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Final report

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Contents

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2 Executive summary

Driven by global and domestic demand, shrimp aquaculture remains important in sustaining livelihoods in many coastal communities in Indonesia. However, smallholder Indonesian shrimp farmers, who comprise a significant but now declining part of the industry, face a complex mix of incompletely understood production constraints. In this context, the project's core aim was to improve health management via validation and progressive scale-out of 'better management practice' (BMP) programs. These comprised sets of practical, science-based management interventions (BMPs) aimed at significantly increasing farmers' chances of harvesting profitable crops in the face of recurrent threats to productivity, most notably from white spot disease (WSD).

For procedural reasons, the project's start was delayed until late 2007. From 2008 to early 2011, project partners worked closely with selected smallholder shrimp farmers, their farmer groups and district extension agencies in Central Java (CJ) and South Sulawesi (SS) on a series of pond-level program implementations, using participatory action research approaches including incremental training/capacity building. Based on these field implementations, and because of time limitations, we conducted the project's two closely integrated research components, 'proof of concept' and 'proof of delivery' in parallel. Under proof of concept, we embedded two studies, one examining key crop outcomes for each participating pond, and the other examining relationships between degrees of individual farmer compliance with component BMPs and pond productivity and profitability. Under proof of delivery, we embedded a pilot socioeconomic study aimed at identifying key demographic and farming practice factors likely to affect program adoption and an extension impact study examining extension approaches used, farmer participation levels and the effects of adoption on farmer livelihoods. Separately, we supported a study examining smallholder participation in farmed shrimp value chains in SS and CJ.

As the project proceeded, we progressively adjusted implementation approaches to accord with findings from our embedded studies and, via participation in FIS2006/144, with findings under related projects elsewhere, notably the successful BMP program scale-outs under way in India. We modified our programs to suit site characteristics (soil type, infrastructure, individual farmer and group capacity) and implemented them at cluster levels using carefully targeted extension approaches. By project's end we had implemented BMP programs in 151 ponds across 11 sites. However, most of our 2008 and 2009 implementations were unsuccessful by project criteria and our definitive implementations in 2010/11, involving 60 ponds at each of two sites, had to be abandoned mid-crop because of severe, unseasonal flooding in both places. We were therefore unable to achieve either proof of concept or proof of delivery in the relatively short time available.

Drawing on this experience, we identified major constraints to success which were unforeseen at the start of the project and which proved far beyond its resources to remediate. They included widespread, physically marginal sites, inadequate local infrastructure, farmers' limited resources and farmer group disunity. The project also highlighted the need for major capacity building and resourcing for (a) district-level extension service agencies and (b) government and university-based researchers involved in aquatic animal health management.

In addressing these challenges via its embedded studies and action research approach, the project has enormously advanced our knowledge of Indonesian smallholder shrimp farmers' demographics, their production systems and related biosecurity challenges, their service-related needs and their often rapidly changing operating environments. Building on these advances, and given the recent implementation of government policies fully favouring BMP program scale-out, we suggest a step-wise, multidisciplinary research and capacity building approach is now needed to progress this important work.

3 Background

In the decades preceding this project, shrimp had become established as the most important export commodity in Indonesia's fisheries sector. Accordingly, and in the face of decreasing wild catches, all levels of government actively promoted shrimp farming to improve prosperity in coastal communities and to generate foreign exchange. By 2005, ~300,000 t of farmed and 200,000 t of wild-caught shrimp were produced. Of these, ~150,000 t, almost half of which were farmed shrimp, were exported, mainly to Japan, the EU and USA, generating over US$1 billion. The farmed shrimp were grown, either alone or in polyculture, in around 200,000 ha of brackishwater ponds, being 40% of the total available area, in coastal or estuarine areas across the archipelago. The proportions of these ponds using traditional, semi-intensive (Table 1) and intensive culture systems, 75%, 15% and 10%, respectively, were relatively stable and, provided market requirements were met, shrimp for export or domestic sale were sourced from all production systems (Fatuchri 2005).

Table 1.Classification of Indonesian smallholder* Penaeus monodon *farming systems used during the project

	Stocking density (shrimp /sq. m)	Artificial feed	Aeration
Traditional (polyculture)	1	None	Via unmanaged macroalgae and/or phytoplankton
Traditional (= extensive)	1-3	From second month	Via managed macroalgae and/or phytoplankton Water sprayed via pump if DO low
Traditional plus	3-6	From stocking	Usually via managed phytoplankton Water sprayed via pump if DO low
Semi-intensive	10-15	From stocking	Via managed phytoplankton, paddle wheels

However, by 2005, important changes were affecting species being farmed, export market conditions and Indonesia's economic development plans. Since its introduction in 2001, the exotic, Pacific white shrimp *Penaeus vannamei* had progressively displaced the indigenous, tiger shrimp *Penaeus monodon* from intensive and semi-intensive systems in Indonesia and by 2005 was increasingly being grown in extensive systems. By then, vannamei comprised ~40% of total farmed shrimp production. Moreover, the supply of unprocessed shrimp to world markets had overtaken demand. To remain competitive, and to protect access to export markets, governments, producers and exporters increasingly recognised (a) the importance of complying with international food safety standards; (b) the importance of value-adding as a competitive strategy; and (c) that over-reliance on particular markets was undesirable.

Furthermore, in Indonesia as in many other countries, contagious viral diseases, notably white spot disease (WSD) continued to cause devastating crop losses in *P. monodon* and *P. vannamei*. However, simple, 'quick fix' control methods, such as chemotherapy, had proved ineffective. In response, other strategies aimed at improving biosecurity were developed and two of these proved particularly successful. The stocking of SPF *P. vannamei* seedstock, combined with comprehensive biosecurity programs on farms, initially in the Americas and more recently in parts of Asia, significantly reduced disease-related losses in that species (Lightner 2005). Biosecurity for *P. monodon* farmers, who continue to rely on seed from wild-caught non-SPF broodstock, came via the development and implementation of similar health management programs incorporating science-based better management practices (BMPs). This approach, delivered via appropriate extension programs implemented at farmer group levels, emerged as an effective way of reducing losses and improving profitability for smallholder *P. monodon* farmers in Asia, notably in India.

In this context, as part of a major directional change in Indonesia's economic development, a Presidential Decree ordering revitalization of the shrimp farming sector was issued in 2005. In a response with important implications for this project, MMAF in 2006 set a production target for farmed shrimp in 2009 of 540,000 t, including 162,000 t of *P. monodon.* A projected total pond area of 262,000 ha was to be used to grow these shrimp, involving a workforce of 985,000 and generating an estimated US$2.25 billion in export income.

In Indonesia generally, a tiny number of large firms tended to dominate the private sector at one extreme, with an abundance of informal 'micro to small enterprises' (MSEs) at the other. Preliminary evaluation of smallholder shrimp supply chains indicated all components, including farmer groups, upstream of processor/coldstore were MSEs.

As well as the biosecurity, product quality and food safety challenges generally facing shrimp producers worldwide, smallholder farmers and related supply chain MSEs in Indonesia faced additional problems. These included: (a) structural limitations in supply chains (e.g. key input supplies not available locally; long distances to export facilities); (b) limited awareness of, and access to information on effective biosecurity and/or compliance with market standards (e.g. in food safety); (c) limited access to accurate and timely information on market opportunities and standards; (d) limited access to credit; (e) limited awareness of, and capacity to engage in, value-adding.

This project aimed to build on the work of FIS/2000/061, the recommendations of that project's reviewers, and the work of other donor-funded projects in India and Vietnam. It aimed to improve productivity and profitability for 'traditional' and 'traditional plus' shrimp farmers, their farmer groups and related supply chain MSEs. Traditional farmers in Indonesia generally own < 5 ha of ponds and often have few alternative livelihood options. They typically have some history of cooperative action within community-based farmer groups. They are open to technical innovation, but are generally risk averse and culturally conservative. We considered it likely that other MSE operators would have similar attitudes to change.

The project aimed to develop, validate and monitor the dissemination of model programs comprising best practice, enterprise-level interventions and 'facilitated action learning' extension methodologies, supported by appropriately skilled extension and health management services. We expected that implementation of biosecurity-related BMPs would immediately and markedly improve pre-harvest productivity and profitability. We expected also that improved product quality and accredited compliance with food safety standards, including traceability requirements, would facilitate access to premium export and domestic markets, and reduce risk of costly shipment rejections. Identification of premium market and value-adding opportunities would further improve profitability. Training would improve capacity of technicians, extensionists and diagnosticians to support independent dissemination of model programs. In turn, dissemination would support DGA's objective of 'revitalising' the sector and attaining national shrimp production targets. The project's aims were also consistent with ACIAR's priorities, which included improving productivity and efficiency of food crop systems, and linking farmers to markets. Importantly, we designed the project so that activities and outcomes would be consistent with best practice as outlined in International Principles for Responsible Shrimp Farming (WB, NACA, WWF, FAO, UNEP, GPA 2006; Appendix I).

4 Objectives

4.1 Sub-project A: Project-supported model program implementation and validation in target supply chains

4.1.1 Objective 1

To improve biosecurity, product quality and food safety through adoption of contextualised BMP programs by smallholder farmer groups and associated MSEs in selected district-based supply chains in Central Java and South Sulawesi

Activities

- Facilitate adoption of contextualised biosecurity-related BMPs by farmer groups producing *P. monodon* or *P. vannamei* in two selected, district-based supply chains in each province
- Facilitate adoption of contextualised biosecurity-related BMPs for broodstock suppliers, large hatcheries and backyard hatcheries producing *P. monodon* or *P. vannamei* in two selected, district-based supply chains in each province
- Facilitate adoption of contextualised pre-harvest and post-harvest food safety and product quality-related BMPs for farmer groups and associated MSEs in two selected, district-based supply chains in each province
- Periodically measure adoption, compliance and impact, and adjust implementation and extension programs as necessary.

4.1.2 Objective 2

To facilitate participation in appropriate BMP compliance certification programs by farmer groups and associated MSEs in participating supply chains

Activities

- Identify certification programs and certifying bodies meeting the needs of participating farmer groups and associated MSEs and their target markets
- Facilitate implementation of appropriate certification programs in selected, district-based supply chains in target provinces
- Periodically review market requirements, assess certification program compliance and usefulness, adjust implementation and extension programs as necessary

4.1.3 Objective 3

To provide market intelligence to smallholder farmer groups and associated MSEs in participating supply chains

Activities

- Facilitate links between smallholder shrimp producers and premium market suppliers
- Develop and implement appropriate methods of providing timely, relevant and accurate market intelligence to farmer groups and associated MSEs
- Provide appropriate training to these groups to enable effective use of the project's market intelligence system
- Establish a database management system to support this information sharing
- Establish links and exchange information with groups providing similar intelligence in other regional countries
- Periodically measure adoption, compliance and impact, and adjust implementation and extension programs as necessary

4.1.4 Objective 4

To provide information on credit access and value-adding processes for farmers, farmer groups and/or associated MSEs in participating supply chains

Activities

- Provide information on credit availability to farmer groups and other supply chain MSEs
- Identify, and provide information about, post-harvest value-adding options for selected, district-based supply chains
- Periodically measure adoption, compliance and impact, and adjust implementation and extension programs as necessary

4.1.5 Objective 5

To improve extension capacity and health management capacity by training selected extensionists, technicians, diagnosticians and epidemiologists

Activities

- Identify relevant training needs in extension theory and skills, and provide training as necessary, for DGA, provincial and district Dinas staff, with particular focus on extension for district-level supply chain development
- Train selected TIU extensionists in each province in advanced, project-related extension methods
- Train new-entrant, enterprise-level technician/extensionists
- Train senior University-based and DGA staff in shrimp histopathology, histotechnology and rapid testing methods (‘train the trainer’)
- Train selected DGA and provincial laboratory staff in shrimp histopathology, histotechnology and rapid testing methods
- Train selected USyd and DGA staff in aquatic animal epidemiology

4.2 Sub-project B: Independent model program implementation in selected supply chains

4.2.1 Objective 1

To identify determinants for successful program implementation in target supply chains

Activities

- Characterise structures and modes of operation of selected farmer groups and associated supply chains participating in Sub-project A
- Identify key determinants for commercial and social success of these selected farmer groups and associated supply chains

4.2.2 Objective 2

To enable smallholder farmer groups and associated MSEs in selected supply chains, in association with government and private sector agencies, to successfully implement contextualised BMP programs independent of project support

Activities

- Facilitate program implementation in selected (i.e. must have essential success determinants) supply chains in ‘naïve’ districts, supported by appropriate, generally available, government and private sector resources only

- Measure adoption, compliance and impact, and adjust implementation and extension support programs as necessary.

5 Methodology

5.1 Overall approach

The project aimed to improve productivity and profitability for participants in Indonesian shrimp supply chains, with the primary focus on smallholder farmers and their farmer groups. We planned to achieve this via two sequential Sub-projects, A and B.

In Years 1 and 2, under Sub-project A, we intended to test, via targeted research, the ability of model BMP programs, supported by trained technicians and extensionists, to consistently deliver profitable crops to selected volunteer farmers and farmer groups under prevailing socioeconomic conditions. Assuming success, and to pave the way for the next step, we planned to establish linkages with in-country and regional experts, agencies and other groups considering or involved in comparable program scale-out. Then, for Sub-project B in Years 3 and 4, we intended to assist independent program dissemination by government agencies and/or the private sector.

Although the project's formal start date was 1 January 2007, a prolonged contractual dispute delayed the start by 10 months; Part H funds were released in June 2007 and remaining Payment 1 funds in October 2007. These delays forced us to postpone project inception until June and, during the period up to October, to focus on low-cost preparatory/organising/scoping activities. Most importantly, the delays forced postponement of pond-level implementations and other activities closely linked with optimal cropping periods.

As the project proceeded, we became increasingly conscious of its complexity, the short time available to completion and, if we were to maximise the chances of success, the need to implement the programs wherever possible during the most favourable cropping periods. In this context, we recognised that an action research approach would be mandatory; i.e. we needed to use a systematic cyclical method of planning, taking action, observing and critically evaluating prior to planning the next research cycle (Avison et al 1999; Riel 2010).

Figure 1 below shows the stepwise 'proof of concept' and 'proof of delivery' activities against BMP program implementations we used during the course of the project.

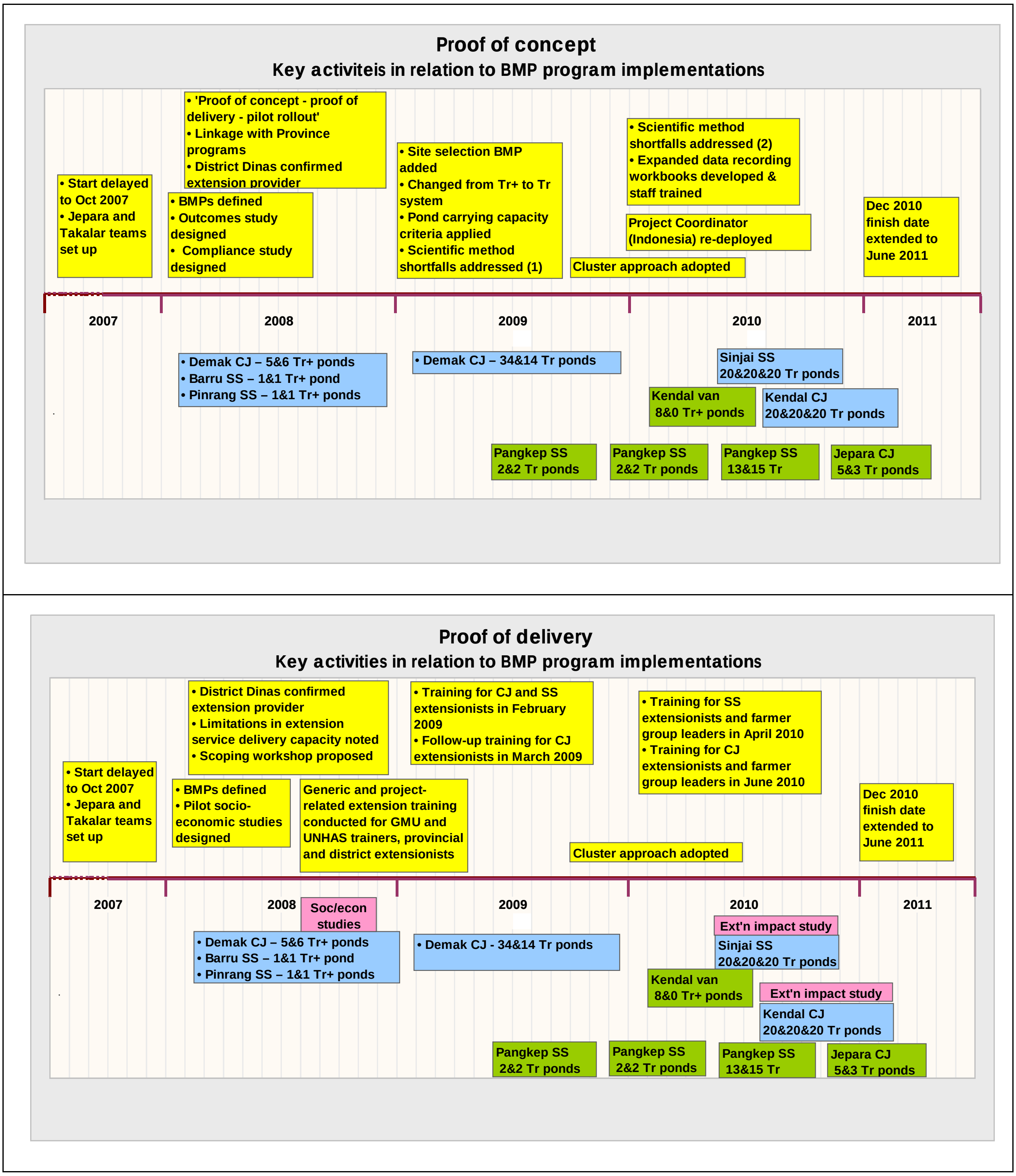


Figure 1. 'Proof of concept' and 'proof of delivery' activities in relation to BMP program implementations throughout the project. Outcomes study implementations are shown in blue, supplementary capacity–building implementations are shown in green.

5.2 Team development, structure and roles

In the lead up to the 2008 field implementations, we concentrated on team development. We set out to build a core group fully competent in (a) farm-level shrimp health management; (b) farm-level extension service delivery and (c) researching relevant health management and social science issues from pond to community levels. We expected this core group would train and support field technicians and extensionists who, in turn, would support program implementations by our trained lead farmers in each province.

We appointed a Project Officer, Senior Technical Officers (STOs) and field technician/extensionists (TEs), identified staff interrelationships (Appendix 2), roles and responsibilities (Appendix 3).

5.3 2008 'outcomes study' implementations

The overall aim of this research was to test the ability of BMP programs, supported by trained technicians and extensionists, to consistently deliver profitable crops to selected volunteer farmers and farmer groups under prevailing socioeconomic conditions.

5.3.1 Outcomes study

As part of his project-funded doctoral program at Gadjah Mada University (GMU), Project Epidemiologist (Indonesia) (PE(I)), assisted by Project Epidemiologist (PE) and Project Coordinator (PC), began a study comparing selected outcomes in traditional BMP-implementing monodon ponds with those from matched control ponds.

Objectives

- To evaluate the impact of facilitated BMP program implementation on the success/failure of traditional monodon shrimp ponds
- To evaluate the impact of facilitated BMP program implementation on the white spot virus infection status of shrimp at harvest from traditional monodon shrimp ponds
- To evaluate the impact of facilitated BMP program implementation on the presence of disease due to white spot virus in shrimp at harvest from traditional monodon shrimp ponds.

Methodology

Using the standard operating procedures (SOPs) and data recording system summarised below, team members collected data from BMP-implementing ponds and matched control ponds.

Standard operating procedures

We produced, or obtained from other appropriate sources (notably from ACIAR project FIS/1997/022), protocols covering BMP program implementations across the cropping period. We paid particular attention to biosecurity issues, given their importance, complexity and the relatively low knowledge levels amongst some staff. To support formal validation of the BMP programs, we developed data collection, recording and reporting systems. Examples of relevant documents are listed below. Note that data collection and recording systems evolved significantly during the course of the project; an example workbook and list of component worksheets for data recording as used in 2010/2011 is shown in Appendix 4.

Implementation protocols

Pre-stocking

- Postlarval selection (Appendix 5);
- Viruses of concern (Appendix 6);
- Examinations for virus infection of monodon (Appendix 7) and vannamei (Appendix 8) postlarvae and juveniles;

Growout

- Testing and sampling procedures (Appendix 9);
- Disease outbreak investigation (Appendix 10);

- Emergency harvest decision tree (Appendix 11);

Harvest

- WSSV infection at harvest (Appendix 12).

