chili are lower in Aceh. In total, the value of material inputs use for Nursery was an average of about Rp 77,750 for 0.1 ha of main field, which varies from Rp. 40,000 (in Pidie) to Rp 95,000 (in Aceh Besar and Northeast Aceh).

In the main field, the highest monetary value of materials inputs was organic fertilizers and all inorganic fertilizers, which account for around Rp 250,000 for 0.1 of crop field, which is about 75% of the total cost for material inputs. The total cost of fertilizer inputs in chili was highest in Northeast Aceh than the other two locations. The value of insecticides applied ranges from Rp 30,000 to Rp 50,000, and the highest was at Pidie. In total, an average of about Rp 413,950 worth of material inputs were used for chili (in the main field), which ranges from Rp 250,000 (Pidie) to Rp 500,000 (in Northeast Aceh). Farmers in Northeast Aceh spent more for the material inputs than those in other two regions, and correspondingly, the chili productivity was also higher in Northeast Aceh than that of the two locations.

Table 6.4. Cost of inputs used in monetary (unit: Rp/0.1 ha)

	Particulars	**Aceh Besar (N=19)**	**Pidie (N=5)**	**Northeast Aceh (N=9)**	**Average (3 sites)**
A	***Nursery field***				
A.1	Seed application	48,753	26,628	58,356	44,579
A.2	Organic fertilizers	17,693	0	0	5,897
A.3	Inorganic fertilizers	3,680	1,838	0	1539
A.4	Pesticides	1,595	1,547	1,299	1480
A.5	Others	23,151	13,230	35,475	23,957
	Sub-total	94,872	43,243	95,129	77,748
B	***Main Field***				

B.1	Organic material	132,129	9,671	207,220	116,340
B.2	Urea	32,461	16,616	98,790	49,289
B.3	SP36	28,645	17,640	35,975	27,420
B.4	KCl	30,082	37,091	35,295	34,156
B.5	NPK	29,424	59,178	38,465	42,355
B.6	Insecticides	47,105	52,494	30,915	43,504
B.7	Fungicides	9,729	0	13,839	7,856
B.8	Surfactant	0	0	0	0
B.9	Others pesticides	89	673	0	7,856
B.10	Irrigation	2,131	0	18,405	4,845
B.11	Harvesting and packing	364	11,605	897	4,288
B.12	Others	11,078	0	0	3,692
	Sub-total	323,236	204,968	479,801	336,001
	Sub-total (A+B)	**418,108**	**248,211**	**574,930**	**413,949**

Overall, the use of material inputs (fertilizers, pesticides and other materials) largely vary across the three sites surveyed. Even, within a region (community), the level of use of materials varies substantially among the farmers, which is also shown by the measure of standard deviation greater than the means for many items in Table 6.5. This is an indication that each farmer has different level of adoption of chili technology. Even within a community, some farmers use high level of material inputs, and others do not use such high level of materials.

Farmers are gradually expanding vegetables acreage, including chili. All of the vegetable produces are not for sale but also for home consumption (subsistent), and only a few farmers grow vegetable only for market-sale. On an average, chili cultivation in Aceh can be safely considered as a low-inputs system, as a much low-level of inputs are used on chili crop in Aceh than that of the other parts of Indonesia. In fact, among the sample of farm households surveyed, many of them were growing vegetables largely for home consumption and with very modest level of external inputs on chili farming.

6.1.2 Labor employed for chili farming

A. Nursery

Labor employed in nursery came from family members, and for the main plot, it came almost equally from family sources and as hired labor (Table 6.5). More labor days were devoted (per unit basis) for cultivation of chili in Northeast Aceh than in other two regions surveyed.

On chili nursery, the share of family members to total labor uses accounted for 70% of total labor uses (i.e., 3 out of 5 days of labor uses). Also for the main field of chili, on an average, the share of family members was about 60% of the total labor uses, except in Aceh Besar- where the share of family members was only about 40% of the total labor uses. On an average, total labor employed in the main field of 0.1 ha was about 18 labor days, which ranges from 13 days-person in Pidie and 26 person-days in Northeast Aceh [6].

Table 6.5. Total labor use for chili cultivation

Descriptions	Level of use (person-day)							
	Aceh Besar (N=19)		Pidie (N=5)		Northeast Aceh(N=9)		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Nursery								
Family labor	2.30	1.27	3.46	1.09	4.08	0.48	3.28	2.94
Hired labor	1.49	1.36	0.31	0.30	2.94	0.86	1.58	0.84
Total labor	3.80	1.89	3.77	1.12	7.02	0.99	4.86	1.33
Main plot								
Family labor	6.15	1.29	9.36	3.00	14.60	1.63	10.04	1.97
Hired labor	8.59	2.96	3.48	1.71	11.95	1.60	8.00	2.09
Total labor	14.74	4.25	12.84	4.71	26.55	3.23	18.04	4.06

Note: SD for average column is derived as arithmetic average of the three SDs of three survey sites respectively.

Of the total labor employed in the main field, higher portion of labor was devoted for tasks like land preparation, transplantation, weeding and harvesting (Table 6.6), harvesting alone was consuming 5.3 person-days. In Northeast Ache, about 270/ha of person days was generated by chili crop; but it was only 120 person days/ha in case of Pidie. The variation on labor-days are due to several factors like level of crop intensification, crop season, etc.

Table 6.6 Labor use in the main field, by activities

Activities	**Level of use (person-day)**							
	Aceh Besar (N=19)		**Pidie (N=5)**		**Northeast Aceh (N=9)**		**Average**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Land preparation	4.01	7.10	1.55	1.41	7.11	6.09	4.22	4.87
Transplanting	1.98	5.27	1.16	1.87	4.78	4.64	2.64	3.93
Fertilizer application	0.77	1.33	1.62	6.22	1.72	2.07	1.37	3.21
Pesticide application	0.67	1.41	2.09	6.73	0.86	0.44	1.21	2.86
Weeding	1.34	6.53	2.48	8.38	2.95	3.24	2.26	6.05

[6] In fact, the labor days of 23 (18+5) for chili farming in Aceh, as estimated from the household survey, underestimates the actual extent of labor days required for chili cultivation by an average farmer. In our focus group discussion among knowledgeable farmers group, we estimated bout 800 person days/ha (or 80 person days per 0.1 ha field) on cultivation of chili in Aceh. But this group was of little more knowledgeable farmers p and production is largely for market sale.. But in our survey sample (in Table 6.5), many sample farmers were using low-inputs and also adopting much less extensive farming and diversification of risk

Irrigation	0.55	2.24	0.00	0.00	0.86	0.44	0.47	1.03
Harvesting	4.70	2.39	3.71	2.48	7.50	0.94	5.30	1.94
On farm transportation	0.19	0.95	0.23	1.34	0.73	1.17	0.38	1.15
Total labor	14.21		12.84		26.51		17.85	

In terms of labor cost, the average labor cost for nursery production was about Rp 80,000 (average of the three sites), but it ranges from around Rp 15,000 (in Pidie) to Rp 150,000 (in Northeast Aceh) (Table 6.7). The labor cost for nursery production in Northeast Aceh was double than that in Aceh Besar and ten fold than that of Pidie. This is because of more intensive nature of chili farming (also of more given in nursery plots) in Northeast Aceh than that of the production practices followed in other two sites..

In the main field, among the activities, the highest labor cost was for land preparation, harvesting, weeding and transplanting, as the number of labor uses for these activities was high. The total labor cost on chili farming (per 0.1 ha basis) ranges from Rp 170,000 in Pidie to Rp 600,000 in Northeast Aceh.

Table 6.7 Total labor cost on chili production by major activities (unit Rp/0.1 ha)

	Labor use by activities	**Aceh Besar (N=19)**	**Pidie (N=5)**	**Northeast Aceh(N=9)**	**Average**
A	Nursery preparation	74,599	15,474	146,870	78,980
B	*Main field*				
B.1	Land preparation	153,772	15,474	196,563	121,936
B.2	Transplanting	58,994	15,474	147,423	73,963
B.3	Fertilizer application	8,124	0	0	2,708
B.4	Pesticide application	28,046	0	6,074	11,373
B.5	Weeding	35,590	77,369	36,994	49,984
B.6	Irrigation	14,313	0	0	4,771
B.7	Harvesting	124,565	61,896	198,220	128,227
B.8	On farm transportation	6,190	3,868	12,147	7,401
B.9	Others	23,822	0	12,270	12,030
	Sub-total	453,415	174,081	609,690	412,395
	Sub-total (A+B)	528,015	189,555	756,561	49,377

Exchange rate in 2007 : USD 1 = Indonesian Rp 10,000

As like that of the material inputs, labor inputs used in chili cultivation in Aceh was less than the case in other intensive production pockets in Indonesia. In fact, the variation in labor use across the three sites surveyed was also very high. Chili farming in Aceh is still at a subsistent level, and only few of the farmers were growing chili for market sale. In addition, the villages selected for household surveys were not the leading vegetable production pockets in Aceh. These communities/villages were purposively selected that were largely damaged by the 2004 tsunami. Due to all of these reasons, the number of labor and/or production cost of chili as such derived in the study greatly vary across the three sites, and also underestimated on many of the inputs applied. Moreover, compared to the cases in other vegetable production pockets in Indonesia, chili production practice in Aceh has not yet been a labor-intensive (and also input-intensive) activity. Among the three sites surveyed, the intensity of both material inputs and labor use on chili farming in Northeast Aceh was relatively more than that of the other two study sites, with the least intensive case in Pidie.

6.1.2 Total cost of cultivation, return and profitability of chili production

Among the three sites, the productivity of chili ranges from 285 kg per 0.1 ha in Aceh besar to 933 kg per 0.1 ha in Northeast Aceh (Table 6.8). The total value[7] of production of chili (per 0.1 ha) was around Rp 2,724,800, Rp 2,400,000 and Rp 10,160,000, in Aceh Besar, Pidie and Northeast Aceh, respectively. The total production cost consisting of material and labor costs was of about Rp. 5,094,995, which again ranges from Rp 2,400,000 (in Pidie to Rp. 10,160,237 in Northeast Aceh. Average net return obtained from 0.1 ha of chili plot was Rp 4,2000,000 but it substantially varied by sites, which as Rp 1,778,600 in Aceh Besar to 8,828,750 in Northeast Aceh. When the cost for family labor is imputed at the existing wage rate in the locality, then the average real net return from chili becomes Rp 3,688,000, which ranges from Rp. 1,471,000 in Aceh Besar to Rp 8,098,000 in Northeast Aceh.

The economic parameters (returns and costs) widely vary across the study sites, which is also due to differences on level of intensification of chili farming across the sites and variation on level of productivity and inputs uses across the study sites. The differences in crop productivity, level of inputs use in production of a chili also represent the level of intensity of vegetable farming in a region. When cultivation practice is more intensive with higher use of external inputs, the land productivity is also expected to be higher. When the family labor is imputed at the normal wage rate, the real net return from chili is still positive, but less than the net return derived earlier (Table 6.8). An average farmers would be getting Rp 5,860 from production/sale of a kg of chili in Aceh, which ranges from Rp. 8,680/kg of profit in Northeast Aceh to Rp 3,735/kg of harvest in Pidie site. Likewise, the ratio of real return to production cost, a real measure of profit from an activity, was highest in Northeast Aceh (3.95) and then followed by Pidie (1.65) and Aceh Besar (1.13), respectively.

[7] Here, total value means gross return, which is basically price multiplied by productivity and for 0.1 ha basis.

Table 6.8. Total Cost and returns from chili farming in Aceh, 2007 (per 0.1 ha basis)

		Aceh Besar (N=19)	Pidie (N=5)	Northeast Aceh(N=9)	Average of three sites
1	Production (kg)	284	400	933	539.00
2	average price (Rp/kg)	9,579	6,000	10,889	8,822.67
3	Total gross return (Rp)	2,724,750	2,400,000	10,160,237	5,094,995.67
4.1	Family labor day (person-day)	8.46	12.82	18.68	13.32
4.2	Hired labor day (person-day)	10.08	3.79	14.89	9.59
4	Total labor day (person-day)	18.54	16.61	33.56	22.90
5	Total material input cost (Rp)	418,108	248,211	574,930	413,749.67
6.1	Total hired labor cost (Rp)	528,015	189,555	756,561	491,377.00
6.2	Total labor cost* (Rp)	835,558	657,640	1,486,496	993,231.33
7.1	Total operational capital cost (Rp)	946,122	437,766	1,331,491	905,126.33
7.2	Total production cost (Rp)	1,253,666	905,851	2,061,426	1,406,981.00
8.1	Net return (Rp) (3 - 7.1)	1,778,628	1,962,234	8,828,746	4,189,869.33
8.2	Real net return (Rp) (3- 7.2)	1,471,084	1,494,149	8,098,811	3,688,014.67
9	Production costs/kg of output (Rp)	4,407	2,265	2,209	2,960.33
10	Profit per kg of output produce (Rp)	5,172	3,735	8,680	5,862.33
11	Ratio of real net return to total investment (operational cost) (ratio)	1.56	3.41	6.08	3.68
12	Ratio of real net return to total production cost (in ratio)	1.13	1.65	3.93	2.24

6.1.3 Factor share of chili production

Analysis on factor shares on chili farming by locations is shown in Table 6.9 and in Figure 6.1. On average, share of labor on total return from chili production was the highest. It was on an average of 22% across the three sites, but it varies from around 15% in Northeast Aceh to 31 % in Aceh Basar. The high value of factor share of labor on chili production suggests that chili production is quite labor intensive in Aceh, or more labor was absorbed in the chili farming. Within the total complementary of labor cost, also included was family labor cost, which is in another sense also an additional income for household growing chili as otherwise, there might not have an alternate sources of income for majority of the farmers in the surveyed locations.

The share of land out of total gross return of chili harvested from 0.1 ha of land, was on an average, about 9% for the average of the three study sites, and it ranged from around 3 % in Northeast Aceh to 13 % of the total value of produce in Pidie. Factor share of pesticides including mulching and irrigation costs is very low, indicating for low input intensive chili farming practices followed in the surveyed sites. Interestingly, share in term of return to management is very high (75%) in Northeast Aceh, and lower in Pidie (50%), and Aceh Besar (40%). When farming is more intensive, return to management variable becomes more critical for farmers acreage allocation decision. Taking average and sum across the three sites, average farmers across the three sites would get about 57% of factor share. The factors share of fertilizers and pesticides are combined, and it is less than 10 % of the total value generated. The information in Table 6.9 and figure 6.1 clearly illustrates that the level of external inputs use on chili plot in Aceh is still at very low.

Table 6.9. Factor share in chili farming

Factors	Share (%)			
	Aceh Besar (N=19)	**Pidie (N=5)**	**Northeast Aceh(N=9)**	Average
Land	11%	13%	3%	9%
Labor (total labor)	31%	27%	15%	22%
Nursery	6%	2%	2%	4%
Fertilizers	9%	6%	4%	6%
Pesticides	2%	2%	0%	2%
Return to management	40%	49%	75%	57%
Total	100%	100%	100%	100%

Land rent is assumed Rp 300,000/0.1 ha of land for a crop season

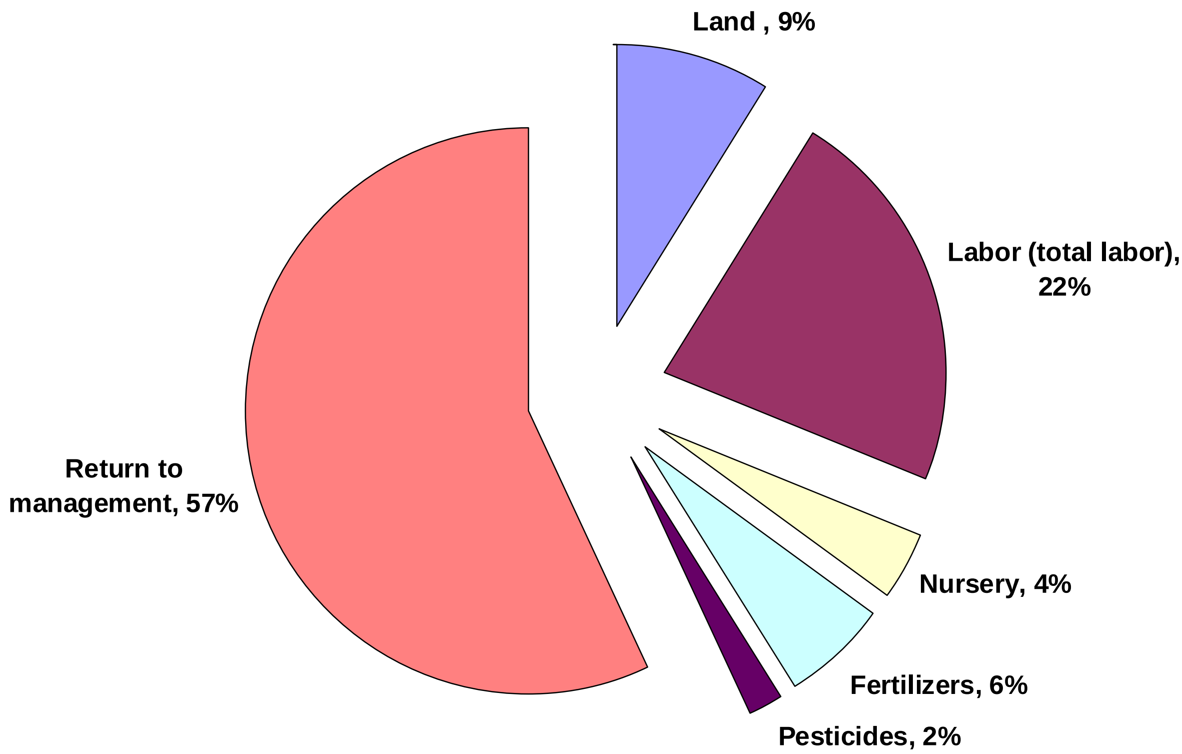


Figure 6.1 Factor share in chili cultivation in Aceh, 2007

7. Recommendations and Implications

Agriculture is important for income, employment and livelihoods in Aceh. Within agricultural sector activities, vegetables grow fast and also provide more income and nutrient per unit of area than cereal crops. Thus, it is considered that vegetable sector intervention may be an effective means for fast pace recovery rural livelihood in the disaster-hit areas. Most of the vegetable cultivation practices in Aceh are of low-input system of farming and with very low level of crop productivity. Productivity of vegetables (chili and several other targeted vegetables) are still at very low level in Aceh than comparetd crop productivity in other parts of Indonesia. Hence, there are many opportunities to improve vegetable productivity thorugh introduction of improved production technologies and crop managment practices even from other parts of Indonesia. Some of the specific reccomendation for strengthening vegetable production and productivity in Aceh, and more in relation to the nature and scoep of the project activities, are illustrated below.

