広島大学ホームカミングデー　生物生産学部・生物圏科学研究科企画

第 4 回 生物圏科学研究科 食料・環境問題国際シンポジウム
「農業・水産現場の自然災害からの復興」

The 4th International Symposium on Food and Environment
“The recovery of agriculture and fisheries from natural disasters”

日時：平成２３年１１月 ５日（土） 13:00 – 16:30
場所: 広島大学生物生産学部 C206 講義室

Date: 5 Nov (Sat) 13:00 - 16:30
Venue: Room C206, Fac Appl Biol Sci, Hiroshima Univ.

研究科長からのご挨拶

近年、アジア地域では、インドネシアの火山噴火、タイでのインド洋地震と津波、中国の四川大地震、および日本での東日本大震災といった自然災害により、農業、水産の現場が甚大な被害を受けています。このシンポジウムでは被災状況を理解し、被災から復興するために大学や試験研究機関が何をできるかについて意見交換します。皆様の活発なご討論をお願いいたします。

研究科長　江坂宗春

Greetings from the Dean

Recently, natural disasters such as the Sumatra earthquake, tsunami and volcanic eruptions in Indonesia, the big Sichuan earthquake in China, the Indian Ocean earthquake and tsunami in Thailand as well as the most recent Tohoku earthquake and tsunami in Japan attacked on agriculture and fisheries facilities in Asia. In this Symposium, we would like to compare information on the various impacts of natural disaster, and discuss the critical role of universities and research institutions in the remediation and recovery efforts to help stabilize food production in these countries. I hope we can learn a lot about this difficult problem through active discussions.

Dean, Prof Muneharu Esaka

Program プログラム

13:00 Part 1　第 1 部
Welcome message from the Dean　（研究科長からの歓迎のご挨拶）
（Dean, Muneharu Esaka　江坂宗春 研究科長）

Effects of the 2004 Indian Ocean tsunami and recovery on aquaculture and fisheries in Thailand
（タイの水産と増養殖が受けた 2004 年インド洋津波の影響と復興）
Methee Kaewnern (Kasetsart University, Thailand)
Chair 司会:　Yukinori Yoshimura 吉村幸則　---Page 1

Recovery of the fishery sector for “Build Back Better” after the 2004 tsunami: Lessons learned from livelihood activities in fishing community, Nangroe Aceh Darussalam (NAD), Indonesia
（2004 年津波後のより良い水産業を構築するための復興: インドネシアのナングロエ ・ アチェ ・ ダルサラームの漁村生活からの教訓）
Achmad Zamroni and Masahiro Yamao (Hiroshima University, Japan)
Chair 司会:　Tadashi Shimamoto 島本　整　---Page 4

Post-disaster (The 2011 East Japan Disaster) recovery plans in Miyagi: Reconstruction of macroalgae aquaculture and new development of microalgae production
（宮城県における 2011 年東日本大震災後の復興計画 : 大型藻類養殖の再生と微細藻類生産の新規開発）
Hiroshi Sasaki[1] and Hiroshi Ito[2] ([1]Senshu University of Ishinomaki, [2]Miyagi Prefecture Fishery Technology Institute, Japan)
Chair 司会:　Kazuya Nagasawa 長澤和也　---Page 8

14:40　Coffee break　休憩
Poster presentation of the research supported by the 2010 Grant-in-aid from Dean
（2010 年度研究科長裁量経費助成研究成果のポスター発表）

15:00 Part 2　第 2 部
International agricultural assistance in the 5.12 Wenchuan Earthquake areas: Is agro-input voucher the answer?
（四川省文川(Wenchuan)地震被災地域における国際農業支援: 農業インプットの回答か？）
Yuansheng Jiang, Hua Guo and Gang Fu (Sichuan Agricultural University, P.R. China)
Chair 司会:　Teruo Maeda　前田照夫　---Page 10

Lesson-learned and approach in recovering agricultural practices after natural disasters in Indonesia
（インドネシア自然災害後の農業復興の取り組みと学んだ教訓）
Didik Indradewa (Gadjah Mada University, Indonesia)
Chair 司会:　Yoshikuni Masaoka 正岡淑邦　---Page 18

16:00
General Discussion　総合討論
General Chairman 総合司会: Lawrence M. Liao and Yukinori Yoshimura

16:30　Closing remarks　閉会

Effects of the 2004 Indian Ocean Tsunami and Recovery on Aquaculture and Fisheries in Thailand

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At 07.58 am of 26 December 2004 the strongest earthquake in the world since 1964 with the magnitude of 9.0 occurred under the Indian Ocean at the west coast of Sumatra, Indonesia, had triggered the cataclysmic tidal wave leading to tsunami which hit and devastated 6 Andaman coastal provinces of Thailand. It is a worst natural disaster that affected massive livelihood in Thailand. Over 8,000 people were died and more than thousand were injured. It damaged or destroyed thousands of houses, buildings, roads, bridges, and other physical infrastructure. Total damages were assessed at around 508 million USD, while losses were estimated at 1,690 million USD. The total of 2,198 million USD accounted for 1.4 percent of GDP. The impact on the affected provinces was quite severe. It was assessed to be equivalent to one half of the combined gross provincial product (GPP). In some cases, such as in the case of Phuket, damage and losses accounted for 90 percent of GPP, and in Krabi and Phang Nga, they were around 70 percent.

The impact of the tsunami was spread over 6 Andaman coastal provinces of Thailand (Phang Nga, Phuket, Krabi, Ranong, Trang and Satun) which comprised of 25 districts 95 sub-districts and 412 villages. In total, the tsunami directly affected 12,815 households comprising more than 58,550 people. A total of 3,302 houses were destroyed and 1,504 were damaged. Phang Nga accounted for 52 percent of total house destruction, followed by Phuket with 21 percent, and Krabi with 14 percent.

Phang Nga suffered the most in terms of human and economic losses (79 percent of the total 5,395 victims), Krabi was the second heaviest loss of life (13 per cent), but damages to infrastructure and the business sector were higher in Phuket province, which suffered the most serious damage to infrastructure of around 100 million USD. Ranong, Trang, and Satun province, suffered mainly from damages to aquaculture and destruction of fishing boats and equipments.

The reports of losses for fisheries and/or aquaculture were in 74 sub-districts and a total of 386 villages Fishing boats that have been reported lost or damaged are 894 large boats (over 10 meters length) and 6,568 small boats (below 10 meters length). Meanwhile, 110,129 units of fishing gears such as gill net, fish trap, squid trap and crab trap were damaged. Beside the fishing boats and gears, a number of fish landing sites in Ranong, Phangna, Satun was also damaged.