Data collection and recording

- When to use disease protocols (Appendix 13)
- Farm and pond enrolment form (Appendix 14);
- Shrimp feeding and survival record (Appendix 15);
- Data storage structure (Appendix 16).

PE estimated that PE(I) would need data, collected as summarised above, from at least 40 implementing ponds and 40 matched control ponds for results to be statistically meaningful.

The 2008 BMP program

Building on BMP programs already implemented in India under the NACA/MPEDA program and, in particular, those detailed in the 'Practical manual on better management practices for tambak farming in Aceh' (ADB / ACIAR / AwF / BRR / DKP / FAO / GTZ / IFC / MMAF / NACA / WWF; 2007), senior project technical staff developed a 15-point BMP program, based on three mandatory principles (Table 2), backed up with full supporting technical information. We then applied this program during the project's 2008 field implementations.

Table 2. BMP program as used during 2008 implementations in Central Java and South Sulawesi.

Mandatory principles	Component BMPs
1. Maintain a unified and disciplined farmer group	• Follow an agreed crop calendar; including all-out, all-in cycle • Do not use pesticides or other banned chemicals • Promptly notify other farmers of disease events • Do not release infected water or material into canal without agreement from group
2. Maintain optimal pond biosecurity	• Use a traditional-plus system comprising growout pond and biofilter (reservoir) pond • Prior to stocking, eliminate wild crustaceans from the system and surround the growout pond with embedded screens and/or fences • Select only high quality tested PLs and minimise stress during transportation and stocking • Store all water for at least 6 days in the shrimp-free biofilter pond and screen (to 300 um) before release into the growout pond • Keep the system free of wild shrimp during growout • Respond quickly to disease outbreaks in the pond or in the locality
3. Maintain optimal pond conditions	• Prepare the pond to minimise environmental stress to shrimp during growout • Monitor water quality and maintain key variables within optimal limits • Use check trays to regulate feeding • Monitor shrimp growth and health • Maintain a pond record book

Field site selection

Fisheries and Marine Affairs, Central Java and Fisheries and Marine Affairs, South Sulawesi are designated Partner Country Collaborating Organisations in the project document. For the following reasons we selected farmer groups in Demak district in

Central Java province and Barru and Pinrang districts in South Sulawesi province for 2008 BMP program implementations.

There are ~ 40,000 ha of brackishwater aquaculture ponds across 16 districts in Central Java province, making it the 7th most important Indonesian province by farmed area. Approximately 7,500 ha are located in Demak district, immediately east of the capital, Semarang. In 2007 there were 20 ‘active’ farmer groups involving 3,000 smallholder shrimp farmers operating these ponds, all of them traditional/extensive. Importantly, regarding district Dinas staff participation, Demak’s Bupati strongly supported the project objectives. Finally, the Main Centre for Brackishwater Aquaculture Development (MCBAD) Jepara, DGA’s lead Technical Implementation Unit (TIU) for shrimp farming is ~1 hr by road from Demak and it was here that the Project Epidemiologist, Project Officer and Senior Technician/Extensionist (CJ) were based.

South Sulawesi (SS) is Indonesia’s leading brackishwater aquaculture province with ~103,000 ha of ponds, operated by ~15,000 farmers. Barru district is 2 hr by road north of the capital, Makassar, with Pinrang district a further 2 hr north. Pinrang district is considered the ‘pillar’ of brackishwater aquaculture in South Sulawesi, with ~15,000 ha of ponds, almost all operated by smallholders. Both districts could be reached relatively easily by project Senior Technician/Extensionists based at DGA’s TIU in SS, the Brackishwater Aquaculture Development Centre (BADC) at Takalar, just south of Makassar. Moreover, local government representatives in both districts expressed strong support for the work.

We recognised from the beginning that target farmer groups and study sites in Years 1 and 2 might not be representative on a national scale, but we were advised that soil types, hydrology, pond systems and farming methods at the selected sites were generally representative of those elsewhere in their respective provinces. We expected each site would present a range of advantages and challenges which would facilitate the project’s subsequent (Year 3) scale-out of successful ‘model’ programs, adapted as necessary for participating farmer groups and supply chains. However, from experience under FIS/2000/061, we were well aware that porous and acidic soils were common in SS, and that these offered particular challenges to successful program implementation.

After consultations with provincial and district Dinas staff, and with interested farmer group representatives, project staff from Jepara and Takalar TIUs selected four farmer groups (two in Demak district, Central Java; one each in Barru and Pinrang districts, South Sulawesi) for 2008 BMP program implementations.

Growout pond + biofilter system

We worked with farmers to implement the BMP programs in biosecure growout pond + biofilter/reservoir pond combinations; a typical configuration is shown in Figure 2. Senior Indonesian project staff identified this general system as being compatible with both existing farming practices and with our requirements for strict biosecurity, increased productivity and profitability. The systems were designed so that farmers, as well as producing shrimp, had the option of producing high-value finfish in the growout pond(s) and in the shrimp-free biofilter pond(s).

Figure 2. 'Traditional-plus' growout ponds (green) with crustacean-free biofilter/reservoir ponds (blue) as used for the 2008 BMP 'proof of concept' trials at Sidorejo village, Demak district, Central Java. The biofilters supplied putatively WSSV-free water to the growout ponds and, together with perimeter fences and the wide canal embankments on the system's east and west sides, were intended to restrict entry by WSSV-carrying crabs.

At each of four sites we worked with lead farmer(s) and their group to implement BMP programs in 'traditional-plus' growout ponds, with their associated biofilter ponds, as follows.

- 3 contiguous ponds at Sidorejo village, Demak district, Central Java (Figure 2);
- 2 contiguous ponds at Serangan village, Demak district, Central Java;
- 1 pond at Madello village, Barru district, South Sulawesi;
- 1 pond at Data village, Pinrang district, South Sulawesi.

In addition, we intended to collect data from nearby matched control ponds, each without biofilter ponds.

Support to participating farmers

Technical support

Trained, project-funded T/Es were permanently located at field sites during each crop, from pond preparation to post-harvest. Under advice from their STO, they helped farmers implement the programs. They collected data and assisted with meetings prior to, during and after the crop.

STOs provided technical advice, via telephone if requested, to T/Es and farmers throughout the cropping period. In addition, they visited each field site weekly, collected data and discussed progress. In collaboration with district Dinas extensionists, T/Es and PE(I), they led the technical components of extension service delivery, notably during farmer group meetings (Figure 2).

PE(I) supervised STOs and, as required under his doctoral research program, visited field sites to provide supplementary expert technical advice. He also assisted in extension activities and in preparation of project-related advisory material.

PC and PE provided detailed technical support to PE(I), STOs and T/Es during coordination visits to project sites and via email during other periods.

Duties for each of these positions are summarised in Appendix 17.

Extension support

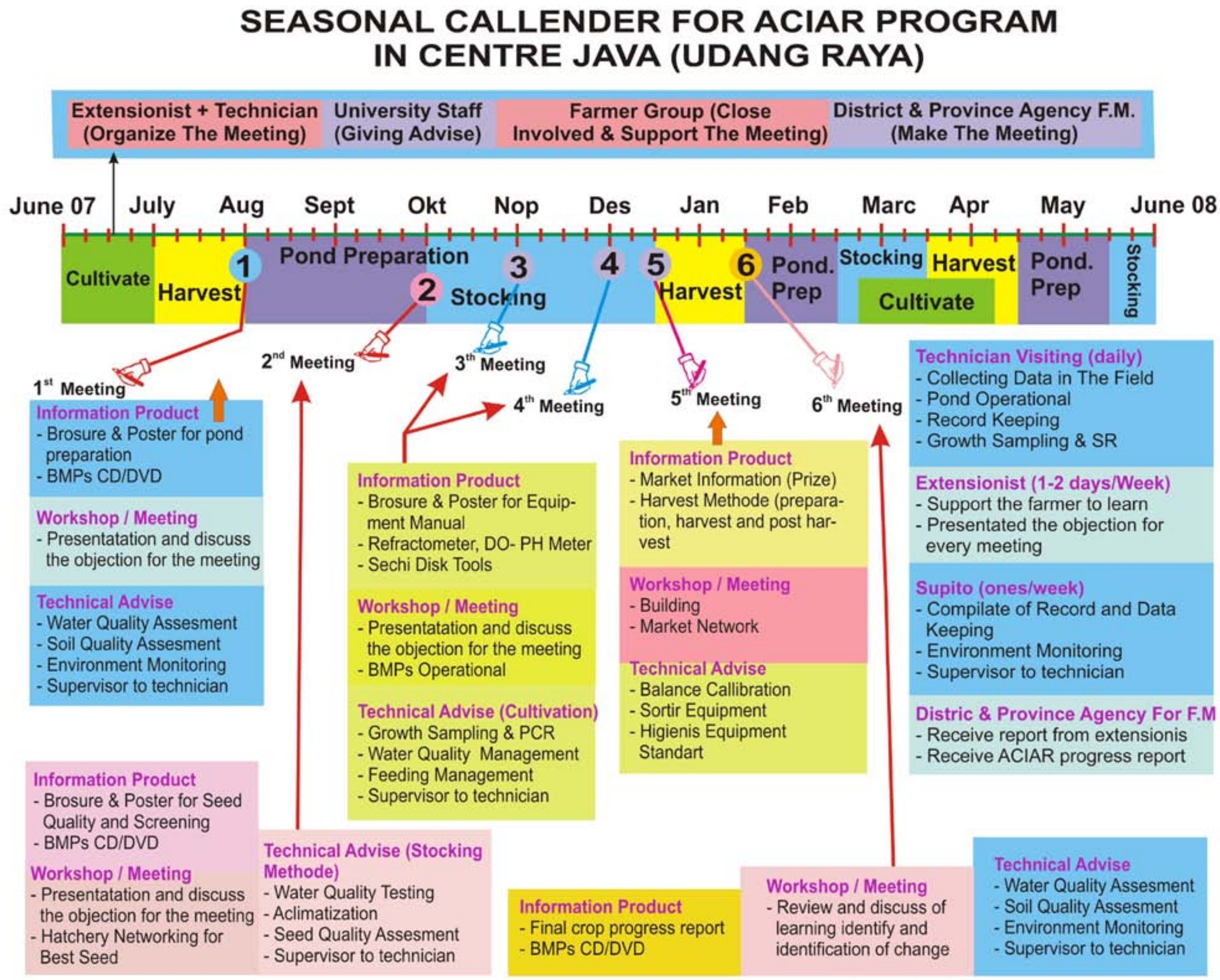


Figure 3. Example crop calendar showing collaborative BMP program-related extension activities involving farmers, district Dinas staff and project technical staff at Udang Raya farmer group, Serangan, Central Java.

Following detailed discussions, senior Indonesian and Australian project staff agreed that district Dinas extensionists would be primarily responsible for all aspects of extension service delivery to implementing farmers, except for technical information, which would be provided by STOs, assisted by T/Es and PE(I). Extension support would be delivered jointly via meetings, demonstrations, brochures, etc, appropriately spaced across crop calendars agreed for each site (Figure 3). To prepare for this, we trained Dinas staff in relevant generic extension skills (such as running farmer group meetings, producing posters and brochures; see Appendix 18) and in basic BMP program theory via Consultant (Extension), PE(I) and our (train the trainer) extensionists from GMU and Hasanuddin University, Makassar (UNHAS). However, as the 2008 field implementations proceeded, we became aware of serious shortfalls, apparently for systemic reasons, in fisheries extension service delivery. Apparently at least in part because of limited resourcing, our project-trained district Dinas staff in practice did not engage with farmers as required under the crop calendars. We notified ACIAR of this unexpected and critical deficiency, and the lack of any obvious alternative extension provider. In response, ACIAR agreed to run a cross-sectoral 'constraints to adoption' workshop in 2008/9 aimed at clarifying the issues and identifying possible ways forward. In the interim, and in an attempt to remove what we understood to be the key remaining constraint, we offered project funds to support district Dinas extensionists' activities as required under the crop calendars.

Following discussions begun in July 2008, SMAR/SADI program managers provisionally agreed to include the project amongst those assisted by their program. The proposed linkage would include assistance with extension material development and design, as well as implementation of the extension impact study. They also agreed to help progress, with RPM Fisheries, the proposed 'constraints to adoption' workshop.

5.4 Pilot socioeconomic studies

On the assumption that our field trials from 2008 onwards would in most cases be technically successful, we needed to know which socioeconomic factors, if any, might influence BMP program adoption and retention by target farmers over the longer term. Accordingly we conducted pilot socioeconomic studies, in collaboration with Consultants (Socioeconomics) from GMU and UNHAS in target districts in Central Java and South Sulawesi, respectively.

5.4.1 Objectives

- To describe the socioeconomic profiles, including demographics and farming practices, of brackishwater pond farmers and their households at project field study sites in Central Java and in South Sulawesi;
- Using these profiles, identify factors likely to affect BMP program adoption by target farmers and farmer groups.

5.4.2 Methodology

In addressing these objectives, consultants in each province used somewhat different approaches.

Central Java

A mixed model design with both quantitative and qualitative components was used. We conducted quantitative field surveys of socioeconomic issues using questionnaire-based interviews and, for the qualitative component, conducted focus group discussions and in-depth interviews with selected key informants.

There was a total of 120 shrimp farmer respondents. We interviewed 60 respondents from each village, each comprising 30 shrimp farmer group (SFG) members selected via census and 30 non-members selected via simple random sampling. In addition to the questionnaire-based interviews, in-depth and focus group discussions with some key informants were used to collect more detailed information on group activities and their possible role in the adoption process.

Twelve explanatory variables relating to each farmer's adoption behaviour were: educational level, number of family members, pond holding, contribution of shrimp farming income to the family income, length of experience in shrimp farming, success experiences in shrimp farming, and farmer's perception of potential problems in relation to individual BMPs within the program. We also included five variables hypothesized to influence each respondent's behavior: SFG membership, personal goals in shrimp farming, whether a full-time shrimp farmer or not, type of secondary occupation and whether growing shrimp in monoculture or poly-culture.

To estimate the parameters of twelve explanatory variables influencing respondents to adopt BMPs technology, a logistic regression model with a dichotomous value was used.

South Sulawesi

The pilot study was conducted in 2008 at the four village sites selected for BMP program implementation.

A sample of 30 farmer respondents was randomly selected from the total pond-farmer households at each site. Data on the following were collected via interviews, using a standard questionnaire (Appendix 19):

- Demographic characteristics, i.e. age, gender, education, dependents, occupation(s), etc.;
- Income sources, with particular reference to shrimp farming and other economic activities;
- Shrimp and/or fish farming practices, i.e. pond preparation, growout, harvesting, financial support, marketing, etc.;
- Socioeconomic activities relating to shrimp or fish farming, with special reference to local farmer group activities and respondents' participation in these.

Focus group discussions (FGD) were used to further evaluate responses to the questionnaire and to identify perceived problems in implementing the BMP program.

Secondary data were collected from existing literature and research reports. Data were analyzed using qualitative methods and presented descriptively.

5.5 2009 'outcomes study' and related BMP program implementations

5.5.1 Action research issues

Results of our 2008 program implementations and pilot socio-economic studies clearly showed that issues affecting broadscale BMP program adoption by smallholder farmers and their communities were more complex and likely to require a longer time investment than we originally expected. Accordingly, we revised our approach in 2009, giving special attention to site selection, biosecurity, extension and profitability issues. In addressing these, we actively sought information on program modifications and improvements from other researchers involved in similar implementations elsewhere in the region. Much of this was done via meetings and subsequent exchanges under FIS/2006/144 'Strengthening regional mechanisms to maximize benefits to small-holder shrimp farmer groups adopting better management practices (BMPs). We also recognised that to have any chance of reaching our research end-point and scale-out objectives in the two years remaining, we needed to establish linkages with provincial and district-level government assistance programs without delay, accommodating where possible their political considerations and resourcing constraints. Following detailed discussions with the SMAR/SADI group in Makassar, we changed our overall scale-out approach to involve two closely integrated components, 'proof of concept' and 'proof of delivery', running in parallel. Using these, we aimed to achieve 'pilot rollout', an arbitrary research end-point whereby approximately 300 farmers had successfully adopted validated BMP programs, by project's end.

Proof of concept

Contrary to our initial assumptions, the 2008 field trial results showed our original BMP programs, applied in 'traditional plus' growout pond + biofilter/reservoir pond systems in environmentally diverse smallholder shrimp farming areas, would not in most cases protect shrimp from disease and/or deliver profitable crops. However, taken together with emerging findings from implementations in India and Aceh, our results suggested that well-managed clusters of 'traditional' BMP ponds in sites with pH-neutral soils of low porosity, protected by biofilter ponds and other barriers to WSSV incursion, would have a good chance of achieving acceptably high productivity. We estimated that, under economic conditions prevailing at the time, these crops would be profitable.

Proof of delivery

As noted above, and contrary to assumptions when the project and its budget were framed, district Dinas staff in 2008 proved unable to engage with target farmers; Leta et al (2005) have identified possible contributing factors, many of which are systemic. However, following discussions with partner agencies, we re-confirmed district Dinas as our primary extension service provider. We did this in the clear expectation that we would be able to (a) identify an effective extension approach via ACIAR's promised workshop and (b) support it, in part, via SMAR/SADI's promise of assistance. Meanwhile, to support the 2009 implementations, we provided BMP program-specific training for selected district Dinas field staff and, with them, developed agreed crop calendars describing extension activities to be conducted across the cropping period at their various field sites. We also offered all necessary funding and material support to enable designated Dinas field staff to support our proposed implementations at Sidorejo and Serangan.

5.5.2 The 2009 BMP program

Evidence from our 2008 trial ponds in SS suggested that problematic local hydrology and soil types strongly influenced WSD outbreak occurrence. To reduce these risks, we introduced a preliminary site selection step, designed in collaboration with Research Institute for Coastal Aquaculture (RICA), Maros staff involved in FIS/2002/076. We also modified the BMP program to include a product quality component. The modified program is shown in Table 3 below.

Table 3. BMP program as used during 2009 implementations in Central Java and South Sulawesi.

Step 1: Identify suitable sites.

Site selection criteria
• Unified, village-based farmer group with strong, respected leader • Members' resources sufficient to implement BMPs • Adequate technical and extension support available • Suitable soil (pH >6.5, seepage loss <10% per week) • Adequate water supply and discharge infrastructure • Growout ponds in tight, biosecure cluster • Adequate biofilter ponds available (≥ 30% growout pond volume) • Tested seed available, < 6 hrs transport time to ponds • Herbivorous and carnivorous finfish fingerlings available as needed • Ponds physically suitable • Farmers skilled in preparing ponds and maintaining good pond conditions during growout • Effective market chain

Step 2: Work with farmers at suitable sites to implement program.

Mandatory principles	Component BMPs
1. Maintain a unified and disciplined farmer group	• Follow an agreed crop calendar; including all-out, all-in cycle • Do not use pesticides or other banned chemicals
2. Maintain optimal pond biosecurity	• Use a traditional-plus system comprising growout pond and biofilter (reservoir) pond • Prior to stocking, eliminate wild crustaceans from the system and surround the growout pond with embedded screens and/or fences • Select only high quality tested PLs and minimise stress during transportation and stocking • Store all water for at least 6 days in the shrimp-free biofilter pond and screen (to 300 um) before release into the growout pond • Keep the system free of wild shrimp during growout • Respond quickly to disease outbreaks in the pond or in the locality
3. Maintain optimal pond conditions	• Prepare the pond to minimise environmental stress to shrimp during growout • Monitor water quality and maintain key variables within optimal limits • Use check trays to regulate feeding • Monitor shrimp growth and health • Maintain a pond record book
4. Maximise food safety, product quality and profitability	• Use better handling and sanitary practices during harvest and post-harvest • Use market information to optimise profits

5.5.3 2009 ‘outcomes study’ implementations

We set out to address the unexpected failure of the 2008 CJ implementations to deliver profitable crops even though technically ‘successful’’. Accordingly, we shifted the outcome study’s focus in 2009 and facilitated adoption of the BMP program in a total of 34 low input cost, ‘traditional-polyculture’ ponds at two sites in Demak district, CJ. We planned to make up the total of 40 implementing and matched control ‘traditional plus’ ponds required for statistical significance via other implementations during 2009 and 2010.

To address data recording shortfalls under the 2008 implementations, PE provided supplementary training for PE(I) and both STOs at University of Sydney prior to the 2009 implementations. Also, to accommodate the change to traditional-polyculture ponds with relatively fewer biofilter ponds, we modified and improved the data recording system.

Aside from these changes, the outcomes study objectives and general methodology remained as for 2008.