- *Need to improve our understanding on the constraints on diversification opportunities*: Vegetable production systems in Aceh are again evolving after the 2004 tsunami disaster. The tsunami has not only destroyed most of the prime vegetable lands along the coastal areas and in lowland areas but also the local institutions supporting the production system in the past. In a situation of complete destruction of land and physical assets, and absence of local institutions and local support systems (credit access, agro-input supply systems and local market infrastructures, additional extension and technology supports specific to vegetable production), vegetable farmers in the Tsunami affected are also facing hosts of constraints and difficulties. Some of these constraints are location specific but many of them are similar across the wide range of geographic areas, as discussed and summarised in this document earlier. In addition to the technology and physical infrastructures, any of the external project interventions also need to strengthen development of local institutions and local level community level capacity to enable production of high value and market oriented vegetables like chili, tomato, cucumber, and others vegetables.

- *Expansion of the vegetables in a location as per local market demands. At present, v*egetable productivity is very low in Aceh compared to other provinces of Indonesia. But, due to its strategic location and access to major markets in Indonesia and even to urban markets in other parts of Southeast Asia, there exists many opportunities to improve vegetable production in Aceh. For example, Medan city, one of the forth-largest cities of Indonesia is located just nearby the province and is well linked with the motor-able road. In addition, through Medan city, vegetables from Indonesia are being exported to Singapore and nearby areas of Southeast Asia. There already exits vegetable marketing linkages, and even with export market linkage from Medan city to Singapore and other nearby urban centers in Malaysia. Any additional produces from Aceh can easily go through this marketing route..

- *Incomes and employment level from vegetables are higher than cereals and alternate crops*. Our comparative assessment of economic performances over range of crops show that income and employment level from vegetables are substantially higher than that or paddy cultivation — alternate mode of farming if not cultivated vegetables. This is the case even in the tsunami affected disaster communities, and with low-input based production system. Among vegetables, the income and employment from some of the crops are higher than others are thus with high impact potential in the rural communities. Because of good market prices and widespread adaptation, chili-pepper popularity has been growing rapidly in Aceh during the recent past. Thus, there is needed a special project on chili pepper and other few vegetables that suit the specific requirements of low-input and semi-subsistence system of farming system in Aceh. In summary, high opportunities exist to improve vegetable production and productivity in Aceh, and this it also for fast restoring livelihoods of communities devastated by the disaster.

- *Need to support public service providing agencies in reducing risk of vegetable production*. Vegetable production is profitable but also with high risk in production due to various factors such as excessive exposure of farmers to market, extreme volatility of prices and seasonal fluctuation of yield and other bottleneck in existing marketing infrastructure, and high investment cost incurred on vegetable production (thus high stake is involved for any gain or loss of harvest). Public sector supports to local communities in development of market infrastructures for vegetable and ensuring better market access to smallholder growers are some of the issues that public sector agencies should be implementing in those tsunami affected communities of Aceh immediately. Likewise, pests and diseases infestation and seasonal water shortage due to inadequate (or damaged) infrastructures are other factors limiting the yield potential of vegetables and farmers' income. Government supports in some of these sectors can help development of a healthy and vibrant vegetable industry in the long-run, and reducing farmers' risk associated with vegetable production.

- *Good prospectus for development of low-input based vegetable systems in Aceh*: With properly managed risk, chili and other vegetables cultivation (low-input based production systems), with improved crop management practices, may become widespread in Aceh. This will ultimately benefit large numbers of smallholder and marginal vegetable growers, and ultimately to wider section of the consumers in the region.
- *Need to strengthen vegetable specific extension services*: Due to limited extension services to vegetable farming, additional public interventions are needed on dissemination of improved technology packages for chilly and other widely grown crops, and specially targeted for smallholder growers (i.e., Pro-poor production packages) and for low-input systems based production. Institutional supports for extensions currently are largely for the cereal and other major food crops. Considering several constraints on expansion of public sector extension agencies to very heterogeneous system of farming like that of vegetables, it is suggested to explore also viability and usefulness of private extension services, and/or NGO led extension services to farmers (farming communities). This may provide some innovations in local extension and service providing modalities in Aceh.
- *Farmers Field School (FFS) institutionalization for vegetable specific issues:* Considering the inadequate training to vegetable growers and a minimal extension support for vegetable growers, FFS type of specific farmers' training package could be effective for tailoring the capacity building process specific tailoring the local needs in a community. This kind of FFS based additional public interventions (in terms of local level training and demonstration) are needed for dissemination of improved technology packages for chilly and other high value crops to smallholder growers in a wider areas. These packages should also be pro-poor production packages, i.e., smallholder farmers should be able to use and also afford to adopt such technology packages.
- *Need to strengthen the access to composts in the rural areas.* Compost is one of the effective and also low-cost options to rehabilitee and restore the tsunami damage land to normal agricultural production practices. At present, several farmers also have some level

of understandings on usefulness of compost on restoring the soil fertility and production benefits to vegetables and other high value crops. Nevertheless, existing local need of compost in Aceh cannot be so easily met, as there is no readily available access to compost at many of these places in Aceh, or even in the nearby provinces. Thus, considering benefits of compost in improving soil structures and restoring soil fertility with exiting locally available know-how and local materials, local entrepreneurship should be developed and their business scale strengthen to cater increased need of the compost at local communities and at nearby locations.

- *Development of rural market infrastructures and local institutions*: In the tsunami-affected areas, local market forces and market access issues are important factors for farmers' crop choices and a specific farming practices followed. For crop like chili, where over 95 percent of the produces are old at the local markets, the level of access to market and marketing related factors are very critical component of framers' practices followed and acreage decision. Thus, market sale of vegetables become major concern in farmers' selection of a particular crop as the tsunami-affected areas recovers, and efforts needed to strengthen market information system (MIS) for agricultural commodities at some of the markets located remotely from the major market towns.
- *Better understanding of local vegetable cultivation institutions*: Any project intervention to improve vegetable cultivation, including encouraging the adoption of particular soil management practices (use of compost, manure, chemical fertilizers, etc) should adapt and address local market and social and institutional factors of the farming community (credit in vegetable farming, training to specific technology and extension services, And access to the agricultural inputs and at fairly competitive process locally). Thus, strengthening capacity and service delivery of institutions supporting specially the needs of the smallholder vegetables growers are critical step in expansion of vegetable production and productivity in Aceh now.

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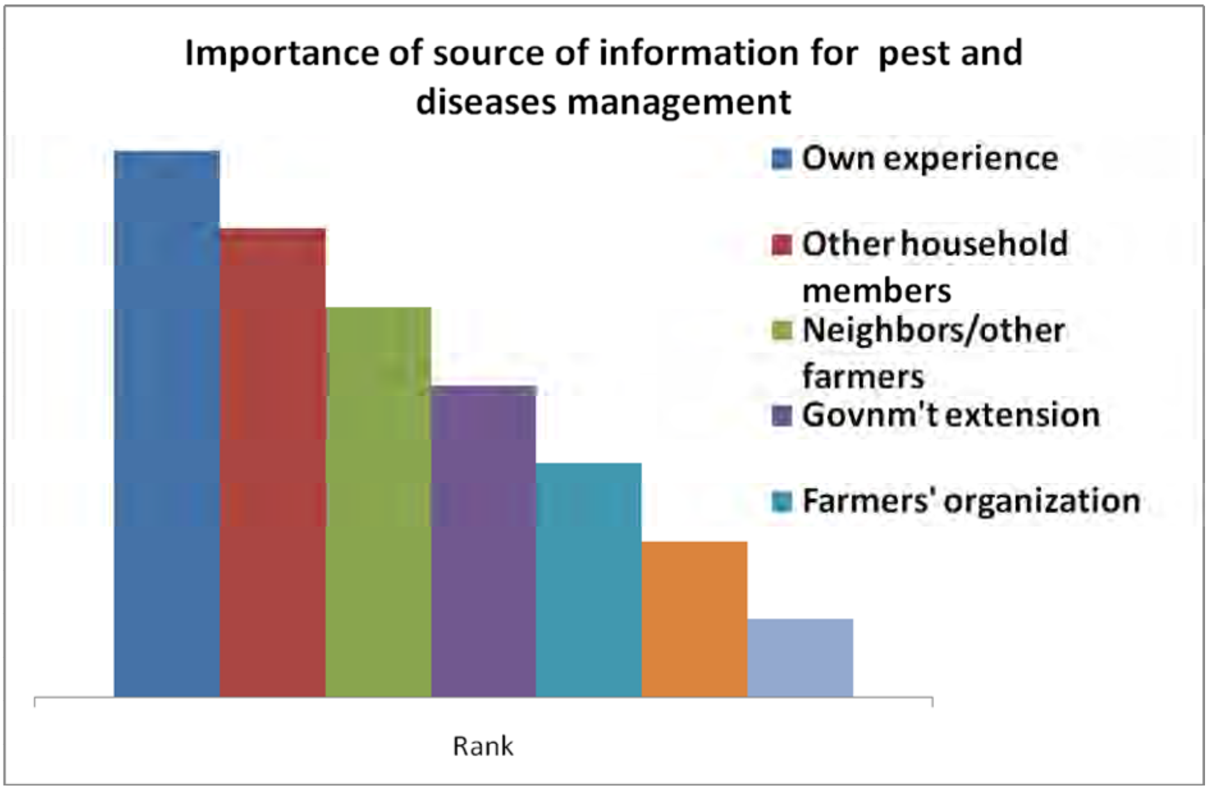
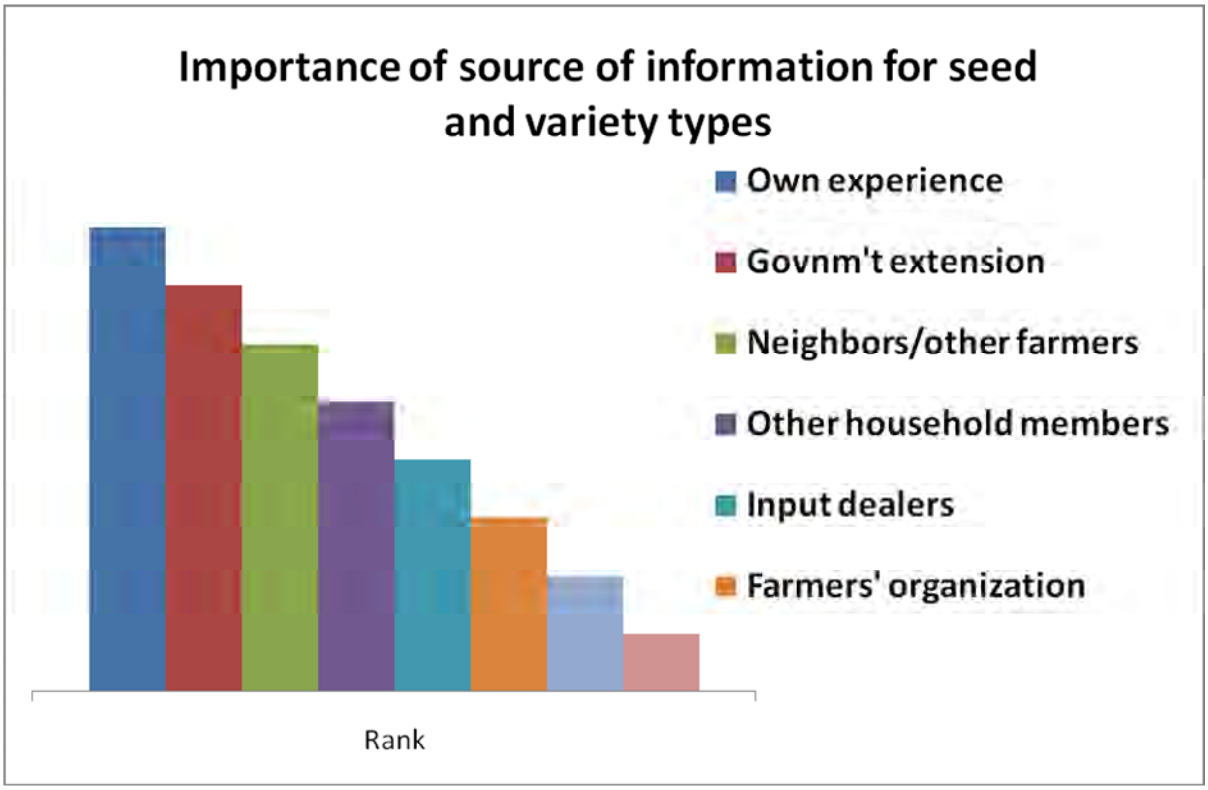
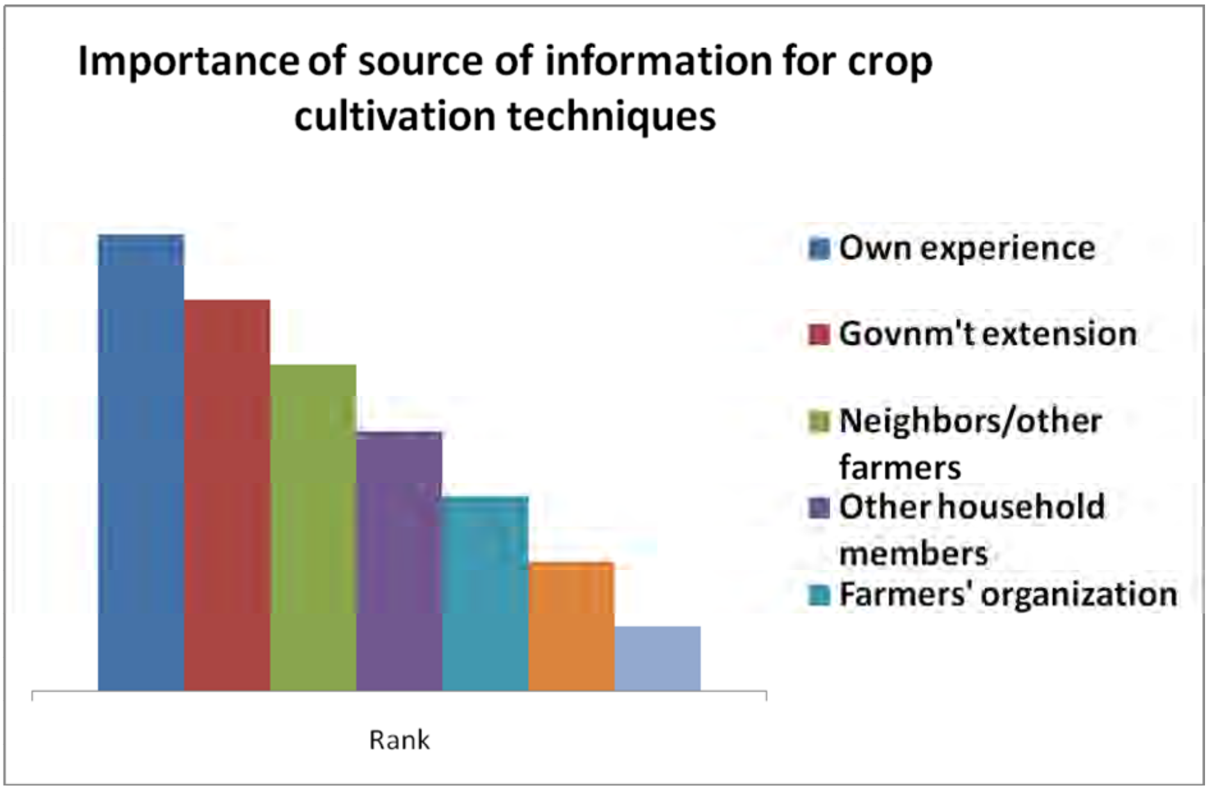
Appendix