For aquaculture, damage and loss of fish cage culture were reported. Normally, cage culture areas are in the mouths of estuaries, seaward parts of delta and/or mangrove areas. These culture areas therefore were affected with rapid rising waters and wave of the tsunami and resulted in the

breakup of the cages and loss or escape of the stocks. More than 1,224,000 m^2 of affected cages were reported. Ranong province was the largest area of cages impacted which amount of 856,000 m^2. Phang Nga province has also a large area of cages impacted (140,870 m^2). Meanwhile the affected cage area in other provinces varied from 23,600 to 84,500 m^2.

Most shrimp hatcheries were not damaged but there are reported of damage in Phuket and Phang Nga with area of 73,300 and 16,100 m^2, respectively. These effected mainly found in medium scale operations. The loss of the hatcheries could affect supplies of post-larvae in Thailand however it is still a limited percentage. There are few reports of damage for shrimp farm and fish hatchery, however at least a damaged grouper hatchery in Phuket was reported.

There was an established system for recovery and registering losses in fisheries and aquaculture. The Thai Department of Fisheries (DOF) established a "Fisheries Rescue Centre" to coordinate and collect of damage and loss information from affected provinces. Primarily, data collected is focused to the cases of lost or damaged fishing boat, fishing gears, and losses incurred in aquaculture farms. Losses or damage claims that may be eligible for government compensation are registered at the Provincial fishery office. The total Cabinet approved budget for RTG's tsunami response is 5,252 million baht, of which, the DOF had 1,343 million baht approved to assist 27,828 fishermen. This includes the repair of 3,426 small fishing boats and 544 larger fishing boats. The compensation criteria and rates were set up for fishing boat, fishing gears, aquaculture and labors.

Beside DOF, many international (such as FAO, CHARM, USIAD etc.) and national organizations including local NGOs played important roles in damages investigation and recovery. FAO was a key international organization in assistance on fisheries and aquaculture, FAO assisted the government's efforts to re-establish sustainable fisheries activities, rehabilitate affected or damaged areas and restore fishermen livelihoods. FAO reported that over 800 fish cages, 180,000 fish fingerlings, 18,000 traps (crab, squid and fish traps) 3,000 sets of shrimp gill nets, 400 wood pieces for boat repair and 300 fish cage nets, 400 boat engines and associated accessories were supplied to fishermen. FAO also approved project for supporting the government on a technical assessment to determine the fishing capacity level and a stakeholder analysis for implementing community-based sustainable coastal resource management as well as empowering coastal fishing communities for the development of their self-help capacities. The project enhanced the coordination capacity of the DOF under a joint DOF-FAO post-tsunami rehabilitation coordination unit which established within the DOF. CHARM was another international organization cooperating with DOF generated project to introduce community-based coastal resources management involving local stakeholders and community people.

NGO and local organizations network played also important role in recovery. A number of public organizations and NGOs have united and mobilized themselves to form the networks for rehabilitation of community and coastal resources. The networks have worked to highlight problems faced by the marginalized groups as a result of the tsunami and facilitate the process to ensure

appropriate immediate and long-term rehabilitation through people's participation. They also provided an immediate relief and ensured sustainable recovery of community and the natural resources.

Academic, research institutions and other relevant organizations not only in Thailand but also abroad also played their key roles to support, conduct and/or produce information to supporting damage investigation and recovery. Several research projects were funded and conducted after tsunami to study on current status, its impacts both in natural and social science aspects. The National Research Council of Thailand (NRCT) and Thai Research Fund (TRF) are the main research funding sources of Thai's government that provided fund for various academic and research institutes according to tsunami impacts and recovery. Besides funding support, some organization also played its role as data and information provider for researchers. Geo-Informatics and Space Technology Development Agency (GISTDA) is an example that provided satellite images or remote sensing data for interested researchers. Research projects on tsunami impacts and recovery in Thailand were not only conducted by Thai researchers themselves, but many projects were joined projects that the researchers came from international organizations or aboard universities.

Recovery of the Fishery Sector for "Build Back Better" after the 2004 Tsunami: Lessons Learned from Livelihood Activities in Fishing Community, Nangroe Aceh Darussalam (NAD), Indonesia

Achmad Zamroni and Masahiro Yamao
Graduate School of Biosphere Science, Hiroshima University, Japan

1. On December 26, 2004, a large earthquake measuring 9.1 on the Richter scale resulted from the movement of two tectonic plates on the ocean floor along a 1,600 km length. Three months later, another earthquake measuring 8.7 on the Richter scale occurred on the nearby island of Nias. About 650 villages were affected by the tsunami that followed and more than 50% (340 villages) suffered damages. The west coast of Aceh was worst hit by the tsunami. About 80 coastal villages of Nias were affected by the tsunami where more than 40,000 people became homeless. According to the final report of the Agency of Rehabilitation and Reconstruction (BRR) for Aceh and Nias, 126,741 lives were lost, 93,285 people declared missing, 500,000 survivors lost homes and 750,000 people lost their livelihoods (BRR, 2009) .

2. In the fisheries sector, 13,828 fishing boats were lost, 27,593 ha of brackish fishpond disappeared, 104,500 small to medium businesses were affected. In addition, the loss of 16,775 ha of coastal forests (mangrove） and 29,175 ha of reefs were documented (BRR, 2009). The total damage to fisheries was estimated to be worth around US$ 600 million, with 50% of the total losses in Indonesia. Small fishers, big vessel owners and crewmembers, fish processors, workers, fish traders, etc. were affected by the tsunami, and almost all kinds of fisheries business had suffered great difficulty in their operation. The aquaculture sector contributed 16% of the total fish production, supported about 4% of the provincial economy and 94,000 people were employed in 47,000 ha of brackish water facilities (local name: *tambak*). The impact of the tsunami was not only in *tambak* physically, but also in terms of cultivated land, livelihoods and capital. At present, these sectors have already improved beyond the rehabilitation and reconstruction phase. FAO noted that 20,429 ha (42.9%) of brackish water in Nangroe Aceh Darussalam (NAD) represented lost production capacity. About 7,300 ha of brackish water were heavily damaged and another 1,000 ha was lost due to the coastline shift. Related with infrastructure, 810 km (66.8%) of irrigation channels and 193 units of hatcheries were severely damaged (Phillip and Budiman, 2005). Furthermore, about 19 units (0.37%) of TPI (places of auction) were damaged, 32 of 72 units of fish landing facilities (PPI) affected by tsunami, 9,563 of 16,070 units of fishing fleet had been affected by the tsunami[1].