Field site selection

Following from the above, and utilising the apparent biosecurity advantages arising from the dominant soil types and ‘stacked’ pond layouts in Demak, in March 2009 we implemented a new round of validation trials in 25 ponds at Sidorejo (Figure 4) and 9 ponds at Serangan. These implementations were designed to provide additional data for PE(I)’s outcomes study described above. To reduce input costs relative to the 2008 implementations, growout ponds at both sites used a ‘traditional-polyculture’ system involving monodon (≤2 shrimp/m^2; natural feed only; no artificial aeration) with finfish. In response to the pilot socio-economic study’s findings, we also greatly reduced the biofilter/growout pond proportions relative to the 2008 trials and, as far as possible given farmers’ cropping preferences, positioned the biofilter ponds as physical barriers to reduce risks of external WSSV incursion and internal WSSV spread.

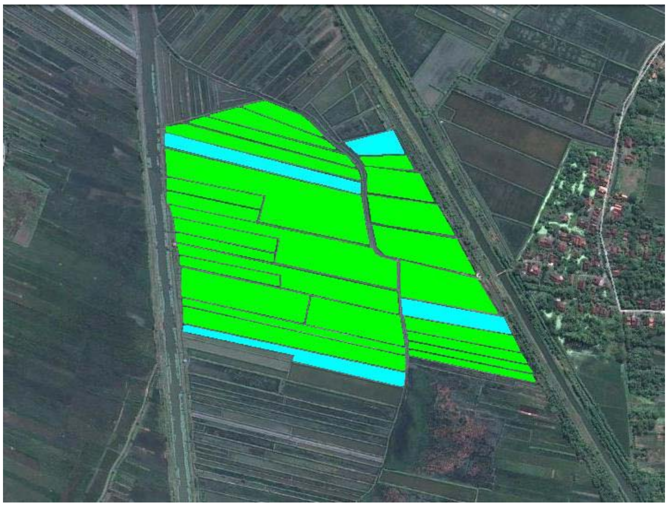


Figure 4. 'Traditional polyculture' growout ponds (green) with crustacean-free biofilter/reservoir ponds (blue) operated by 'Windu Jaya Dua' farmer group for the 2009 outcomes study trials.

5.5.4 2009 supplementary, capacity-building BMP program implementations

Pangkep, South Sulawesi

Because of the importance of brackishwater aquaculture in South Sulawesi, and despite the failed 2008 implementations in Pinrang and Barru districts, we resolved to continue program implementations there in 2009, provided we could find a suitable site. We did this in part to maintain project momentum, further build capacity and linkages, and provide a basis for the Takalar-based STO's masters program. However, we recognised that adverse hydrology and soil factors would eliminate many localities. Accordingly, we implemented programs in 2 'traditional-plus' growout pond + biofilter polyculture systems owned by an entrepreneurial village head in a putatively favourable (but not widely replicable) site in Pangkep district. Surrounding this study site (Fig 5) are ~900 ha of ponds operated by >300 farmers. Soil at the site is predominantly clay, with low porosity, and pond water is taken from a freshwater river mixed as required with saline (20 ppt) groundwater from on-site wells. In mid-2009, at the time of implementation, there was no active farmer group but we proposed working with district Dinas to involve local farmers in pond visits during the implementation.

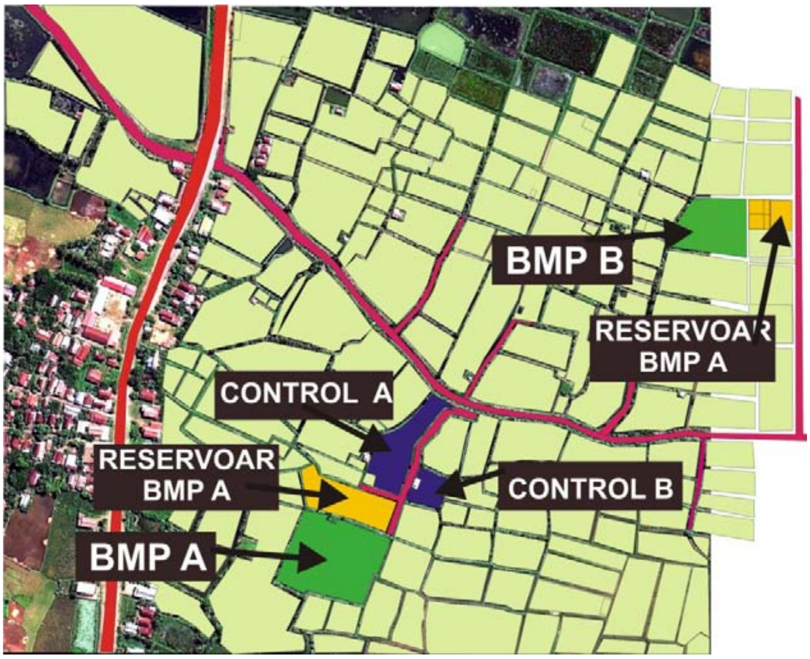


Fig 5. Map showing location of ponds participating in 2009 BMP program implementation in 'traditional-plus' systems at Pangkep, South Sulawesi.

Research under project-funded masters degrees

Submerged aquatic plants are common in smallholder shrimp ponds in Indonesia, particularly those in relatively low salinity areas. Emerging evidence during 2009 field trials in both Demak and Pangkep districts suggested that the low dissolved oxygen (DO) concentrations being recorded were causally associated with the abundance of submerged aquatic plants including and *Nitella* spp., *Ruppia* spp. and *Ceratophyllum* spp. and a relative absence of phytoplankton. We also consistently recorded poor growth rates and very low survival in shrimp in these ponds, resulting in productivity and profitability losses comparable to those caused by WSD outbreaks.

In order to better manage DO during growout, we needed a better understanding of interactions between these plants, the shrimp and the pond environment. Accordingly, with permission from RPM Fisheries, we arranged to use existing project funds to support 2-year masters degree programs, focused on these issues, for the Jepara and Takalar-based STOs at Diponegoro University (DU), Semarang and UNHAS, respectively.

5.6 South Sulawesi value chain study

In collaboration with ADP2005/066, we provided funds to broaden their existing study of smallholder shrimp supply chains in South Sulawesi. This was to be followed by a descriptive statistical study for Central Java, described separately below.

Objectives

- Identify trends in the restructuring of value chains for shrimp;
- Identify determinants and outcomes of participation by farmers in different value chains;
- Identify policies and programs that would promote the competitiveness and inclusiveness of the transformation of shrimp value chains.

Methodology

The study proposed to identify segments and sub-segments within the value chains involving monodon farmers in SS. To understand the structure and performance of these chains, the study would use interviews with key informants including farmers (traditional, 'modernising' and intensive), wholesalers, brokers and processors, together with farm surveys and trader surveys. Issues addressed would include production (quantity, variety); technology (inputs used, quantity used); capital (land, equipment, human, financial) and coordination (spot-market, credit, contract).

5.7 SRA (FIS/2009/035): pilot study of WSD outbreak determinants

Project findings to 2009 identified an emerging and urgent need to simplify BMP programs, improve their cost-effectiveness, and make them more adaptable to the spectrum of smallholder shrimp farming practices. We therefore applied (successfully) to ACIAR for a small research activity (SRA) grant, in collaboration with participants in FIS/2002/075 and FIS/2002/076. Under this SRA we planned to examine relationships between locality factors, WSSV genotype distributions, pond factors and WSD outbreaks at a representative site in South Sulawesi, with a view to simplifying the programs.

5.8 Linkages with provincial assistance programs

As noted above, we recognised that, to enable scale-out beyond our research end-point, we needed to establish formal linkages with provincial and district-level government assistance programs to smallholder shrimp farmers. Typically, under these programs, selected farmers in target districts are supplied with set quantities of free shrimp seed, milkfish seed and feed, with the aim of encouraging them, and their colleagues, back into shrimp polyculture production. Beginning in 2010, Central Java and South Sulawesi governments proposed to assist, respectively, 5 farmers in each of 10 districts and ~100 farmers in each of 19 districts. Note that these farmers were to be selected without reference to issues relevant to BMP programs. Moreover, neither Province nor District Dinas had the extension capacity to provide BMP-related information to assisted farmers and their groups. Accordingly, following detailed discussions with project partners FMA, Central Java and FMA, South Sulawesi, we agreed to provide preparatory training in BMP programs for extensionists in all target districts during 2009. We also agreed to provide technical and extension support to assisted farmer groups in selected target districts in 2010/11.

5.9 2010/11 'outcomes study' and related BMP program implementations

5.9.1 Action research issues

We recognised that, if we were to meet the project's objectives, all field work relating to proof of concept and proof of delivery would have to be completed by early 2011 at the latest. Also, under this definitive round of implementations, we needed to address several new challenges.

- Evidence from the 2009 CJ trials suggested that compliance failures, including inadequate pond remediation (Serangan site), breakdown in farmer group discipline (Sidorejo site) and poor management of submerged aquatic plants (both sites) were key causes of the poor results. We attributed these failures to:

  - our project team's collective inability to enable farmers and their groups to bridge the gap between entrenched farming practices and those required under our BMP program;
  - an almost complete absence of extension support to farmers during the crop by our project-trained and resourced district Dinas staff;

- Major shortfalls in data collection/recording during the 2009 field trials in Demak district had rendered the outcomes study results for that year unusable. Early in 2010, with the assistance of ACIAR's Jakarta office, we formally identified causes for these shortfalls. Remedial action, taken in close consultation with field staff, involved (a) the promotion of two high-performing T/Es to STOs responsible for data collection, one based at Jepara, the other at Takalar; (b) major overhaul of the data recording system; (c) translation of data record workbooks into Bahasa Indonesia; and (d) re-training of all relevant staff in their use.
- In early 2010, PE(I) who also coordinated day-to-day project activities in Indonesia, was promoted to Head, 'Center for Fish Disease and Environmental Investigation', DGA's newly constructed institute in Banten province, western Java. Given the heavy demands of this new position, he was directed to minimise his time commitment to the project, although he remained committed to his project-funded doctoral program. After consultations with his GMU supervisors, we agreed to shift the focus of his doctoral program to laboratory-based research proposed under the SRA (FIS2009/035).
- Extension Consultant Dr Ageng S Herianto (Faculty of Agriculture, GMU) agreed to replace the redeployed PE(I) as Project Coordinator (Indonesia), reporting directly to PC.
- Emerging evidence from Aceh and India, shared under FIS2006/144 in 2009, strongly suggested the following:
  - Success of BMP programs is significantly improved when they are implemented using a 'cluster management' approach (Appendix 20). Cluster management is defined as 'collective planning, decision making and implementation of crop activities by a group of farmers in a cluster (i.e., a defined geographical area, for example sharing a common water source) through a participatory approach in order to address the common risk factors and accomplish a common goal (e.g. maximize returns, reduce disease risks, increase market access, procure quality seed)'.
  - The smaller and more discrete the cluster, the better the result;
  - Emerging evidence from FIS2002/075, relating to work done in India, strongly suggested that for small-holder farmers, the situation is now a matter of 'living with the virus'.
  - In this context, programs implemented at suitable sites can be reduced to only five mandatory BMPs: (a) maintain farmer group unity and discipline; (b) adjust shrimp stocking density according to pond grade; (c) stock only PCR tested WSSV-negative seed; (d) use all-out, all-in stocking; (e) ensure prompt intra- and inter-group notification of disease outbreaks.
  - The combination of large incentives and limited program-related advice to farmers usually leads to poor results, whereas the opposite approach usually produces good results.

5.9.2 'Full' and 'basic' BMP programs

In early 2010, we applied these emerging findings to create a new program by deleting some of the 'full' BMP program's more conservative interventions. The resultant 'basic' BMP program (Table 4) was more compatible with existing smallholder farming practices while retaining the key biosecurity interventions of the 'full' BMP program used in 2009.

Table 4. Comparative summary of the project's full BMP, basic BMP and control pond implementation components as applied under 2010/11 implementations

BMP advocated	Implementation components		
	Full BMP	Basic BMP	Control*
Site meets all criteria	+	+	+
Farmer group active, disciplined	+	+	No advice
Growout pond closed except for necessary water exchanges	+	-**	No advice
Biofilter/reservoir	Optional	-	No advice
Ponds prepared correctly (includes dry out, removing black sediment)	+	-	No advice
Good quality PLs, PCR test negative for WSSV, properly transported and acclimated	+	+	No advice
Stocking density	According to pond grade (see Table 5 below)		No advice
Water quality regularly monitored	+	-	No advice
Pond bottom and submerged plant abundance managed	+	+	No advice
Biosecurity measures applied	+	Partly (e.g intake restricted during notified outbreaks)	No advice
Apply outbreak decision tree	+	+	No advice
Monitor shrimp health	+	+	No advice

* *Dependent on unassisted, project-independent advice from Dinas extensionists and subsequent implementation by the farmers*

*** Open ponds allow entry by wild shrimp*

We then implemented these programs in 2010/11. As part of these implementations, we graded participating ponds and applied stocking recommendations (Table 5) derived from work done in Aceh and provided by colleagues under FIS2006/144.

Table 5. Pond grade criteria and stocking recommendations.

Pond grading criteria	Pond grade			
	A	B	C	D
Sludge removal	Completely removed	Partially removed	Slightly removed	Not removed
Condition of embankment	Good	Medium	Bad	Very bad
Minimum water depth	60-100 cm	45 - 60 cm	30-45 cm	< 30 cm
	Stocking recommendations			
Maximum shrimp stocking density	2 per sq m	1 per sq m	0.5 per sq m	Do not stock shrimp
Maximum milkfish stocking density	1500 juvenile/ha	1000 juvenile/ha	750 juvenile/ha	0 - 500 juvenile/ha

5.9.3 Data recording system

As noted above, major shortfalls in data collection/recording during 2009 seriously hampered program validation. As part of our remedial action, we produced comprehensive data recording workbooks (Figure 6) in Bahasa Indonesia and (separately) English. These workbooks, in the form of Excel files, were used to record data from full BMP ponds, basic BMP ponds, reservoirs/biofilters and control ponds. Component worksheet titles in the BMP pond workbook (the most complex) were: Pond enrolment; Pond area and soil; Pond map and biosecurity; Pond preparation; Pond stocking; Daily pond; Weekly pond; Shrimp feed and survival; Fish feed and survival; Shrimp harvest; Fish harvest; Post harvest; Outbreak (pond data); Outbreak (lab data).

Resultant data were intended to support the Outcomes study and Compliance/Productivity/Profitability study (see below).

An example workbook cover and list of component worksheets are shown in Appendix 4.

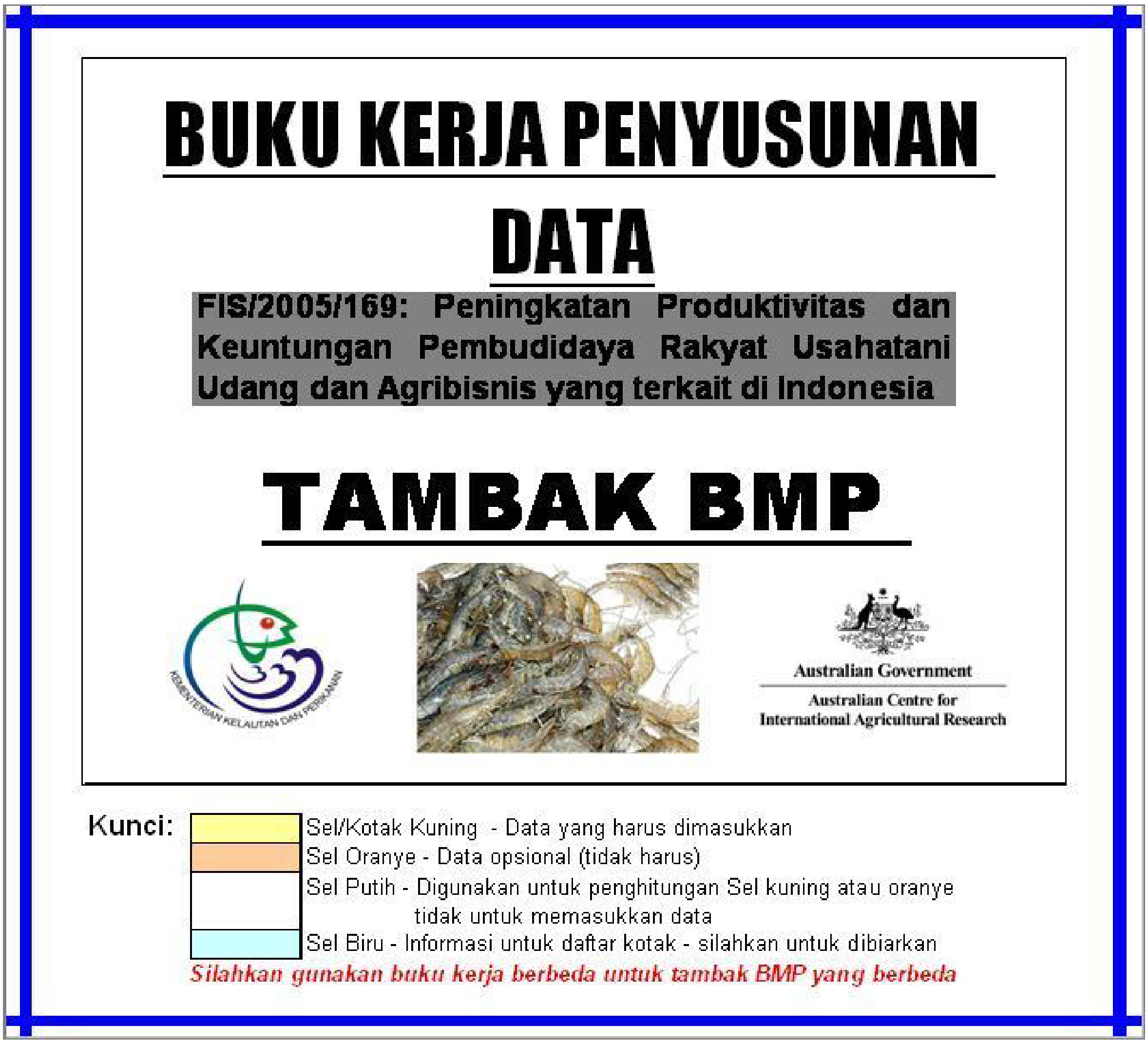


Figure 6. Cover page of the Bahasa Indonesia version of the full BMP pond data recording workbook, an Excel file used for program implementations in 2010/11. We produced matching workbooks for basic BMP ponds, reservoir/biofilters and control ponds.

5.9.4 2010/11 'outcomes study' implementations

These were our definitive implementations under 'proof of concept' and 'proof of delivery'. To address the above action research issues, we implemented BMP programs with volunteer farmer groups in localities meeting program criteria in Sinjai district, South Sulawesi and Kendal district, Central Java, beginning in July 2010 and September 2010, respectively. Importantly, we embedded these implementations within province-funded assistance programs to smallholder monodon farmers in both provinces.

The study objectives and general methodology were as for 2009, except we now included an additional pond category, i.e., 'basic' BMP at both the Sinjai and Kendal sites. To accommodate PE(I)'s redeployment, PC, PE and PC(I) assumed joint responsibility for study design and implementation. The (now) four STOs advised on, supervised and participated in day-to-day implementations while closely supporting T/Es in data collection.

For each BMP program, we used optimally arranged biosecure clusters of 20 traditional polyculture ponds, with finfish ponds (holding no farmed shrimp) interspersed as biosecurity barriers where possible. We also included 20 randomly selected, matched control ponds in each locality. Pond arrangements are shown in Figures 7 and 8.

Consistent with our broad collaboration with government assistance programs, and for reasons of equity, we arranged varying levels of support to participating Sinjai and Kendal farmers and their groups across the cropping period as follows. We agreed to provide 'full' and 'basic' BMP farmers with detailed technical support, tailored to their programs via project T/Es and STOs. Similarly, we agreed to provide these farmers with detailed extension support via project-trained and resourced district Dinas staff. We agreed to provide control farmers with generic technical and extension support only via project-trained district Dinas staff.