Appendix Table 1. The importance of source of information for plant protection and new technology

Source of information	Rank of information			
	Aceh Besar	Pidie	Northeast Aceh	Overall
Pest and diseases management				
Own experience	6	2	1	1
Other household members	3	1	2	2
Neighbors/other farmers	2	3	3	3
School/NGO	7			7
Govnm't extension	1		4	4
Input dealers	5			6
Farmers' organization	4	4	5	5
New seed and varietal types				
Own experience	2	2	1	1
Other household members	5	1	5	4
Neighbors/other farmers	3	3	3	3
School/NGO	6			7
Government extension	1	4	3	2
Input dealers	4	5	2	5
Farmers' organization	7	5	4	6
Newspaper/magazine/other print media			5	8
New crop cultivation techniques				
Own experience	2	2	2	1
Other household members	4	1	4	4
Neighbors/other farmers	3	3	1	3
School/NGO	5			6
Government extension	1	4	3	2
Input dealers	7	5		7
Farmers' organization	6		4	5

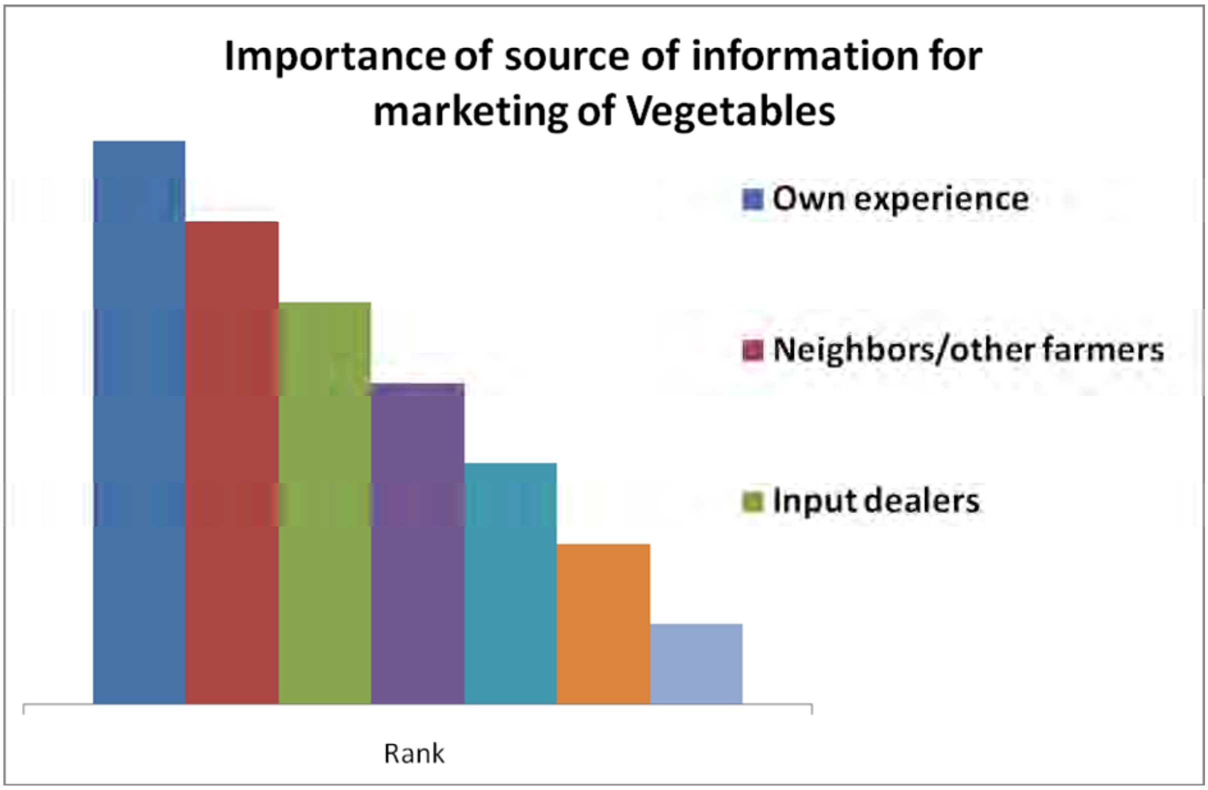

Importance of source of information for pest and diseases management
Own experience
Other household members
Neighbors/other farmers
Govnm't extension
Farmers' organization
Rank


Importance of source of information for seed and variety types
Own experience
Govnm't extension
Neighbors/other farmers
Other household members
Input dealers
Farmers' organization
Rank



Appendix Table 2. The importance of source of information for marketing

Source of information	Rank of information			
	Aceh Besar	Pidie	Northeast Aceh	Overall
Vegetable (agric) prices / Market information				
Own experience	1	2	2	1
Other household members	4	1	4	4
Neighbors/other farmers	3	3	1	2
School/NGO	5			5
Government extension	6		6	6
Input dealers	2	4	3	3
Newspaper/magazine/other print media	7		5	7



Appendix Table 3. The importance of source of information for irrigation

Source of information	Rank of information			
	Aceh Besar	Pidie	Northeast Aceh	Overall
Irrigation and water application techniques				
Own experience	1	2	1	1
Other household members	2	1	2	2
Neighbors/other farmers	3	3	3	3
School/NGO	5			6
Government extension	3		4	5
Farmers' organization	4	4	5	4
Newspaper/magazine/other print media			5	7

Appendix Table 4. The importance of source of information for livestock

Source of information	Rank of information			
	Aceh Besar	Pidie	Northeast Aceh	Overall
Animal husbandry and livestock raising				
Own experience	1	2	1	1

Other household members	2	1	2	2
Neighbors/other farmers	3	3	3	3
School/NGO	4			5
Government extension	4		4	4
Farmers' organization	5			6

Appendix Table: Monthly Average Price of Selected Vegetables Banda Aceh 2008

Vegetable	January	February	March	April	May	June	July	August	Sept	Oct	Nov	Dece.	Average
Shallot	13,611	11,967	12559	14111	13765	18750	17944	14833	15167	12,500	12885	14500	14,383
Garlic	8,500	7,167	6735	6389	7324	7875	9278	8250	8500	8,583	9500	9500	8,133
Bean	4,500	4,167	4853	4556	4912	5250	4500	5333	4833	6,250	5423	6500	5,090
Potato	4,500	3,700	4441	4500	5029	5250	5389	5500	5167	5,417	5192	5357	4,954
Cabbage	3,444	3,100	3500	2389	3324	3500	3500	3667	4500	4,083	3500	3500	3,501
Tomato	5,167	4,167	4118	3444	4382	5125	5667	5250	7700	4,833	4500	5786	5,012
Carot	3,833	3,967	4500	4500	4971	6188	6111	4917	5833	5,083	4808	6357	5,089
Red kriting chilli	12,389	19,700	25088	21389	21294	22500	27833	25750	21967	16,917	22885	38929	23,053
Rice - Tangse No.	5,322	5,200	5200	5200	5459	5594	5600	5625	5700	5,700	5700	5700	5,500
Rice - Blang Bintar	5,200	5,200	5200	5200	5259	5394	5400	5425	5500	5,500	5500	5500	5,357

Source DINAS Pertanian, Banda Aceh. Based on the daily prices record at the Banda Aceh

Appendix Note 1.
Questionnaires used for Individual Household Level Survey

Household Level SURVEY (C 1) **1. Vegetable growing HH recently (2007/06/05) 1.Yes [------]2. No[-----]-**

Draft copy: January 6, 2008.

HH No --1---------

Baseline Survey:
Production and Supply of Vegetables in Aceh, 2008[8]

Date: ………../ … ……./2008
Questionnaire code #:…**A 10**………….
Name of the Enumerator:……………………

Note:
1. First, enumerator should introduce himself/herself and explain to the respondent the purpose of this field survey.
2. **Project purpose**: To enable rehabilitation of vegetable production to help restore and enhance food security, nutrition, and livelihoods in the project area. (**Farmers Field School** and **Field Trials**)
3. The personal identities/information of the responding HH will not be shared with any other agencies in Indonesia, but will be used by the surveying institutes and only for research purposes.

SECTION I.

GENERAL INFORMATION

A. General background

1. Name of the Farmer/HH head: ___________________________ 2. Age of HH Head. Years

3. Gender of Household head: Male ----- Female -----: 3.1 Name respondent: ----------------------

4. Province/State:	5. District:	6. Sub-district:	7. Village:
Nanggroe Aceh Darussalam	…………………….	…………………….	……………………..

B Household (HH) Information and Family Profile:

S. N	Description	Unit	Data	Remarks
1	HH head education level	Years		
2	HH head farming experience	Years		
3	HH head vegetable growing experience[1]	Years		
4	HH head Training in vegetable farming	months		
5	Main occupation of the HH Head			
6	Secondary occupation of the HH Head[&]			
7	Total family members living in the house	No.		Adults: Children:
7				

Note: 1. Years growing vegetables, including before the Tsunami disaster

[8] This is the baseline survey carried out by AIAT- NAD in partnership with KEUMANG, FHCAS-NAD, UNSYIAH, Austcare, IVEGRI, NSW DPI (Australia),and under the technical supervision of AVRDC- The World Vegetable Center, with its HQ based in Taiwan. This baseline survey is part of the project, “Integrated Soil and Crop Management for Rehabilitation of Vegetable Production in the Tsunami-affected Areas of NAD Province, Indonesia” (ACIAR project CP/2005/075).

& Occupation Code: Farming = 1; Civil servant = 2; Retail shop = 3 ; Local trader = 4; fishermen = 5 others = 6
3. Children = Less than 15 years of age

C. Agricultural Land Holding, Crop Production and its Characteristics

i) Land status: (In meter squared or in ha)

1. Total own crop area: …2…………(ha)	2. Rented in/Shared cropped area: …1………….. (ha)	3. Rented out: ……. (ha)
4. Uncultivated land: …0.5…………………... (ha)	5. Total cultivated area: …2.5…………….. (ha)	6. Number (#) of cultivated parcel land (no. of plots): …4…………
7. Total low land area: -- 1.5---------(ha)	8. Total dry land (upland) 0.5--- (ha)	9. Remarks:

Note: 4 ha = 1 hectare (if the farmers can answer the question in square meter (or Meter x meter) then that should be recorded directly instead of this ha).

ii) Major Land use types

Land use type	Total Area (ha)	Names of Crop(s) Planted³	Source of Irrigation²	Distance to water source (meters)	Major Soil Types	Remarks
1. Home garden (house not included)						
2. Paddy field						
3. Land for vegetable crops						
4. Land for other annual crops						
5. Land for perennial crops						
6. Barren land/uncultivated land						
7. Other use (specify): ___________						

1. Code for soil types: Local language: 1 = clay soil; 2= sandy ; 3 = Sandy Clay; 4 = River bed; 5 =
2. Code for irrigation source: Rainfed = 1; Irrigation canal = 2; Well = 3; small pump = 4; river = 5 ??? 6= (specify).
3. Code for the crops (grown in the areas): Rice = 1; Soybean = 2; Groundnut = 3; Chili pepper = 4; Tomato = 5; Cucumber = 6; Amaranth = 7; Shallot = 8; kangkong = 9; pak choy (*sawi*) = 10; yard-long bean = 11; eggplant = 12; cauliflower = 13; other = 14 (specify).

D. Vegetable Production Types and Level

D.1. Are you currently growing vegetables? Yes [ ] No [ ] *(if NO go to D.2; If YES go to E)*

D.2. *(If NO in 3.1)* Did you ever grow vegetables, even before Tsunami disaster? Yes [ ] No [ ] If YES go to D.**3** below If NO Go to D.**7 (non-Adopter category)**				
D.3	When did you plant vegetables in the past?	**D7**	Why have you decided not to	Rank_

	Year: ________			plant vegetables on farm land? *(What are the constraints to growing vegetables to you?)* __ our land (soil) is not suitable __ No irrigation access to land ___ no experience with vegetab __ vegetable prices are too low __ vegetable prices are fluctuat __ vegetables are difficult to ma __ pest/disease problems __ too risky a crop __ fertilizer is too costly __ cannot obtain credit __ better to do something else __ not enough labor __ not enough land __ other reason: ______________________	
D.4	Purpose: - Only for home consumption [ ] - For market & home [ ]				
D.5	Have you stop growing vegetables recently, but used to grow before Tsunami)? 1) Yes [---]; 2) No [----]				
D.6	Any other reasons that you stopped growing vegetables recently? __ our land is not suitable __ vegetable land damaged by tsunam __ no experience with vegetables __ vegetables are difficult to market __ High pest/disease problems __ too risky a crop __ fertilizer is too costly __ cannot obtain credit __ better to do something else __ not enough labor __ not enough land __ vegetables prices are too low __ vegetables prices are fluctuating _ other reason:__________________	Rank			

Note: Need to make code for each factor (& possibly rank these issues after listing the important ones).
Vegetable grower those who are growing vegetable on 50 sq. meter or more land.

SECTION II.

Farm Income Structures, Livelihood, and Food Security

A.1. Cropping pattern, production level, and farm income in 2007 (cereal and others)
Please provide details on crops grown in last one year cycle and related activities (Area: land unit???)

Code	**Crop types**	**Crop**	**Area (ha)??**	**Total Production (Kg)**	**Production distribution**		**Market sale**			**Any Remarks**
					Home cons (%)	**Sold (%)**	**Quantity sold (Kg)**	**Avg. price /Kg**	**Value MKT sale) (x 1000 Rp)**	
a1	Cereal	Paddy (Rainy season	1.5	6000	90	10				Local unit
		Paddy (Dry season)	0.5	2500	30	70				
		Maize								
		Others								

Code	Crop types	Crop	Area (ha)??	Total Production (Kg)	Production distribution		Market sale			Any Remarks
					Home cons (%)	Sold (%)	Quantity sold (Kg)	Avg. price /Kg	Value MKT sale) (x 1000 Rp)	
a2	Cash & others	Oilseeds (??)								
		Sugarcane (Tabu)								
		Groundnut								
		Cassava								
		Others								
a3	Pulses	Soybean								
		Mung bean								
		Pigeon pea								
		Others								

A.2. Cropping patterns, production I, and farm income in 2007 crop year (Vegetables)

Code	Crop types	Crop	Variety	Area (MxM)	Total Production (Kg)	Production distribution		Market sale			Any Remarks
						Home cons (%)	Sold (%)	Quantity sold (Kg)	Avg. price /Kg	Value of MKT sale) (x 1000 Rp)	
A1	Veget-ables	Chili-pepper	T M 99	1500	4000	10	90				
		Tomato		500	2000	5	95				
		Cucumber									
		Amaranth		50x3times							**bundle**
		Shallot									
		Long bean									
		Others									
	Fruits	Coconut									
		Mango									
	Other crops	??									

Remark: Need to Specify crops as per the local conditions now. (Variety: only with the major/dominant variety if apply here (need to work with Greg).
Other Vegetables: 1= Kangkong; 2 =Yard-long bean; 3=Eggplant; 4=Cauliflower; 5=Chinese cabbage/ pak choy (*sawi*); 6=other (specify).
Fruits - Trees Code: 1= Coconut; 2= Jack fruit; 3 = Melinjo (*Gnetum gnemon*) ; 4=petai (*Parkia speciosa*); 5=rambutan; 6=durian; 7=mangosteen; 8=other (specify).

Note: Ferizal and the project team needs to specify the crop types as per the locations/areas of Aceh)

B. Household Level Food Security

B. 1. Is your own farm produced paddy production is sufficient for your family's needs for the whole year? 1. Yes [ ] 2. No [ ]

B. 2. If no, how many months are you food insufficient from your own farm's production?
_3______________ (months)
What are the food insecure (Rice insecure) months (list the months here)?
____

B3. If food production (rice) is not sufficient year-round, what are the possible reasons? Reasons:

1. Very little land [ ] 2. Low land productivity [ ]
2. Big family size [ ] 5. Not intending to produce food [ ]
3 Land damaged by Tsunami [-----] 7. Doing other labor wage [….]
4. High salinity due to Tsunami [ ] 8. Doing fishing activities [----]
9. In sufficient capital [-----]; 9. Others specify :

B4. How do you manage to meet your food needs during food insufficient months?

1. Buying from local market [ ]
2. Growing vegetables and high value crops
2. Borrowing money to buy food [ ]
3. Borrowing grain [ ]
4. Fish catch from the sea [ ]
5. Wild catch or gathering from forest [ ]
6. Earnings from the labor wage in the village[ ]
7. Migration to outside (certain months) [ ]
8. Others: ________________________________

B 5. On average, how much vegetable does your family consume weekly and per season?