3. This paper aims to review the recovery of the fishery sector after the tsunami by referring to problems and issues about marine and fisheries rehabilitation, and to learn the lessons of community

1 The fishing fleet included 3,969 units (41.5%) of boats without motor, 2,369 units (24.8%) of boats with outboard motor and 3,225 units (33.7%) of motor boats sized between < 5 GT and 50 GT

based participation for rehabilitation and reconstruction of the fisheries sector affected by the tsunami in NAD. This study is mainly based on literature review with supplemental information from additional surveys.

4. Since the mid-2005, various donors, including international non-governmental organizations (NGOs) came to assist the Government of Indonesia (GoI) in starting aquaculture rehabilitation and livelihoods of tsunami-affected fishers. In aquaculture, the FAO in cooperation with the Ministry of Marine Affairs and Fisheries (MMAF) and the Australian Centre for International Aquaculture Research (ACIAR) published and promoted 15 steps as a guideline for aquaculture rehabilitation in Aceh, which was divided into three stages: firstly, an assessment, community mobilization and planning[2]. Second was rehabilitation[3]. Third was crop management and extension[4] (Padiyar et al., 2005).

5. The process of reconstruction and rehabilitation of marine and fisheries sector in Aceh and Nias was made possible by several actors. 1) The GoI established a coordination body called Reconstruction and Rehabilitation Body (BRR)[5]. It seeks to ensure community participation, maintenance of quality standards, identify problems, gaps and help finding solutions in close collaboration with government bodies, NGOs, communities and civil society. 2) Government fishery institution such as Ministry of Marine Affair and Fisheries (MMAF) was involved in planning and coordinating the multilateral and bilateral projects included in facilitating counterpart of fishery programs. 3) United Nations (UN) and international financial institutes such as FAO collaborated with MMAF in producing a series of assessment related to rehabilitation, damage in various fisheries such as capture fisheries, aquaculture, boatbuilding, infrastructure and fish processing. Meanwhile, ADB supported some components for rehabilitation of fisheries, namely; community empowerment, rehabilitation of small-scale capture fisheries, rehabilitation of aquaculture facilities and production systems, rehabilitation of small-scale fish landings and post-harvest facilities, coastal rehabilitation and support services for restoration and provision. 4) International and local NGOs and many international donors contributed to the rehabilitation of fisheries and fishing community, not only fisheries exclusively but also non-fisheries. International donors such as JICA, Oxfam, Mercy Corps, ICR, UNDP, have distributed the aids to support various economic activities. 5) Traditional

2 The steps: a) Village entry and primary assessment, b) rapport building and motivating the farmers, c) participatory detailed need assessment, d) cluster mapping, e) farmer group building, and f) participatory rehabilitation planning.

3 This stage includes farm and canal re-construction, and planting the mangroves.

4 This stage has seven steps, a) crop planning and prioritizing the better management practices, b) procurement of farm inputs, c) extension services, d) management of common water resources, e) marketing farm produce, f) monitoring and evaluation and g) sharing experiences

5 The main role of BRR was to coordinate the disbursement of aid funds and ensure that they are used effectively, quickly and transparently.

institutions such as the*Panglima laot*[6] has existed in the coastal areas of Aceh since the 4th century. In this case, the *Panglima laot* coordinated in debris clean up, gave living allowances to families, organized a province-wide prayer meeting, consulted and coordinated government and donor activities, and provided training for fishers in cooperation with several NGOs (Pomeroy et.al., 2006).

6. MMAF of Indonesia has adopted the policies to restore the economic condition of fishermen, fish farmers and people who lived in the coastal area. Temporary employment[7] was created to recover temporary economic activities in the work for cash scheme. It aims to help people with cash payment in order to fulfill their daily needs. The working capital was given to both fishermen and fish farmers to re-start their business. Of course, it was supported with technical assistance coming from the private sector especially banks to provide the means for rebuilding infrastructure. Further effort was conducted to develop fishery activities, such as; 1) rehabilitation of capture fishery, 2) rehabilitation of fish culture, and 3) rehabilitation of fishery infrastructure. Rehabilitation of capture fishery aimed to encourage fishermen to go to the sea again and increase production of fish and simultaneously to ensure economic ability of fishermen. Rehabilitation of fish culture was aimed to boost fish production in existing fishponds or *tambak* with technical assistance that provided baby fishes (seeds) or fries, feed mills, pesticides etc. Besides, MMAF had rehabilitated fishery facilities such as fish landing base, fishery port, hatchery, fishery quarantine station and fishery school.

7. According to some reports, there are at least 3 major problem issues in the rehabilitation of the tsunami affected fishing communities; 1) coordination and control, 2) competition and 3) complaints. The international community includes international NGOs, UN agencies and the Indonesian government including military authorities provided immediate relief. Unfortunately, they lacked the coordination on needs assessment, approaches and implementation. In some cases, local government such as district and sub district ignored minimum standard and scientific norms in the adjustment of the agenda and regulations from the agencies since there were many strategies of interventions to the problem. There was a lot of money to spend and signing MoU with local governments in beneficial activities, but they lack an integrated concept. Finally, local communities often did not know whom they should address and where they had to register their protest and criticism. However, since BRR was established, rehabilitation and reconstruction process gradually became more effective.

8. Low and unsuitable quality of some aids such as the boats was observed in the case of unsuitable designs of boat for local condition, low quality of materials, low ability of technicians, etc. In this case, the small boats given to small fishermen were more effective than those of larger sizes.

6 In general, the tasks of the Panglima laot are to control all customary sea law decisions, coordinate fishing ventures, resolves disputes and conflicts, administer all traditional sea ceremonies, attempt to improve the standard of living in the area, and, at the provincial level, act as a link between the fishing community and outsiders (other communities and government).

7 Temporary employment activities: boat repair, pond cleaning, irrigation water cleaning, re-construct canals and other cleaning activities.

The smaller boats were more important for small fishermen for going back to the sea to catch the fishes.

9. Finally, rehabilitation and reconstruction after natural disaster need extraordinary efforts in order to maximize their impacts. At first, a simple design of re-development concept, uncomplicated bureaucratic procedures and greatest commitments among the people are needed to start a better work. These principles could be used to support an organization that has a flexible work system (such as ad hoc organization), which operates for reconstruction and rehabilitation. A community-based livelihood program is a suitable approach to encourage fishermen and fish farmers to involve them in rehabilitation activities and restore them to normal life. Strengthening *Panglima Laot* as a local-traditional institution is needed to improve their capacity and maintain information flows from and to the coastal communities.