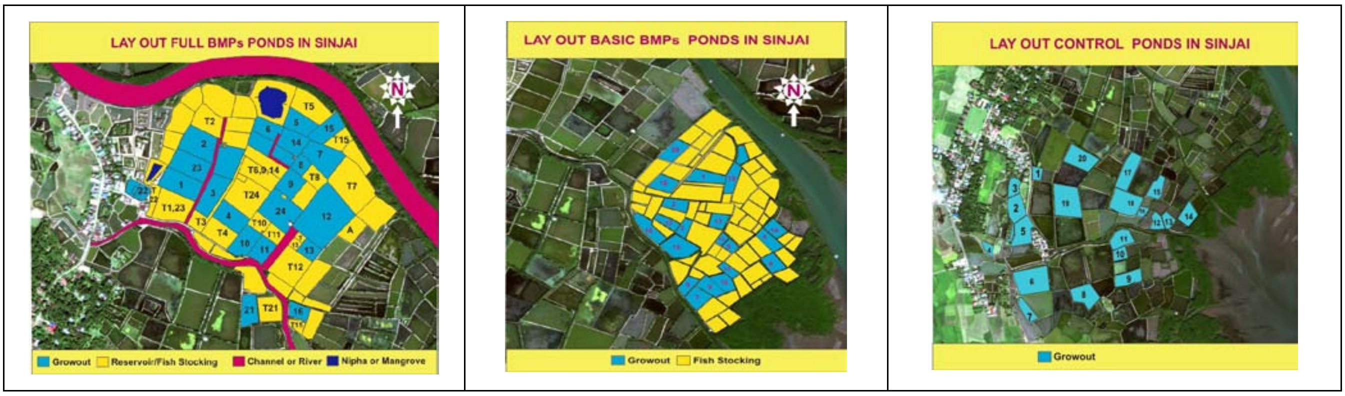


Figure 7. Shrimp ponds (blue) participating in 2010 program implementation in Sinjai district, South Sulawesi. Biosecure clusters of 'full' BMP ponds (n=20) and 'basic' BMP ponds (n=20) are each, as far as possible, embedded within groups of finfish ponds (yellow). Control ponds (n=20) were randomly selected from those in a nearby pond cluster.

Figure 8. Shrimp ponds participating in 2010/11 program implementation in Kendal district, Central Java. Left and centre: Clusters of 'full' BMP ponds (n=20) and 'basic' BMP ponds (n=20), respectively, are shown in yellow, with associated biofilter/reservoir ponds shown in green. Right: Control ponds (n=20), randomly selected from those in a nearby pond cluster, are shown in blue.

5.9.5 2010/11 supplementary, capacity-building BMP program implementations

Kendal vannamei

We implemented BMP programs, with SOPs appropriately modified for vannamei, in eight 'traditional' ponds in a small, biosecure cluster (Figure 9) within a favourable site in Kendal district, Central Java in the cropping period February – July 2010. These ponds were owned by a single farmer; they were stocked with vannamei (~10/m^2) and milkfish *Chanos chanos* (150–600/ha), the latter to augment manual control of the macroalgae, *Nitella* spp. which were abundant in the locality. Reflecting the common fears amongst farmers about growing shrimp, no matched control ponds were available within working distance of the site.

Fig 9. Vannamei BMP program implementation site at Kendal, CJ in 2010. Growout ponds are shown in blue, biofilter/reservoir ponds in yellow.

We undertook this implementation to address traditional farmers' strong interest in growing vannamei, to trial the program with this species and to further build capacity amongst the CJ team, including Kendal district extensionists, pending the definitive monodon implementations beginning in September.

Depending on natural food availability, shrimp were fed commercial feed once or twice daily, beginning ca. one month post-stocking; amount fed was 3-8 % of the estimated shrimp biomass.

Pangkep monodon

We conducted two further full BMP program validation trials in 'traditional-plus' monodon growout pond/biofilter pond systems plus matched control ponds at the Pangkep site, SS. Implementations in December 2009 – March 2010 involved the same ponds as used in 2009, while those in May 2010 – August 2010 involved 13 BMP ponds and 15 control ponds. These implementations provided additional data for the Takalar-based STO's masters degree program.

Jepara monodon

To provide data for the Jepara-based STO's masters degree program, BMP programs were implemented in five traditional (extensive) ponds in Jepara district in the cropping period November 2010 – January 2011. The following pond arrangements, in the same locality but a short distance from one another, were used: (a) a contiguous group of five growout ponds with biosecurity barriers, bracketed by shrimp-free ponds and canals (Figure 10). For comparison, a single growout pond/biofilter combination and two contiguous growout ponds without biofilter were included.

Fig 10. BMP program implementation site at Jepara, CJ in 2010. BMP ponds are shown in green, biofilter/reservoir ponds in yellow.

5.10 Study of smallholder participation in CJ farmed shrimp value chain

To complement the 2009 SS value chain study described above, we supported a descriptive statistical study of smallholder participation in CJ farmed shrimp value chains. The study was conducted in July and August 2010 by the ADP2005/066 team.

The study focused on the evolution of farming households, with particular attention to smallholders, in response to rapidly developing market settings, deteriorating environmental conditions, and advancement in production technologies. Primary research objectives were to identify key factors either impeding or promoting farmers' progression regarding adoption of new production technologies, particularly the shift to vannamei as seen for 'modernisers' in SS. Accordingly, a survey of 500 CJ shrimp farming households was conducted under which farm householders were asked a battery of questions addressing the research questions:

- How concentrated is the shrimp aquaculture production, and the concentration of inputs used by these households?
- What is the distribution of land holdings and tenure arrangements among aquaculture farming households?
- What is the proportion of farms adopting new technology over time and over space? What are some conditions and correlates to the adoption of new technology?
- What market channels are farmers selling into and purchasing inputs from?
- What institutional arrangements are being used for output sale and input purchase?
- What are the differences (market channel, institution, output quantity produced, input quantity used, other characteristics) between farm households that have adopted new technology and those that have not?

5.11 Compliance/productivity/profitability study

The study was led by Consultant (Socio-economics). It was designed to use data relating to compliance, production, expenditure and income collected from the Sinjai 20/20/20 and Kendal 20/20/20 ponds, as recorded in the workbooks.

Objective

To measure the effects of degrees of BMP compliance on productivity and profitability.

Methodology

Using data collected under the 2010/11 outcomes studies, conduct the following analyses.

Bioeconomic Analysis

To quantitatively consider the effects of various degrees of compliance to BMPs on farmer productivity and profitability. A specific outcome of the study may be a set of BMPs that have greatest influence on productivity and profitability.

Institutional Analysis

To consider the incentives and disincentives of group decision making processes, and therefore the likelihood to achieving success of implementing BMPs at the group and/or cluster level.

5.12 Extension impact study

Despite earlier promises, decisions within ACIAR meant that our 2010/2011 extension program proceeded without SMAR/SADI engagement and without the benefits arising from a ‘constraints to adoption’ workshop.

Accordingly, we designed a formal extension impact study led by Consultant (Extension) in collaboration with two Consultants (Extension – Indonesia), one based at GMU, the other at UNHAS. The study elements are summarised below; the full study design is presented in Appendix 21; more detailed descriptions of methodologies applied in the field are shown in Appendices 25 and 26.

5.12.1 Objective

To provide information on:

- Extension methods used by Dinas staff to work with cluster pond groups in Kendal and Sinjai;
- Level of farmer participation and satisfaction with BMP cluster approach;
- Relative influence of input by extensionists and project technical staff (STO and T/E) on farmer group outcomes;
- Positive and negative impacts of the extension approach on farmer livelihoods.

5.12.2 Research questions and data required

Farmer Participation

- To what extent have farmers participated in group activities to implement BMPs in cluster ponds? (Numbers, changing roles, nature of group meetings)
- Who has participated and how they have they participated? (Names, active, passive?)
- What has influenced certain farmers to participate? (Motivations, information available, peer influence, extension input, etc)
- What has been/is the level of farmer learning? (Changes in knowledge and skills)
- How do farmers learn best about the BMPs? (Most effective learning methods, e.g., asking questions/peer discussion/hands on experience, reading/stories/songs/photos?)

Influence of extension methods and STO input

- What methods have extensionists and technical staff used with farmer groups? (eg 1:1, group meetings, field visits, phone calls/SMS, TV/radio, brochures, video/CD)
- How effective have these methods been in encouraging participation and BMP compliance?
- What factors have influenced extension and technical staff input? (eg constraints, motivators or drivers, differences between extension and technical staff input)

Impacts of extension and BMP on farmer livelihoods (some overlap with compliance/productivity/profitability study)

- What have been the positive impacts (benefits) on farmer's livelihoods (eg use of income, labour savings, status in village, increased collaboration, spin-offs, diversification, informed decision making, cultural benefits, market links etc)
- What have been the negative impacts on farmer's livelihoods (eg increased labour, labour distribution, increased input costs, reduced returns, stress and anxiety, status in village, cultural impacts etc)

5.12.3 Methodology

These research questions and related data collection were addressed via farmer group meeting records, observations and discussions with farmer group leaders, interviews with individual farmers, interviews with Dinas staff and ratings given by farmers re usefulness of extension program components.

Researchers used a mixed model design including quantitative and qualitative approaches.

6 Achievements against activities and outputs/milestones

Sub-project A: Project-supported model program implementation and validation in target supply chains

Objective 1: To improve biosecurity, product quality and food safety through adoption of contextualised BMP programs by smallholder farmer groups and associated MSEs in selected district-based supply chains in Central Java and South Sulawesi

Activity 1.1 Facilitate adoption of contextualised biosecurity-related BMPs by farmer groups producing P. monodon *or* P. vannamei *in two selected, district-based supply chains in each province*

Outputs/milestones	Completion date	Comments
BMPs addressing pond management, biosecurity, product quality, food safety formally listed	June 08	Adapted from BMPs used in India and Aceh under external programs
BMP implementation trial with 4 farmer groups, involving ‘traditional plus’ monodon ponds, 5 in Demak(CJ) and 1 each in Barru and Pinrang(SS) with matched controls	September 08	Demak BMP crops technically ‘successful’ but unprofitable under prevailing (atypical) economic conditions. Barru and Pinrang BMP crops lost due to WSD; attributed to unfavourable site factors
BMPs revised to include comprehensive site selection criteria	March 09	Addressed those inadequate site selection criteria applied in 2008 contributing to Barru and Pinrang failures
BMP implementation trial with 2 Demak farmer groups, involving 34 ‘traditional polyculture’ monodon ponds, and matched controls	September 09	Farmer non-compliance at both sites attributed largely to extension delivery vacuum. Despite resultant poor pond management and some WSD outbreaks, many BMP farmers harvested profitable crops.
BMP implementation trial with 2 Pangkep (SS) farmers involving 2 ‘traditional plus’ monodon ponds and matching controls	June 09	BMP crops successful at atypical but favourable site. Done to maintain project momentum in SS and to support project-funded masters program.
BMP implementation trial with 2 Pangkep (SS) farmers involving same 2 ‘traditional plus’ monodon ponds and matching controls as above	December 09	BMP crops successful at atypical but favourable site. Continued to maintain project momentum in SS and to support project-funded masters program.
BMP implementation trial with Pangkep (SS) farmers involving 13 ‘traditional plus’ monodon ponds and 15 matching controls	May 10	BMP crops successful at atypical but favourable site. Continued to maintain project momentum in SS and to support project-funded masters program.
All protocols and data recording workbooks revised and translated into Bahasa Indonesia	May 10	Collaborative, agreed response to major data recording shortfalls during 2009 trials
BMP demonstration trial with 1 Kendal (CJ) farmer involving 8 ‘traditional’ vannamei ponds; no control ponds available	July 10	Addressed strong farmer interest in growing vannamei and further built project team capacity. No WSD outbreaks, but low productivity attributed to inability to manage aquatic weeds.

BMP implementation trial with Jepara (CJ) farmers involving 5 'traditional' monodon ponds	November 10	Done to support project-funded masters program for Jepara-based STO.
BMP implementation trials in 'traditional polyculture' monodon ponds in Sinjai district (SS). Involved 'full' BMP program (one farmer group; 20 ponds), 'basic' BMP program (second farmer group; 20 ponds), matched controls (third farmer group; 20 ponds).	November 10	Definitive 'proof of concept' and 'proof of delivery' trials in collaboration with government programs. No WSD in BMP ponds, but extreme unseasonal rainfall, combined with extreme high tides completely flooded the study site. Systemic issues within district Dinas rendered extension service delivery counterproductive.
BMP implementation trials in 'traditional polyculture' monodon ponds in Kendal district (CJ). Involved 'full' BMP program (one farmer group; 20 ponds), 'basic' BMP program (same farmer group; 20 ponds), matched controls (second farmer group; 20 ponds).	December 10	Definitive 'proof of concept' and 'proof of delivery' trials in collaboration with government programs. Extreme unseasonal rainfall caused flooding of the study site and introduced WSD from adjacent, non-participating ponds.

Activity 1.2 Facilitate adoption of contextualised biosecurity-related BMPs for broodstock suppliers, large hatcheries and backyard hatcheries producing P. monodon or P. vannamei in two selected, district-based supply chains in each province

Outputs/milestones	Completion date	Comments
Not attempted; not required under Activity 1.1 implementations	Not applicable	Seedstock for Activity 1.1 were supplied by government operated hatcheries (monodon) or large private hatchery (vannamei), each with comprehensive BMP programs already in place.

Activity 1.3 Facilitate adoption of contextualised pre-harvest and post-harvest food safety and product quality-related BMPs for farmer groups and associated MSEs in two selected, district-based supply chains in each province

Outputs/milestones	Completion date	Comments
Adoption completed under Activity 1.1 implementations	December 10	Limited impact given project's inability to achieve pilot roll-out.

Activity 1.4 Periodically measure adoption, compliance and impact, and adjust implementation and extension programs as necessary.

Outputs/milestones	Completion date	Comments
Adoption, compliance and impact measured, programs adjusted as necessary	December 10	Given data collection shortfalls, measured qualitatively and adjustments made via action research approach up to July 10. Attempted quantitatively, but abandoned due to site flooding, via Sinjai and Kendal 20/20/20 implementations

Objective 2: To facilitate participation in appropriate compliance certification programs by farmer groups and associated MSEs in participating supply chains

Activity 2.1 Identify appropriate programs and certifying bodies

Outputs/milestones	Completion date	Comments
Certification requirements of major markets identified	Not completed	Linkages explored with ATINA, a company exporting organic shrimp to Japan. NACA findings, delivered via FIS2007/144, showed that certification and traceability for smallholder shrimp farmer groups generally is complex, problematic and beyond the scope of this project.

Activity 2.2 Facilitate program adoption

Outputs/milestones	Completion date	Comments
Farmer groups and related MSEs implementing BMPs consistent with market requirements	December 10	BMP compliance underpins compliance with many certification program standards. Project did not achieve pilot roll-out; BMP program implementations on limited scale only.
Traceability system meeting market requirements	Not attempted	NACA findings, delivered via FIS2007/144, showed that certification and traceability for smallholder shrimp farmer groups generally is complex, problematic and beyond the scope of this project.
Testing and monitoring programs meeting market requirements	Not attempted	Due to above constraints, third party certifying body not engaged

Activity 2.3 Review market requirements, adjust programs

Outputs/milestones	Completion date	Comments
Reliable measures of program adoption, compliance and impact developed	Not attempted	No formal project engagement with certification programs. Measurement of BMP compliance, which underpins compliance with many certification program standards, was attempted, but abandoned due to site flooding, under Sinjai and Kendal 20/20/20 implementations.
Effective remedial approaches identified	Not attempted	No formal project engagement with certification programs.

Objective 3: To provide market intelligence to smallholder farmer groups and associated MSEs in participating supply chains

Activity 3.1 Facilitate producer-to-premium market supplier links

Outputs/milestones	Completion date	Comments
Links identified, participants informed	September 11	SS and CJ supply chains characterised (Appendix 22, Appendix 23, respectively). Market issues further progressed at November 2009 FIS2006/144 coordination meeting (Appendix 24)

Activity 3.2 Provide market intelligence to farmer groups and associated MSEs

Outputs/milestones	Completion date	Comments
Appropriate, effective methods identified and implemented	Not attempted	Proposed by Consultant (Socio-economics) but abandoned following Sinjai 20/20/20 and Kendal 20/20/20 crop failures

Activity 3.3 Enable effective use of market intelligence system

Outputs/milestones	Completion date	Comments
Training programs developed and participants trained	Not attempted	Activity 3.2 not progressed

Activity 3.4 Establish a data management system

Outputs/milestones	Completion date	Comments
Management system established	Not attempted	Activity 3.2 not progressed

Activity 3.5 Establish a data management system

Outputs/milestones	Completion date	Comments
Link with regional market intelligence providers	Not attempted	Activity 3.2 not progressed

Activity 3.6 Periodically measure adoption and adjust programs

Outputs/milestones	Completion date	Comments
Reliable measures of program adoption, compliance and impact developed	Not attempted	Activity 3.2 not progressed
Effective remedial approaches identified	Not attempted	Activity 3.2 not progressed

Objective 4: To provide information on credit access and value-adding processes for farmers, farmer groups and/or associated MSEs in participating supply chains

Activity 4.1 Provide information on credit

Outputs/milestones	Completion date	Comments
Participants informed re affordable credit sources	December 10	UPP scheme (to 2010) was effectively inaccessible to target farmers. DGA's PUMP program (from 2011) can provide direct capital aid to selected farmer groups

Activity 4.2 Provide information about post-harvest value-adding options

Outputs/milestones	Completion date	Comments
Value-adding opportunities and suitable participants identified	December 10	Engagement explored with ATINA re organic shrimp export to Japan, with particular focus on SS farmers

Activity 4.3 Periodically measure adoption and adjust programs as necessary

Outputs/milestones	Completion date	Comments
Reliable measures of program adoption, compliance and impact developed	December 10	Project engagement with DGA, province and district programs strengthened farmer group access to Minapolitan strategy and PUMP program
Effective remedial approaches identified	Not attempted	Effective engagement with credit providers not possible until emergence of PUMP program in 2011.

Objective 5: To improve extension capacity and health management capacity by training selected extensionists, technicians, diagnosticians and epidemiologists

Activity 5.1 Identify field extensionist training needs

Outputs/milestones	Completion date	Comments
Needs identified and training provided	December 10	District and province extensionists formally trained in generic extension issues (2007) and BMP-specific issues (2008). Unidentified, systemic service delivery constraints within district-level extension services confirmed in 2009. For internal reasons, ACIAR's promised 'constraints to adoption' workshop cancelled, along with promised collaboration under SMAR/SADI. Comprehensive extension materials prepared and remedial extension training workshops conducted in 2010, in lead up to Sinjai 20/20/20 and Kendal 20/20/20 implementations.

Activity 5.2 Train selected TIU extensionists

Outputs/milestones	Completion date	Comments
Needs identified and training provided	December 10	All STOs trained in technical and extension methods as for Activity 5.1. Additional remedial training in data collection and recording given prior to 2009 implementations and again, using revised workbooks, in lead up to Sinjai 20/20/20 and Kendal 20/20/20 implementations.

Activity 5.3 Train new-entrant technician/extensionists (T/Es)

Outputs/milestones	Completion date	Comments
Needs identified and training provided	December 10	All T/Es trained in technical and extension methods as for Activity 5.1. Additional remedial training in data collection and recording, using revised workbooks, given prior to Sinjai 20/20/20 and Kendal 20/20/20 implementations.

Activity 5.4 Conduct 'train the trainer' diagnostic methods training

Outputs/milestones	Completion date	Comments
Trained staff available to train 'front line' diagnosticians	October 07	Project Coordinator and senior diagnostician (ex GMU; subsequently key participant in FIS2009/035) trained in shrimp pathology at Mahidol University, Bangkok. Follow-on training of 'front line' diagnosticians considered relatively low priority and not proceeded with.

Activity 5.5 Train selected laboratory staff in diagnostic methods

Outputs/milestones	Completion date	Comments
Front line diagnosticians and researchers trained	December 10	Researchers, STOs and T/Es trained to use pond-side 'Shrimple' test kit for WSD. Researchers and laboratory staff trained to use 'i-screen' rapid, low-cost test for WSSV. Histopathology training of 'front line' diagnosticians considered relatively low priority and not proceeded with.

Activity 5.5 Train staff in aquatic animal epidemiology

Outputs/milestones	Completion date	Comments
Trained staff expert in aquatic animal epidemiology	Ongoing	Former Project Epidemiologist (I) completed coursework component of project-funded GMU doctoral program in aquatic animal epidemiology. Research component content has shifted from FIS2005/169 to FIS2009/035, but on hold following promotion and redeployment in 2009.

Sub-project B: Independent model program implementations in selected supply chains

Objective 1: To identify determinants for successful program implementation in target supply chains

Activity 1.1 Characterise selected farmer groups and chains

Outputs/milestones	Completion date	Comments
Supply chains characterised	September 11	SS and CJ supply chains characterised (Appendix 22 and Appendix 23) under collaborative linkage with ADP/2005/066.

Activity 1.2 Identify key success determinants

Outputs/milestones	Completion date	Comments
Key success determinants identified	Not completed	The following three studies were initiated in 2010 to identify success determinants via Sinjai 20/20/20 and Kendal 20/20/20 implementations: (a) outcomes study; (b) compliance/productivity/profitability study; (c) extension impact study. Outcomes study and compliance study discontinued following site flooding. Extension impact study reports are presented in Appendix 25 and Appendix 26.