Vegetable and fruit consumption by your Family (in the HH)		**No. of people in HH**	**Unit**	**Dry Season (April-July)**	**Early Wet (Aug-Dec)**	**Late Wet Season (Jan-March)**	**Remarks**
Vegetables	Total quantity of vegetables consumed per week	6	Kg / week	6	3	4	
	Out of this, the % of vegetables grown in your farm & home garden		%	60	80		
	Out of this, the % collected from ocean/wetlands/rivers		%	20	10		
	% of vegetables purchased at local market		%	20	10		

	Amount of money spent for vegetable purchases		Rp. /week	20,000	10,000		

1. Note: Number of months in each season : early wet season: late wet season : ……..????
2. Note on the vegetables exchanged by the hh among his neighbour

SECTION III
VEGETABLE PRODUCTION : SPECIFC ISSUES

(This is the questionnaire for hh growing vegetable recently during 2005, 2006, or 2007). If not grower, go to page No::??

A. Reasons for growing vegetables

Why are you cultivating these vegetables (chili, tomato, cucumber, amaranth) on the land and not other alternate crops (First list the farmers' reasons and rank them at the end).

S. N.	Reasons for cultivating the vegetables by the respondent HH	Rank	Code	Remarks
A.1				
A2				
A3				
A4				
A5				

Note: First the enumerator should list any reasons the farmers would recall; then rank these reasons later on, asking farmers then to rank and prioritize the most important and then 2nd, 3rd, and so on.

B On-Farm marketing of vegetables

1. What is/are sources of market information (price..) ? Rank in (5= as highest)

Media/Sources of information	Rank	Media/Sources of information	Rank
a. TV		f. Radio X	3
b. Newspaper X	2	g. Government Department	
c. Internet		h. Co-operative Organization/association	
d. Trader/collector X	5	i. Any other (Please specify)	
e. Neighbor farmers X	4		

Code for ranking the items : 5 = highest rank and 1 = lowest rank

2. Where do you usually sell your vegetable produced (tick mark where appropriate)? _

S.N.	Type of middle men	% of the veg. sale	Remarks
2.1	At farm/field X	50	
2.2	Local wholesale market		
2.3	Traders coming to the village to buy the produces X	20	
	2.4 Vegetable vender (?) X	30	
	2.5 Carry to the urban market center		
	2.6 Others (please specify)		

3. How well do you know about prices prevailing in the market?
3.1 Very well ------------- 3.2 Not Very well -------------- 3.2 Very little ---------

4. Do you have a fixed trader whom you sale your produces Yes: -- No: --

5 If yes, do you also borrow money/inputs from the collectors Yes: -- No: --

6. If no fixed traders, how many traders did you contact before deciding to sell the vegetables (No)---2; -------

7. Major marketing of vegetable related concerns/problems that you are facing now?

S. N.	**Major factors /concerns/limitations**	**Rank**	**Remarks**
A.1	Traders cheating on weight	4	
A2	Low market prices	3	
A3	Few traders to the village	1	
A4	At pick time very few traders	2	
A5	Transportation to the market	5	

Note: First list down the concerns and then rank each of them later on. (5 = most important)

C. Vegetable production and irrigation (water management) specific Issues

1. Irrigation types and costs involved for irrigating the crops

S. N	**Vegetable Types**	**Irrigation**			
		Source (£)	**Type of watering (¥)**	**Number of times irrigation applied in a crop season#**	**Remarks**
	Chili-Peppers	**2**			
	Tomato				
	Cucumber				
	Amaranths				
	Shallot)				
	Otherss				

Codes for this table
£ Source of irrigation: {(1 = Canal, 2 = Pump from (TW) or well, 3 = Tank, 4 = Lake, 5 = Rain fed, 6 = Any other (specify)
¥ Type of Irrigation {1 = Flooding (w/o ridges), 2 = Flooding (w/ ridges), 3 = Manual from TW or other well, 4 = Manual from tank/lake, 5 = Trickle (Gumber), 6 =Any Other (……….)},

2. Are you facing any irrigation related problem on Vegetable production decision/activities; if so what is its severity on vegetable production **:**
1. Major problem [….]--; 2 Minor problem 3. In fact, no Problem-- -[-----]

3. What is the scale of drainage and flooding (water stagnated) is problem in your vegetable crops (Chili in specific). Circle the appropriate one:

(Scale: 5 Very Serious 4 Serious; 3. Moderate; 2. Very Minimal 1 No problem at all

4. If problem is mentioned in number 3, what are the major irrigation related problems on vegetable production to your field as you have faced recently

S. N.	Types of irrigation related major problems in Vegetable field(s)	Code	Problem Ranking	Remarks
A.1				
A2	Several times flooding		4	
A3	low vegetable land			
A4	Bund damaged by Tsunami		3	
A5.	Irrigation canal damaged by tsunami		5	

Note: First list the problems randomly whatever the farmers can recall, and then later on rank each of them: 5 = most significant problem; 4 = less severe, and so on as 1 = least problematic one

D. Major problems and concerns of the household for Vegetable Farming

A. Major constraints of the household for production of vegetables, in general.

S. N.	Major factors /concerns/limitations	Rank them (5 to 1)	Remarks
A.1	Very high fluctuation of prices	5	
A2	Good quality seed is not available		
A3	High pest and disease attach		
A4	Flooding of the vegetable field and crop damage	4	
A5			
A6			

Note:
Note: First list the problems randomly whatever the farmers can recall, and then later on rank each of them: 5 = most significant problem; 4 = less severe, and so on as 1 = least problematic one

SECTION IV

VEGETABLE PRODUCTION RELATED ISSUES

A. CREDITS AND RELATED FINANCIAL ISSUES

1. Did you borrow loan/credit for farming during 2006 & 2007? 1. Yes [------] 2. No [------]

2. What are your most important sources of credit (for farming)?

3.1 Most important source: ___________________________________
3.2 Second most important source: ___________________________
3.3 Third most important sources:_________________________

3**. If yes in 1, then the level and kind of Loan/ Credit (borrowed fund) during 2006 and 2007**

Source of Loan	**Amount**			**Interest Rate per year basis**		**Other Costs**	**Purpose Loan ++**	**Remarks**
	Cash	**Kind**		**Cash**	**Kind**			
		Item	**Value**					
Govt. Bank								
Private Bank								
Co-operative/ Micro Credit								
Private money lender in village	1 million							
Friends\Relatives								
Vegetable collectors/merchant								
Commission Agents								
Any other ……….								

Purpose of loan ++: (1)= Vegetable Farming; (2) other Cereal cultivation (3)= Off-farm (business, micro-enterprise, etc); (4)= Health; (5)= Housing; (6)= Festivals; (7)= Education; (8)= Consumption; (9)= Others (specify)

3. Did you receive loan from the vegetable collector recently? 5.1 Yes [---]; 5.2 [--]

If yes Remarks:
4. Are you facing difficulties in getting loan for farming?
5) Most sever constraint, 4 (Difficulty)
1 ; little problem [-----]

5. What are your problems on obtaining credit for vegetable farming?
5.1 Not getting credit when I need it
5.2 High interest rate
5.3 In bang long bureaucracy

B. Training and Extension Services in Vegetables Farming

Training and extension:

1. Did you or any member of your family attend any training, workshop over the last 3 years in relation to vegetable production? 1.1 Yes [ ] 1.2 No [ ]
2. If yes, please specify the following information:

Name of the training, workshop	**Who organized the training**	**Duration (days)**	**Who attended 1= Male 2= Female**	**Do you/your family requested first Yes= 1; No = 2**	**Benefit from the training****	**Remarks**

1.						
2.						
3.						
4.						
5.						

** 1= Skill improved 2= Increased cash income; 3= Family health improved; 4= Employment generated; 5= Soil erosion prevented; 6= other (specify): ---------

Please provide your opinion about the followings:

3. In general, how supportive are training and extension activities in the village for the well-to-do and poor households?

For both better-off and poor households [ ]
Mainly for well-to-do households [ ]
Mainly for poor households [ ]
Any further comments/feed backs: --------------------------------

4. Access to information: What are your sources of information now on the following issues of vegetable farming?

S. N.	Types of issues	Sources of Information (*)	
		Most important source	Other sources
1	General farming and Paddy cultivation		
2	Vegetable production		
3	Soil salinity management (reclaiming the Tsunami damaged soil)		
	Soil fertility management		
	Pest and diseases management (control)		
	Vegetable (agril) prices/Market information		
	Fertilizer application		
	Irrigation and water application techniques		
	New crop cultivation techniques		
	New seed and varietal types		
	Animal husbandry and livestock raising		
	Others:…		

(*) Access to information: 1=own experience 2=other household members 3= neighbors/other farmers 4= school/NGO 5=government extension workers 6=private company extension workers 7=input dealers 8=radio/television 9=farmers' organization 10=newspaper/magazine/other print media

5. How do you rate on the technical services (training) provided for vegetable farming in the village (circle the one rating below)________________

(5) Very Adequate 4 Adequate; 3: Okay; 2 Not good 1 No such training at all)

6. In general, how supportive are training and extension activities in the village for men and women members of the community?

1.1 Equal for men and women [ ] 1.2 More for men [ ] 1.3 More for women [ ]
Please explain: ---

C. Gender and Vegetable Production
(on farming in general, in case of non-vegetable grower)

2. What activities performed, and/or decisions of vegetable farming, are made by men and women in the household?

Activities and decisions in Vegetable farming		Male&& (in %)	Female (in %)	Remarks
Vegetable production training (NGO, Gvt.)				
Area of crops to be grown		25	75	
Seedling preparation		40	60	
Intercultural operation (weeding, etc)		20	80	
Fertilizer purchase/ application		100		
Pesticide purchase/application/		100		
Harvesting decision		50	50	
Drying, cleaning, grading of vegetables				
Purchasing farm inputs				
Selling of the vegetables		25	75	
Working in home garden				
Making major farming decisions		80	20	
Credit attainment for farming				
Participation in village meetings				
Participation in Ag. training & extension				
Other spending in household needs				

Note: && The total % number must be 100.

Part V Other Sources of Livelihood:

A. Fishing and Maritime livelihoods

1. Do you go for fishing in the ocean or in the River Nearby?
Yes [---] No [---]

2. If yes, on an average how many hours in a day you go for fishing and by seasons:

SN	Particular	Dry season April-Oct)	Wet season (Nov-March)			Remarks
	Avg. Number of hours going to fishing (also other catches)	2 hr	3 hr			
	Avg. catch/day (Kg/day)	10 kg	2 kg			
	(or in Rp/day)	100,000	20,000			
	Market sale of the total fish catch (in Rp/day)	8	0			

3. What percentage of your HH income (or time) comes from Fishing activities (%)---40%--

5. Are you member of any fishing community in the village : Yes ------- No--------

6. What are your major problems/concerns in marine fishing activities
6.1
6.2

6.3

B. Other means of livelihoods and income sources
1 Number of livestock owned by the Household now
Cattle(Cow and Ox): Buffalo: Poultry: Goat: Others:

Total income from livestock animal and livestock products sale in 2007: ---- million Rp.

2. Other sources of annual income of household in 2007:

a) job/salary :--------10 million Rp------------
b) Village shop_----------------------
c) Other Business (specify)---5 million -----------
d) *Wage labor earning*:
e) agriculture trading
f) Other household income in annual term (specify): …15 million …………..

1. If wage labor earning income
Number of days worked as wage labour /year --120 days-------. Avg. wage rate:---30,000----
Remarks:
(Code required for kind of labor:

3. : HH appliances, equipment, items, and living conditions.

A. Farmers Living conditions and other important Assets:

A1. Farm machinery and equipment owned by the family household:

Kind	**N0**	**Kind**	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**#**
Tractor …..HP		Tractor trolley		Truck		Power tiller		Water pump		Thresher		Power sprayer		Manual sprayer	
Drill		Rice transplanter		Rota vator		Cultiv ator		Disc plow		Mold board plow		Any other			

A3. Transportation vehicle and other means got by the household

Kind	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**No**	**Kind**	**Yes**	**No**
Pick up		Jeep		Motorbike		Tricycle		cycle		other				Cell phone		

B. House Condition (use your own judgment):
B.1. Poor [------] B.2 Below average = [------]
B.3 Average HH [--]
B.4 Above Average HH = [------] B.5 Very well to do HH: [------},

Note: The enumerator should use own judgment to group this HH into one of the categories above and not to ask this particular question to the respondent HH.

C. Any remarks and/or additional useful information of the household in terms of vegetable production/marketing
1.
2.
3.……………………………………………………………………………………

THANK YOU VERY MUCH
(TERIMA KASIH)

First draft document prepared for feedback, and as an attachment of the Aceh Project Report. A short version of this paper is targeted for "World Development" journal

Impacts of Farmers' Field School for Vegetables Production in Tsunami affected Communities of Aceh, Indonesia

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Abstract

This paper evaluates the impacts of farmers field school (FFS) in the Tsunami-affected communities in Aceh. The impacts of FFS were documented 1-2 months after completion of FFS thus the impacts documented here are only of the short term impacts of FFS. The assessment was done at individual survey and at group survey (participatory rural appraisal) across 27 different project sites (FFS implemented communities) in Aceh during June-September 2009. For the individual survey, using structure questionnaires, an intensive consultation was done with 270 FFS-graduate farmers from 27 different FFS sites. Likewise, group survey was conducted by applying participatory methods to 27 FFSs, with 10-12 farmers from each group. For this purpose, "before and after" method of impact assessment framework; and an *ex ante* evaluation approach was applied since the FFS participants stated impacts (or perceived impacts of FFS) are based on the results what they have seen at the participatory managed experiment plot (i.e. perceived impacts); the actually impacts of FFS can be best documented only after 3-4 years of FFS once farers grow the crop on their field using the several technology components learnt at the time of FFS. The results indicate that FFS has very favorably increased vegetable farming capability and knowledgebase of the FFS participants. Farmers are now able to distinguish between insect pests and beneficial insects, as well as kinds of pesticides for targeted pests. Farmers reported that they could increase yield with reduced uses of chemical pesticides and other inputs. From participatory survey with group of FFS participants, we analyzed FFS impacts on five livelihoods assets (capitals): physical, financial, human, social, and natural capitals. They reported very positive impacts of FFS on all of the five categories of livelihood assets. After attending a crop season long FFF, farmers' knowledge on plant protection and soil fertility improvement increased nearly by double fold. On an average, farmers perceived crop (chili) yield has increased by over 30% and level of pesticide uses on chili reduced by 1/3rd than what they were using before attending the FFS. In summary, FFS has successfully delivered the improved knowledge and skill on chili farming, and vegetable production in general, to the farming communities. Besides, the FFS has strengthened the group formation and social capitals related to vegetable farming in the remotely located communities, that were in fact divested by the 2004 Tsunami.

Keywords: farmers' field school (FFS), ex-ante impact evaluation, chili production, participatory approach, Livelihood assets (capital), Aceh, Indonesia.

First draft document prepared for feedback, and as an attachment of the Aceh Project Report. A short version of this paper is targeted for "World Development" journal

1 Introduction

1.1. Background

The December 2004 tsunami caused its greatest damage and loss of life in the Nanggroe Aceh Darussalam Province (Aceh) of Indonesia. About 170,000 persons perished, over 700,000 people became homeless, and 50,000 hectares of agricultural prime land were destroyed; economic loss due to infrastructure damage totaled more than US$4 billion. Recently, vegetable production is gradually picking up in Aceh. Hence, in the context of complete destruction of physical, institutional and social fabric of the farming communities in several places of the coastal areas of Aceh, there is an urgent need for external support for strengthening institutions, particularly on research and development, extension and technology transfer, and better market access.

In this context, under the ACIAR funded project in Ache, Indonesia, AVRDC and its partners led project in Aceh in 2006 adopted a strategy of restoring soil fertility, enhancing food security, nutrition and livelihoods of the tsunami affected communities through rehabilitation of vegetable production land, and building technical capacity of the farmers on soil and crop management.. Vegetables were selected for FFS since vegetable production creates more income and jobs per hectare than cereal production (Weinberger and Lumpkin 2005), hence vegetables FFS was initiated since vegetable would quickly restore the rural livelihoods. The project was implemented through Farmer Field Schools (FFS) adapted to vegetables and trained 1648 farmers in 77 villages of Aceh. In addition training to farmers, 20 FFS trainers, and several other mid-level professionals of government agencies, and of the local community organizations, were also trained on managing and facilitating the FFS locally.

