# Agricultural and fisheries extension in Indonesia – origins, transitions and current challenges

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**Abstract.** In recent decades, changes to Indonesia's government extension systems have been driven primarily by shifts in agricultural development policies, albeit with a continuing focus on rice self-sufficiency, by the 'autonomy' process and by budgetary constraints. Under these changes, the T&V system was abandoned, despite being considered effective by extension workers and farmers. Current extension systems, variously applied by autonomous provincial and district governments, are often poorly resourced and undervalued, leading to poor service provision and dissatisfaction amongst both extensionists and farmers. In this context, Indonesian governments recognise the potential of the fisheries sector, particularly shrimp farming, to contribute substantially to both the domestic and lucrative export markets. Two cases of ongoing ACIAR research projects indicate that better management practice (BMP) programs can improve productivity and profitability for traditional shrimp farmers using a group approach. However, effective extension systems are extremely limited to support the shrimp farmer groups in committing to adopt these relatively complex programs and in scaling out beyond demonstration sites.

**Keyword**: Indonesia, extension system, agriculture, fisheries, historic review, BMP.

## Introduction

Agriculture continues to play an important role in Indonesia's economic development as a contributor to food security and as a generator of income, employment and foreign exchange. Rice is the main agricultural commodity and is the staple food for about 97% of the population; at a national level rice provides 60% of the total calories consumed, 44% of total protein intake and 55% of total consumer expenditure (Suryana and Erwidodo 1996; Setiawan, 2006). However, estate crops such as rubber, palm oil, coffee and tea, together with fisheries products, such as shrimp and tuna are the main primary export commodities.

Indonesia has a coastline of about 81,000 km, of which only about 10%, 40% and 0.01% of potential freshwater, brackish water and marine areas, respectively, are in use (Nurdjana 2008). Consequently, aquaculture is seen as having considerable potential for further expansion in response to growing domestic and export market demands. Currently, farmed shrimp ranks highest amongst brackish water aquaculture commodities, comprising 80% of the total sector value; most of the shrimp crop is exported. In addition, mariculture products, such as finfish, and seaweed, obtain good prices on export markets in East Asia, Europe and the United States.

In most cases, Indonesian smallholders, including brackish water farmers, do not have ready access to financial support for farm development. Nor do they have ready access to information on appropriate innovations, primarily because of the very limited government extension services currently available under the decentralization policies of the past decade. Historically, agricultural extension services in Indonesia have been driven by the central government's Ministry of Agriculture and have focused on food crops, estate crops (e.g. palm oil, tea, coffee, sugar) and livestock, with the aim of improving production and reducing reliance on imports, particularly of rice. Notably, until 1999, the fisheries and aquaculture sectors received relatively little support from the extension services. However, with Presidential Decree No 355 Year 1999, the Ministry of Marine Exploration was established as an agency separate from Agriculture, with responsibility for managing the marine and fisheries sector. Subsequently, Presidential Decree No 94 Year 2006 established the Ministry of Marine Affairs and Fisheries, within which the Agency for Marine and Fisheries Human Resources Development was given responsibility for development of human resources in fisheries extension only; delivering fisheries extension services remained the responsibility of Provincial and District governments.

This paper describes three related aspects of agricultural extension provision and system development in Indonesia. Its purpose is to improve understanding of the system and its focus on food crops and fisheries. The paper is organized into sections as follows: (1) origins and historic review of agricultural extension systems in Indonesia; (2) transition in Indonesian agricultural extension from training and visit (T&V), to Farmer Field Schools, to Decentralized

Agricultural Extension; and (3) the current initiatives and processes being used in selected projects, funded by Australian Centre for International Agricultural Research (ACIAR) and aimed at assisting aquaculture development in Indonesia.