Objective 2: To enable smallholder farmer groups and associated MSEs in selected supply chains, in association with government and private sector agencies, to successfully implement contextualised BMP programs independent of project support

Activity 2.1 Independently implement programs

Outputs/milestones	Completion date	Comments
Programs successfully implemented in identified supply chains using available resources and linkages	Not achieved	Two main reasons for non-achievement were: (a) the project did not reach research end-point; (b) key BMP program issues did not adequately align with existing Indonesian government programs, e.g., physically suitable sites, functional supply chains, functional farmer groups; availability of credit, adequate extension support. Recently announced government programs, Minapolitan (2010) and PUMP (2011), specifically address these issues.

Activity 2.2 Measure adoption and adjust programs

Outputs/milestones	Completion date	Comments
Reliable measures of program adoption, compliance and impact developed	December 10	Measures were developed under (a) outcomes study; (b) compliance/productivity/profitability study; (c) extension impact study. These could not be applied due to post-flooding abandonment of the Sinjai 20/20/20 and Kendal 20/20/20 implementations
Effective remedial approaches identified	May 11	Requirement re enabling policy environment for BMP program implementation, now potentially available via Minapolitan and PUMP, clarified through attendance by project staff at CIBA/ASEM/MPEDA/NACA Workshop (16-18 May 2011) in Chennai, India: Better management practices (BMPs) and cluster management for empowering small scale farmers: Scaling up strategies

7 Key results and discussion

7.1 2008 BMP 'outcomes study' implementations

We were mistaken in our assumption that the project's BMP programs using 'traditional plus' growout ponds, each with a biofilter/reservoir pond, when applied in selected Indonesian smallholder shrimp farming areas would invariably (a) protect shrimp from disease and (b) deliver profitable crops. Implementations in mid-2008 in 5/5 'traditional-plus' (5-10 shrimp /m^2; artificial feed from second month; pump-driven aeration as necessary) monodon ponds in generally favourable locations at Demak, Central Java resulted in successful crops according to our criteria (>90 day growout period, >60% shrimp survival), but these crops were unprofitable under the prevailing economic conditions (small shrimp sizes, low shrimp prices, high feed costs, abnormally high fuel costs, poor/nil returns from biofilter ponds).

Outcomes of interest from 'traditional-plus' growout ponds stocked with *Penaeus monodon* are shown in Tables 6 and 7 below. All five BMP ponds at the Sidorejo and Serangan sites were successful according to defined criteria, whereas the BMP ponds at Barru and Pinrang failed due to WSD outbreaks. In comparison, all matched control ponds at the Sidorejo and Serangan sites failed; data from control ponds at Barru and Pinrang were not available.

Table 6. Outcomes from BMP growout ponds (stocking density 6 PL/ m^2) in 2008

	Pond	Shrimp survival (%)	Days of culture	WSD outbreak	WSSV infection prevalence at harvest
Sidorejo	A	76	107	No	na
	B	75	99	No	na
	C	62	104	No	na
Serangan	A	71	100	No	na
	B	70	106	No	na
Barru	A	0	42	Yes	na
Pinrang	A	0	53	Yes	na

na: not available

Table 7. Outcomes from control growout ponds (stocking density 1–10 PL/ m^2) in 2008

	Pond	Shrimp survival (%)	Days of culture	WSD outbreak	WSSV infection prevalence at harvest
Sidorejo	Amu	17	60	na	na
	Bari	8	60	na	na
	Kas	29	60	na	na
Serangan	Roni	11	75	na	na
	Sby2	11	90	na	na
	Sby3	2	90	na	na
Barru	Kml	na	na	na	na
Pinrang	Taju	na	na	na	na

na: not available

7.1.1 Productivity issues

WSD outbreaks at Barru and Pinrang sites

In general, WSD outbreaks will occur when WSSV-infected shrimp are stressed; the higher the viral 'load' in shrimp, the lower the stress level required to initiate outbreaks, and vice versa. Outbreaks invariably occur when shrimp carrying heavy viral loads are exposed to high levels of stress.

The following were important causal factors for WSD outbreaks and consequent crop losses at both the Barru and Pinrang study ponds.

- High soil porosity (67% sand, 23% silt, 8% clay at Barru; 81% sand, 14% silt, 5% clay at Pinrang) caused seepage loss of >10% total water volume/day from each growout pond.
- Biofilter ponds, in similarly porous soil, were unable to supply sufficient virus-free water (i.e., retained for >6 days post entry from the canal system in order to inactivate WSSV) to maintain the recommended 80 cm water depth during the cropping period. Mean growout pond water depth was 44 cm at Barru, 43 cm at Pinrang.
- Numerous WSD outbreaks were reported in surrounding ponds prior to the outbreak in the BMP pond.

Additional site-specific causal factors are listed below.

Barru

- A separate collaborative ACIAR study, conducted during the cropping period, showed that the canal system supplying water to, and draining water from, ponds in this locality, including the study pond + biofilter pond, was very poorly flushed. Consequently, WSSV-laden water, released from outbreaks in nearby ponds, was probably introduced to the biofilter and thence to the growout pond.
- Preceding the WSD outbreak on DOC 42, a heavy phytoplankton bloom (water transparency 15 cm) from DOC 30-42 was associated with very low dissolved oxygen concentrations at dawn (minimum 2.1 ppm on DOC 35).

Pinrang

- Dissolved oxygen concentrations at dawn throughout the cropping period were usually dangerously low, at <3 ppm. From DOC 46-49, following a phytoplankton bloom collapse, concentrations fell further to <2 ppm. From DOC 49 onwards, water remained completely transparent until the WSD outbreak on DOC 53.

Undersize shrimp harvested at Sidorejo and Serangan sites

With acceptable traditional-plus pond management and absence of WSD outbreaks, we expected BMP program farmers would harvest approximately 400 kg of size 35 shrimp/ha from ponds initially stocked at 5/m^2. These 14,000 harvested shrimp would represent a very modest 28% survival but, at the 2008 price of IDR 45,000/kg would return IDR18 million to the farmer. However, despite survivals of >60% in all CJ study ponds, harvested shrimp were predominantly small and of low market value. To illustrate, results for Serangan ponds A and B are shown in Table 8.

Table 8. Returns, by size of shrimp harvested, from Serangan ponds A and B in 2008.

	Shrimp size (number/kg)	Kilograms harvested	Price/kg (IDR1000)	Return to farmer (IDR1000)
Pond A	38	53	46	2438
	58	136.5	38	5947
	120	54.5	26	1417
			Total return (shrimp) Pond A	**9802**
Pond B	41	60	44	2618
	56	136.5	38	5187
	106	35	26	910
			Total return (shrimp) Pond B	**8715**

To grow well, shrimp need dissolved oxygen concentrations in the range 5 – 6 mg/l. When exposed to concentrations of 4 mg/l, even intermittently, shrimp will continue to eat but will not convert feed efficiently and growth rates will decline. At concentrations of 2 – 3 mg/l shrimp will not feed and become weak; the associated stress increases their susceptibility to disease. At dissolved oxygen concentrations <2 mg/l, shrimp begin to die from hypoxia (Chanratchakool et al. 1998).

Dissolved oxygen concentrations measured at 17:30 h in Serangan ponds A and B during the cropping period were, with few exceptions, at acceptable levels >4 mg/l. However, concentrations measured throughout the cropping period at 05:30 h were usually in the 2 – 4 mg/l range (Figure 11) and almost certainly were the main reason for the low growth rates achieved.

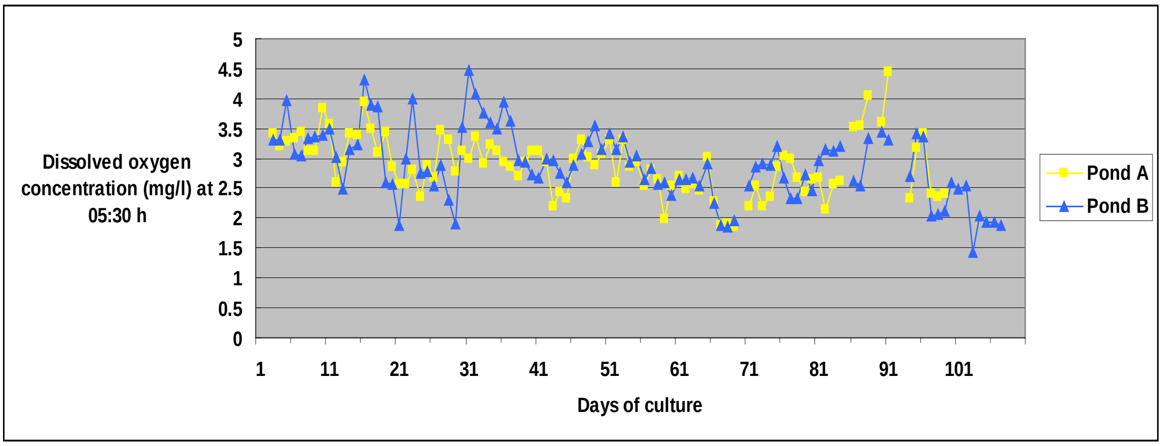


Figure 11. Dissolved oxygen concentrations measured at 05:30 h in Serangan ponds A and B during the 2008 cropping period.

We attributed these low DO concentrations to incomplete breakdown of organic matter in sediment during pond preparation, to progressive further accumulation of organic matter, including unconsumed feed, on the pond bottom, and to heavy phytoplankton blooms during the crops.

7.1.2 Profitability issues

Although five of seven BMP ponds were ‘successful’, none were profitable when considered alone or when considered as a growout pond + biofilter combination. Relevant data are summarized in Tables 9 and 10 below.

Table 9. Average costs/ha for BMP growout ponds at Sidorejo (n = 3) and Serangan (n = 2).

	Costs/ha - IDR1000 (% total)	
	Sidorejo	**Serangan**
Fuel	6,868 (38)	6,108 (31)
Feed	5,646 (31)	7,656 (39)
Seed	3,102 (17)	2,090 (11)
Pond preparation	864 (5)	1,352 (7)
Labour	756 (4)	60 (0)
Infrastructure	441 (2)	1,050 (5)
Other	440 (2)	1,239 (6)
Total	**18,117**	**19,554**

Table 10. Average income/ha from growout ponds at Sidorejo (n = 3) and Serangan (n = 2).

	Income/ha – IDR1000 (% total)	
	Sidorejo	Serangan
Shrimp	11052 (90)	18517 (100)
Finfish	1229 (10)	0 (0)
Total	**12,281**	**18,517**

Profit data re finfish harvested from biofilter ponds during this cropping period were available only from the Serangan site. Total profit from these five biofilter ponds, with a combined area of 1.6 ha, was IDR1,037,000, giving a mean profit/ha for the crop of IDR648,125.

Profit estimates for non-BMP traditional shrimp ponds under current conditions in Indonesia vary widely. Figures as high as IDR 9 million/ha/crop have been suggested (Yi, unpublished – 2009 Semarang coordination meeting) but available evidence from Central Java (Yi, unpublished – see Section 7.9) and Aceh (Padiyar, unpublished – 2009 Semarang coordination meeting) suggests IDR 0.5 million/ha/crop is more realistic, assuming the crop is successful. Using this lower figure, actual profits from BMP program implementation at the Serangan site are compared (Table 11) with profits potentially available, i.e., the opportunity cost, had these ponds been used to produce a successful crop of shrimp using traditional, non-BMP methods.

Table 11. Profits (IDR1000) from Serangan growout ponds (1 ha total area) and associated biofilter ponds (1.6 ha total area) using a traditional-plus BMP program in 2008, compared with estimated profits from the same 2.6 ha using non-BMP traditional method.

	Growout ponds	**Biofilter ponds**	**Combined ponds**
Traditional-plus BMP program	- 1037	1037	0
Estimated non-BMP traditional approach	500	800	1300

Using this calculation, the Serangan farmers lost at least IDR 1.3 million by implementing the BMP program in their combined 2.6 ha of ponds. The figures on costs and income (Tables 9 and 10 above) suggest losses to farmers at other project sites in 2008 were even higher. On this basis, we revised the BMP program, with a focus on improving our site selection process and reducing input costs.

However, we were encouraged by the absence of WSD outbreaks in the five Demak ponds, in the face of putative multiple WSD outbreaks reported in surrounding ponds. Although data on WSSV infection prevalence and viral loads were not collected from BMP ponds, acceptable survival results suggest values for these variables probably remained low during growout. Had high values been present, it is very likely that the consistently stressful DO concentrations would have triggered serious WSD outbreaks. Although the program's biosecurity interventions, including use of biofilter ponds, did not prevent wild shrimp entering the Demak growout ponds in low to high numbers, these do not appear to have been an important source of infection for the farmed shrimp. If so, it is likely that, for some other reason, storage of water in the biofilter ponds effectively minimised exposure of shrimp to WSSV during growout. To help clarify these issues and allow BMP programs to be simplified and adapted to a range of farmer practices, ACIAR agreed to fund the SRA (FIS2009/035).

7.2 Pilot socioeconomic studies

Recall that these studies were intended to:

- describe the socioeconomic profiles, including demographics and farming practices, of brackishwater pond farmers and their households at project field study sites in Central Java and in South Sulawesi;
- identify factors likely to affect BMP program adoption by target farmers and farmer groups.

Although detailed written reports from the studies (Appendices 30 and 31) were not completed before the 2009 field implementations, we were able to apply general conclusions at that time.

Both the CJ and SS studies showed that farmers in target groups were generally very interested in the potential of BMP programs to improve their livelihoods but wanted to see clear evidence that these programs, in the hands of trusted farmer colleagues, could significantly improve production and profits.

Findings also suggested that, to enable program adoption in farmer communities, we needed to re-evaluate the more complex program components in the context of farmers' education levels, individual pond holdings, resources and current practices. Key sticking points were farmer inability/reluctance to (a) dedicate what were currently shrimp ponds to shrimp-free (= low profit) biofilters; (b) change from repeat stockings to an 'all out all in' system; (c) invest scarce funds in a currently unvalidated approach. Results also showed that promulgation of BMP technology amongst farmer groups and individual members requires a dedicated extension program delivered by credible extensionists with strong technical and social communication capabilities.

Key findings from these studies are summarised in Table 12 below.

Table 12. Summarised key findings from the 2008 socioeconomic surveys of target farmer groups in Central Java and South Sulawesi.

		Demak district, Central Java		Pinrang and Barru districts, South Sulawesi
		Sidorejo village	**Serangan village**	**Composite ex Data and Madello villages**
Demography	**Household size**	Av. 5 persons	Av. 4 persons	3-4 persons (52%); 5-6 persons (29%)
	Farmers aged 30-50 yrs	83%	90%	62%
	Farmer education beyond junior high school (Yr 9)	3%	50%	48%
Income generation	**Main occupation**	Pond operator and food crop farmer: 50%	Pond operator: 70%	Pond operator: 87%
	Main shrimp farming practice	Traditional polyculture. Monodon with milkfish, one crop/yr with repeated fry stockings and harvests	Either traditional polyculture as for Sidorejo or multicrop/yr vannamei culture	Traditional polyculture. Monodon with milkfish, one crop/yr with repeated fry stockings and harvests
	Proportion of owner-operator farmers	50%	75%	77%
	Mode number of ponds operated (range)	1 (1-3)	2 (1-6)	1 (1->3)
	Av. total area of shrimp ponds operated (ha)	1.3	1.5	-
	Annual household income from aquaculture (IDR)	Av: 5,700,000	Av: 8,600,000	<6,000,000 (53%); 6-18,000,000 (37%)
	Annual household income from monodon when farmed (IDR)	Av: 4,200,000	Av: 2,600,000	-
Farmer groups	**Group size**	30 members, varying degrees of involvement	16 members, all inactive since 2005	10 – 32 members
	Main reasons for participating in group	Improve income via access to information (73%)	Improve income via access to information (70%)	Access to physical inputs and finance (52%); access to information (23%)
Obstacles to BMP program adoption	**Information**	Insufficient information currently provided	Insufficient information currently provided	Farmers primarily trust info from successful leaders

	Incompatible with current practice	-	75% grew vannamei previous crop	Wild shrimp harvests from growout ponds supplement income
	Physical resources	-	Reluctant to dedicate biofilter pond	Most (72%) operate one pond only; remainder reluctant to dedicate biofilter pond
	Investment	Additional investment needed	Additional investment needed	Additional investment needed but farmer prosperity declining
	Adoption	-	Purported profit too small	Unwilling to change existing practices without strong evidence

The 2008 program implementations and pilot socio-economic studies clearly showed that issues affecting broadscale BMP program adoption by smallholder farmers and their communities were much more complex than we originally expected and that we would be hard pressed to achieve ‘pilot rollout’ within the project’s time frame. In the face of these challenges and using action research principles, we revised our approach for 2009, giving special attention to (a) emerging site selection, biosecurity, pond management, productivity and profitability issues as well as to (b) the need to enhance training for extensionists.

7.3 2009 ‘outcomes study’ and related BMP program implementations

7.3.1 Outcomes study

The technical team worked closely with collaborating farmers and their groups to implement BMP programs in ‘traditional’ monodon ponds, using 25 ponds plus controls at Sidorejo, and 9 ponds plus controls at Serangan. However, data from these implementations could not be used for the following reasons.

1. Contrary to the agreed study design, complete sets of control ponds, matched to study ponds, were either not included in the study or, if they were, very few data were collected from them. Because of wider data collection and submission shortfalls (see following point), PC and PE were not aware of this until the 2009 implementations were concluded.

2. Despite prior agreements and repeated, strongly-worded exhortations from PC and PE prior to and during the study urging field staff and their supervisors to collect complete data sets (using the 12 jointly developed Excel worksheets for each pond) and send them progressively to PC for assessment, neither of these things happened. Collected data sets were made available only at the end of the implementation; they were seriously deficient and therefore unsuitable for analysis under the outcomes study.

   Using the Sidorejo BMP implementations as an example, Table 13 summarises the degrees of completeness of submitted data record worksheets. In almost all cases, the 12 worksheets for each pond were either not submitted or complete data were not recorded in them.

Table 13. Summary of shortfalls in data recorded on 12 Excel worksheets from the 25 BMP ponds at Sidorejo in 2009.

	Worksheet title	Number of worksheets submitted (required total = 25)	Amount of required data recorded in typical submitted worksheets
1	Farmer enrolment questionnaire	0	0
2	Farm and pond enrolment (bmp)	21	++++
3	Farm id and pond soil (bmp)	3	+++
4	Pond map and biosecurity (bmp)	0	0
5	Pond and reservoir prep (bmp)	20	+
6	Pond and reservoir stocking (bmp)	21	++
7	Daily pond (bmp)	21	++
8	Weekly pond (bmp)	16	+
9	Shrimp feeding and survival (bmp)	0	0
10	Finfish feeding and survival (bmp)	0	0
11	Pond and reservoir harvest (bmp)	21	+
12	Pond outbreak (bmp)	9 (some WSD ponds missing)	+

0 - +: No/very small amounts of required data recorded or else sheet not submitted

++: Small to moderate amounts of required data recorded

+++ - ++++: Most or all required data recorded

As noted previously, causes for the shortfalls were formally identified early in 2010 and, in collaboration with ACIAR Jakarta office, remedial action taken prior to the 2010/11 implementations.

3. The outcome study's validity was predicated in part on adequate extension input during the course of the crop. Despite program-specific pre-implementation training for designated Dinas staff, plus offers of all necessary support for field work under the agreed crop calendars, their participation levels were generally much lower than expected and required. Indeed, we attribute the serious breakdown in Sidorejo farmer group unity and discipline, i.e., the non-compliant, supplementary stocking by some BMP farmers which preceded WSD outbreaks in nine ponds, to insufficient extension input. Similarly, we attribute to insufficient extension input the failure by some BMP Serangan farmers to remediate their ponds and water supply channels, as agreed prior to the crop; this failure almost certainly contributed to the subsequent flooding of BMP ponds, WSD spread from surrounding non-project ponds and crop losses.

The following descriptions of outcome study findings, based on usually fragmentary datasets, are not necessarily definitive.

Sidorejo

Twenty five BMP ponds were stocked on 14 April 2009. Following covert, non-compliant supplementary stocking of WSSV-untested juvenile shrimp into four ponds around DOC 45, crops in these ponds and five neighbouring ponds, were lost to WSD in the period DOC 54 - 65 (Fig 12).

Figure 12. Crop outcomes for BMP program implementations at Sidorejo, Central Java in 2009. Ponds receiving supplementary stocks of non-compliant juvenile shrimp (WSSV status unknown) are marked with asterisks. Ponds recording normal harvests are shown in green; ponds recording WSD outbreaks are shown in red, and barrier ponds, free of farmed shrimp, are shown in blue.