In fact, farmers' field school (FFS) is a process of learning by doing. The World Bank and a number of other development agencies have been promoting FFS in the developing countries since it is a more effective method to extend science-based knowledge and farm practices (Feder et al. 2004). FFS uses a participatory approach to assist farmers to develop their capability on analytical skill, critical thinking and creativity such that farmers can make better decision. In short, the objective of FFS is to enhance human resource development, in which farmers become experts in their fields. Farmers are expected to be able to conduct observations, to analyze agro-ecosystems, to make decisions, and to implement pest control strategies based on the results of their field observations and a crop season long of participatory research on farming practices, popularly called as FFS. In reality, the FFS usually involves pest control strategies, and other critical aspects of farming such as balanced and efficient fertilizing, efficient use of water, crop rotation, soil conservation, and so on.

In Aceh, the process of FFS was carried out using a framework of an agro-ecosystem analysis. Farmers-participants learnt about the agro-ecosystem and dynamics of insect population during the process of making observations in the two plots during the period of a crop season long period. Chili was cultivated on a plot as per the farmers usually followed practices in the community. The same variety of chili was planted in another plot but with the improved technology components as developed by the project team, and was planned/designed as per structure and condition of the local agro-ecological systems and socio-economic system of farming in Aceh. The key to understanding pest outbreaks lies in comprehensive relationships between dynamics of insect pest and its natural enemies in which farmers lack in-depth knowledge of the relationship. A topic designed to open the unknown complexity of local agro-ecosystem and socio-economics of vegetable cultivation in the tsunami affected localities. Over a crop season long period, the participating farmers in each FFS observed the dynamics of insects representing natural food chains in agro-ecosystem. One of the most important concept discovered by farmers through this special topic was their increased ability of determine whether a particular insect is pest of a vegetable (chili), which is harmful to the particular crop, or natural enemies and other insects that are beneficial to crop production.

FFS, which were originally created for IPM training in Asia, is a participatory learning process, which lasts for four to five months of a crop season (for annual crops). FFS has been adapted for dissemination of intensive knowledge in many sub-sector of agriculture, forestry and health (CIP-UPWARD, 2003), and technologies have also to be selected and adapted for particular systems of natural resources management (Lilja and Dixon, 2008). A recent empirical study of successful adaptation and spread of farm technologies reported that farmers who were members of FFS groups were significantly better off than non-member farmers (Lilja and Dixon, 2008). In many farming sector trainings in Indonesia, a farmer field school (FFS) approach has been adapted locally (Luther *et al*., 2005; Pontius *et al*., 2002). In this case, FFS adaptation was emphasized on soil remediation techniques but also include other ICM components of vegetable such as improved composting, low-cost drip irrigation, Botanical pesticides, pest and disease identification, netting over nursery, use of mulch, use of starter solution, etc.

Chili was selected as the main topic of the FFS as many farmers demanded for FFS on chili during the rapid survey and consultation with the targeted communities done in 2008. This was also due to prevailing fairly good market prices of chili than that of other vegetables in 2008 and in 2009, and in turn, a higher profit margin from chili than that from other vegetable crops. Chili has also highest crop acreage than other vegetables in Aceh, covering of 9680 ha in 2007 (government statistics). Before the tsunami, the annual combined value of production of smallholder farmers for the province of Aceh was estimated to be about AUS$ 60.6 million for chili. The average net return to farmers has been estimated at 20.9 million IDR/ ha for chili (Mustafa *et al.*, 2005).

In this context, the overall objective of this paper is to evaluate impacts of a FFS process adapted to chili cultivation in Aceh in 2008 and 2009, which was implemented by AVRDC and its partner agencies (BPTP/Aceh) in Aceh. In specific term, the FFS had adopted ICM based chili cultivation FFS process and had used over 12 different sub-component technologies for enhancing productivity of chili in the targeted project sites. We analyze and document these impacts on different c components of livelihoods of farmers attending the training, and we have used both qualitative and quantitative assessment methods. Out of 77 FFSs that were implemented in Aceh by the AVRDC led project, in this impact assessment study, we have surveyed and consulted ate at in 27 FFS sites, and with interview of 270 farmers both individually and in a group comprising 10-12 farmers at each of the 27 FFS sites, .

1.2. Farmer Field School implemented in Aceh

Using a participatory approach of research and training, the farmers' field school adapted for vegetable farming (i.e., chili cultivation) in Aceh provided assistance to farmers in developing their capability on analytical skill, critical thinking and creativity such that farmers can make better decision. In short, the direct objective of FFS was to enhance farmers' capacity to cultivate chili with improved technologies that are ecologically friendly at the local farming system. At the same time, the underlying objective of FFS was also of human resource development, in which farmers to become experts in their vegetable fields. In FFS, farmers are expected to be able to conduct observations, to analyze agro-ecosystems, to make decisions, and to implement pest control strategies based on the results of their field observations. Farmers would obtain those capabilities from participating FFS. The FFS adapted to vegetables in Aceh also adopted the same concept and overall procedures to engage framers in participatory action research, which lasted for over a crop season long at each of the FFS sites.

2. Literature Review

In Indonesia, Farmers field school (FFS) has been a famous method to disseminate new agricultural technologies and production practices. In the recent past, one of the largest disseminations of technologies through FFS in Indonesia has been on integrated pest management (IPM), when the Government of Indonesia revolutionized its policy on plant protection strategy by implementing the Integrated Pest Management (IPM) Program by issuing Presidential Decree No. 3 in 1986. At that time, the presidential degree (and need of IPM program) was motivated by the fact that pesticides were no longer effective for controlling few selected pests in Paddy field, largely also due to unwise use of pesticides, leading to huge economic losses associated with pest outbreaks in the 1960s (Settle *et al.*, 1996) and in the 1980s (Barbier, 1989). In addition, there were other adverse impacts of unwise use of pesticides on local environmental and health of farming communities including farm labor (Bond, 1996; Kishi *et al.*, 1995). The comprehensive packages of IPM related farmers level training on paddy was then implemented three years later (Rölling and Fliert, 1994), with the objectives of: higher productivity, increased farmers' income, guarded pest population (i.e. to keep pests below economic threshold levels), limited use of chemical pesticides, and an improved environment and better public health (Untung, 1996).

There exists a strong claim that IPM program in Indonesia has been able to reduce the use of pesticides significantly. In the field trials, the training has been able to cut down pesticide use by 50% without sacrificing the level of production (Bond, 1996). Farmers have adopted the several components of IPM principles (Kuswara, 1998a, 1998b; Paiman, 1998a, 1998b; Susianto et al., 1998), and there is an indication of strong diffusion of IPM knowledge among Indonesian farmers (Mariyono, 2007a). However, many other critics argued that the decrease in use of pesticide is not only affected by the IPM program, but large part of this is also influenced by the increase in the price of pesticides in the recent past. For example, using farm level data in Indonesia, Feder *et al*., (2004) reported that there is no difference between IPM-trained and non-trained farmers in terms of change in pesticide use and yield of rice. But, at the aggregate level, studies of Mariyono and Irham (2001), Mariyono *et al*. (2002) and Mariyono (2003) show that the decrease in use of pesticides in Jogjakarta province of Indonesia is due largely to simultaneous increase in the price of pesticides and the dissemination of IPM principles. Further studies of Mariyono (2007b and 2008) in the same region demonstrate that farmers reduce pesticide use because of delay in spraying as farmers become more tolerance toward pests after participating FFS on IPM. Mancini and Jiggins (2008), using participatory approach of research, illustrated that the deeper understanding of the occupational hazard of handling pesticides indeed induced a change in the FFS participants' attitudes towards pesticides'. Based on an empirical study of successful adaptation and spread of pro-poor technologies, it was found that farmers who were members of FFS groups were significantly better off than non-member farmers (Lilja and Dixon, 2008). A recent study by Mariyono et al. (2010) showed that changing from the Green-Revolution-based technology to IPM-based technology in Indonesian rice production practices has also brought an agro-chemical saving technological progress by significantly decreasing pesticide use along with dissemination of IPM knowledge. The gradual decrease in pesticide use in Indonesia did not occur instantaneously after implementing the program in 1986, but was due partly to good performance of FFSs that were started in 1990s (Mariyono, 2009).

In other countries, FFS methods have been adopted to introduce new tools and technologies in farming as well as in broader sectors of natural resources management. With a summary on participatory research involving an impact assessment of agricultural technology, Lilja and Dixon (2008) suggest that with farmer empowerment, and changes in opportunity structures, rural poverty has been reduced in many countries by combining farmer-empowerment and innovation through experiential learning in farmer field school (FFS) groups. This was also facilitated by changes in the opportunity structure through transformation of local government staff, establishment of new farmer-governed local institutions, and emergence of private service providers.

Thus, FFS is one of effective ways to disseminate improved technologies to farmers. Modified and adapted FFSs on other crops and topics are expected to have positive impacts on farming practices and better understanding of farmers on complex farming technologies such as vegetable production and high value crop production practices, as discussed and illustrated in this study.

3. Study Methodology

Immediately after completion of FFS, we evaluated the process involved and some of the perceived impacts of the FFS on the changes of farmers' knowledgebase and their farming practices in general. The real impact of FFS will be achieved only after few years when the farmer participants would actually apply the improved knowledge and technology know-how learnt at FFS at their own farm and would obtain changes on crop production and productivity levels. Nevertheless, it is important to document to these perceived impacts immediately after the training, and within the project period, so that the farmers' perspectives on the project activities can be documented in time for improved decision-making.

3.1. Analytical framework

This study used framework of ex-ante evaluation[1]. This means that farmers have already completed FFS training and have got crop-production experiences during the one crop growing season, and they would be applying these knowledge and technology learnt during FFS in the next crop-growing season. Here, farmers were asked to provide their expectation and perceived effects of FFS on range of vegetable farming issues. Thus, the results on consequences of FFS as documented in this study are also kind of short term impacts FFS. The long term.

In many agricultural extension projects, the participants and locations are usually selected with several criteria. For example, active and innovative farmers and easily accesses places are usually the ones selected by such trainings. Active and innovative farmers are selected because they are expected to be the core of the project and source of information for other farmers. Locations that easily accessed, which is close to main road, market and centre of city, usually

[1] There is ex ante impact assessment of likely future expected impacts of the FFS and training activities, as perceived by the farmer participants of FFS. Ex-ante impact assessment is applied to assist in decisions on approval and funding of research and is generally done at a project level. It is conducted also to rank research programs and set priorities for resource allocation at a research system level (FAO, 2000).

have better fertility of land. All of these potentially could lead to *selection bias*. But, with limited resource and availability of short time, using "before" and "after" comparison still avoid selection bias, because the change in performance level of farmers is due mostly to program. This is also based on assumption that farmers without access to project have not enough time to improve their performance level, or in other words, this method does not account the benefits accrued to the FFS through the diffusion process in the communities. Considering all of these issues, resources constraints, and a short duration of FFS in each of the communities (3-4 months), we have used "before" and "after" approach of program evaluation (Gittinger, 1982).

In this study, we have combined focus group discussions (FGD) tool of PRA with selected tools and techniques of Participatory Impact Assessment (PIA). Using the framework five components of livelihood assets, we have documented impact of FFS on each of the components of livelihood assets. These five livelihood capitals include: physical capitals, financial capitals, human capitals, social capitals and natural capitals[2]. Then, using impact scoring techniques, improvements on farming and crop management knowledge of farmers, after participating FFS, were recorded. The specific topics within broad category of knowledge included starting from land preparation to harvesting, and marketing of harvested products. For quantifying the impact of FFS, farmers were assumed to have initial score of 10 (i.e., $X_0 = 10$) on each of the factor before participating FFS. After immediate completion of the FFS sessions, farmers were asked to record improvement by adding the existing score. Then, the changes were measured in percentage formulated as:

$$\%C = \frac{X_1 - 10}{10} \otimes 100\% \qquad (1)$$

where X_1 is the score reported by farmers after completing FFS; and $\%C$ = change in score of value in percentage term.

3.2. Data collection and presentation

Two surveys methods were used to collect data: individual (conventional) household survey and group level survey using techniques of PRA. Considering the nature of activities, and the short

[2] For the detail on five capitals/assets in people's livelihood, please see Neubert (2000).

time period we had for impact assessment task, combining participatory and conventional methods also enhanced the effectiveness of impact assessment task as such (Mancini. and Jiggins, 2008). The use of participatory methods enabled us to explore several qualitative and social and institutional impacts of FFS. But, the PRA based methods are also not sufficient and out of criticism, as they are often criticized for being ''quick and dirty'' research methods. Likewise, the hypotheses and generalizations in the PRA or RRA report about farmer problems and constraints remain untested, mainly because most of the data gathered remain un-coded (Gladwin and Peterson, 2002). Information obtained from PRA is also very location specific.

To be sufficient, data collected from PRA were complemented with data from individual survey. Individual survey would accommodate variation among respondents, and provide information on some statistical test, and, the use of individual survey extrapolation of observations from small samples to wider population (Feder et al., 2004). Therefore, we analyze impacts of FFS at individual farmer participants using a structure forms, and through head to head consultation with farmer participants. In this case, farmers are asked about their expectation or prediction of farming with the improved technologies introduced during FFS. Among 77 FFS completed in Aceh, individual survey was conducted in 27 sites of FFS, and individually interviewing 270 farmers. Data collected in the individual survey include general background of farmer participants, knowledge improvement on pest and diseases, improvements in farming practices, and comment and suggestions of farmers on FFS process as a whole.

Participatory group survey was carried out in the same 27 FFS sites as noted earlier. Qualitative approaches and multiple-choice tests (scores) were used to document impacts as perceived by the FFS participants. At each of 27 FFS group surveyed consists of 10-12 farmers graduated from FFS. Pre- and post- knowledge level of farmers, for a sample of 27 FFS sites (group consensus) were documented and the results compared. Survey techniques and tools of participatory impact assessment (PIA) were used to collect qualitative survey data by raising specific questions to each of FFS group. Every farmer in the group had equal opportunity to answer all questions, based on her/his perception or experiences during the sessions of FFS. We allowed for different answers among farmer-participants, and a consensus data points were recorded in the chart sheet shown to all of the participants. The specific issues/topics were selected were related to impacts of FFS prepared beforehand, using concept of PIA.

3.3. Presentation of findings

For qualitative data, the frequency each issue is reported in terms of number of farmers or groups proving response to respective issue. For quantitative features, mean value of a particular variable was calculated using sample average of the variable, which is formulated as:

$$\overline{X} = \frac{\sum_{i=1}^{N} X_i}{N} \tag{2}$$

where X is the variable of ith to be analyzed, N is the number of samples. Standard deviation of each variable is also provided to identify the dispersion of information.

For certain important factors, analyses on weighted rank (WR) were conducted by calculating the score reported by farmers. The weighted rank is formulated as

$$WR = \frac{\sum n.*S}{N} \tag{3}$$

where n is number of farmers responding to each category, S is score, and N is total sample. A higher score was given for a particular response (variable) when farmers reported that such a variable was more important. For example, during the field survey, if there were five choices, and a farmer gave a first rank for a certain variable in a list, then the particular variable was scored (ranked) as 1. If the farmer gave it as second rank, then it was scored as 2, and so on. If the farmer did not mention anything on ranking, then the score for this particular factor/variable became zero. Thus, a higher value of weighted average rank means the factor (response) was more important and mentioned by many farmers during the survey.

4. Results and Discussion

4.1 General information of locations and farmer participants of FFS

In Aceh, FFSs selected for this evaluation were conducted in three vegetables production zones that were also severely hit by the 2004 Tsunami. They were: Aceh Besar, Pidie and Northeast Aceh. Table 1 shows the distribution of FFS sites by each production zone (region). For the impact assessment purpose, a total sample of 27 FFSs were taken proportionately from each of the region of Aceh (Table 1). Survey sites in Aceh Besar are about 5 kms distance from provincial capital city of Aceh, whereas the survey sites in NE Aceh are about 200-250 kms. Moreover, all of the FFS survey sites were located close to the main roads and accessible easily.

Table 1. Basic characteristics of the surveyed sites

Description	Aceh Besar	Pidie	Northeast Aceh	Total
Number of districts	1	2	2	5
Number of villages where FFS was implemented by the project	40	24	12	80
Number of sampled FFS villages	12	9	6	27
Number of total participants	120	90	60	270
Average distance of villages from capital city of Aceh	5-10 km	100-120 km	200-250 km	

Characteristics of farmer participants surveyed are illustrated in Table 2. Average farmer participants were of around 40 years old, and with junior high school of education, or of about 5-6 years of schooling years. On average, farmer participants in FFS have about 13-year experience on vegetable production practices. Total farmland owned by an average farmer participant varied from 3000m^2 in Northeast Aceh to 4000m^2 in Pedie region.

Table 2 Characteristics of the surveyed FFS participants

Description	District							
	Aceh Besar		Pidie		Northeast Aceh		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Education level (year)	5.3	1.8	5.9	1.5	5.6	1.8	5.6	1.7
Average age (year)	42.5	8.6	40.7	7.8	37.3	7.1	40.8	8.2
Experience on vegetable (year)	12.9	7.3	12.0	6.2	12.7	5.8	12.5	6.6
Total farm land owned (ha)	0.39	0.49	0.39	0.22	0.30	0.15	0.37	0.36

On average, farmers selected to be FFS participants were educated and more experienced in vegetable farming that those who were surveyed in these communities by the project previously for the project baseline survey report. This suggests that farmer– participants involved in the FFS were of relatively more experience on vegetable growing and also better off than those average farming households in the communities[3].