Post-disaster (The 2011 East Japan Disaster) recovery plans in Miyagi: Reconstruction of macroalgae aquaculture and new development of microalgae production

Hiroshi Sasaki[1] and Hiroshi Ito[2]
[1]Senshu University of Ishinomaki, [2]Miyagi Prefecture Fishery Technology Institute, Japan

The Great East Japan Earthquake (magnitude 9.0) occurred at 14:46 JST on Friday, 11 March 2011, with the epicenter approximately 80 km east of Ishinomaki, Miyagi. It was the most powerful earthquake to have hit east Japan. The earthquake triggered extremely destructive tsunami waves of up to 40.5 m in Miyako, Iwate. The massive tsunami killed thousands of people and flooded nearly half of the city Ishinomaki. In addition to loss of life and destruction of infrastructure, the tsunami caused many nuclear accidents in the Fukushima Nuclear Power Plant.

What do people need in disaster areas? For example, people who lost their houses and jobs need temporary houses, jobs and money. Fishermen or aquaculturists who want to restart their works, need new fishing boats or restored aquaculture facilities. People who hope a step forward than before, need developments of new industry with jobs using unused natural resources. Recovery activities have begun to rise up from the disaster in Miyagi as well as in Iwate and Fukushima. The present report looks only at some of the ongoing activities of industries using aquatic biological resources in Miyagi. One of them is the post-disaster reconstruction of aquaculture with macroalgae (seaweed "Nori") to pre-disaster level, and the other is the post-disaster plan of new development of microalgae industrial production.

In Miyagi, all sea-based facilities (rafts with bracing struts) for seaweed aquaculture ("Nori") were destroyed, and most of shore-based facilities for processing and making manufactured "Nori" are unavailable due to tsunami attacks. Then the production of "Nori" in 2010-2011 decreased to 390 million sheets $year^{-1}$, being 56% of the average yearly production. Thereafter the "Nori" aquaculture industry is being restored and reconstructed by intensive efforts of aquaculturists and communal supports both by the Miyagi Fishery Cooperatives and the Miyagi Prefecture Fishery Industry Institute. Main approaches for the recovery are (1) to obtain new seed spores from outside Miyagi, (2) to know environmental changes around aquaculture areas due mostly to the ground sinking, and to maintain sea-based facilities for effective spore fixing and nursing culture processes in optimum environmental conditions as much as they can. In addition to these technical approaches, (3) cooperative networks will have to be organized using available sea- and shore-based facilities.

One of the post-disaster plan of new industry development using unused natural resources is to make use of marine "microalgae". Microalgae contain lipids (<20%), and some of them with high lipids (>30%) are of great interest in the search for mass-oil producing crop (e.g. biofuel). Marine microalgae have advantages for fuel production relative to land plants for the reasons that (1) the rapid growth rates (high CO_2 uptake, rates), (2) the higher lipid and hydrocarbon contents, and (3)

the higher production efficiency in terms of biomass produced per unit area. Furthermore, the microalgae production plants can be built in disaster areas, primarily because afflicted people need to reutilize extensive damaged rice fields flooded by saltwater of tsunami and depressed lands due to ground sinking at waterfronts which will never be used as rice fields and residential areas. One of the promising microalgae is *Nannochloropsis* sp. of <5μm in diameter which is known to have high lipid contents. Brief summary of our study is as follows. The maximum cell density of *Nannochloropsis* sp. reached to $>10^8$ ml^{-1} in laboratory culture bottles. The cells become bloated (rich in lipids) under low temperature (<10°C), which can adapt to natural winter temperature in Ishinomaki. The cell yields (cell density × cell volume) in an outdoor culture tank can be maximized through the year under controlled conditions (optimum incubation time, and enough supply of nutrients and CO_2 etc.). The maximum cell yields will be profitable as lipid-producing microalgae.

What do we have to do next are (1) to find other potential algal strains such as *Aurantiochytrium* sp. which possibly grow faster than *Nannochloropsis* sp., (2) to know how to maximize cell yields in outdoor big culture tanks, irrespective of season, (3) to extract effectively useful lipid constituents (e.g. EPA), and (4) to collaborate closely with chemical and mechanical engineers, and specialists of business managements, which will lead us to develop new industry of microalgae.

Although the recovery activities need to be supported financially, the recovery plans mentioned above of local level initiatives does not require the complex and time-consuming processes of governmental level with long-term reconstruction plans. These activities should contribute to improving the conditions of afflicted people through the revival of aquaculture and biological resource industries, and go beyond the simple restoration of pre-disaster levels, but step forward the creation of more sustainable livelihoods.

International Agricultural Assistance in the 5.12 Wenchuan Earthquake Areas: Is Agro-input Voucher the Answer?

Yuansheng Jiang, Hua Guo and Gang Fu
College of Economics and Management, Sichuan Agricultural University

Abstract: It was imperative to assist agriculture in disaster-affected areas with agricultural inputs because home rebuilding was their priority, which had almost depleted them of money. Agricultural input voucher program (AIVP) launched by the Food and Agriculture Organization of the United Nations was an innovation for international agricultural assistance to disaster-affected areas and was for the first time used in the 5.12 Wenchuan earthquake stricken areas. First of all, this paper briefly introduces the operating procedures and mechanism of AIVP. The major objective is to evaluate the impact of agro-input voucher programs on agriculture, livelihood of farmers based on a dataset collected from a 454-household questionnaire survey. Results demonstrated that the AIVP had a positive impact on agricultural production, rural livelihoods, local agro-input markets, and was more efficient in assisting the affected farmers in restoring their production and livelihoods compared with direct input distribution program (DID). Results also indicated that the beneficiaries prefer AIVP over DID approach. Some experiences and lessons from the program implementation were summarized. It concludes with a few recommendations for perfecting the procedures.
Key words：Agricultural Inputs, Voucher, Evaluation, lessons

1. Introduction

The Wenchuan earthquake on May 12 of 2008 and the abnormally strong rains that followed not only deprived hundreds of thousands of people of lives and made millions families displaced but also caused a huge loss to agriculture. In order to restart the rural farmers' agricultural production to secure their livelihoods, a total of US$2,261,391 of fund donated by Sweden, Belgium, Luxemburg, Latvia, as well as FAO itself were utilized to assist in agricultural production in the worst-disaster areas. The international agricultural aid executed by FAO included four projects coded as OSRO/CPR/801/BEL, TCP/CPR/3108, OSRO/CPR/802/LUX and OSRO/CPR/803/SWE and were implemented through two approaches: *Direct Inputs Distribution* (DID) and *Agricultural Inputs Voucher Program* (AIVP). The Food and Agriculture Organization of the United Nations (FAO) used to assist the disaster-affected farmers by providing agro-inputs via DID program. It has frequently been criticized for its limited choice of inputs, late arrival, and arbitrary decision on needs of farmers'. The AIV Program was a tentative program innovated by FAO to address the problems with DID program and used for the first time for international agricultural assistance in the 5.12 Wenchuan earthquake affected areas in China.