### Method

In this paper, a mixed model design with both qualitative and quantitative methods (Payne and Payne 2005) was used. In the first and second sections, we used a documentation review method. For the third section, we applied a quantitative field survey with focus on socioeconomic issues using questionnaire-based interviews as part of an ACIAR-funded aquaculture project, i.e., FIS2005/169 'Improving productivity and profitability for smallholder shrimp farmers and related enterprises in Indonesia'. This work was done at a study sites in Central Java province via collaborative research between University of Sydney, Main Centre for Brackishwater Aquaculture Development (BBPBAP-Jepara) and the Universitas Gadjah Mada Yogyakarta. Specifically, two villages, each supporting its own shrimp farmer group, in Demak district were selected as a research area where the demonstration ponds for better management practice (BMP) programs were located. There were 120 shrimp farmer respondents. We interviewed 60 respondents from each village, each comprising 30 members and 30 non-members of the shrimp farmer group. Adoption and its determinant factors was analysed with a logistic regression method (Herianto, 2004)

### Origins and historic review of Indonesian agricultural extension systems

Rice, coconut, nutmeg and cloves were important commercial crops in the Indonesian archipelago even before the colonial era. These crops, cultivated by various indigenous groups, represented important economic activity for the Indonesian economy. However, between 1830 to 1870, farmers were forced to produce compulsory export crops such as indigo, tobacco and sugarcane under the Dutch East Indies colonial government's *Cultuurstelsel* system, which was administered by a single institution - an indigenous civil service (*Pangreh Praja*) (Purwanto 2002).

After the gradual abolition of the *Cultuurstelsel* system, the first attempt to develop an agricultural extension system was the establishment of an agricultural school at *Buitenzorg*, near the Botanical Garden in Bogor, West Java. The botanical garden included various collections of local rice varieties and other commercial crops; it became a famous research centre where demonstration plots were used as focal points for the agricultural extension services (Boomgard 1987). However, the production gap between the demonstration plots and those operated by farmers was still noted. In order to bridge the gap, in 1905 the colonial government united the services from the Botanical Garden and other research institutions into the Agriculture Department. However, some constraints in disseminating technologies via extension services throughout the country still remained. In response to these problems, in 1911, this Department was restructured to become the Agriculture, Industry and Trade Department incorporating the *Landbouw Voorlichtings Dients*- LVD or the Agricultural Extension Service as a new branch with specific tasks in disseminating research results to the farmers (Sumintareja 2001).

The extension service's task was to suggest, but not compel, improvement of agricultural practice, particularly for estate crops destined for export, by encouraging farmers to adopt innovations developed by the *Algemeene Proefsation voor den Landbouw* – APL (= Agricultural Research Centre). APL was supported by LVD and conducted many experimental plots at outstations, mainly in Java, where landholder farmers and tenant farmers could directly observe agricultural innovations under the *olie vlek* system, and voluntarily adopt appropriate innovations. This agricultural extension system was propagated to local or provincial governments throughout Indonesia under a decentralization policy in agricultural development up to the 1940s. This could be considered a model era of "voluntary and participatory" agricultural extension approach, in that farmers adopted the innovations with no compulsion from the government (Reksohadiprojo 1963 cit Sumintareja 2001).

In the 1940's, the agricultural development policy shifted its focus from export crops to food crops, especially for rice. During the period of Japanese occupation (1942-1945) and in the two decades following Indonesian independence in 1945, the agricultural extension system returned to a compulsory system. In this period, officers of the Agricultural Civil Service *(Mantri Tani* and some post-independence graduates of Wageningen Agricultural School, were directed to implement a policy whereby rice crops were compulsorily acquired and distributed by the government in order to promote food security. With this approach, eventually the agricultural civil service became a dominant apparatus, with farmers locked into its ineffective process of disseminating agricultural innovations.