Even though none of the remaining BMP ponds were successful by outcomes study criteria (Table 14), because of very low input costs, many produced profitable shrimp crops. Consequently, most farmers were keen to continue with BMP programs, given they had only rarely harvested commercial grade shrimp from these ponds in recent years. However, corresponding available data from the small number of matched control ponds raise some doubts about this claim.

Table 14. Key outcome results (where available from submitted worksheets) from the 2009 outcomes study implementation.

		Number of ponds	Mean survival % (range)	Days of culture (range)	WSSV infection prevalence at harvest
Sidorejo	BMP ponds	25	18 (0 – 57)	77 (54 – 99)	na
	Control ponds	5	27 (0 – 60)	53 (35 – 57)	na
Serangan	BMP ponds	9	na	92 (70 – 124)	na
	Control ponds	4	3 (0 – 5)	90 (56 -139)	na

na: not available

Tables 15 and 16 give more complete presentations of findings from the 2009 outcomes study at Sidorejo.

The wide range of survivals in BMP ponds not recording WSD outbreaks is noteworthy, but we could find no obvious causal relationships in the data. More detailed investigation of this key issue is warranted and the project-funded masters studies may provide some useful information.

Serangan

Nine BMP ponds were stocked on 23 March 2009. WSD outbreaks occurred in all nine control ponds ca. DOC 18. After floodwaters breached the BMP ponds' non-compliant, low embankments ca. DOC 45, most shrimp in these ponds were lost to WSD outbreaks in the period DOC 48 – 80; presumably WSSV infection was introduced via floodwater or infected shrimp, etc, from non-BMP ponds in the locality.

Tables 17 and 18 give more complete presentations of findings from the 2009 outcomes study at Serangan.

Table 15. Selected outcomes for BMP ponds at Sidorejo 2009

BMP pond	Pond area (m2)	Number PLs stocked	Stocking density (n/m2)	Days of culture	Size (piece/kg)	Total shrimp weight harvested (kg)	Survival (%)	WSSV infection prevalence at harvest	Production (kg/ha)	Production cost (IDR)	Income (IDR)	Profit/loss (IDR)	Comment
1	2,300	3,000	1.3	83	30	33	33	na	144.8	130,000	1,872,900	1,742,900	Normal harvest
2	2,300	3,000	1.3	85	50	20	33	na	87.0	130,000		-130,000	Normal harvest
3	10,000	10,000	1.0	61	50	40	20	na	40.0	450,000	1,500,000	1,050,000	Normal harvest
4	10,000	10,000	1.0	81	50	10	5	na	10.0	325,000	400,000	75,000	Normal harvest
5	3,000	3,000	1.0	65	na	0	0	na	0	230,000	0	-230,000	Crop failure - WSD
6	10,000	15,000	1.5	85	65	32	14	na	32.0	450,000	1,000,000	550,000	Normal harvest
7	3,000	3,000	1.0	84	40	36	48	na	120.0	130,000	1,690,000	1,560,000	Normal harvest
8	2,300	3,000	1.3	85	30	21	21	na	91.3	130,000	918,500	788,500	Normal harvest
9	2,300	3,000	1.3	84	70	10	23	na	43.5	130,000	300,000	170,000	Normal harvest
10	2,300	3,000	1.3	84	75	10	25	na	43.5	130,000	250,000	120,000	Normal harvest
11	2,300	3,000	1.3	84	70	8	19	na	34.8	130,000	240,000	110,000	Normal harvest
12	6,000	7,000	1.2	98	40	80	46	na	133.3	275,000	2,000,000	1,725,000	Normal harvest
13	15,000	15,000	1.0	58	na	0	0	na	0	625,000	0	-625,000	Crop failure - WSD
14	10,000	10,000	1.0	54	na	0	0	na	0	400,000	0	-400,000	Crop failure - WSD
15	10,000	15,000	1.5	58	na	0	0	na	0	475,000	0	-475,000	Crop failure - putative WSD
16	10,000	10,000	1.0	58	na	0	0	na	0	400,000	0	-400,000	Crop failure - WSD
17	10,000	10,000	1.0	58	na	0	0	na	0	260,000	0	-260,000	Crop failure - WSD
18	10,000	15,000	1.5	58	na	0	0	na	0	525,000	0	-525,000	Crop failure - WSD
19	7,000	7,000	1.0	98	30	40	17	na	57.1	482,500	2,200,000	1,717,500	Normal harvest
20	7,000	7,000	1.0	99	44	44	27	na	62.1	130,000	2,436,000	2,306,000	Normal harvest
21	7,000	7,000	1.0	98	40	100	57	na	142.9	250,000	5,000,000	4,750,000	Normal harvest
22	25,000	20,000	0.8	98	50	60	15	na	24.0	600,000	2,400,000	1,800,000	Normal harvest
23	3,000	3,000	1.0	64	na	0	0	na	0	125,000	0	-125,000	Crop failure - WSD
24	10,000	10,000	1.0	70	45	80	36	na	80.0	250,000	3,600,000	3,350,000	Normal harvest
25	na	na	Na	na	na	na	na	na	na	na	na	na	na

na: not available

Table 16. Selected outcomes for control ponds at Sidorejo 2009

Control pond	Pond area (m2)	Number PLs stocked	Stocking density (n/m2)	Days of culture	Size (piece/kg)	Total shrimp weight harvested (kg)	Survival (%)	WSSV infection prevalence at harvest	Production (kg/ha)	Production cost (IDR)	Income (IDR)	Profit/loss (IDR)	Comment
1	7,000	7,000	1.0	35	na	0	0	na	0	250,000	0	-250,000	Failed Harvest
2	7,000	7,000	1.0	57	135	16	31	na	23	250,000	192,000	-58,000	
3	7,000	7,000	1.0	57	120	35	60	na	50	250,000	420,000	170,000	
4	7,000	7,000	1.0	57	130	25	46	na	36	250,000	300,000	50,000	
5	7,000	7,000	1.0	57	na	0	0	na	0	250,000	0	-250,000	Failed Harvest

na: not available

Table 17. Selected outcomes for BMP ponds at Serangan 2009

BMP pond	Pond area (m2)	Number PLs stocked	Stocking density (n/m2)	Days of culture	Size (piece/kg)	Total shrimp weight harvested (kg)	Survival (%)	WSSV infection prevalence at harvest	Production (kg/ha)	Production cost (IDR)	Income (IDR)	Profit/loss (IDR)	Comment
1	7,000	9,090	1.3	86	na	10	na	na	14	397,500	0	-397,500	Crop failure - putative WSD
2	21,000	19,190	0.9	86	na	0	na	na	0	807,250	0	-807,250	Crop failure - WSD
3	14,000	19,190	1.4	124	na	4	na	na	3	800,250	100000	-700,250	Crop failure - putative WSD
4	7,000	19,190	2.7	70	na	11	na	na	16	795,250	405000	-390,250	Crop failure - putative WSD
5	14,000	10,100	0.7	98	na	2	na	na	1	397,750	40000	-230,000	Crop failure - putative WSD
6	7,000	10,100	1.4	98	na	0	na	na	0	825,500	0	-825,500	Crop failure - putative WSD
	Canal												
7	7,000	10,100	1.4	83	na	25	na	na	36	407,750	732000	324,250	Crop failure - putative WSD
8	7,000	10,100	1.4	96	na	2	na	na	3	397,750	40000	-357,750	Few shrimp harvested
9	7,000	10,100	1.4	83	na	2	na	na	3	397,750	80000	-317,750	Crop failure - putative WSD

na: not available

Table 18. Selected outcomes for control ponds at Serangan 2009

Control pond	Pond area (m2)	Number PLs stocked	Stocking density (n/m2)	Days of culture	Size (piece/kg)	Total shrimp weight harvested (kg)	Survival (%)	WSSV infection prevalence at harvest	Production (kg/ha)	Production cost (IDR)	Income (IDR)	Profit/loss (IDR)	Comment
1	7,000	10100	1.4	56	70	0	0	na	0	297,500	0	-297,500	Crop failure - putative WSD
3	12,000	19440	1.6	74	na	na	na	na	na	466,560	1030000	563,440	
4	12,000	17010	1.4	na	na	2	na	na	2	408,240	40000	-368,240	Crop failure - putative WSD
7	12,000	18180	1.5	139	75	10	4	na	8	454,500	300000	-154,500	Crop failure - putative WSD
8	10,000	10100	1.0	90	40	4	1	na	4	252,500	140000	-112,500	Crop failure - putative WSD
9	10,000	10100	1.0	90	na	2	na	na	2	252,500	40000	-212,500	Crop failure - putative WSD
10	7,000	10530	1.5	122	na	na	na	na	na	252,720	na	na	
11	10,000	14580	1.5	na	na	5	na	na	5	349,920	240000	-109,920	Crop failure - putative WSD
12	28,000	40500	1.4	75	80	25	5	na	9	972,000	700000	-272,000	Crop failure - putative WSD

na: not available

7.3.2 2009 supplementary, capacity- building implementations

Pangkep

We implemented 'full' BMP programs in 2 'traditional-plus' growout pond + biofilter polyculture systems owned by an entrepreneurial village head in a putatively favourable (but not widely replicable) site in Pangkep district. Stocking densities for shrimp, milkfish and tilapia, respectively, for BMP ponds were 3, 0.1 and 0.1/m^2 and, for matching control ponds, were 1.3 – 3, 0.1 and 0.1/m^2. Summarised results are shown below.

Table 19. Key results from the 2009 traditional-plus Pangkep implementation.

	Number of growout ponds	Mean DOC	Mean shrimp survival (%)	Mean shrimp production (kg/ha)	Mean milkfish production (kg/ha)	Mean tilapia production (kg/ha)
Full BMP	2	105	39	173	150	141
Control	2	na	10	10	100	50

na : not available.

Although only small numbers of ponds were involved and shrimp survivals relatively low, results were very encouraging, particularly regarding potential scale-out at favourable sites in South Sulawesi.

7.4 Supply chain study, South Sulawesi

The following key findings are based on information from Dinas office, a BADC Takalar informant, individual industry informants, and the Shrimp Club Indonesia – South Sulawesi president. Researchers interviewed a significant number of people but, usually for local political reasons, randomly selected samples were often not available, and the estimates below may reflect this bias (Dale Yi, personal communication).

1. The sector appears to be concentrating over time. In SS there are many small farmers and some medium and large, but the overall volume distribution for shrimp is very concentrated, roughly as shown in Tables 20 and 21.

Table 20. Key characteristics of main farmer categories within the South Sulawesi shrimp farming sector.

	Traditional	Modernizer	Intensive
Land (ha)	2.5	2.5	15
Variety	Monodon	Vannamei	Vannamei
Output /ha/year	450kg 800 kg milkfish	4 MT	30 MT
Population	10,000	300	11
Production Share	48%	14%	14%

Table 21. Production characteristics of main farmer categories within the South Sulawesi shrimp farming sector.

Annual	Traditional	Modernizer	Intensive
Product differentiation	Organic (processor)	None	None
Cost (per ha)	$800	$8,400	$93,000
Cost / kg	$1.80 (?)	$2.10	$3.10
Profits (per ha)	$2,000	$5,500	$15,000

Findings suggested that the total annual farmed shrimp production in SS is around 145,000 tons. The semi-intensive small/medium farmers may present the greatest opportunity for the project, as their existence means that small/medium farmers are “graduating” – if they can make the threshold investments – from the ranks of the traditional, or are at least emerging by buying or renting ponds from the traditional group. Traditional farmers appear to have the poorest prospects, because at least some seem “stuck” in a low level equilibrium (poor quality water, shallow porous ponds, disease-susceptible, bottom-dwelling monodon, dependence on local traders, etc).

2. There appears to be technological and species change and differentiation in SS.

There is forced and chosen disadoption, apparently by traditional farmers who find feed costs too much in the face of dwindling yields due to disease in monodon. The emergence of the semi-intensive small/medium and intensive vannamei farmers is consistent with progressive intensification.

The study found a trend of concentration with traditional farmer numbers declining, while the other groups grow and absorb land from the traditional group. Key features of each farmer category (Figure 13) are as follows:

Traditional
- Grows monodon
- Stagnant volume and market share declining from 95% to 48%

Modernizer
- New type of farmer: started < 3 yrs ago
- Intensification of traditional ponds
- Variety shift to vannamei– 10 times more productive: 400kg increased to 4 MT

Intensive
- Intensification of semi-intensive ponds
- Grows vannamei - 10 times more productive: 3MT increased to 30 MT

The change from traditional to modernizer is driven mainly by feed wholesalers aiming to grow their market for vannamei feed. They provide feed on credit to modernizer farmers at 60% of cost. The process involves the following steps:

- Site and farmer selection (profit share 50/50)
- Demonstration pond (traditional vannamei): allows implementing farmer (and interested others) to learn vannamei’s requirements
- Intensification: increase density by steps
- Result: more profit for both
  Feed- 10x feed consumption growth
  Farmer- 2.5x profit

Investments required to make the transition are summarized in Table 22 below.

Table 22. Investments required to move between main farmer categories

	Traditional - to - Modernizer	Modernizer - to - Intensive
Investments	Construction, aerators, generator, electricity infrastructure	Construction, aerators, large generator
Total / ha	$2,800	$4,500

Value chain performance for each farmer category is summarized in the following table.

Table 23. Value chain performance by main farmer category

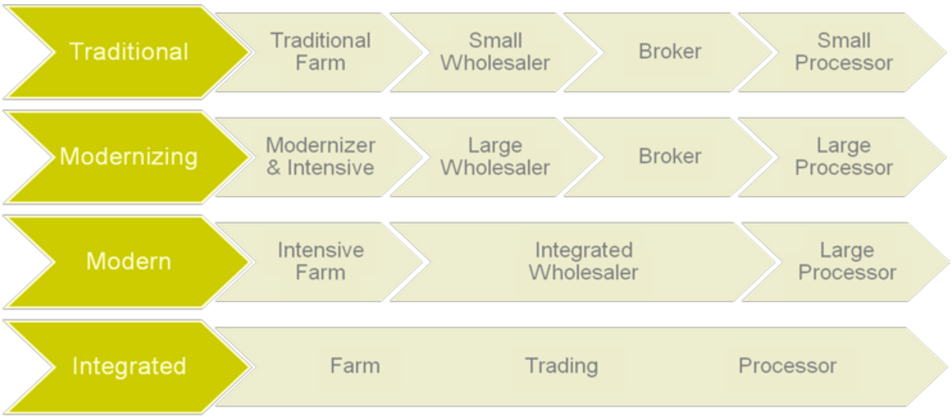
	Traditional	Modernizing	Modern
Growth	Stagnant	Taking off	Fast
Traceability	Wholesaler	Farmer	Pond
Assembly / Transport Cost	High	Moderate	Low
Profits	High Margin Low Volume	Medium Margin Medium Volume	Low Margin High Volume

Some study findings suggested that input or processing companies' competition is facilitating intensification and species change; this subject needs to be further explored. However, it was clear that processing companies and hatcheries are switching toward vannamei, suggesting that the change at farm level is not merely passive, but a trend encouraged by processors and input companies.

3. The input market appears to be concentrating and perhaps spatially integrating. There are probably competition forces at play that we did not yet study but that influence the technology change and farm sector concentration processes.
4. The output market is concentrated, mainly export oriented, and apparently playing a role in inducing technological and species change.

Key study informants said that most of the shrimp go to the export market. However, various key informants gave conflicting estimates of this share. The SCI informants estimate that supermarkets in Indonesia have a 15-20% share of the domestic shrimp market and that share is steadily rising.

Figure 13: SS value chain components for main farmer categories



	Market share
Traditional	48%
Modernizing	14%
Modern	14%
Integrated	24%

The processing sector in SS appears to be concentrated. There are some 6-10 large processors aimed at the European, US, and Japanese market. There are another 20 medium processors aimed at mainly the Southeast Asian market and some domestic market. There are 3-4 smaller processors aimed at the domestic market.

The wholesale sector appears to be fairly concentrated at the level of the main suppliers at least to the top 10 processors, and perhaps beyond that.

There is evidence from the interviews that the collectors' ranks are thinning and concentrating. This appears to be inducing great "output-input and output-credit market linkages" with collectors competing for suppliers with credit as well as using feed and larvae advances provided by the vertically integrated processor.

7.5 2010/11 ‘outcomes study’ and related BMP program implementations

7.5.1 Outcomes study

Sinjai, South Sulawesi

The study involved three clusters of ponds, i.e., 20 full BMP ponds (plus biofilterponds), 20 basic BMP ponds and 20 control ponds at Samataring in Sinjai district and was conducted in the period July to November 2010.

Extremely heavy, persistent and unseasonal rainfall occurred in the study area from June to October. Even though crops were allowed to run their full course, we abandoned the study in September when combinations of floodwaters from the adjacent river and high tides breached the embankments of most participating ponds (Figure 14), thereby rendering all study outcomes meaningless.

Figure 14. Left: Graph showing monthly rainfall (mm) for years 2008-2010 at Sinjai - red area shows divergence from normal during the outcome study cropping period; centre: Heavy rain fell during pond stocking; right: Typical breached pond embankment

Kendal, Central Java

As for SS, the study involved three clusters of ponds, i.e., 20 full BMP ponds (plus biofilterponds), 20 basic BMP ponds and 20 control ponds in Kendal district, Central Java.

Figure 15. The entire site was flooded in November 2010. Left: Graph showing last-quarter rainfall (mm) for years 2006-2010 at Kendal; centre and right: typical partly submerged pond embankments.

Ponds were stocked on 13 October 2010. Extremely heavy, persistent and unseasonal rainfall occurred in the study area from September to December. Even though crops were allowed to run their full course, we abandoned the study in November when floodwaters breached the embankments of most participating ponds (Figure 15), thereby rendering all study outcomes meaningless.

7.6 Supplementary, capacity-building implementations

Kendal, Central Java (vannamei)

Despite the lack of control ponds in the implementation, we considered these crops very successful and promising for local scale-out, even more so if cost-effective ways of dealing with overgrowth of submerged plants can be found. Just as importantly, farmers observing the crop were said to be very impressed with the overall result and enthusiastic about adopting the BMP approach. Average shrimp productivity across the eight ponds was 567 kg/ha; we recognised no WSD or other significant infectious disease outbreaks during the cropping period (Table 24) despite reports of outbreaks in nearby monodon ponds. We attributed the generally lower than optimal survivals to very low dissolved oxygen concentrations around sunrise (Figure 16), which in turn were probably related to submerged plant abundance during growout; the very low survival in pond B3 was due to an escape episode.

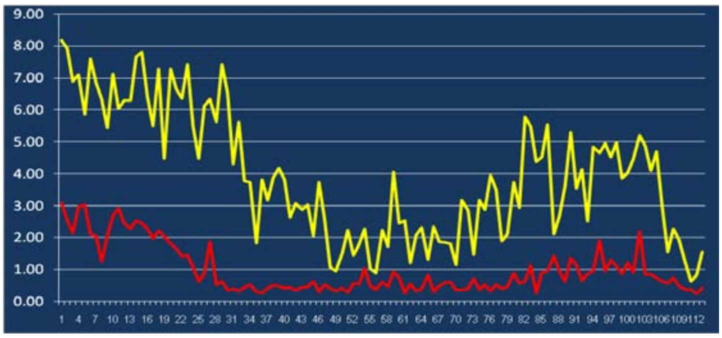


Figure 16. Dissolved oxygen concentrations at dawn (red) and late afternoon (yellow) in a representative growout pond during the 2010 Kendal vannamei implementation. Y-axis shows concentrations in mg/l, X-axis shows DOC.

Pond	Area (m2)	Stocking density		Survival (%)		Shrimp DOC	Shrimp feed (kg)	Shrimp FCR	Productivity (kg/ha)	
		Shrimp	Milkfish	Shrimp	Milkfish				Shrimp	Milkfish
B1	3,480	11	0.15	34	91	107	315	1.28	707	193
B2	3,422	11	0.15	29	92	107	315	1.61	573	228
B3	6,102	9	0.09	11	94	107	366	2.74	220	161
B4	6,200	9	0.08	70	93	121	552	1.05	848	94
C1	16,000	9	0.06	42	96	121	938	1.01	579	67

C2	5,980	10	0.08	37	96	121	462	1.42	547	100
C3	7,530	8	0.07	45	94	121	468	1.13	552	89
C4	6,275	9	0.08	36	95	121	468	1.47	508	108

We can compare this productivity with the average of 379 kg/ha/crop calculated from the CJ supply chain sample survey findings (see 7.9 below). The surveyed CJ 'adopters' used a range of inputs, but in many cases grew vannamei as if it were monodon, without additional feed or aeration. However, comparison with SS vannamei 'modernisers', with their average productivity of 2t/ha/crop, is less useful, given that the interviewed farmers were considered not representative of the SS group as a whole; they were not randomly selected and were probably 'poster boys' at the upper end of the semi-intensive spectrum (Dale Yi, personal communication).