In general, a voucher is an official piece of paper which is worth a certain monetary value and which may be spent only for specific reasons or on specific goods. Agricultural input voucher is issued by Chengdu office of the FAO and the Department of Agriculture (DoA) of Sichuan that can be used to buy agro-inputs in designated agro-input stores. There have been a few reports of

fertilizer subsidy vouchers in African countries, e.g., Malawi, Mozambique, Zambia (Dorward, 2008; Longley, 2005). However, it is for the first time that an international agricultural assistance to the disaster-affected farmers is being implemented through an approach of agro-input voucher. The most important difference between agro-input voucher in the international aid program and African fertilizer voucher is that AI voucher being a complete substitute of cash can buy any agro-inputs in designated input stores, while African fertilizer voucher can only be exchanged for fertilizers. The fertilizer subsidy through voucher in African countries had a significantly positive impact on the agricultural yield, given that African countries have a fairly low level of fertilizer utilizing (Longley, 2005). The AI voucher offered farmers a high degree of freedom in the selection of proper inputs in accordance with their practical needs, types of crops, and farming season. This may have a larger effect on agricultural yield and income enhancement.

The implementation of agro-input voucher program includes about 12 steps. We would like to introduce six key steps. The first key step is to select the beneficiary households following six criteria with the assistance of local officials and village leaders. At the same time or after the beneficiary selection, the FAO staff must carefully design and print the agro-input voucher to prevent fraud. The third key step is to select the qualified input suppliers. This step takes long and includes many small steps such as to establish a selecting committee, to generate a list of agro-inputs and to negotiate prices based on a price survey. The fourth key step is to train dealers and farmers as well as local cadres concerning the instruction of voucher use. The fifth key step is that the FAO staff distributes the vouchers and the beneficiary households exchange vouchers for the ago-inputs at their own choice. The sixth key step is to have the verified vouchers reimbursed by FAO. This takes long time because AIV program is an innovative approach that has not been familiar to FAO officials, so the procedures need to be carefully checked up. Figure 1.1 shows the implementation procedure of the AIVP.

The main objectives of the paper are: (1) to summarize the experiences and lessons of the AIVP implementation; (2) to evaluate impacts on agriculture and farmers livelihoods compared with direct input distribution approach.

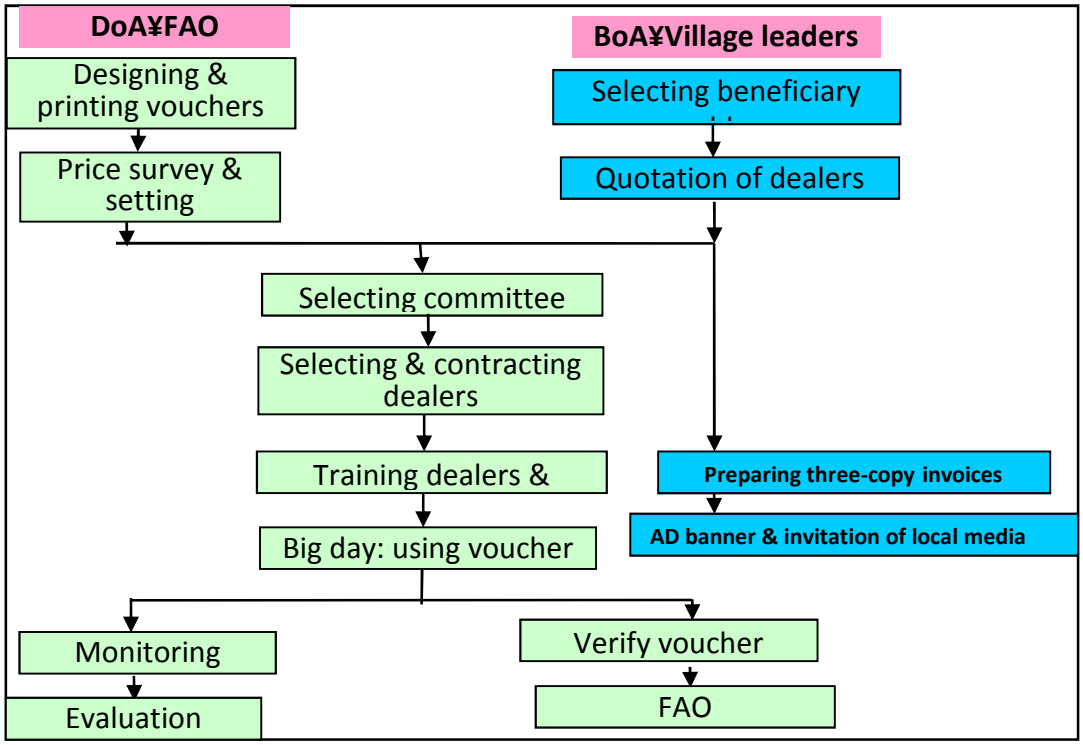

Figure 1.1 the implementation procedure of the AIVP

2. Data sources and analytical method

2.1 Data resources

The data of this study was mainly from a survey of four categories of people related to the implementation of project: (1) the administrative personnel in the FAO facility (ERCU); (2) the officials of the Bureau of Agriculture (BoA); (3) the rural households (beneficiaries and non-beneficiaries) and (4) the agro-input dealers in the disaster-hit counties. The survey was conducted through questionnaire responding and two focus group interviews.

However, the impact evaluation was mainly based on Agriculture Inputs Voucher Assistance Survey (AIVAS) to 454 households in 6 Townships of 5 worst-affected counties. Finally 204 AIVP beneficiary households and 150 DID beneficiary households were selected and surveyed. In addition 100 non-beneficiary households were also surveyed as a control group. The distribution of the sampled households in each village is shown in Table 1.