**Recent transitions in Indonesian agricultural extension systems**

In the early 1960s, a completely new approach was applied. Using the limited human resources of the agricultural extension services, students at Bogor Agricultural Institute and Universitas Gadjah Mada conducted demonstration plots promoting "green revolution" technology. They introduced a five production inputs program (*Panca Usaha*) for rice to farmer groups using demonstration plots in targeted areas. With this system, rice productivity doubled in the demonstration area. Subsequently, between 1964 and 1966, the agricultural extension service promoted adoption of rice production technology innovation using a mass demonstration approach, termed the DEMAS system

From 1966 onwards, under Soeharto's New Order (ca. 1966 – 1998), an agricultural extension program, designated 'Improvement and Strengthening of Agriculture Extension Activities' was developed under the system of five years development plans, *Rencana Pembangunan Lima Tahun (REPELITA)*. The program emphasized qualitative and quantitative improvement of the extension services. This involved adoption of various approaches to extension methods and materials, as well as expanded interaction with target groups, mainly male, female and youth-based farmer groups. As well, increased numbers of field extension workers were recruited and the Rural Extension Centres (REC or *Balai Penyuluhan Pertanian*) at local levels were rehabilitated (Sumintareja 2001).

During the New Order period, the Ministry of Agriculture comprised four technical Directorates General (Food Crops, Livestock, Estate Crops and Fisheries), each having its own extension section. However, extension service resources were generally commodity-focused (with most resources devoted to rice) rather than farm-focused (Ameur 1994). With its focus on rice intensification and improving farmers' incomes, the extension service implemented a Bimbingan Massal – BIMAS (Mass Guidance) program. To support this social engineering approach (Nuraini 1977), the Ministry of Agriculture created several enabling agencies, including the Agency for Mass Guidance (*Badan Pengendali Bimbingan Masal-BP Bimas*), responsible for human resource management, the Agency for Agricultural Research and Development (AARD), responsible for generating research information and the Agency for Agricultural Education and Training, together with its Agricultural Information Centre (AIC or *Balai Informasi Pertanian*) primarily for education and training of extension personnel and production of extension material.

In this context, the BIMAS program implemented a number of significant changes in agricultural extension services in Indonesia. In order to achieve rice self-sufficiency, extension services were delivered through a LAKU (*Latihan dan Kunjungan)* or Training and Visit (T&V) system, introduced with World Bank sponsorship as part of the green revolution technology campaign in the early 1970s. There were three components to the system, i.e. capacity building programs for extensionists, programs of visits to motivate farmers to adopt new technologies for rice or other commodities, and programs in assessing extensionists' work performance and farmers' adoption levels. Within the system, Field Extension Workers (FEW, *penyuluh pertanian lapangan*, *PPL*) were responsible for field visitation and technology dissemination tasks; middle level Senior Extension Workers (SEW, *penyuluh pertanian madya*, *PPM*) for devising and supervising field extension programs; and graduate subject-matter extension specialists (SES, *penyuluh pertanian spesialis*, *PPS*) for periodically training the FEW and SEW on innovations arising from AARD. At local levels, FEW and SEW extensionists worked in the REC area. A single REC area, designated REC working area (*Wilayah Kerja BPP*, WKBPP), covered about 10 village unit areas (VUA or *Wilayah Unit Desa*, WILUD). Under SES supervision, FEWs and SEWs at each REC office conducted field trials in locally-adapted technologies before disseminating them to farmer groups. Each office was supplied with printed extension material and media produced by AARD and AICs.

At the grassroots level, individual FEWs were responsible for visiting their Working Area of Agricultural Extension (*Wilayah Kerja Penyuluh Pertanian*, WKPP) which was divided into 16 Farmer Group Areas *(Wilayah Kelompok Tani*, WILKEL) across two or three villages. Typically, in any one week, a FEW would visit and motivate a separate farmer group area morning and afternoon from Monday to Thursday. In this way, each FEW would visit eight WILKEL per week. Each Friday, following these visits, FEWs were required to prepare a weekly report of their field activities and the progress of technology adoption. On the Saturday, they attended training on new recommended technologies.

Two supporting institutions were central to the success of BIMAS and other rice intensification programs using the T&V extension system. Local branches of the national bank (*Bank Rakyat Indonesia Unit Desa*, BRI-UD) provided credit to rice farmers and village cooperative kiosks (*Koperasi Unit Desa*, KUD) sold agricultural inputs to farmers and purchased their unhulled paddy for on-selling to the national Food Logistic Board (BULOG). Accordingly, the BIMAS and other rice intensification programs using the T&V system can be described as a planned and structured highly commodity-specific extension system.