Table 24. Key results from the 2010 Kendal vannamei implementation.

Average	9	0.09	38	94	116	486	1.46	567	130

Pangkep, South Sulawesi

Building on the success of the 2009 Pangkep implementations , we repeated the process in the same two 'traditional-plus' growout pond + biofilter polyculture ponds in the cropping period December 2009 to March 2010. Stocking densities for shrimp, milkfish and tilapia, respectively, for BMP ponds were 3, 0.1 and 0.1/m^2 and, for matching control ponds, were 1.3 – 3, 0.1 and 0.1/m^2. Results are summarized in the table below.

Table 25. Key results from the December 2009 –March 2010 traditional-plus Pangkep implementation.

	Number of growout ponds	Mean DOC	Mean shrimp survival (%)	Mean shrimp production (kg/ha)	Mean milkfish production (kg/ha)	Mean tilapia production (kg/ha)
Full BMP	2	142	36	181	194	167
Control	2	na	29	46	83	96

na : not available

As for 2009, and although only small numbers of ponds were involved, results were very encouraging, and served as the basis for a wider local scale-out in the following cropping period. Accordingly, from May – August 2010 programs were implemented in 13 ponds and 15 ponds were used as controls; to better match farmer preferences, we applied 'basic' BMPs. Stocking densities were as above. Results are summarized in the table below.

Table 26. Key results from the May - August 2010 traditional-plus Pangkep implementation.

	Number of growout ponds	Mean DOC	Mean shrimp survival (%)	Mean shrimp production (kg/ha)	Mean milkfish production (kg/ha)	Mean tilapia production (kg/ha)
Basic BMP	13	n.a.	40	202	191	253
Control	15	n.a.	24	128	204	123

na : not available

Jepara, Central Java

BMP programs were implemented in Jepara district during November 2010 – January 2011. Available outcomes for the five BMP ponds and three control ponds are shown in Table 27 below. Although BMP ponds remained free of WSD, productivity was generally low, probably in part due to the dense stands of grass which dominated the ponds' central areas during months 1 and 2 (Figure 17). The grass probably limited shrimp access to the central area for feeding. Low salinity during much of the crop was cited as favouring grass growth and manual efforts to remove it were unsuccessful. This provides yet another example of smallholder monodon crops being adversely affected by aquatic weeds; solutions to these must be found if BMPs are to be successfully implemented in susceptible sites.

Figure 17. A typical BMP pond during the Jepara 2010 monodon implementation showing dense grass growth in the central area, sparing the deeper peripheral trench. Attempts at manual removal were unsuccessful.

Table 27. Key results from the November 2010 – January 2011 traditional Jepara implementation.

BMP pond	Area (m^2)	Stocking density (n/ m^2)	Survival (%)	DOC	Productivity (kg/ha)	WSD outbreak
A1	12000	2	22	91	125	No
A2	15000	2	19	85	53	No
A3	15000	2	6	55	15	No
A4	10000	2	15	89	50	No
A5	20000	2	16	88	45	No

Control pond	Area (m^2)	Stocking density (n/ m^2)	Survival (%)	DOC	Productivity (kg/ha)	WSD outbreak
B1	7000	3	0	35	0	Yes
B2	7000	3	0	30	0	Yes
B3	10000	3	20	85	85	No

7.7 Compliance/productivity/profitability study

As for the outcomes study, flooding at the Sinjai and Kendal sites, with consequent escape and mixing of shrimp populations, forced the abandonment of this study.

7.8 Extension impact studies

Sinjai, South Sulawesi

Alleged internal rivalries and other systemic issues within the designated district Dinas office, unrecognized by project staff until too late, resulted in counterproductive extension support to the implementation. In fact, none of the project funds and extension materials supplied to district Dinas were used to support the program implementations via the crop calendar as agreed. Instead, they were used, at least in part, to support activities involving non-participating farmer groups. Consequently, aside from minimal Dinas involvement at the beginning of the cropping period, the only extension advice to BMP farmers during the implementation was provided informally and on request by project TEs, visiting STOs and the UNHAS team.

Given the above, the Sinjai extension impact study findings are not derived from an agreed program as originally conceived, i.e., led by trained, well–resourced Dinas staff and based on activities coordinated under an agreed crop calendar. Instead, the study described the effect of this stop-gap extension input on adoption of BMP technology by farmer groups participating in the (eventually abandoned) outcomes study implementation. Observations focused on the three participating farmer groups: Tajolo Lagoari (Full BMP), Hijau Lestari (Basic) and Lestari (control), with particular attention given to socio-economic and technical aspects of production.

The study showed that extension has a positive effect in increasing farmers' knowledge and awareness in key areas affecting production. Specifically, as a result of the extension effort, farmers recognised that:

(a) preparing the pond well decreases the likelihood of disease occurrence;

(b) stocked seed must be virus free by PCR test;

(c) careful attention needs to be given to quality and infectivity of water source (input and output), as well as maintaining water quality and depth during growout;

(d) shrimp growth during growout must be carefully monitored;

(e) intra- and inter-group communication and cooperation is essential to limit disease spread;

The study also identified the following obstacles to BMP program adoption:

(a) each farmer's limited available pond area meant they were reluctant to dedicate ponds as shrimp-free biofilters;

(b) canal systems (used for source and release) were often sub-optimal;

(c) difficulty in sourcing PCR test-free seedstock.

Kendal, Central Java

Report findings from this failed implementation are summarised in Appendix 26; tables showing quantitative survey results are presented in Appendix 27.

Key qualitative study results (taken from Appendix 26) include the following.

- Extensionists have insufficient confidence in delivering the BMP message;

- Extensionists need formal, legal linkage with Dinas. 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. However, the current extension system is not yet formally established because a Presidential Decree executing the law is still pending.
- Farmer group members were enthusiastic at the beginning of the BMP implementation but enthusiasm declined rapidly after the first WSD outbreak;
- Farmer groups currently do not have strong “group objectives” with each member being focused on their personal objectives;
- Farmer group size and variations in members’ bakgrounds have negative effects on the group cohesiveness;
- BMP implementation sites should be preselected based on site characteristics, suitable historical backgrounds of farmer groups and the extensionists’ performance;
- The BMP implementations should be designed and integrated with a demonstration plot where the participants (extensionists, FG leaders, scientists etc) are closely involved in the implementation and observe the results.

7.9 Study of smallholder participation in CJ farmed shrimp value chain

The CJ survey found that, despite major efforts aimed at improving farm production of the traditional monodon variety, a number of forces are increasingly pulling and pushing farmers to adopt the more productive vannamei variety. The adoption of this new variety appears to follow the early part of the classic diffusion curve. Currently, it appears that CJ farmers are in the earlier to middle stage of adoption as the rate of adoption is still increasing quickly over time. Interestingly, CJ farmers appear to be much more able and willing to adopt new varieties compared to similar farmers that were interviewed in SS and, under a separate study, Lampung province.

The CJ adopters of vannamei technology have relatively higher expected returns from their ponds. This adoption was seen as critical in the improvement of farm household welfare, and in the expansion of output from the Indonesian shrimp farming sector. Adopting households continue to increase their market share, from 30% in 2005 to over 60% in 2009; there is a concomitant shrinkage in monodon market share. Overall growth in the farming segment of the industry can be attributed to the growth in adoption of the new vannamei variety and its resultant boost in farm productivity.

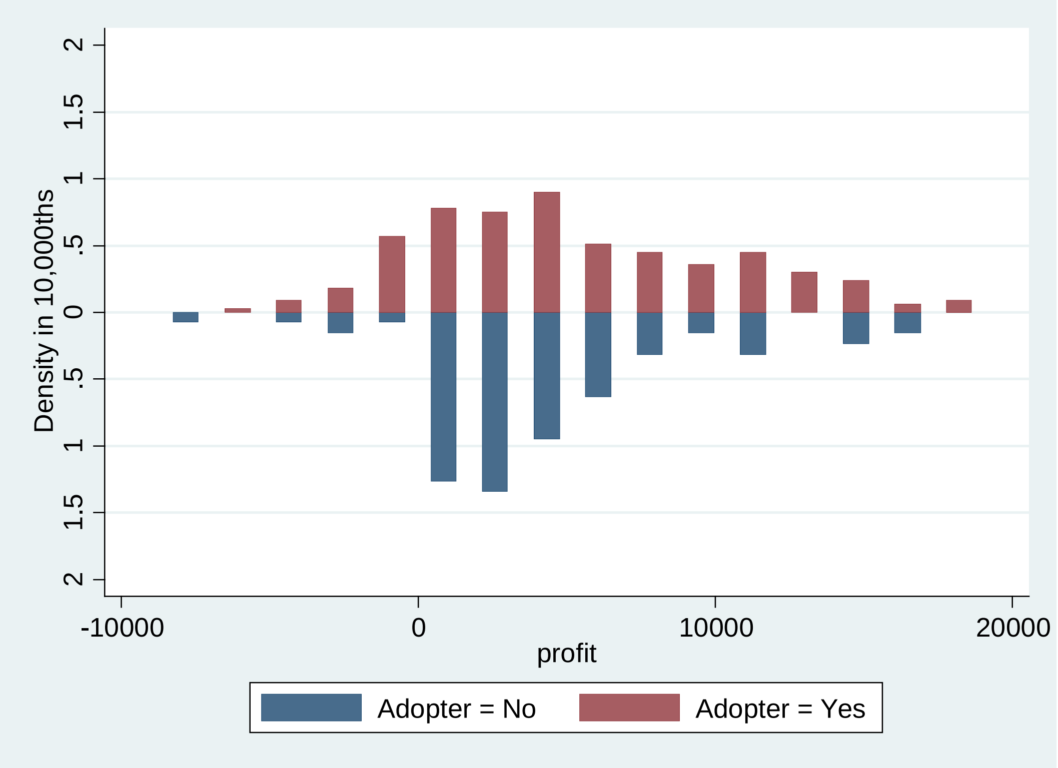


Figure 18. Distribution of annual profits per hectare by adoption (thousands of IDR)

The figure above shows the probability distribution of annual income outcomes by adoption. In general, adopters of the vannamei variety (top red) show a higher probability of earning high profits per hectare and lower probabilities of earning low profits compared to the non-adopting group (bottom blue). However, the adopting group is also more likely to earn negative profits (the red bars to the left of zero). The ability to cope with this risk and risk preferences of the farming household may also be important factors in dissemination of this technology.

Interestingly, adopting farms appear to be selling to mostly the same type of actor, the small wholesaler. However, marketing of the new shrimp variety may prevent some new challenges for farmers. First, the buyers of the new variety are based further away on average than buyers of traditional varieties and may bear higher cost of transportation. In addition to transportation, buyers may face higher transaction costs as the new variety is subject to increased scrutiny on size and verification of traceability measures.

Access to key production inputs is also a critical factor in the adoption of the new variety and expansion of production. Access to the key input, vannamei post-larvae, is extremely important. The limited number of vannamei hatcheries in our study areas means that farmers must travel much longer distances (or incur cost of delivery) in order to acquire these post-larvae compared to the lower cost of procuring locally available (but more risky in relation to disease) monodon post-larvae. The expansion of input supply will be a critical factor for facilitating increased adoption of the new variety and expansion of shrimp production.

Feed is another key input as the vannamei variety requires much more feed in the production process compared to monodon. It represents, often times, the highest single cost item on an adopting farm. Adopting households use more than 10 times the amount of feed than non-adopting households. The scale of procurement appears to be causing farmers to shift away from sourcing shrimp feed from the local farm input shop and towards using wholesale agents or factory direct to acquire feed. Also, feed is often purchased on credit. Development of a more efficient market channel for delivering feed will also be important in the uptake of the new technology.

Households engaged in off-farm activities, particularly those self-employed in other sectors, were more likely to be adopters. Sources of off-farm income may be important in stabilizing income shocks and also in investment into complementary inputs.

Also, the availability of skilled labor appears to be another factor related to adoption as adopting households employed more technicians who were better educated and more experienced than technicians on non-adopting farms. The ability of the local aquaculture labor pool may be important factor in household decisions to adopt.

Cooperative activities were also an important facilitator of technology adoption. Members of producer organizations were more likely to adopt the new technology than non-members. In addition, the characteristics of the cooperatives also mattered. Adopters were more likely to have come from active cooperatives that met frequently, and engaged in activities relevant to shrimp production such as sharing labor, capital, monitoring disease, and maintenance of water resources.

Land is also an important factor. Aquaculture in general appears to be expanding as both non-adopting and adopting households have increased their land holdings and the total amount of operated land. Over the time period of the survey, adopting households operated more pond area in aquaculture production than non-adopting households. In addition, adopting households appeared to be substituting owned land for rented land as they expanded production. How well land rental markets function in these areas may be a very important in the adoption of new aquaculture technology.

8 Impacts

8.1 Scientific impacts – now and in 5 years

Compared with the situation at the beginning of the project, we now have a much clearer understanding of the Indonesian smallholder shrimp farming sector, its complexity, its interactions with the agencies responsible for serving it, and its attempts to meet market demand in the face of major challenges, including the ubiquitous WSD threat.

The project's inability to achieve its research end-point for BMP programs in the relatively short time available could be seen as the cumulative effect of a wide array of contributing factors including significant shortfalls in essential background knowledge, in research skills and technical knowledge amongst key participants, and in extension skills and their delivery amongst key service providers.

In this context, the project's main current and future scientific impact has been to bring these shortfalls into clear view and to identify remedial research and related capacity building needs. These needs are outlined in 9.2 Recommendations below.

8.2 Capacity impacts – now and in 5 years

The project's limited success highlighted serious capacity shortfalls and, accordingly, an urgent need for improvement in both the aquatic animal health and related extension service fields.

8.2.1 Shrimp health management

The project exposed participating DGA staff to a set of systematic, scientific approaches addressing a major national aquatic animal health problem, i.e. the smallholder sector's slow motion collapse in the face of WSD. Capacity of front-line researchers improved progressively during the project via their participation in BMP program implementations requiring formal adherence to protocols and systematic data collection and recording. We further built capacity using step-wise remedial training as necessary. We believe it was only the forced abandonment of the 2010/11 outcomes study implementations, due to extremely abnormal weather conditions, which prevented these researchers from demonstrating major improvements in research capacity by project's end.

Capacity of three senior front-line researchers was further enhanced via their participation in project-funded postgraduate programs. These comprised a doctoral program, still in progress at the time of writing, at GMU for the now re-deployed PE(I) and masters programs for two STOs, one at DU and the other at UNHAS. We expect that exposure to project approaches under these doctoral and masters programs has confirmed, for university-based supervisors, the urgent need for high standards in their coursework and research activities.

We hope also that the experience of limited success from such a large collaborative effort has alerted senior staff in partner agencies to the need for rigorous scientific approaches in their future research programs and field implementations. This will require not only well-trained and resourced front-line researchers but also, very importantly, strong scientific leadership, especially from TIU directors.

8.2.2 Extension services

Despite strong support from project partners, particularly senior Provincial Dinas staff, vacuums in extension service delivery at field levels crippled both 'proof of concept' and 'proof of delivery' throughout the project. Designated District Dinas extensionists, trained under our step-wise capacity building programs and offered/provided with all necessary resources and funding, with very few exceptions proved unable to deliver services as agreed under the crop calendars.

Evidence suggests the causes of this inability are systemic within District Dinas agencies, but it was beyond the project's scope to identify and address them. ACIAR's decision, reversing an earlier firm commitment made after we recognised the seriousness of the problem, not to support a workshop examining extension service delivery for fisheries in Indonesia, leaves this key issue unresolved. Furthermore, ACIAR, for apparently internal reasons, decided not to proceed with a provisionally agreed shrimp BMP project-SMAR/SADI linkage, under which we may have been able to learn from successful extension approaches used for other commodities. Until an effective extension service delivery pathway is found, it is likely the smallholder shrimp sector, especially for monodon farmers, will continue its slow decline.

8.2.3 Socioeconomics

The project also improved capacity at GMU UNHAS, through their participation in the pilot socioeconomic and extension impact studies.

8.3 Community impacts – now and in 5 years

Despite the team's best efforts, the project did not achieve the pilot rollout research end-point, i.e., ~ 300 farmers successfully adopting BMP programs by early 2011. Nonetheless, even the project's limited successes typically generated strong interest at farmer group level and, often, a commitment from farmers to continue the implementations, albeit often in modified forms. However, in the absence of facilitated unified farmer groups, plus an ongoing, effective extension program and some technical support from TIUs, these efforts are likely to founder in the face of the omnipresent WSD threat.

8.3.1 Economic impacts

Our formal compliance/productivity/profitability studies were abandoned after extreme, unseasonal rainfall caused flooding of the Sinjai and Kendal sites in 2010/11. We therefore have no information on economic impacts of BMP program adoption by smallholder monodon farmers in Indonesia.

8.3.2 Social impacts

The almost complete extension service delivery vacuum at our BMP program implementations meant that positive social impacts resulting from the fostering of farmer group and local community unity were minimal. In fact, this extension vacuum may have exacerbated community tensions; the BMP non-compliant supplementary stocking at Sidorejo in 2009, which almost certainly allowed WSD to spread to neighbouring ponds operated by BMP- compliant farmers, could be a case in point.

8.3.3 Environmental impacts

The project formally included site selection criteria as part of a critical first step in BMP program implementation. If this approach is adopted by service providers such as TIUs and Dinas in their ongoing assistance programs to smallholder farmers, then positive environmental impacts should follow.

8.4 Communication and dissemination activities

We progressively reported project achievements and discussed key issues with researchers involved in similar programs at annual meetings under FIS2006/144 Strengthening regional mechanisms to maximize benefits to small-holder shrimp farmer groups adopting better management practices (BMPs). The third and final meeting under 06/144 was held jointly with 05/169's annual coordination meeting at Semarang in 2009.

In April 2009, a media group comprising representatives of ABC radio and Indonesian print media (including Kompas and Bisnis Indonesia), accompanied by senior DGA and ACIAR Jakarta office staff travelled to BBPBAP, Jepara where they met with, and interviewed, senior Australian and Indonesian project staff during a project coordination trip. The group then proceeded to the Sidorejo 'outcomes study' field site where they met with farmer group leader and members.

The following papers were presented at Asia-Pacific Extension Network's November 2009 meeting in Bussellton WA and have been accepted for publication in Extension Farming Systems Journal.

- Ageng Setiawan Herianto, Sri Peni Wastutiningsih, Derek Foster, Mike Rimmer, Richard Callinan. 'Agricultural and fisheries extension in Indonesia – origins, transitions and current challenges' (Appendix 28).
- Joanne Millar. 'Adapting extension approaches to cultural environments in South East Asia: experiences from Laos and Indonesia' (Appendix 29).

9 Conclusions and recommendations

9.1 Conclusions

The project has clarified our understanding of the Indonesian smallholder shrimp farming sector, its complexity and its attempts of subsets within it to operate profitably in the face of major challenges, including the ubiquitous WSD threat. We also have a much clearer understanding of the capacities and cultures of agencies serving the sector

Despite this improved understanding, we were unable to reach our arbitrary 'pilot rollout' research end-point whereby ~300 farmers had successfully adopted BMP programs by project's end.

We see this inability as the cumulative effect of many factors including the following.

- Very unusual seasonal conditions led to severe flooding at both our major field study sites in 2010/11, where program implementations involved a total of 120 ponds. Consequently we were forced to abandon the three definitive studies, i.e., the outcomes study, the compliance/productivity/profitability study and the extension impact study, embedded in these implementations. Had we been able to complete this work, we would have achieved most of the project's key objectives.
- Given the project's late start, we had less than four years to facilitate adoption and adaptation of sets of complex practice changes by a relatively large number of farmers. Processes such as this usually require more than five years, so our inability to reach the pilot rollout target should not be surprising.
- During most of the project we were not fully aware of the diversity of smallholder shrimp farming systems and were therefore unable to target the most compatible system(s) for program adoption. Consequently, as in Sidorejo in 2009, covert non-compliance by some farmers led to serious failures.
- We were mistaken in our assumption that BMP programs, properly applied at most locations, would significantly increase smallholders' productivity and profitability; site factors including soil types, canal function, as well as pond layouts and structure all appeared to strongly affect outcomes.
- The BMP programs comprised complex sets of interventions, derived from earlier risk factor and laboratory studies, aimed at optimising each pond's productivity and profitability while minimising WSD outbreak risk. When fully implemented, they required practice changes which proved too complex and/or beyond the resources of many farmers.
- Again contrary to our original assumptions, many participating farmer groups proved unable or unwilling to maintain the discipline necessary for successful program implementation. Perhaps because of scepticism about previous government programs, at least some farmers seemed motivated more by access to short term gains such as free seed, rather than by a desire to improve productivity in the longer term.
- From the beginning of the project, there were significant knowledge gaps in some technical areas amongst senior scientific staff. We were particularly limited in our ability to deal with rampant submerged/emergent plants in ponds at most study sites.
- Research skill limitations amongst key scientific staff, combined with project protocols' often complex requirements, often led to damaging shortfalls in data recording and sample collection. Despite determined remedial efforts, these failures seriously limited the research value of most of our program implementations, particularly in 2009;

- There was an extension vacuum during most of our implementations at farmer group levels, even though such input was mandatory, requiring close linkage with crop calendar activities. Given that we provided training, funds and all other necessary resources to support the required extension delivery, we attributed its absence to unidentified systemic issues within District Dinas agencies. Our technical field teams were usually able to successfully take on this role with small, manageable numbers of farmers. Once whole farmer groups were involved and Dinas input became essential, as under the outcomes study in 2009, the extension vacuum emerged and the implementations failed.
- In India, since 2004, government agencies have widely scaled out comparable BMP programs for smallholder monodon farmers under a specifically tailored, enabling policy environment. Except at the end of the project, Indonesia lacked a comparable policy environment at national, provincial and local levels. Major new Indonesian government initiatives (Minapolitan strategy and PUMP program) aimed at helping smallholder monodon farmers raise production and meet national targets, are now in place and promise to correct this situation.