Table 1. AIVAS Sample households Distribution

County	Township	Assistance approach	Number of sample households
Shifang	Jiandi	DID	19
		Non-assistance	23
Mianzhu	Guangji	AIVP	123
		DID	58
		Non-assistance	18
Jiangyou	Jiuling	DID	29
		Non-assistance	24
Anxian	Tashui	AIVP	81
		DID	20
		Non-assistance	19
Beichuan	Yuli Leigu	DID	24
		Non-assistance	16
Total			454

2.2 Analytical method

The method of Cost-effectiveness Analysis (CEA) was used to evaluate the efficiency of AIVP compared with DID. CEA is a specific type of economic analysis in which all costs are related to a single, common effect. Decision makers can use it to compare different resource allocation options in like terms. It is a comparison tool and not only indicates a clear choice, but also evaluates options quantitatively and objectively based on a defined model. CEA can compare any resource allocation with measurable outcomes. Here we briefly explain the cost-effectiveness analysis and use it to compare the voucher approach with the direct supply. The steps usually included in the construction of a cost-effectiveness analysis are as follows: (1) Specify objectives and identify constraints; (2) Formulate alternative means of meeting objectives; (3) Estimate costs of each alternative; (4) Estimate the effective attributions of each alternative; (5) Select the best alternative.

The costs and benefits are usually categorized as direct or indirect costs or benefits. Direct costs include research and planning expenses, initial capital outlay, maintenance and operating expenses over the project's life. Some items of direct cost will be difficult to estimate because they are implicit. For example, the cost of using government-owned resources in the project would be estimated using an opportunity cost approach. Indirect costs are generally external costs such as the outputs of the project not accounted for in outlays of the government for project components. These kinds of costs are always difficult to estimate because of its partial non-market nature. Nonetheless, they must be considered in the analysis. On the benefits side, direct benefits generally accrue to users of the voucher project. Much like the indirect costs, indirect benefits stem mainly from externalities.

3. The assessment of the FAO assistance through the AIVP

The assistance of FAO delivered through the AIV program aims to help farmers restart agricultural production and to help local agro-input suppliers in restoring business. As can be seen in Table 2, in general, 1,427,900 Yuan worth of vouchers were distributed under two projects with the funded money to 2,245 beneficiary households. Of them, 1,166,900 Yuan worth of vouchers were distributed to 1,875 households in Guangji and Tumen Townships in Mianzhu County, while the rest were received by 370 households in Tashui Township, Anxian County.

The expected result of the AIVP compared with DID is the diversification of the inputs exchanged by vouchers. Therefore it is interesting to calculate the composition of the agro-inputs purchased by the voucher recipients. In the case of Guangji, the beneficiary households exchanged vouchers for 4 categories agro-inputs of them, fertilizer accounts for 93 percent of the total sale, pesticide, seed and agro-tool account for 4%, 2% and 1 % respectively. In Tashui town of Anxian County, totally three categories of agro-inputs were exchanged by vouchers: fertilizers, pesticides and agro-tools, which account for 81%, 3% and 16% respectively. Despite of 3-4categories, there are totally 20-25 varieties of agro-inputs, far diversified than 2 varieties of fertilizers through DID approach.

Table 2. Voucher allocation per Project per County

County	Township	Amount (RMB)	Project	No. Beneficiary households
Mianzhu	Guangji	350,000 Yuan	OSRO-CPR-802-LUX	708
	Tumen	816,900 Yuan	OSRO-CPR-803-SWE	1,167
Anxian	Tashui	261,000 Yuan	OSRO-CPR-803-SWE	370
Total		1,427,900Yuan		2,245

Source: FAO Household survey database

It is the diversity of inputs that enables the beneficiary farmers to increase agriculture yield per hectare, income and then consumption. The impact of AIVP is to be assessed based on the assumption that all the sampled beneficiary households did not have statistically significant difference in basic characteristics and the difference in yield, income and consumption may only be attributed to assistance approach, through AIVP or DID.

3.1 The impact

(1) The impact on agro-production. Statistics showed that AIVP made an absolute positive effect on the agro-input purchase and the farmers' income. On average, the surveyed beneficiary households purchased 6213.6 Yuan worth of inputs per hectare, while AIVP households purchased 6763.8 Yuan worth of inputs per ha and DID households 5122.8 Yuan per ha. Obviously, the AIVP farmers invested intensely in farmland in comparison with DID households. The AIVP households' average agro-product value was RMB 1,363.8 Yuan per ha higher than that of DID households, indicating a more apparent effect on enhancing the agro-product value. As a result, the average income of the beneficiary households grew.

(2) The impact on income. Statistics showed that the total income of all the surveyed

beneficiaries in 2008 was RMB 10,922.6 Yuan per capita, and fell to 9,224.8 Yuan in 2009, a decline of 15.5%. This was because of a large amount of transfer income from the government, NGOs or their relatives in 2008. Yet the average total income per person of the surveyed AIVP households in 2009 still rose by 0.78% compared with the year 2008, while the DID and non-beneficiary households witnessed a sharp drop in average income per capita, indicating the significant positive effect of AIV programs on the income enhancement.

(3) The impact on consumption. Economic theory suggests that both AIV programs and DID programs should have income effect and then the beneficiary household would spend more on living consumption. An indicator of the monthly expenditure is a good measure. The average monthly living expenditure of the surveyed households increased from 1,067.9 Yuan in 2008 to 1,124.27 Yuan in 2009, with a growth of 5.3%. The average monthly expenditure of the surveyed AIVP households increased by 8.8%, the growth rate was a little higher than that of DID program households. The monthly expenditure on food, as the largest share of the living consumption, of the investigated beneficiaries went up from 575 Yuan in 2008 to 617 Yuan in 2009, with an increase of 7.3%.

(4) The impact on agro-input dealers. Results demonstrated that despite a small rise in the total annual agro-input sales, the sale volume of the fertilizers in project implementing month was a little higher than that of the same month in 2007. Overall, the sale revenue during the voucher project month was RMB 76,855 Yuan higher than that of the same month in 2007, an increase of 15.5%. Sale revenue of agro-inputs such as pesticides, seeds and agro-equipment increased considerably too. The wholesale and retail sales of agro-equipment grew by 44.79% and 50.2% respectively. Similarly, the wholesale and retail amount of seeds increased by 13.0% and 20.9% respectively. So the designated agro-input dealers benefited much from the voucher projects.