By 1984, Indonesia was self-sufficient in rice as a result of green revolution technology and there is no doubt that the BIMAS and other rice intensification programs with T&V system played a significant role in this achievement. However, negative impacts of the programs also emerged. Excessive use of inorganic fertilizers and chemical pesticides endangered the environment and significant financial and social problems generated by the program, particularly among small scale and poor farmers, were often overlooked (Thorberke and Pluijm 1992).

In 1985 and 1986, serious outbreaks of brown plant hopper affected rice crops and forced the abandonment of the rice intensification program's T&V system with its conventional technology package and top-down approach. The Indonesian government banned 57 broad spectrum pesticides for rice, gradually eliminated state subsidies on other pesticides and disseminated integrated pest management (IPM) technology to irrigated rice farmers across the country. To support these changes, a new extension approach, with training based on adult education principles, experiential learning, farmer participation and empowerment, was applied at farmer field schools (FFSs)(Quizon et al. 2001; Anderson 2007).

However, experience has shown that this extension system is unsustainable, mainly because of its cost. One solution being explored is to use 'special training for farmer' (TOFT or PETANDU – Guiding Farmers) programs. Under this arrangement, TOFT alumni will organize and facilitate the local FFS using local resources to disseminate the technology to neighbouring farmers The IPM FFS approach involves daily monitoring of the pest situation in rice fields, identifying the types and abundance of natural enemies of the pest in the observation plot, determining the economic threshold of pest, promoting group dynamics and cooperation, sharing information and coordinating strategies with neighbouring farmers (Quizon et al. 2001). Currently, the alumni of TOFT have established the FFS Alumni Association which meets annually. Some alumni are also looking at extending the IPM principles to enable organic farming with zero use of pesticides and inorganic fertilizers (TO Suprapto, FFS Chairman, Alumni Association, personal communication). In support of this participatory extension approach, the Ministry of Agriculture has established FFS for Agribusiness, designated SL UBA (*Sekolah Lapangan Usahatani Agribisnis*) with the aim of disseminating agribusiness principles to farmers. This FFS extension system was implemented until the reformation movement began in 1998.

In 2000, as a means of increasing 'autonomy' in government, the central government in Indonesia transferred responsibility and funding for most services to district-level and, to a lesser extent, provincial-level governments. Extension services were included in this process, with the intention of replacing the traditional top-down approach and its linear research-extension-client farmer relationship with a bottom-up, participatory approach responsive to farmers' needs. This decentralized extension system is based on Law No 22/1999 (subsequently amended as Laws No 32/33/2004) and is implemented using decentralized adaptive agricultural research conducted at Agricultural Technology Assessment Institutes (Balai Pengkajian Teknologi Pertanian = BPTP). These Institutes integrate research and extension functions under one roof and assess new adaptive technology to formulate solutions to local farmers' problems. In order to implement the policy in agricultural extension services, the World Bank funded two consecutive projects, i.e., the Decentralized Agriculture and Forestry Extension Project (DAFEP) beginning in 1999 and the FEATI project beginning in 2007. In general, the projects aimed at enhancing farmers' capacity to participate in extension activities and at integrating research and extension components at local level using information technology to improve market access and increase incomes and competitiveness. The current Extension Law (Law No 16/2006) recognizes the roles of multi-provider actors including government and private sector extension workers as well as self-supporting extension volunteers. In addition, it also reunified three primary sectors (agriculture, fisheries and forestry) by establishing a new institution named the Agency for Extension Coordination (*Badan Koordinasi Penyuluhan* – BAKORLUH). The current extension system shares some features with the 1970s extension system, however the implementation program is not yet well established because a Presidential Decree executing the law is still pending.

However, there remains a wide gap between local and national government perspectives on the importance and roles of agricultural extension services. In addition, much district-level funding is being allocated to routine programs rather than agricultural development and its extension activities (World Bank, 2002). As a result, extensionists are uncertain about their roles, are poorly paid and have little support for their activities. In fact, most farmers we have interviewed state that the extensionists are unable to help in solving their problems under the current autonomy system.