[3] Such differences on vegetable growing experiences and holding could also be due to small sample size in FFS impact study in each site (only 10 farmers in each FFS site) compared to about 30 farmers selected in each communities in the project baseline survey carried out previously.

Table 3. Composition of participant, by gender

Description	Aceh Besar		Pidie		Northeast Aceh		Total	
	n	%	n	%	n	%	n	%
Female	11	9	9	10	12	20	32	12
Male	109	91	81	90	48	80	238	88
Total	120	100	90	100	60	100	270	100

Note: n is number of farmers

On an average only 12 % of the farmer participants of FFS were women, thus, woman farmers' participation in FFS was very low. This lower rate of participation of women in FFS could be due to local cultural factor. Relatively strong religious and socio-culture factors in Aceh might have contributed for lower participation of women farmers. Any future FFS or farmers level training needs to give special emphasize on these issues and needs to give incentives and favorable environment for participation of more women members of the farming communities.

4.2. Plant protection management in FFS sites

Plant protection consisted of pests, diseases and control agents including natural enemies and pesticides. Table 4 shows pests, diseases and natural enemies recalled by farmer participants of FFS. There were more than five pests reported by farmers. The most important pests in Aceh Besar and Northeast Aceh was leave-feeding caterpillars, while in Pidie, the most important pests was aphids and mites. Geminivirus was the most important diseases in Aceh Besar, but was not the case in other regions, where curling/wrinkled leave were the most serious diseases. A few farmers in Besar could mention natural enemies, but no one in other regions.

Table 4. Most important insects and mites, known by the participants

Description	Aceh Besar		Pidie		Northeast Aceh		Average	
	Rank	Freq	Rank	Freq	Rank	Freq	Rank	Freq
Catterpillars	3.46	99	3.11	51	3.37	25	3.31	175
Aphids and mites	3.22	87	4.11	61	3.17	22	3.50	170
Fruit fly	1.42	39	0.79	13	2	14	1.40	66
Curling leaf	0.38	9	0	0	0.47	3	0.28	12
Bugs	0.23	7	0	0	0.33	3	0.19	10
Grasshoppers	0.19	6	0.34	6	0.1	1	0.21	13
Geminivirus	0.1	3	0	0	0	0	0.03	3

Fruit Borer	0.07	2	0.29	5	0	0	0.12	7
Other	0.04	1	0	0	0	0	0.01	1
Cricket	0.03	2	0	0	0	0	0.01	2

Note: Higher Rank is the most important

Table 5. Most impoirtant diseases known by the participants

Description	Aceh Besar		Pidie		Northeast Aceh		Average	
	Rank	Freq	Rank	Freq	Rank	Freq	Rank	Freq
Curling	3.7	117	3.97	70	3.7	28	3.79	215
Roten fruit	1.12	46	1.41	34	0.5	5	1.01	85
Antraknose	0.94	35	1.31	31	0.4	4	0.88	70
Roten root	0.48	18	0.34	8	0.4	4	0.41	30
Roten leave	0.1	4	0	0	0.1	1	0.07	5
Bacterial wilt	0.15	5	0	0	0	0	0.05	5
Geminivirus	0.13	9	0	0	0	0	0.04	9
Spoted leave	0.08	3	0	0	0	0	0.03	3
Other	0.02	1	0	0	0	0	0.01	1

Note: Higher Rank is the most important

Table 6 shows pesticide use in chili. On average, farmers sprayed pesticide to chili 8-9 times per season, with 1-2 times per week at vegetative stages; and 7-8 times per season, with around one time per week at flowering stages of crop. Farmers reduced the number of sprays during the flowering stage as they believed that spraying at this stage could affect flowering process.

Table 6. Number of times pesticides applied on chili crop, average

Description	Aceh Besar		Pidie		Northeast Aceh		Average	
	times/ week	times/ season	times/ week	times/ season	times/ week	times/ season	times/ week	times/ season
Vegetative stage	1.25	8.18	1.34	8.60	1.18	8.29	1.26	8.33
Flowering stage	1.07	7.90	1.09	6.30	1.00	7.05	1.06	7.26

Farmers were aware on the adverse impact of pesticides. But, they could only provide information on human health. Table 7 shows that farmers mentioned that pesticides have potential of causing human health. Only a few of them knew that pesticides could also cause pest resistance, could kill natural enemies and could contaminate the environment.

Table 7. Danger of pesticides used by framers as reported by number of farmers

Description	Number of farmer reporting							
	Aceh Besar		Pidie		Northeast Aceh		Total	
	n	%	n	%	n	%	n	%

Human health	115	96	68	76	30	50	213	79
Killing natural enemies	10	8	2	2	1	2	13	5
Poisoned	1	1	0	0	9	15	10	4
Soil contamination	2	2	4	4	0	0	6	2
Polluting environment	2	2	0	0	2	3	4	1
Pest & disease resistant	0	0	0	0	1	2	1	0

Note: n is number of farmers who respond questions on damage done by pesticides.

Farmers applied pesticides because of fear of increased pest attack. Table 8 shows that more than half of total surveyed farmers took pest population and level of crop damaged by pests and diseases into account while applying pesticides. Only around one third of them followed scheduled spray. Only around 15 percent of them sprayed pesticides based on the recommendation of spray regimes from the extension agents. Price of pesticides was not important factors affecting farmers' decision to pesticide application among the surveyed farmers.

Table 8. Factors considered by farmers for their decision to apply pesticides

Description	Number of farmer reporting							
	Aceh Besar		Pidie		Northeast Aceh		Average	
	n	%	n	%	n	%	n	%
Pest population	81	68	49	54	33	55	163	60
Research recommendation regimes	18	15	9	10	10	17	37	14
Following a regular schedule	68	57	33	37	6	10	107	40
Damage to the crop	85	71	82	91	42	70	209	77
Other factors:								
Price	0	0	3	3	0	0	3	1
Adverse impact	0	0	2	2	0	0	2	1
Information from government	0	0	2	2	0	0	2	1

Note: n is number of farmers who respond questions.

Several farmers did not depend solely on pesticides to control pest diseases. Several farmers also already had basic knowledge on the pest management during the survey time. Table 9 shows the usual methods of pest and diseases management adopted by farmers. They used pesticides and netting and combination of them for the control of the pests and diseases. Netting was the most common technique to reduce Gemini virus attack, other than pesticides use. Around 25 % of surveyed farmers' knew that protecting nursery by using nylon net is one of the effective ways to reduce Gemini virus attack. More than half of surveyed farmers understood that Gemini viruses are transmitted by whiteflies. Another disease that was well-known to the farmer participants at that time was anthracnose. This disease was reported as one of the severe cause of chili crop damages and yield losses.

Table 9. Usually followed pest and diseased management practices and farmers knowledge

Description	Number of farmer reporting							
	Aceh Besar		Pidie		Northeast Aceh		Average	
	n	%	n	%	n	%	n	%
Method follow for managing pest and disease on chili								
with pesticide	19	16	14	16	4	7	37	14
with netting	59	49	56	62	37	62	152	56
both of them	38	32	18	20	19	32	75	28
other	4	3	2	2	0	0	6	2
How chili plants get infected with Gemini virus								
It comes through air	8	7	2	2	8	13.3	18	7
Whiteflies transmit it	107	89	80	89	51	85.0	238	88
Others	2	2	2	2	1	1.7	5	2
Some of the ways of reducing Gemini virus attacks on chili								
Spraying pesticide	107	89	67	74	53	88	227	84
Covering nursery with netting	21	18	32	36	8	13	61	23
Pulled out	9	8	4	4	0	0	13	5
Participants knowledge on anthracnose								
Yes	120	100	90	100	60	100	270	100
No	0	0	0	0	0	0	0	0
If yes, how severe is the anthracnose problem								
not a problem	0	0	0	0	0	0	0	0
small problem	0	0	0	0	0	0	0	0
medium level	15	13	15	17	0	0	30	11
very severe problem	105	88	75	83	60	100	240	89

Note: n is number of farmers who respond questions.

Various varieties of chili were grown by farmers. Table 10 shows that TM999 was the most famous variety in three regions surveyed in Aceh, as reflected by highest rank factor and over 80% of farmers growing TM999 during the survey period. After TM999, other varieties most favored by farmers were Taro and Lado.

Table 10. Varieties of chili grown in Aceh by districts

Variety	Aceh Besar		Pidie		Aceh Utara		Overall	
	Rank	Freq	Rank	Freq	Rank	Freq	Rank	Freq
TM 999	4.08	108	4.48	87	4.35	54	4.27	249
Taro	1.61	48	0.00	0	0.00	0	0.71	48
Lado	1.11	36	0.98	22	0.00	0	0.82	58

New taro	0.71	19	0.00	0	0.00	0	0.31	19
CTH 01	0.30	12	0.09	2	0.00	0	0.16	14
Other	0.00	0	0.11	2	0.00	0	0.04	2
Krida	0.09	3	0.00	0	0.00	0	0.04	3

Note: Higher Rank is the most important

4.3. Impact of FFS: Individual survey

It is expected that FFS would provide positive impacts And would increase farmers knowledgebase on cultivation of a particular after their attending the crop season long FFS. Overall, farmers' knowledge on chili farming has been enhanced after participating FFS. On average, farmers stated that their overall knowledge on chili farming was enhanced by 70%.

Specifically, farmers' knowledge on pests, diseases and natural enemies increased considerably (Figure 2). Farmers' knowledge on pests and diseases after participating FFS doubled than the case before participating in FFS. Meanwhile, for natural enemies, not every farmer knew natural enemies before participating FFS. After participating FFS, two farmers could mention at least one natural enemy of insect pests.

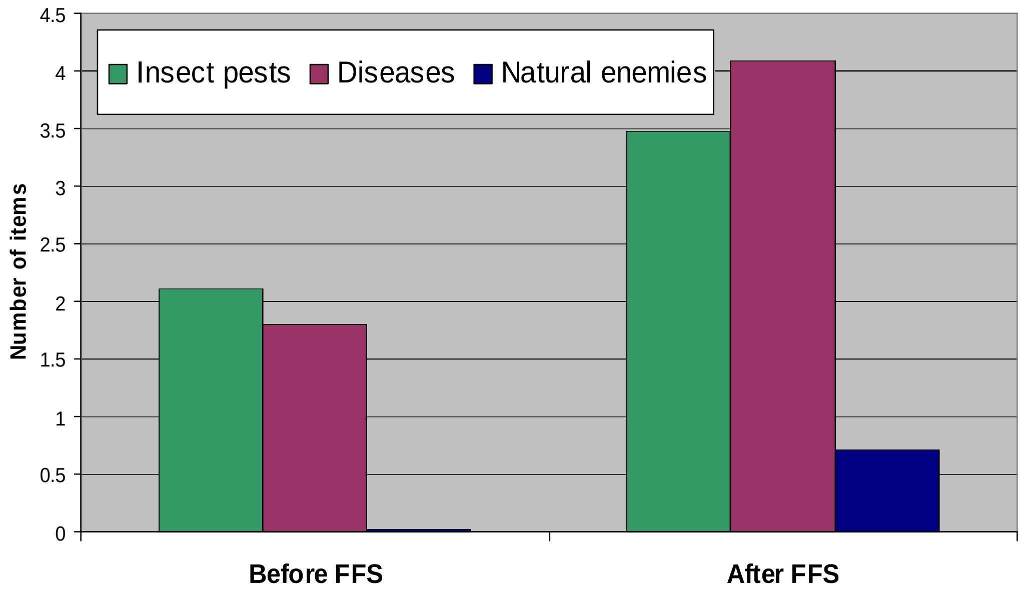

Figure 2. Enhancement in knowledge on pests, diseases and natural enemies

In addition to the number of pests, diseases and natural enemies, there are substantial changes in the perception of such issues. Table 12 shows top-five important pests, diseases and natural enemies perceived by farmers before and after participating FFS. In addition, they could not distinguish between concept of pest and disease. Perception on insect pests and natural enemies also changed substantially after participating the FFS. However, diseases identification was a difficult for farmer to observe in the field as the signs (and symptoms) of one disease to another are almost similar. As shown in Table 11, before participating FFS, farmers perceived some unimportant insect pests to be considered as serious pests; and by contrast, they perceived harmful insect pests to be considered as unimportant pests. This implies that farmers did not understand role of every insect-pest. After participating FFS, their perception of insect pests has changed substantially. For example, earlier, farmers believed that whitefly was not an important insect. But, after participating FFS, they consider that some of the insects are very important and also very beneficial. Similarly, the importance of natural enemies has changed after participating FFS. Previously, farmer perceived that some kind of birds were potential natural enemies in their farm. But, after participating FFS, they believed that wasps and bees are beneficial insects playing important role of natural enemies of pests in the chili farming.

Table 11. Change in the importance pests, diseases and natural enemies

Rank	Before FFS			After FFS		
	Pests	**Diseases**	**Natural enemies**	**Pests**	**Diseases**	**Natural enemies**
1	Lices	Curling leafs	Birds	Whiteflies	Curling leafs	Wasps & bees
2	Catterpillars	Decayed fruit	Dragonfly	Lice	Fruit spoiled	Dragonfly
3	Fruit fly	Anthracnose	Ants	Catterpillars	Anthracnose	Spider
4	Grasshoppers	Rooten root	Grasshopers	Fruit fly	Spotted leaf	Coccinelid battles
5	Curling leafs	Bacterial wilt	Spider	Aphids	Gemini viruses	Grasshoppers

Note: Rank 1 stands for the most important pest and disease and rank 5 stands for least important.

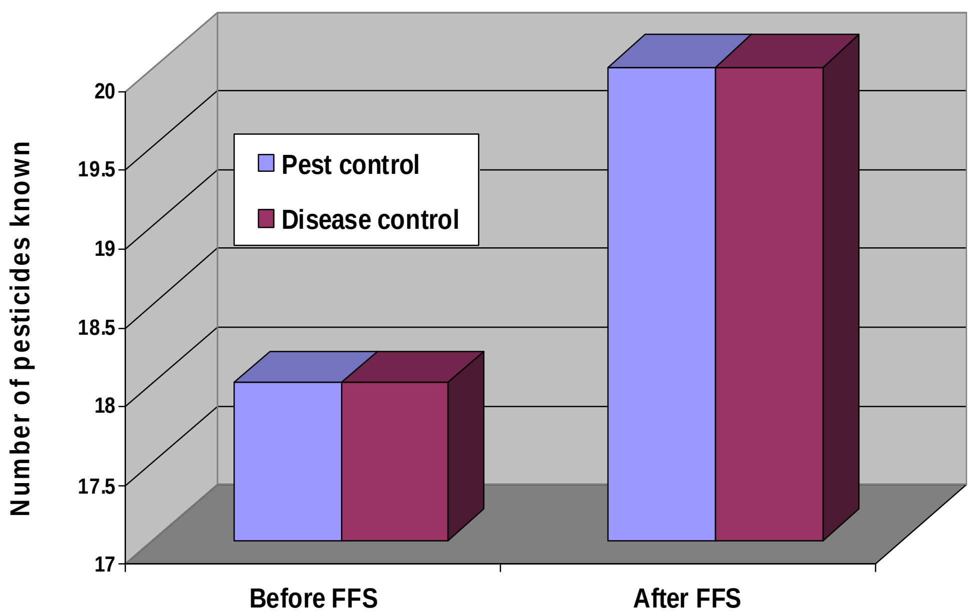

Figure 3. Change in pesticide knowledge

Even though farmers have already recognized a number of pesticides before participating FFS, knowledge on pesticides use also increased substantially (Figure 3). Before participating FFS, farmers knew around 17 kinds of pesticides used for pests and diseases. After participating FFS, farmers recognized around 20 kinds of pesticides used for controlling both pests and diseases.

Not only knowledge on kind of pesticides was enhanced, but knowledge on adverse impacts of pesticides was also enhanced. Table 12 shows that before participating FFS, around 80% of surveyed farmers were only aware that pesticides can adversely affect human health, but they were not aware that pesticides also have adverse impacts on sectors and on natural environment. After participating FFS, all farmer participants become aware that pesticides can adversely affect human health, kill natural enemies and other beneficial organisms, contaminate soil and the environment, as well as bring about pest and disease resistance.