3.2 Cost-benefit analysis and preference

By computing the ratios of effectiveness to cost in money terms of the AIVP and DID, the cost effectiveness analysis (CEA) produced a result that E-C ratios of the AIVP and DID were 1.564 and 1.207 respectively. The result indicated that given the project costs including the direct and indirect costs, AIV programs were more effective in assisting agriculture rehabilitation than DID programs did. A preference survey of the 454 households was used to verify the result of the cost effectiveness analysis. Statistics showed that 55.5% of the surveyed farmers preferred an AIV program over a DID program, while only 17.2% had an opposite preference. So the AIV program was much more preferable than the DID programs. This innovation should be extended to more agricultural rehabilitation and restoration programs in disaster-affected areas.

In brief, all the results and analysis demonstrated that the AIVP made a positive effect on agricultural production, rural livelihood, local agro-input markets, and was more efficient in assisting the affected farmer in restoring their production and livelihood.

4. Lessons from the implementation of AIVP

First of all, some of the villagers unqualified to beneficiary were not satisfied with the AIVP and this increased difficulty of the BoA work. The seven pre-set criteria were useful for the selection, but some additional standards like cultivated area and whether or not being engaged in a specific

production (garlic or fruits) made many unqualified farmer unsatisfied with the AIV program. Because the earthquake was a covariate crisis for all the villagers, an improvement in this step is quite essential. With regard to the restrictions in the varieties of voucher-convertible agro-input, some agro-inputs that the farmers in fact needed were not listed within the convertible range. In short, the design of the project did not adequately consider the different needs of different farmers.

Secondly, the steps of price setting and reimbursement take long and the qualified dealers are not adequate. The designated dealer selection was time-consuming and related to commercial interests. The criteria of a qualified dealer included a license, fixed business place, abundant stock and good post-sale services. This was too much and prevented more dealers who were actually local farmers to benefit from the programs. Price negotiation with the dealers was based on an overall price survey by the national expert at the provincial level and in the local market. Of course, this took a lot of time. The fact that some of the small designated dealers did not have their own bank account did not meet the basic requirements and made some trouble in reimbursement. At the same time, the number of designated dealers was not sufficient for forming a competitive market. This may cause a monopoly or an oligopoly.

Thirdly, a seven-day trade period was too long for beneficiaries to exchange their vouchers for agro-inputs. A long period might enhance the chance of fraud. As a result, the cost of monitoring went up accordingly. In the second and third round the exchange period was being shortened to three days.

Fourthly, some important agro-inputs were not included in the agro-inputs list. The feedstuff for pigs was a case in point. In 2009, the livestock industry accounted for more than 50% of farmer's net income per capita, and pig-keeping was the pillar of livestock industry. The restraint of assistance in crop might hinder a quick growth of farmers' income.

Finally, the cost of implementing AIVP incurred to DoA and BoA was higher than that of DID. Results and calculation showed that the AIVP costs was really higher than that of the DID, this included the expenses of the transportations, accommodations for the market survey, training, cost for the employees, and especially the time cost. Therefore, any measures to curb the costs might help improve the efficiency of AIVP. Besides extra costs to FAO and BoA, the designated dealers had to undertake a fair amount of financial expenses occurred due to stock-in-trade, e.g., the interests they had to pay the bank if this amount of money had been loaned from the banks.

5. Recommendations for improvement

First of all, selecting beneficiaries should focus on the worst-affected farmers by reducing the voucher value. In order to take aim at the worst-affected farmers, the criteria such as the death of family members, the female-headed family and the collapse of home should be given the highest priority. Findings indicated that 700 Yuan worth of vouchers per household were a little higher compared with their needs. If the assistance value for each household were reduced half, more disaster-affected farmers could have been aided given the total donation value. In addition, the families who have migrated to the city and are not engaged in agriculture should be excluded.

Secondly, the designated dealers should be sufficient for competition, and prices should be set one week before the big day. To prevent a monopoly or an oligopoly, there ought to be three dealers

or more. Dealers should be geographically and reasonably close to the households. Information on dealers should be readily available. The dealers should be reminded of preparing triple-receipt for writing down the transactions. To allow more small dealers to participate in the AIV program, the dealers must be subsidized a proportional share of financial expenses.

Thirdly, an instruction for voucher used for training should not be complicated. The inventory and price list should be clear to facilitate the exchange and to assure the negotiated prices. The training of beneficiaries being scheduled before the issuing of vouchers could reduce time costs. With regard to the training materials on voucher use, one page of instruction would be enough. An inventory and price list with 2-3 pages is quite essential.

Finally, the coupon should be designed carefully and printed colorized to fight counterfeit. A very important measure against fraud should be to design a counterfoil of the voucher, which should be drilled and then make the vouchers easily be pulled apart. The positive face of the voucher should contain the randomly started code, the face value, the unit of the issuance, complaint phone number etc. The negative side of the voucher should be designed with blank of the signature of the farmer, ID number, and address of farmers'. When distributing the vouchers, the farmers' name must be registered in accordance with the code in the "registration list of the vouchers". FAO staff should entrust a competent printing company to print the colorized vouchers. In order to prevent farmers from exchanging the vouchers for cash or from purchasing daily necessities, the suppliers must nail a receipt with vouchers and filled in the names of the goods, amount and its prices.

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Lesson-Learned and Approach in Recovering Agricultural Practices after Natural Disasters in Indonesia

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Introduction

Indonesia is a country prone to seismic activity that causing earthquakes, volcanic eruptions and occasionally destructive tsunamis. Indonesia are situated within a zone of high seismic activity known as the Pacific Ring of Fire. Along the Sunda megathrust, the Indo-Australian Plate is being subducted beneath the Eurasian plate. The subduction creates regular earthquakes, many of them of megathrust type. (Wikipedi, 2011b).

On Sunday, December 26, 2004, at 07:58 local time with an epicentre off the west coast of Sumatra, Indonesia, occurred Indian Ocean earthquake. The earthquake was triggered a series of devastating tsunamis, reached Aceh some 20 minutes after the earthquake, killing over 230,000 people in fourteen countries. Indonesia was the hardest hit, especially Aceh, followed by Sri Lanka, India, and Thailand. With a magnitude of between 9.1 and 9.3, it is the third largest earthquake ever recorded on a seismograph and had the longest duration of between 8.3 and 10 minutes (Wikipedia, 2011a).

On September 30, 2009 Sumatra earthquake occurred just off the southern coast of Sumatra, Indonesia and had a moment magnitude of 7.6. Government reports have 1,115 dead, 1,214 severely injured and 1,688 slightly injured. In addition, around 135,000 houses were severely damaged, 65,000 houses were moderately damaged and 79,000 houses were slightly damaged. An estimated 250,000 families (1,250,000 people) have been affected by the earthquake through the total or partial loss of their homes and livelihoods. (Wikipedi, 2011b).