The research system, whereby innovations consistent with local technologies are developed in government research institutes or university sites, is essential to real changes in agricultural development and productivity. However, under their own initiative, farmers have been reviving indigenous knowledge from local practice and experiments and either disseminating this knowledge to neighbours or inheriting it through intergenerational transfer. This indigenous knowledge is to some extent related to religious belief and culture. For example, local farmers in Java believe that natural pesticides can be effective against plant diseases and pests. Based on their indigenous knowledge, some Yogyakarta farmers use natural pesticides made of brown planthopper for controlling brown planthopper attacks in their paddy fields. They trap planthoppers, grind them and mix with water before spraying onto rice plants (Sutanto Dhobo, organic farmer of Sleman-Yogyakarta, personal communication).

## BMP programs for smallholder shrimp farmers – current extension initiatives

Aquaculture is an important component of the Indonesian fisheries sector as it contributes to national income, employment generation and foreign exchange earnings. Shrimp is the most important aquaculture commodity with shrimp exports generating about US$1 billion annually with 93% from the farmed shrimp (ACIAR, 2007). However, white spot disease (WSD) caused by white spot syndrome virus (WSSV) is a major problem in shrimp farming, not least for smallholders. BMP programs offer a solution to this problem; they focus on proper management of the pond environment, on maintaining pond biosecurity and on socioeconomic issues. Their aim is to improve the productivity and profitability of shrimp farming. In this context, the Centre for Brackishwater Aquaculture Development (BBAP- Ujung Batee, Aceh) and the Main Centre for Brackishwater Aquaculture Development (BBPBAP-Jepara, Central Java), with support from ACIAR, have been conducting action research involving BMP technology application in Nanggroe Aceh Darussalam (Aceh), Central Java and South Sulawesi provinces of Indonesia. A technology dissemination process based on demonstration ponds is being applied in these areas.

### *Nanggroe Aceh Darussalam Province*

A key step in the development of project-based extension and advisory services to farmers in Aceh in the aftermath of the 2004 tsunami was the development of a coordinated approach by the major donor agencies involved in aquaculture reconstruction and rehabilitation. This resulted in the formulation of a 'Practical Manual – Better Management Practices for Tambak Farming in Aceh' jointly produced by the Asian Development Bank (ADB), ACIAR, Aquaculture without Frontiers, the Food and Agriculture Organization of the United Nations, German Technical Cooperation (GTZ), the International Finance Corporation of the World Bank, the Network of Aquaculture Centres in Asia-Pacific and the World Wildlife Fund. This coordinated approach allowed the dissemination of a consistent set of technical recommendations across the various projects operating in Aceh, and ensured that farmers received consistent advice.

While the responsibility for fisheries and aquaculture extension lies principally with the District Department of Marine and Fisheries (*Dinas Kelautan dan Perikanan [DKP] Kabupaten*), surveys and conversations with DKP staff and farmers in Aceh have indicated that the effectiveness of government extension services is extremely limited. A survey of 200 farmers in Aceh by Briones (2008) found that 93% had never met a government extension agent, 6% had met 'rarely', 1% 'sometimes' and none 'regularly'. Results for farmer associations were somewhat better, with 15% meeting 'rarely', 15% meeting 'sometimes' but only 1% meeting 'regularly' with a farmer association representative. DKP staff cite lack of training, lack of resources (transport, fuel) and lack of practical experience for their reluctance to actively engage with farmers.

Many projects have overcome this constraint to extension service provision by employing 'field facilitators' who provide technical information and support either directly or indirectly to farmers who participate in BMP implementation programs. While this approach provides a short-term solution, the field facilitators are not available to farmers following the cessation of project activities, leaving a void in the provision of extension services.