Table 12. Danger of pesticides used by Framers as reported by number of farmers

Description	Percentage of farmers							
	Before FFS				After FFS			
	Aceh Besar	Pidie	Nort heast Aceh	Total	Aceh Besar	Pidie	Nort heast Aceh	Total
Human health	80	84	83	29	100	100	100	100
Killing natural enemies	7	2	3	2	100	100	100	100
Poisoned	1	0	25	1	100	100	100	100
Soil contamination	1	5	0	1	100	100	100	100
Polluting environment	1	0	6	1	100	100	100	100
Pest & disease resistant	0	0	3	0	100	100	100	100

Importantly, with the enhanced knowledge, farmers have been confident that in the next season, they will be able to increase productivity of chili with reduced use of chemical pesticides. Table 13 shows that only a few farmers stated that there will no increase in yield; none of them say that there is no change in pesticide use. About 60 % of the farmer participants surveyed expected that they would be able to increase productivity of chili by 25% and about 40% of the farmers reported they would be able to reduce pesticide use by 25% in the next season and would also increase crop yield at the same time. In fact, over 20 % of farmers also predicted that they would be able to increase crop yield by around 50% and the same percentage of farmers reported that they would be able to reduce pesticide use by 50%. This is an adequate indication of high performance level of FFS, which would also lead to higher level of crop productivity and the lower level of pesticide use (Mariyono, 2009).

Table 13. Impacts of FFS on predicted crop yield and pesticides use

Description	Number of farmer reporting							
	Aceh Besar		Pidie		Northeast Aceh		Overall	
	n	%	n	%	n	%	n	%
Increased yield of chilli								
no improvement	0	0	4	4	0	0	4	1
10%	24	20	9	10	7	12	40	15
25%	61	51	57	63	42	70	160	59
50%	31	26	15	17	10	17	56	21
60% or more	4	3	2	2	1	2	7	3
Decreased pesticide use		0		0		0		
no change	0	0	0	0	0	0	0	0
10% less	19	16	7	8	5	8	31	11
25% less	54	45	37	41	19	32	110	41
40% less	32	27	26	29	16	27	74	27
50% less	15	13	18	20	18	30	51	19

Note: n is number of farmers who respond questions.

Among the 14 different technology components that were discussed at the FFSs surveyed for the impact assessment, about 90 percent of the surveyed farmer participants, out of the 270 farmers surveyed, reported that they would be using in the next season technology components such as composting, botanical pesticide (neem), learning about the natural enemies and fruit fly pheromone. Participating farmers were quite confident on applying several technologies taught and discussed at the FSSs (Table 15).

Table 14. Technologies which the framers will most likely to be using in next crop season

Description	Number of farmer reporting							
	Aceh Besar		Pidie		Northeast Aceh		Overall	
	n	%	n	%	n	%	n	%
1. Composting	111	93	87	97	49	82	247	91
2. Botanical pesticide	111	93	74	82	52	87	237	88
3. Learning about natural enemies	105	88	77	86	50	83	232	86
4. Fruit fly pheromone	106	88	80	89	49	82	235	87
5. Light traps to control insect	92	77	73	81	50	83	215	80
6. Pest and disease identification	102	85	80	89	51	85	233	86
7. Proper pesticide uses	94	78	78	87	51	85	223	83
8. Use of bio-pesticides	111	93	85	94	52	87	248	92
9. Use of sticky traps for insect	96	80	71	79	49	82	216	80
10. Netting over nursery	112	93	86	96	50	83	248	92

11. Use of mulch	117	98	75	83	51	85	243	90
12. Starter solution technology	102	85	78	87	50	83	230	85
13. Hot water seed treatment	109	91	73	81	50	83	232	86
14. Soil fertility/fertilizer management	89	74	74	82	50	83	213	79

Note: n is number of farmers who respond questions. Not all of these technology components were discussed in every FFS.

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4.4. Impacts of FFS on livelihood capitals: farmers group level survey

As like other common property resources in agriculture such as soil fertility and water resource, it has been long recognized that pest population is also a common property resource, but with a detrimental effect on farming (Regev et al. 1976). Thus, the pest population at any place is not a sole responsibility of individual farmer. An individual farmer can control only the pest population in his/her field during a season, which is presumably, only a small part of the total agro-ecosystem, which determines pest outbreak at a place. Therefore, for an effective pest control strategy at wider landscape, several farmer members in a community need to cooperate with each others and to be responsible for keeping tolerable level of pest population on his/her field. Thus, in many places in developing countries, we can also see jointly management schemes for some of the common access resources such as management of soil fertility at wider areas, management of water resources, controlling pest and disease at wider landscape, and for management of other components of local agro-ecosystem. These resources need to be kept productive by all community members, with an appropriate level of group activities or through community level resources management regime. If one of members violets the group norms (or breaks the existing informal agreements), it will possibly not raise any major adverse impact at large-scale; but if every member thinks so, then this would lead to a "tragedy of common" in local management of the resources with informal arrangement. A good FFS is expected to provide better understanding to the farmer participants on structure and function of the local agro-ecosystem and facilitating group efforts in managing common property resource locally.

Thus, besides training on technology components to farmers and changes in pest-management techniques, FFS has also social goals: goals that seek to position farmers as field experts, who collaborate with the extension staff to find solutions relevant to the local realities. FFS programs emphasize farmers' ownership of development processes, partnership with other development agents, and group collaboration (Mancini and Jiggins, 2008). FFS likely to impacts favorably on livelihood of farmer, which can be observed in the level of change in five different sets of livelihood assets: physical capital, financial capital, human capital, social capital, and natural capital. In this section, we have analyzed impacts of the FFS separately on each of the livelihood capitals of the participating farmers, and also have quantified related impacts using scores and in percentage terms.

The impact of FFS on individual components of five livelihood capitals could be positive or negative. Nevertheless, it is expected that overall there would be net positive benefits of FFS on livelihoods components, which was priori expected. But, the level and scale of such benefits vary by the FFS site, and with several other internal and external factors in the communities. The other aim of this study is also to properly analyze and document these issues.

Major impacts of FFS on physical capitals of participant-farmers, and as perceived by the FFS participants, have been summarized in Table 15. Over 2/3rd of the farmers surveyed have expected that they would be using 25 % of less of chemical materials on their chili plot in the coming year than what they have been using so far. After the FFS, farmers perceived that they would be using less material inputs (chemical pesticides and chemical inputs) on chili, except for organic materials. On an average, over 20-25 % of farmers expected to reduce use of chemical materials by 20-25 percent. They preferred to use more of organic materials instead of inorganic materials in chili farming. In the surveyed sites, synthetic pesticides could also be partly replaced with botanical pesticides (Neem paste). Inorganic fertilizers will be partly substituted with composts. However, farmers considered that production level would still be expected to increase by 10-25 per cent with these substitutions and trade off on the application of inputs. All of them are very positive impacts of FFS on physical capital. In Aceh Besar and Northeast Aceh, farmers' expectation on increase on productivity is relatively low, but their expectation on lower use of chemical inputs (and reduce production cost) is substantially high in Aceh Besar than in other two regions surveyed.

Table 15. Impact of FFS on physical capitals of the chilli farmers who attended the FFSs

Impacts	Aceh Besar		Pidie		Northeast Aceh		Total	
	n	%	n	%	n	%	n	%
Increase on use of bio-pesticides	2	17	2	22	0	0	4	15
Decrease on chemical fertilizers use	9	75	6	67	3	50	18	67
Reduce on use of chemical pesticides	8	67	7	78	0	0	15	56
Rise in production	3	25	6	67	2	33	11	41
Rise in organic fertilizer	2	17	2	22	2	33	6	22

Note: n is number of groups proving response on the respective variables/physical capitals.

Level of labor input used on chili is expected to increase after attending FFS. This is because of increased numbers of hired labor used for preparing organic materials, and increased number of regular monitoring and observation of pests and diseases on the field. Farmers perceived that increase in labor input is considered as negative impact as it requires additional labor and costs. This is particularly true if farmers have to pay wage for hired labor, or spend extra time such that they lose opportunity to earn additional sources of money from alternative sources. When there is a rampant unemployment in the village, creation of additional employment is good for the social objective of development projects, as discussed here. Because of already a high-level of uncertainty of employment in the urban areas nearby. These farmers (peasants) in Aceh are not likely to migrate to urban area in the near future soon, In fact, another negative impacts related to the use of compost is that majority of the farmers believe that compost will cause increased fungus and weeds infestation in wet season. Thus, fungus and weeds have potential to reduce plant growth and in turn reduce crop productivity. The increased weeds level also leads to increase labor use for weeding-related activities, thus an increased inputs cost.

Overall, more positive benefits of FFS than negative effects were perceived by large number of farmers in the communities surveyed. Increase in labor use on farming due to adoption of new technology (crop) could be positive effects for some households (labor income earning households) while a negative factor for others (Better off farmers).

Impacts of FFS on physical capital also strongly relate to financial capital because the physical capitals have monetary value based on market price and wage rate. Impacts of FFS on financial capital are summarized in Table 16. Positive impacts of FFS relate to saving of costs for materials use, particularly chemical materials that farmers could not produce locally and they need to purchase from the nearby markets. Its substitution with organic material may also save scarce capital of the farming communities. Majority of farmers attended reported that they perceived increased in value of production after the FFS training, as farmers would get cost saving on external inputs and increased crop productivity at the same timing. Percentage fall in total costs of fertilizers and pesticides to be used on farming ranges from 15 per cent to 25 per cent. But they still expected that gross return or value of production at the same time would rise by around 25 per cent. Eventually, more efficient use of agrochemicals and enhancement on productivity means an increased level of profit to farmers from per unit of land. On an average, such increase on produce value is about 20 per cent. In Aceh besar, farmers perceived more benefits from saving of labor cost due to reduction in inputs use. In Pidie, farmers expected increased benefits largely from higher productivity after adoption of the improved technology components learnt in FFS.

Table 16. Impact of FFS on financial capitals

Impacts	Aceh Besar		Pidie		Northeast Aceh		Total	
	n	%	n	%	n	%	n	%
Fall in fertilizer cost	4	33	2	22	3	50	9	33
Fall in pesticide cost	5	42	2	22	1	17	8	30
Fall in production cost	8	67	3	33	0	0	11	41
Rise in produces value	2	17	3	33	1	17	6	22
Rise in profit/income	5	42	6	67	1	17	12	44

Note: n is number of groups proving response to respective issue.

Negative impacts of FFS on financial capital were related to opportunity cost of employment and increased wage rate structures. After the FFS training, labor wage rate in many villages increased due to more labor uses and more time to be devoted to collect organic materials for compost and for preparation of botanical pesticides. Farmers used compost and botanical pesticides to substitute inorganic fertilizers and synthetic pesticides. Because of more time spent in securing organic products, farmers also perceived that they have lost chance to earn additional wage income from the local markets. Overall, the FFS participant- farmers' groups have an expectation that their net financial return from growing chili in the coming season (impacts of FFS) would be increased by 45 %. Labor cost saved from reduction in external material use has also been offset by labor cost associated with collection of organic materials. Collecting raw material of compost also involve substantial opportunity cost for farmers, when the labor market is relatively tight in Aceh.

Within a crop season of training, impact of FFS on human capital was also very positive and identified/reported by all of the farmers groups surveyed (Table 17). Increase in human capital strongly related to enhancement of knowledge on vegetable farming in general, and chili production in production. More achievement in human capital mostly came from improved knowledge on plant-protection and crop management related factors. Increases in human capital were intangible and farmers could not provide exact value of change for several elements related to human capitals, and in quality terms (Table 17). Overall, all of these issues related to human capitals were positives, suggesting for a positive impacts of the FFS on farmers' overall increase on farming knowledgebase and improve skill on growing chili.

Table 17. Impact of FFS on human capitals

	Aceh Besar		Pidie		Northeast Aceh		Total	
Impacts on knowledge of	n	%	n	%	n	%	n	%
Seed technology	2	17	3	33	1	17	6	22
Pest and disease management	7	58	9	100	4	67	20	74
Soil fertility & fertilizer	4	33	2	22	3	50	9	33
Natural fertilizer and pesticides	6	50	2	22	0	0	8	30
Economic and market	2	17	2	22	0	0	4	15
General farming on chili	7	58	2	22	2	33	11	41

Note: n is number of groups proving response to respective issue.

Among three production sites in Table 17, there is no major difference related to farmers' expectation on positive impacts of FFS on human capital. The greatest impacts of FFS felt by participant farmers were on pest and disease control strategies, and soil fertility management. Likewise, recognition of several kinds of pests, diseases and natural enemies were other positive impacts of the FFS initiatives in FFS. Farmers in Pidie felt better on pest and disease management than in other two places.

The farmers' groups surveyed identified no any noticeable negative impact of FFS on the factors related to human capital. Nevertheless, few farmers groups also reported that the negative impact on human capital is increased jealousness among farmers who were left out from the FFS training in the village. Among the farmers participating the FFS, not all have same interest on subject (technologies) on different aspects of vegetable farming. Some farmers wanted to focus more on certain topics of chili farming (e.g., pest management), and some wanted on other issues. These envy and internal conflict of heterogonous interests were not so serious but was a natural course on a development intervention, which will gradually disappear over farmers as knowledge diffusion takes place across the farmers and communities.

There is no noticeable difference in terms of farmers' perception on social capital related impacts of FFS between farmers group in Aceh Besar and in Pidie (Table 18). After completing FFS, the social relationship (or cohesiveness) among farmers within group as well as between groups has become more coherent and strong. Out of 27 FFS surveyed, farmers in 20 FFS group) reported on an average increased cohesive by over 75%. This is the most noticeable impact on social relationship. The level of communication among farmers has also become more frequent and with more effective information as available in the community. This is supported by the increased in frequency of farmers' group meetings in the village. Information sharing, particularly for vegetable production technology, has now become more frequent and effective because of the improved relationship, and increased frequency of contact, between farmers and agricultural officers. Farmers no longer hesitate to consult agricultural officers if they find any problem on farming and other issues. These unquantifiable impacts on social capital are strong aspects of FFS than that of other kinds of formal training, as noted earlier.

Table 18. Impact of FFS on social capitals

Impacts	Aceh Besar		Pidie		Northeast Aceh		Total	
	n	%	n	%	n	%	n	%
Communication among farmers	1	8	4	44	2	33	7	26
Information sharing	1	8	3	33	1	17	5	19
Cohesiveness	11	92	3	33	6	100	20	74
Relationship with agric. Officers	4	33	2	22	2	33	8	30

Note: n is number of groups proving response to respective issue.

Positive impacts of FFS on natural capital of the farming were also identified by the several farmers group. Because of high level of inputs and services related to natural resources and their sustainability in the farming (Table 19). Farmers reported clear and noticeable positive impacts of FFS on natural capital such as improvement on soil fertility, increased biodiversity, and human health. There was also a highly similarity between perceived impacts reported by farmers in Aceh Besar and in Pidie. 37 % of the surveyed FFS site reported positive impacts on agro-ecosystem, largely due to balance population of pests and their natural enemies. FFS also led to improved soil fertility and more balance soil structures because of increased use of organic materials. Farmers also learnt techniques on reducing synthetic pesticides use, which helped in avoiding possible contamination to agro-ecosystem and the risk of pesticide poisoning. Farmers in Pidie and Northeast Aceh perceived higher impacts of FFS on chili farming than that those in Aceh Besar. All of them contributed to positive impacts on human health.

Table 19. Impact of FFS on natural capitals

Impacts	Aceh Besar		Pidie		Northeast Aceh		Total	
	n	%	n	%	n	%	n	%
Agro-ecosystem	6	50	4	44	0	0	10	37
Soil fertility	5	42	7	78	5	83	17	63
Natural enemies	2	17	0	0	0	0	2	7
Human health	3	25	2	22	2	33	7	26

Note: n is number of groups proving response to respective issue

However, farmers also perceived few negative impacts of FFS, as they believed that pests and diseases tend to increase if farmers do not perform regular observation in the field and adopt control measures. They believe that efficacy of botanical pesticides, the substitute of synthetic ones, was lower than that of chemical pesticides. Farmers also believed that the use of compost, the substitute of inorganic fertilizers, carries several seeds of weeds, thus increased use of compost in the community might also increased weeds infestation on the crop field.

In general, after completing FFS, farmers have realized that, they have been more benefits out of FFS, and the negative aspects of FFS are only minor not so important ones. In a short time, skill and knowledge on farming have been improved for many of the FFS participating farmers. These participants were interested, and also capable now, to adopt in the following crop season many of the technology-components learned during the FFS sessions. Likewise, farmers were willing to continue to learn more agricultural technology through FFS in the following season, if it were organized. Many of the participants were even agreed to pay for part of the cost associated with FFS training in the community, if were organized there again.

4.5. FFS impacts on farmers' overall knowledgebase: group survey

Farmers reported that their knowledge and skill on many aspects of chili farming have improved substantially after completing the FFS (Table 20). Using impact scoring method, we have analyzed increased farming knowledgebase of the participants. After attending the FFS, the FFS participants' knowledge on plant protection was increase by around 40 per cent than the level of understanding on plant protection that they had earlier.