Merapi is an active stratovolcano located on the border between Central Java and Yogyakarta, Indonesia. It is the most active volcano in Indonesia and has erupted regularly since 1548. The 2010 eruptions began in late of October when Merapi began an increasingly violent series of eruptions that continued into November. The latest Merapi eruption was said by authorities to be the largest since the 1870s. Over 350,000 people were evacuated from the affected area. However, many remained behind or returned to their homes while the eruptions were continuing. More than 350 people were killed during the eruptions (Wikipedia, 2011c).

Impact on Agriculture

The earthquake and tsunami in Aceh resulted in great human loss in farming communities, inundated productive land with salt water, destroyed standing crops, eroded and scoured topsoil, deposited marine sediments and debris on fields, silted up irrigation and drainage channels, destroyed field bounds, and changed land levels and drainage patterns. The type and nature of damage were highly variable. Agricultural damage on the west coast was more severe than on the east coast due in part to the height and power of the tsunami wave which was estimated at 15-30 m

compared with 2-5 m of the east coast. Assessments of the total area damaged vary from 65,000 to 85,223 hectares of agricultural land.

Immediate activities were done by removed debris and sediments that could not be incorporated into soil. In the short term, it was impossible to generate income from farming activities, so it was important to employ farmers and their families to assess and repair drainage and irrigation infrastructure, assessed soil salinity and nutrients, and composted organic waste. These activities provided income and help returned their farming land to production.

Rice is the main food crop in west Sumatera covering some 235,000 ha. The most serious damage of west Sumatera earthquake occurred in the villages where landslides buried about 100 ha of rice fields and completely destroyed about 350 ha of irrigation systems. A slight reduction (10 percent) in the yield of the standing crop on some 41,000 ha was projected as farmers would need to give higher priority to non-farming activities to deal with the emergency situation following the earthquake. The estimated losses take into account that it may require 5 to 7 years before the buried rice fields are restored to the original production level. However, some land may have to be abandoned permanently. The production loss for rice was estimated at about 2 percent of the provincial annual rice production (BPPN and Governments, 2009).

The eruption of Merapi has a direct impact on the closure of the ground and destruction of plants growing on it. Closure of land with volcanic ash depend on the distance from the top and can reach a thickness more than 10 cm. Snake fruit plants and coconut of around 1350 ha suffered severe damage, because their leaves fall to the ground. Damage to agricultural crops and vegetables in this location were about 206 ha (Suriadikarta et. al., 2011).

The harvested area and production of rice at the household level on affected areas of those natural disasters were greatly reduced but at the provincial level the annual rice productions were not significantly affected. The average harvest area of rice in Aceh, West Sumatera and Yogyakarta within 2000-2010 was 340,534 ha, 420,247 ha and 135,380 respectively. The harvested areas of rice in Aceh were slightly reduced of about 1 % in 2005 the year after the tsunami was occurred. The harvested area of rice in West Sumatera and Yogyakarta were also not affected after the natural disaster (www.deptan.go.id/pusdatin/)

Universities roles

Universities have a role in disaster management through preparation, emergency response and disaster recovery. Preparation for disaster is done to reduce disaster risks through the improved ability to cope with disasters. The role of the university conducted in the form of education, research, publications and community service. Gadjah Mada University has Masters Degree in Disaster Management Program (MPBA) which aims to prepare human resources with an ability to cope with disasters, especially volcanic eruption (http://tsipil.ugm.ac.id/ akademik/program-pascasarjana/ mpba/). Gadjah Mada University also has a Center for Natural Disaster Studies (PSBA UGM). This study centers play a role in assessing the vulnerability of disaster-prone areas, both in the assessment of physical, social, economic, and environmental impacts (Sahana, 2010). Gadjah Mada University has a Disaster Emergency Unit (DERU), an organization of volunteers who assist people during

disasters, conducting health services for refugee, provide temporary housing and counselling in various fields.

Various seminars in the framework of disaster management have been conducted by several universities. Workshop and Annual Seminar on Disaster Risk Management were conducted by Faculty of Engineering Gadjah Mada University (UGM), bringing experts in the field of Geology and disaster prevention (http://bencana-kesehatan.net)

Role of Research Institute and Faculty of Agriculture mostly are in disaster recovery. Post tsunami in Aceh, early salinity survey was done to identify areas suitable for farming. Periodic monitoring ensures that farmers did not commence cropping before salinity levels had dropped to acceptable levels. Varieties of rice and other crops that could be grown in saline soils were identified and recommended to farmers while there was still a possibility of salt in the soil. Farm demonstrations and field days showed farmers what methods were better (Sahana, 2010). An experiment showed that under low salinity (EC < 1.0 dS m-1) rice yield was 5.6 up to 8.2 t ha-1, under medium salinity the yield was around 4.0 t ha-1 but no yield was produced under high salinity level of > 4,32 dS m-1 (Zulham, 2009).

A few days after the disaster, Faculty of Agriculture, Gadjah Mada University sent a team of researchers to observe the eruption of Merapi, which can provide a recommendation to handle the recovery. Academicians from Faculty of Agriculture UGM are also involved in a variety of other disaster management activities. The analysis of volcanic ash shows that pH and electrical conductivity were 4.9 and 4.0 - 5.0 mS, respectively. Plants are generally damage when exposed volcanic material with conductivity greater than 2.0 mS. Volcanic ash contained several elements essential for plant growth, among them were Si, P, S, and Ca. The content of Si was very high reaching 54% as well as P that reached more than 100 ppm (Utami et al., 2010). The community services performed by the Gadjah Mada University in collaboration with some NGO's, among them were LPPNU and HKTI, showed that land covered by volcanic ash (>50 cm thickness), could be recovered by mixing the ash with the original soil coupled with manure as much as 10 tons / ha and 125 kg NPK / ha. The land was then planted with various types of crops, including corn, soybeans, peanuts and green beans. Observation on demonstration plots of maize and peanuts intercropping showed that grain yield of corn and peanut reached 2.5 tons / ha of dry beans (Shiddieq, 2011).

Conclusion

Various natural disasters that occurred in Indonesia have a massive destructive impact, including on land and agricultural crops. At the household level, the land productivity was greatly reduced, but at the provincial level the annual rice and other staple crops production were not significantly affected by natural disasters. Universities and Research Institutes have important roles in disaster management, namely preparation, emergency response and disaster recovery. Faculty of Agriculture has a role in the disaster management, especially disaster recovery. Activities undertaken ranged from impact analysis to counselling in the form of demonstration plots.

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