The Aceh Aquaculture Rehabilitation Project, funded by the Australian Indonesia Partnership for Reconstruction and Development, developed BMP demonstration ponds in Bireuen and Aceh Utara districts. Their purpose was to allow staff of *Balai Budidaya Air Payau* (BBAP) Ujung Batee to practice the implementation of BMPs for shrimp culture in an 'on-farm' situation, and to provide farmers and DKP staff with an opportunity to learn about BMP implementation in a practical setting. BBAP Ujung Batee staff use the demonstration ponds as focal points for the provision of information and technical support services. The 'crop calendar' approach, based on the crop calendar in the BMP Practical Manual, is used to coordinate extension needs with farm production cycles. BBAP Ujung Batee staff hold farmer field days to teach farmers about key aspects of BMP implementation in shrimp farming. The field days are a combination of theoretical and practical teaching, with the demonstration ponds being used to train farmers in the relevant techniques. The farmer training is supported by extension products developed by BBAP Ujung Batee, primarily technical brochures explaining key BMPs and based on the 'Practical Manual – Better Management Practices for Tambak Farming in Aceh'.

While the demonstration pond sites have been valuable in providing focal points for BBAP Ujung Batee and DKP staff to engage directly with farmers, they have also demonstrated the high level of risk associated with shrimp culture in Aceh, with only one successful crop to date. However, the demonstration sites have successfully stimulated interest amongst farmers in specific aspects of pond management, such as pond preparation, and in culturing milkfish (*Chanos chanos*) at higher densities to improve farm profitability.

A significant development for aquaculture extension in Aceh has been the recent establishment of the Aceh Aquaculture Communications Centre at BBAP Ujung Batee. The AACC is funded by the Indonesian Government's Department of Marine Affairs and Fisheries, with support from ADB's Earthquake and Tsunami Emergency Support Project, ACIAR's Aceh Aquaculture Rehabilitation Project, and the Japan Fund for Poverty Reduction. The AACC provides technical support to farmer groups, arranges technical training through farmer field days, publishes a monthly newsletter including a question-and-answer column for farmers, and manages an information website (www.tambak.org).

***Central Java Province***

During 2008 and 2009, under FIS/2005/169, staff from BBPBAP Jepara have assisted farmers operating demonstration/BMP trial ponds in two villages in Demak District, on the north coast of central Java. Each village supports its own smallholder shrimp farmer group: the inactive 'Udang Raya (UR)' group in Serangan and the active 'Windu Jaya Dua – (WJ)' in Sidorejo. The demonstration/trial ponds are operated by selected volunteer farmers under close advice from the project's field technicians who live on-site and advise operators on BMP implementation during the approximately four-month period between pond preparation and pond harvest. Senior technical staff from BBPBAP Jepara visits the ponds regularly to provide additional technical support

Briefly, the BMP programs aim to reduce risks of crop losses (mainly due to shrimp-specific virus disease) to acceptable levels and to maximise the quality of harvested shrimp. Although the project's BMP program comprises 16 BMPs comprising both technical and socioeconomic components, these can be simplified to the following: (1) Implement programs in physically suitable locations only; (2) Maintain a unified and disciplined farmer group; (3) Maximise pond biosecurity (= keep dangerous shrimp viruses out of the pond); (4) Maintain optimal pond growing conditions; (5) Maximise food safety, product quality and profitability

Conducting the demonstration ponds in each farmer group's village allowed other group members, as well as non-members and farmers from surrounding areas to directly observe the demonstration ponds. In this way, interested farmers can learn and discuss the ponds' management and shrimp production with the resident field technicians. The active farmer group has monthly member meeting to discuss the technology adoption and other issues important to their group. This demonstration pond method appears similar to the *olie vlek* extension system by which the technology eventually will be adopted and spread by the farmers via a slow diffusion process.

It is important to note that, as for Aceh, the government's district-based fisheries extensionists are currently unable to participate fully in facilitating BMP program adoption at these Demak sites. Informal enquiries indicate inadequate training, poor remuneration, poor resources and unclear job direction are the main reasons for this inability. Not surprisingly, Leta et al. (2005) identified an almost identical set of factors impeding the effectiveness of Indonesian agricultural extensionists in West Timor. There are additional specific factors limiting the fisheries service extensionists' participation in the Demak demonstrations. First, because the District Marine Affairs and Fisheries office lacks extensionists specialising in shrimp development and no formal shrimp-focused program, extensionists have little hands-on experience in this very challenging field and few contacts with shrimp farmers. Second, they lack confidence in disseminating BMP technology since the innovation is new to them. For these reasons, the project, in collaboration with the Provincial MAF office conducted training for selected government extension workers and field technicians in February and April 2009 to assist disseminating BMP programs to those parts of their working areas targeted by the district governments.