Table 20. Improvement in farmers' knowledge on agronomy aspects of chili farming

Topics/Issues	Aceh Besar		Pidie		Northeast Aceh		Overall	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE

Insect pest	40	13	34	11	41	8	38	12
Diseases	42	12	40	9	46	10	42	10
Natural enemies of pests	40	12	36	9	38	7	38	10
Pesticides	42	8	43	8	50	16	44	10
Soil fertility	37	9	38	14	42	11	39	11
Use of organic fertilizers	50	18	40	18	49	14	46	17
Use of fertilizers	43	9	45	5	38	13	43	9

Note: SE is standard deviation, which indicates variation of farmers' responses

Farmers' understanding on diseases and pesticides has also increased dramatically. Before participating FFS, farmers knew little about pests and diseases on chili and kind of pesticides to apply for a particular pest and disease. Earlier, farmers knew nothing about natural enemies; then they also used to think that all insects found on the field were pests. After attending FFS, farmers have realized that not all insects are pests and they could able to distinguish harmful and beneficial insect types to chili and other vegetables from that of the harmful insect pests. Likewise, they also able to distinguish pollinators or natural enemies of pests. Farmers' knowledge on pesticides has been enhanced substantially, particularly knowledge on botanical pesticides. After the FFS, farmers also know that pesticides do not only kill insect pests, but also eliminate beneficial insects from the field, such as natural enemies of pests and insect pollinators.

Table 21. Improvement in information sharing and cohesiveness

Particulars	Percentage change after the FFS							
	Aceh Besar		Pidie		Northeast Aceh		Total	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Cohesiveness of farmers in the community	34	18	43	15	51	16	41	18
Information sharing within farmers' group	49	12	43	8	53	11	48	11
Information sharing between farmers' group	47	12	43	8	43	12	45	11

Note: SE is standard deviation, which indicates variation of farmers' responses

After completing the FFS, farmers felt that their knowledge on managing soil fertility and fertilizer application has enhanced than what they knew earlier (Table 20). Their know-how on application of manure increased by over 45% than the case earlier. After attending the FFS, solidarity of farmers' group also enhanced (Table 21). Likewise, after attending the FFS, intensity of information sharing among farmers within FFS group, as well as with non-FFS attending farmers has also been doubled.

4.6. Usefulness of FFS and farmers' feedback

Majority of farmers stated that FFS was very useful for them, particularly in improving their chili farming practices. All in all 15 different kinds of technology components[4] were introduced to farmers through a way of which farmer could interact with the trainer and learn from direct experience out of the on-farm field research (See Appendix). Out of these technologies, composting, identification of pests and diseases, and use of bio-pesticides were the three most useful topics for over 90% of the farmer-participants of FFS (Appendix 1). Likewise, over 90% of the FFS participants were eager to adopt these technologies on their field in the following season. It is not accidental that the most useful topics in FFS have also been interestingly delivered in the training. The most interesting contents in FFS are to create compost and pest and disease related issues (Appendix 1). The sesions of FFS delivered were simple and as per the level of understanding of farmer-participants, as none of farmers stated that FFS sessions were difficult to follow (Table 22). On overall, 73% of farmer participants understood most of topics delivered by the FFS facilitators.

Table 22 Simplicity of the FFS sessions delivered by the facilitators

Description	Number and percent of farmers reporting by site							
	Aceh Besar		Pidie		Northeast Aceh		Overall	
	n	%	n	%	n	%	n	%
1. Very easy to follow	23	19	7	8	5	8	35	13
2. Understood most of the topics	90	75	63	70	43	72	196	73
3. Fairly understandable	7	6	20	22	10	17	37	14
4. Some sessions were difficult	0	0	0	0	0	0	0	0
5. Most of session were difficult	0	0	0	0	0	0	0	0

Note: n is number of individual farmers providing response on the respective factors/issues.

Farmers were mostly satisfied with the way the FFS was implemented. Training facilities were adequate and the quality of trainer/facilitator was also high and as per need of the farmers at each site. Overall, the farmer participants scored as 7 (1 to 10 score where 10 is maximum) for both of

[4] Not all 15 technologies were introduced in all of the village suficient

training facilities and quality of training facilitator. Considering several other constraints in vegetable production in Aceh, such level of scores for the training are fairly well.

Even though farmer participants have satisfied with FFS, it does not mean that there were no major problems in the training process at all. In fact, farmer participants also identified and reported some of the constraints and limitation of FFS process as a whole. The major limitation of the FFS process initiated as reported by majority of the farmer participants are: the time of training did not properly match with the actual crop planting season in the local communities; several training materials and technology/inputs discussed at the FFS are actually not available in local market (such as bio-pesticide (neem), fruitfully pheromone, etc); size of trial plot designed for on-farm trails were smaller than the average plot size of the farmers for growing chili; at many places germination of seed was not satisfactory, there was shortage of irrigation water on trial plot during FFS period, and the trial plots at several places were also partially damaged due to freely roaming livestock (goat, cow, chicken) in the community.

For better implementation of the FFS for vegetables in the future, these issues need to be taken into consideration. In fact, farmers have also suggested following points to be considered while designing and planning FFS for vegetables in the areas in future, such as the FFS topics need to be better adjusted to local problems in each community; also need to involve other farmers in the community to avoid jealousy and conflict among members within a community; FFS process need to use materials that are easily applicable and available in the local markets; and if possible, FFSs should conducted on-farm trial on a larger plot size. They are very valuable suggestions and any agencies following up FFS in the region need to address these issues and concerns.

5. Conclusions and implications

During 2008-09, a chili crop based FFS on integrated soil management, combined with pest and disease management, was implemented in selected communities in Aceh that were devastated by the 2004 tsunami in the region. FFS does not only help farmers to enhance know-how and their skill on crop production but also help to enhance empowerment of the farmers groups. As expected, FFS has very favorably impacted on farmers' knowledge and farming practices. Farmers' ability of distinguishing harmful insects and beneficial insects has been improved substantially and their overall chili farming knowledgebase has been enhanced. The results on level of reduction on pesticides use and improvement on crop productivity are very much expected results of the kind of FFS that was implemented in Aceh. By and large, the FFS has been able to transfer improved technology components and farming know-how to majority of the farmers in the selected communities. The real beneficial impacts of FFS would be realized more when several of these farmer-participants also adopt the technologies introduced in the FFS Process.

At community level, the findings from the impact assessment suggest that the FFS has provided a very positive impact on all five categories of livelihood capitals of the average farming households in the project implemented sites. Some of the major impacts of the FFS, as perceived by the majority of farmers, are as listed below. After participating in the FFS, farmers believe that they would use farm inputs more efficiently, without any loss of crop yield they think that they will be able to reduce the level of chemical inputs that are environmentally unfriendly (reduce level of application of chemical pesticides), and/or, would replace them with inputs that are environmentally friendly (organic in origin or less toxic compounds). The farmer participants also believe that they can reduce cost of chili production by over 1/3rd than the cost incurred now simply by following some of the techniques learnt at the FFS, which will ensure more productivity and more profit from the chili farming. Likewise, in term of social implication of the FFS, majority of the farmer participants also feel that participation in the FFS has further enhanced solidarity and interaction among farmers, and between farmers and agricultural officers in the surveyed areas. After the FFS, sharing of crop production and extension related information became more effective as the number of farmers' group meeting in a year has increased substantially. These kinds of impact were also due to improvement on human capital of the FFS participants, and an increased farming related knowledgebase of the participants.

In addition to enhanced farmers' understanding on chili production practices, farmers' awareness on marketing of vegetable production, particularly chili, has also been increased. All of these processes have also help in strengthening chili farmers' group formation process in the local communities, which will also help in improving market access issues in the future. Farmers also feel that they can now make better negotiation with traders or chili collectors in their communities. In short, FFS has successfully delivered the improved knowledge and know-how on chili production to the selected farmers who attended FFS, some of these impacts would spread even in far-flung locations in Aceh. This knowledge is equally also relevant for production of other vegetables, and improving farming practices in Aceh, in general. Farmers also expressed their interest to continuation of such FFS in the future even with sharing part of the cost for its implementation, which reflects farmers have very well realized usefulness and value of such FFS for enhancing crop productivity and farm income. There are some indications that the local agricultural extension (and partner agency of this project in Ache) would also continue some of the FFS in selected few locations in the future. We also believe that the farmers' suggestions and feedbacks on the process of FFS, and results from impact evaluation as documented in this study, will be useful to any future FFS program for vegetables production to be implemented in Aceh or other parts of Indonesia.

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Appendix 1: Farmers choices and preferences over the FFS topics included

Table A1. The technology components/topics of FFS session those are very useful

Description	Number of farmers reporting							
	Aceh Besar		Pidie		Northeast Aceh		Overall	
	n	%	n	%	n	%	n	%
1. Composting	117	98	84	93	56	93	257	95
2. Botanical pesticide	108	90	75	83	50	83	233	86
3. Learning about natural enemies	114	95	80	89	56	93	250	93
4. Fruit fly pheromone	115	96	72	80	54	90	241	89
5. Light traps to control insect	106	88	74	82	46	77	226	84
6. Pest and disease identification	117	98	80	89	43	72	240	89
7. Proper pesticide uses	101	84	78	87	45	75	224	83
8. Use of bio-pesticides	117	98	82	91	49	82	248	92
9. Use of sticky traps for insect	103	86	65	72	48	80	216	80
10. Netting over nursery	119	99	80	89	49	82	248	92
11. Use of mulch	94	78	62	69	49	82	205	76
12. Starter solution technology	106	88	66	73	50	83	222	82
13. Hot water seed treatment	113	94	63	70	50	83	226	84
14. Soil fertility/fertilizer management	99	83	60	67	49	82	208	77
15. Drip irrigation/water management	67	56	15	17	14	23	96	36

Note: n is number of groups proving response to respective issue.

Table A1.2 The most useful topics of FFS as perceived by the farmer participants

Description	Aceh Besar		Pidie		Northeast Aceh		Overall	
	Rank	Freq	Rank	Freq	Rank	Freq	Rank	Freq
1. Composting	4.15	108	2.90	61	3.30	43	3.54	212
2. Botanical pesticide	1.14	37	0.37	13	0.40	8	0.72	58
3. Learning about natural enemies	0.64	22	0.86	24	0.83	14	0.76	60
4. Fruit fly pheromone	0.67	26	0.06	1	0.17	2	0.35	29
5. Light traps to control insect	0.02	1	0.00	0	0.00	0	0.01	1
6. Pest and disease identification	1.70	59	2.43	53	2.33	31	2.09	143
7. Proper pesticide uses	0.29	10	0.82	21	1.00	18	0.63	49
8. Use of bio-pesticides	1.57	50	1.04	28	1.42	22	1.36	100
9. Use of sticky traps for insect	0.33	12	0.67	21	0.12	2	0.39	35
10. Netting over nursery	1.83	61	2.18	56	1.12	19	1.79	136
11. Use of mulch	0.08	5	0.16	7	0.00	0	0.09	12
12. Starter solution technology	0.19	16	0.00	0	0.00	0	0.09	16
13. Hot water seed treatment	0.28	13	0.00	0	0.00	0	0.13	13
14. Soil fertility/fertilizer management	0.23	8	0.43	9	0.37	5	0.33	22
15. Drip irrigation/water management	0.38	23	0.41	17	0.07	1	0.32	41

Note: Larger the value of rank the more important the topic as perceived by the farmers.

Table A 1.3 The most interesting FFS topics as perceived by the farmers

	Aceh Besar		Pidie		Northeast Aceh		Overall	
Description	Rank	Freq	Rank	Freq	Rank	Freq	Rank	Freq
1. Composting	3.14	79	3.04	64	3.00	37	3.08	180
2. Botanical pesticide	0.70	23	0.34	10	0.25	5	0.48	38
3. Learning about natural enemies	1.55	49	1.07	26	1.00	15	1.27	90
4. Fruit fly pheromone	0.53	20	0.00	0	0.00	0	0.23	20
5. Light traps to control insect	0.11	3	0.00	0	0.00	0	0.05	3
6. Pest and disease identification	0.76	27	2.01	43	1.90	25	1.43	95
7. Proper pesticide uses	0.15	8	1.09	27	0.60	10	0.56	45
8. Use of bio-pesticides	0.19	14	0.52	16	0.57	11	0.39	41
9. Use of sticky traps for insect	0.13	4	0.00	0	0.00	0	0.06	4
10. Netting over nursery	1.19	38	1.87	49	1.88	32	1.57	119
11. Use of mulch	0.08	5	0.22	10	0.00	0	0.11	15
12. Starter solution technology	0.38	12	0.00	0	0.00	0	0.17	12
13. Hot water seed treatment	0.35	14	0.00	0	0.00	0	0.16	14
14. Soil fertility/fertilizer management	0.24	7	0.33	7	0.42	6	0.31	20
15. Drip irrigation/water management	0.57	20	0.58	15	1.27	21	0.73	56

Note: highest rank is the most important

Appendix 2: An overview on standard procedures on implementing FFS

A unit of FFS could comprise the following key elements. A FFS consists of training a group of 20-25 farmers, selected either from one farmer group, or across such groups within one village. Ideally, it is expected that about 1/3rd of participants would be woman farmers, which in fact varies by several local factors in the communities. Each FFS has one training field, divided into two plots: one new managed field and one field with locally conventional management. The main activity of FFS, the first thing to do in the morning at each FFS site, is to go into the demonstration fields in groups of five to six farmers and observe sample plants, usually chosen randomly along a diagonal across the field. Observations will be made and noted down of insects, spiders, damage symptoms, weeds, and diseases, observed on each plant. The stage of the plant is carefully observed, as is the weather condition. Interesting insects and other specimens are caught and placed in small plastic bags to be discussed in the subgroup and group with facilitator. The field has become the main training material and farmers' own observations the source of knowledge for the group. During each session, special subjects are introduced. Special topics relate to pertaining field problems such as growth of rat population, effects of insecticides on natural enemies, and life cycles of pest, and so on. Group dynamics, which are exercises enliven the field school and create a strong sense of belonging to the school and in a close cohesive group in the community. Through their own experiments and observations, farmers gain ecological knowledge. To be a standard process of learning, FFS needs sufficient material and financial supports, which constitute honorarium of the facilitator, preparation and coordination expenses, facilitator's transport, materials, refreshments, compensation of land. Detailed over views on standard procedures of FFS for rice and cotton and other major crops as adopted in Asia and in Africa are summarized and documented in FAO (2000), Van den Berg (2004), Feder et al (2004), and Norton et al (2005).

There are essential processes that have to be fulfilled to enable FFS can run normally. Several weeks before planting, the group of facilitator has to make consultation and coordination with other programs working in the regions; identification of communities that fulfill the criteria for establishing FFS; and identification of suitable participants. Observation, analysis and action FFS hold 12 times of weekly meetings throughout one planting season (around three months). The first meeting begins two to three after planting. This is to cover observation of all critical stages of growth and development of crops. Improved decision making rises from an iterative process of analyzing a situation from multiple points of view, synthesizing the analysis, making decisions correspondingly and implementing the decisions, observing the outcome, and then evaluating the overall impact. This process is carried out using a framework of an agro-ecosystem analysis. All participants learn about the agro-ecosystem and dynamics of insect population during the process of making observations in the two plots during one planting season. Agro-ecological systems are structured by a few key processes. The key to understanding pest outbreaks lies in comprehensive relationships between dynamics of insect pest and its natural enemies in which farmers lack knowledge of the relationship. The school includes insect zoo activity, a topic designed to open unknown the complexity of agro-ecosystem. Farmers observe the dynamics of insects representing natural food chains in agro-ecosystem. The most important concept discovered by farmers through this special topic is ability of determining whether insect is pest, which is unbeneficial or natural enemies and other insects, which are beneficial. In each FFS meeting, there is a group dynamics, which is an exercise to strengthen teamwork and problem-solving skills, promote creativity and create the importance role of collective action. The facilitators suggest a problem or a challenge to be solved. The exercise usually involves physical activities but some time takes the form as rational puzzles or brainteaser in a fun manner.

In reality, the FFS involves not only pest control but also other aspects of farming such as balanced and efficient fertilizing, efficient use of water, crop rotation and soil conservation (Untung, 1996). The focus of the FFS was, and still is, on learning process through discovery, experimentation, informed decision making, and group or community leadership and action (Mancini. and Jiggins, 2008). Thus, FFS has social goals beyond mere changes in pest-management techniques: goals that seek to position farmers as field experts, who collaborate with the extension staff to find solutions relevant to the local realities. FFS programs emphasize farmers’ ownership of development processes, partnership with other development agents, and group collaboration. Evaluations of the accomplishments of various FFS programs agree in their main conclusion that attending an FFS strengthens farmers’ ecological knowledge of pests and predators. In most reported cases, the understanding of the crop ecosystems has induced a reduction in pesticide use, as well as higher yields and profits.

Appendix 3: Photos illustrating some key activities of FFS in Aceh

FFS Facilitator illustrating anthracnose and fruit fly damage on chili peppers with participating farmers (one session of FFS in Aceh)

Farmer participants observing the chili pepper plants in the FFS plots

Appendix 3: Documentation of Survey

Participatory Rural Appraisal for evaluation of impacts of FFS in Aceh, 2009

Individual Survey of FFS participants