After two shrimp stocking seasons in the demonstration ponds, the project, with support from consultants from Universitas Gadjah Mada, conducted a socioeconomic study involving farmer group members and non-members. The main objective was to identify socioeconomic determinants, including personal, demographic, asset and technological factors influencing BMP program adoption. In order to estimate the parameters of twelve explanatory variables influencing respondents to adopt BMPs, a logistic regression model was used. The explanatory variables were as follows: education level, number of family members, pond holding, contribution of shrimp farming income to the family income, length of experience in shrimp farming, successful experiences in shrimp farming, and the farmer’s perception of potential problems in relation to individual BMPs within the program. In addition to these variables, five dummy variables were also hypothesized in influencing the respondent’s behaviour, including membership in a shrimp farmer group (SFG), personal goals in shrimp farming, whether a full-time shrimp farmer or not, type of secondary occupation and whether growing shrimp in monoculture or polyculture.

### Estimated logistic regression model for BMP technology adoption

The estimated function using standardized regression coefficients for WJ in Sidorejo village in Table 1 shows that education level, number of family members and pond holding were significant and positively associated with adoption behaviour. The positive sign of the education level variable indicates that those respondents with higher education level were more likely to adopt BMP technology. The positive sign of the number of family members implied that the greater the number of family members, the more likely the respondent was to adopt the BMP technology. It suggests that they expected the BMP technology would provide higher potential margin or income than traditional shrimp technology. Since the BMP technology requires a bio-filter pond for managing water and maintaining bio-security, only those farmers with more than one pond were able to adopt BMPs. Out of five dummy variables, one dummy variable – SFG membership, was positive and significantly influenced shrimp farmers’ behaviour. It indicated that, with demonstration ponds in the farmers’ group area, the SFG members had greater opportunity to observe and discuss BMPs with the project FA than non-members.

**Table 1. Determinant factors for BMP technology adoption levels based on individual shrimp farmers responses from Sidorejo village, Demak District, Central Java, 2008.**

| Determinant Variables | Unstandardized coefficients | Standardized Coefficients (β) | T - test | Significance level |
|---|---|---|---|---|
| (Constant = $\beta_0$) | 1.959 | | 0.803 | 0.426ns |
| Education level | 0.384 | 0.362 | 2.914 | 0.005** |
| Occupation (DV) | 1.020 | 0.120 | 1.022 | 0.312ns |
| SFG membership (DV) | 2.463 | 0.370 | 2.540 | 0.014** |
| No of Family member | 0.597 | 0.358 | 2.773 | 0.008** |
| Pond holding | 0.000 | 0.332 | 2.514 | 0.015** |
| Contribution of SFarming Income | 0.005 | 0.040 | 0.281 | 0.780ns |
| Personal Goal in SF (DV) | -0.127 | -0.046 | -0.379 | 0.707ns |
| Length of Experience in SF | 0.054 | 0.084 | 0.574 | 0.569ns |
| Success experiences in SF | 0.042 | 0.025 | 0.205 | 0.569ns |
| Types of Shrimp Farmer (DV) | -0.179 | -0.027 | -0.183 | 0.856ns |
| Types of Shrimp Farming (DV) | 0.431 | 0.040 | 0.319 | 0.751ns |
| Farmer’s Perception in the problems of BMP components | 0.018 | 0.077 | 0.673 | 0.504ns |

Notes: *=significance at α=10%; ** =significance at α=5%; ***=significance at α=1%; $R^2$ = 0.443 and Adjusted $R^2$ = 0.301; F test ***

Source: Field Survey Data Analysis 2008

The estimated function of UR in Serangan village using the same model in Table 2 shows that two explanatory variables, i.e., education level and the farmer’s perception of the problems relating to BMP program adoption were positive and significant. The positive sign of education level indicates that those respondents with higher education levels were more likely to adopt the BMP technology. It is consistent with the fact that the BMP technology is more complex than traditional technology. The better-educated respondents, therefore, will have better understanding of the advantage of this technology and have higher probability of achieving better income than the respondents with low education level.

Two dummy variables of SFG membership and type of shrimp farming in Table 2 below were positive and significantly affected the respondent's behaviour. The SFG membership variable indicated that members had higher likelihood of adopting. The type of shrimp farming variable indicates that shrimp farmers who have more than one pond in Serangan village with monoculture shrimp farming had higher probability to adopt the BMP technology on order to minimize the risk of viral disease infection by practicing recommended technology components, such as bio-filter and bio-security management.

**Table 2. Determinant factors for BMP technology adoption levels based on individual shrimp farmers responses from Serangan village, Demak District, Central Java, 2008.**

| Determinant Variables | Ustandardized coefficients | Standardized Coefficients (β) | T - test | Significance level |
|---|---|---|---|---|
| (Constant = $\beta_0$) | 5.141 | | 2.357 | 0.023** |
| Education level | 0.221 | 0.263 | 1.747 | 0.087* |
| Occupation (DV) | -1.550 | -0.165 | -1.289 | 0.204ns |
| SFG membership (DV) | 1.598 | 0.236 | 1.817 | 0.076* |
| No of Family member | -0.150 | -0.074 | -0.660 | 0.512ns |
| Pond holding | 0.000 | 0.188 | 1.500 | 0.140ns |
| Contribution of SFarming Income | 0.020 | 0.162 | 1.391 | 0.171ns |
| Personal Goal in SF (DV) | 0.175 | 0.077 | 0.652 | 0.518ns |
| Length of Experience in SF | -0.035 | -0.100 | -0.836 | 0.407ns |
| Success experiences in SF | 0.217 | 0.053 | 0.470 | 0.641ns |
| Types of Shrimp Farmer (DV) | 0.158 | 0.025 | 0.204 | 0.839ns |
| Types of Shrimp Farming (DV) | 1.456 | 0.225 | 1.875 | 0.067* |
| Farmer's Perception in the problems of BMP components | 0.185 | 0.556 | 4.502 | 0.000*** |

Notes: * =significance at α=10%; **=significance at α=5%; ***=significance at α=1%; $R^2$ = 0.508 and Adjusted $R^2$ = 0.383; F test ***

Source: Field Survey Data Analysis 2008

These findings indicate the difficulties farmers faced in committing to BMP program adoption and the challenges faced by extensionists in facilitating such adoption.

## Conclusions

This research includes a review, from era to era, of the long history of agricultural extension in Indonesia. The shift in agricultural extension systems is in line with the government's focus and policy on agricultural development, with the democratization process, as reflected in the autonomy policy, and budgetary constraints.

During earlier phases, the agricultural and fisheries extension services used a commodity-based, linear, top-down approach under which self-sufficiency in rice, the priority goal, was achieved. This was followed by an emphasis on environmental friendly technology, as exemplified by the FFS system used for disseminating IPM technology. More recently, in the autonomy era, the focus has shifted to farmers' needs and institutional collaboration. The establishment of the Agency for Extension Coordination has led to extension effort across agriculture, forestry and fisheries becoming more balanced. However, problems remain in the organisational structure and in the delivery of this multi-sectoral extension system. Indonesian solutions to these problems must be found to enable wider scale-out of promising technologies across all three sectors.

The Indonesian government is currently giving considerable attention to the fisheries sector, especially shrimp farming, with its potential for foreign exchange earnings. The two ACIAR-funded BMP projects aim to increase productivity and profitability of shrimp farming using group approach. However, based on the adoption research and its extension services research, there is a need to formulate an effective extension strategy to roll out the technology across major shrimp farming areas; the projects' demonstration plot method, as in the *olie vlek* system, is too slow in disseminating the relatively complex BMP technology.

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