9.2 Recommendations

Driven by global demand, shrimp aquaculture remains important in sustaining livelihoods in many coastal communities in Indonesia, as elsewhere in the region. However, smallholder Indonesian shrimp farmers, who comprise a significant but now declining part of the industry, face a complex mix of incompletely understood production-related constraints.

The current project aimed to improve health management via validation and progressive scale-out of ‘better management practice’ (BMP) programs, with a key focus on WSD prevention. This approach exposed serious limitations under then prevailing Indonesian conditions. By carefully investigating outcome shortfalls and by comparison with successful program scale-out in India, staff identified several largely unforseen constraints to scale-out. These included limited research and extension service capacity, individual farmers’ limited knowledge and resources, lack of farmer group unity, marginal sites, inadequate infrastructure, rapid socioeconomic change, and (until recently) lack of an enabling policy environment.

These constraints must be addressed, using a coordinated multidisciplinary approach, if major new Indonesian government initiatives (Minapolitan strategy and PUMP program) aimed at helping smallholder monodon farmers raise production and meet national targets, are to succeed. Accordingly, Indonesian partner agencies and farmer groups have urgently and unanimously requested further assistance in sustainably integrating BMP program scale-out into these formal business development initiatives.

9.2.1 Understanding the cultures of key partner agencies

Outcome shortfalls under the current project clearly show that Australian proponents would have benefited by having realistic information, from the project development stages onward, of partner agency cultures where available; proponents’ untested assumptions based on cultures of seemingly equivalent Australian agencies proved misleading. Specifically, in the areas covered by the current project, this included assumptions about the service delivery obligations, motivations and capacity of (a) TIUs and their staff and (b) District Dinas offices and their staff. ACIAR may consider closer guidance to proponents on these issues in future.

9.2.2 Further research and capacity building

Further research, closely linked with capacity building, is urgently needed to advance shrimp health management specifically, and aquatic animal health generally, in Indonesia.

Shrimp health management

To help advance smallholder shrimp farming in a rational, sustainable way, further research, building on findings from ASEM2001/107, FIS2002/075, FIS2002/076, FIS2005/169, FIS2006/144 and FIS2009/035, and taking advantage of the newly-emerged, supportive policy environment in Indonesia, is urgently needed. A 2-step approach is proposed. The second step should proceed only if first-step outcomes are satisfactory.

Step 1: situation appraisals addressing the following:

- Identifying the extent of areas in Indonesia suitable for smallholder shrimp (monodon and vannamei) farming under current conditions;
- Characterising the main smallholder shrimp farming systems with particular focus on those systems amenable to BMP program implementation;
- Characterising smallholder demography, socioeconomics and aspirations;
- Identifying constraints and solutions to extension service delivery;
- Identifying constraints and opportunities for farmer group/private sector partnerships.
- Identifying determinants for BMP program success/failure at farmer and farmer group levels in India.
- Identifying partner agencies e.g., TIUs or Universities, best fitted for future research into ‘proof of concept’ and ‘proof of delivery’ for BMP programs.

Step 2: BMP program implementations at selected sites, addressing the following research questions:

- Can BMP programs enable profitable and sustainable shrimp production, intensified at least to traditional-plus levels, for selected catchment-based farmer groups (‘clusters’) in physically suitable areas?
- To enable scale-out beyond the life of an externally funded project, is such intensification best done in collaboration with the public or private sector?

Capacity building in aquatic animal health management

The project exposed major capacity building needs in the following areas:

- TIU researchers urgently need (a) training in scientific methodologies and (b) close mentoring in their field applications;
- Indonesian universities urgently need assistance in upgrading programs in aquatic animal epidemiology and diagnostic pathology;
- Separate from the wider systemic issues mentioned above, for District Dinas staff to interact confidently with farmers, they urgently need training in aquatic animal health technical issues, including shrimp BMP programs and their rationale. To address this, senior Indonesian partners have suggested fostering policy changes at national and district levels, under which extensionists are deployed specifically to support aquaculture.

Multisystems approaches and realistic time frames

Because the issues affecting smallholder shrimp farmers and their adoption of BMP programs cover a wide range of disciplines (see above), any future research must use a coordinated multidisciplinary approach and be closely linked with Indonesian government initiatives (Minapolitan strategy and PUMP program). Moreover, experience from India with shrimp BMP programs, and with similar programs in the region targeting other commodities, suggests that facilitating adoption by farmers of complex practice changes usually requires at least five years before the ‘pilot rollout’ research end point can be reached. This must be allowed for if follow-on research on shrimp BMP programs is considered.

9.3 References cited in report

ADB / ACIAR / AwF / BRR / DKP / FAO / GTZ / IFC / MMAF / NACA / WWF (2007) Better management practices for shrimp farming in Aceh. 54 pp.

Avison D, Lau F, Myers M, Nielsen P (1999) Action research. Communications of the ACM 42: 94-97.

Chanratchakool P, Turnbull J, Funge-Smith S, MacRae IH, Limsuwan C (1998) Health management in shrimp ponds. Aquatic Animal Research Institute, Bangkok, Thailand. 152 pp.

Fatuchri (2005). A brief on shrimp culture in Indonesia. Directorate General Aquaculture. 11 pp.

Leta R, Murray-Prior R, Rola-Rubzen M (2005) Factors constraining extension workers effectiveness in improving horticultural production: a case study from West Timor, Indonesia. Acta Horticulturae 88: 8-18.

Lightner DL (2005) Biosecurity in shrimp farming: pathogen exclusion through use of SPF stock and routine surveillance. Journal of the World Aquaculture Society 36: 229-248.

Riel, M. (2010). Understanding Action Research, Center for Collaborative Action Research. Pepperdine University. Accessed online on 8/9/2011 from http://cadres.pepperdine.edu/ccar/define.html.

9.4 List of publications produced by project

Herianto A, Wastutinigsih S, Foster D, Rimmer M, Callinan R (2010) Agricultural and fisheries extension in Indonesia – origins, transitions and current challenges. Extension Farming Systems Journal 6 (1): 23 - 31

Millar J (2009) Adapting extension approaches to cultural environments in South East Asia: experiences from Laos and Indonesia. Extension Farming Systems Journal 5 (1): 143 - 148

10 Appendixes

10.1 Appendix 1:

International Principles for Responsible Shrimp Farming

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Project personnel chart

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Extension impact study (Central Java)

10.27 Appendix 27:

Extension impact study (Central Java) – quantitative

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10.29 Appendix 29:

Millar (2009)

10.30 Appendix 30:

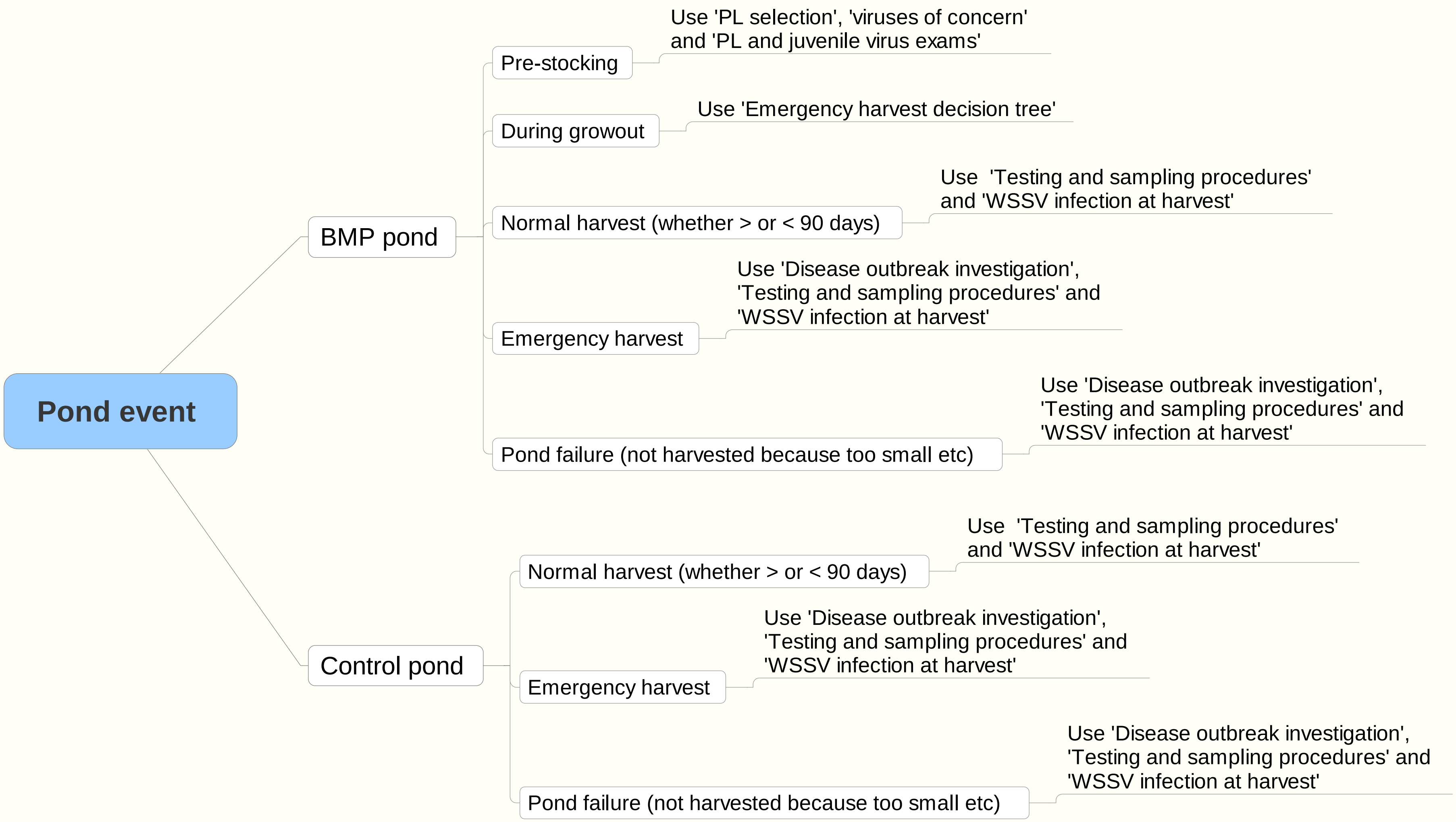
Pilot socioeconomic study (Demak 2008) report

10.31 Appendix 31:

Pilot socioeconomic study (SS 2008) report

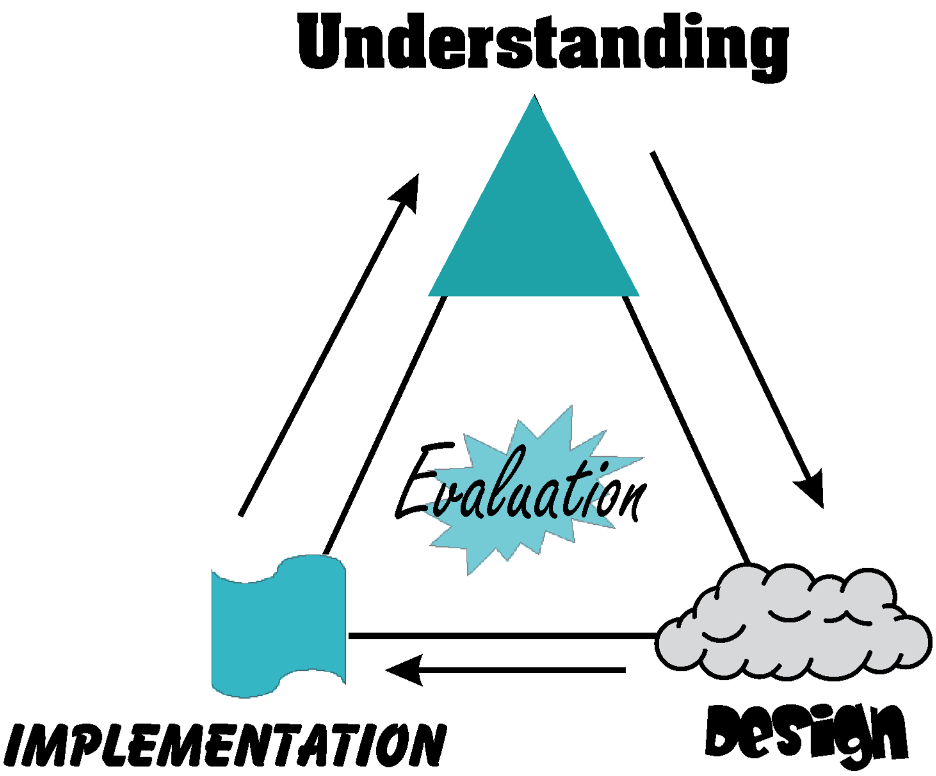
Appendix 13

This diagram shows when to use disease-related protocols. Note that protocols are part of the project's SOPs and are different from the Excel worksheets we use to record data. Follow each protocol to ensure the data we record in the Excel worksheets are the result of consistent procedures and are technically correct



Extension Handbook

Smallholder aquaculture shrimp supply chains in Indonesia



Produced to support ACIAR projects

Aceh Aquaculture Rehabilitation Project
ACIAR Project FIS/2006/002

Improving productivity and profitability of smallholder shrimp aquaculture and related agribusinesses in Indonesia
ACIAR Project FIS/2005/169

Australian Government
Australian Centre for International Agricultural Research

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Contents

Teman Teman Saya,

Welcome to the world wide family of *Penyuluh*. We operate in every country in the world. Our job is to help others achieve a better life for themselves and to help them learn and grow as people. We operate in many different areas of human activity, agriculture, aquaculture, business, health, community development and peace work.

Wherever we operate our skills remain constant and our focus is on helping others find their dreams.

It is my honour to be able to help you help people to improve their ability operate tambak.

I wish you all the best in your endeavours and encourage you to maintain a professional and committed approach to improving the lives of people.

Derek Foster

Extension Specialist

Preface

This publication is designed to be a seeding publication and is the first installment in an action research process for the Indonesian Government / ACIAR projects;

Aceh Aquaculture Rehabilitation Project, ACIAR Project FIS/2006/002

Improving productivity and profitability of smallholder shrimp aquaculture and related agribusinesses in Indonesia, ACIAR Project FIS/2005/169

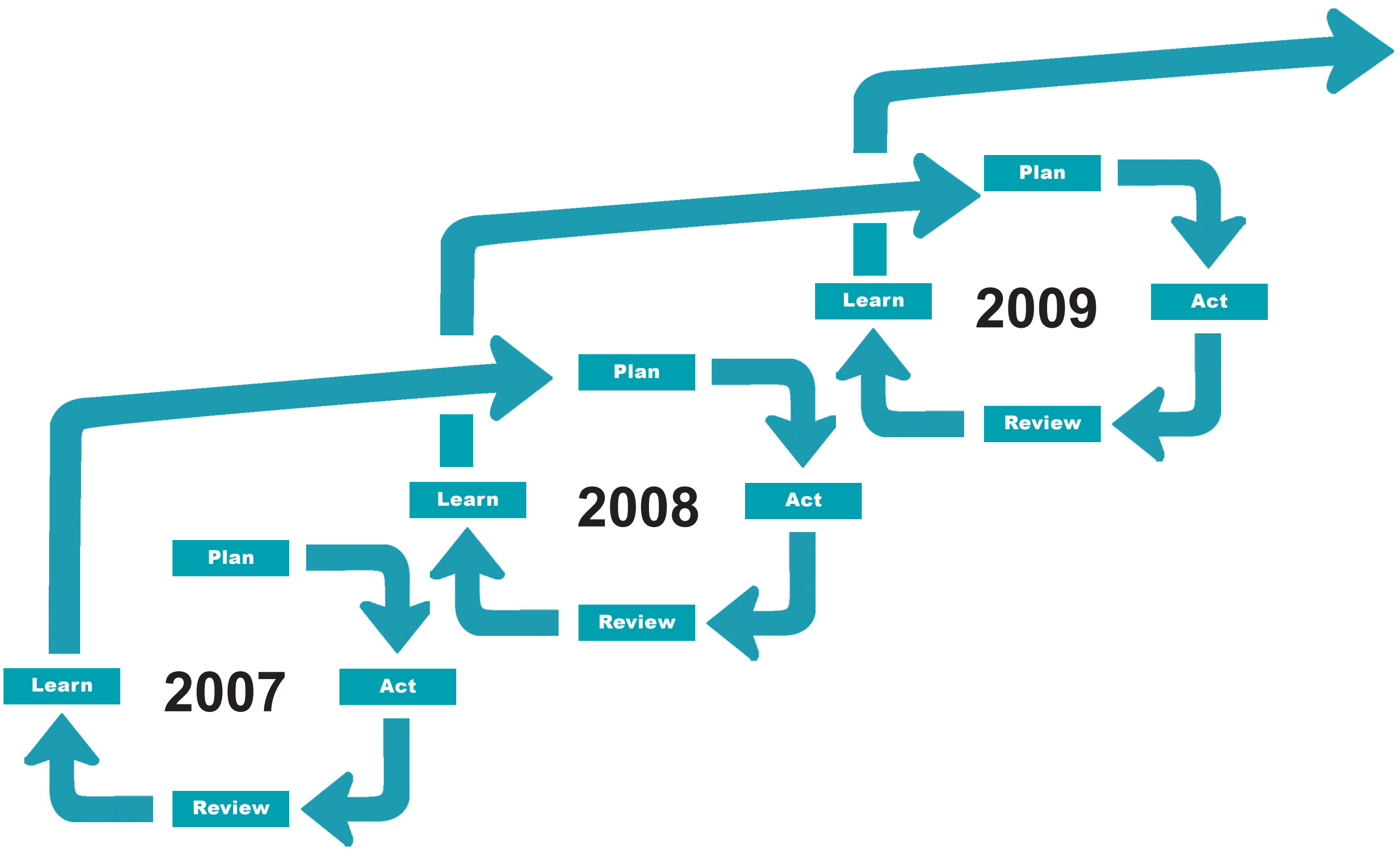
As such, it is important to understand how this publication is to be used.

This Action Research project is designed to allow Indonesian extensionists to build a publication that outlines EXTENSION Best Management Practice for the smallholder shrimp supply chains in Indonesia.

The action research project is designed with high level participation principles underpinning the activities and therefore contributions to the project are welcome from National, Provincial, District extension staff, University staff, project sponsored technical and extension staff, farmers, hatchery operators, and any one else in the smallholder shrimp supply chain who is involved in the project.

At regular intervals there will review meetings to make adjustments to the publication, add neceaary sections, rethink the scope of training activities for extension staff and develop processes for the uptake of improved extension services throughout Indonesia.

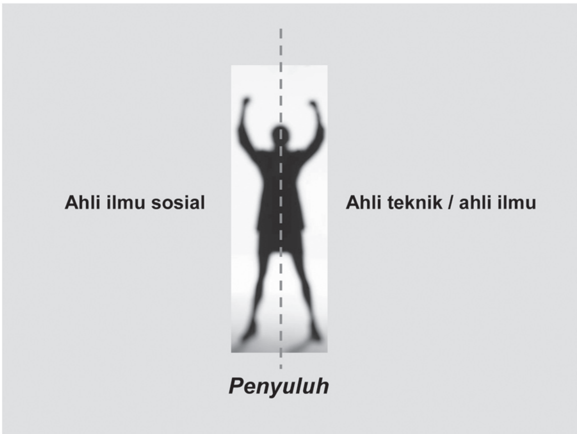
The process follows the action research cycle and by 2009 a product should emerge that is the basis for improved supply chains. This publication should then be regularly review for continuous improvement into the future.



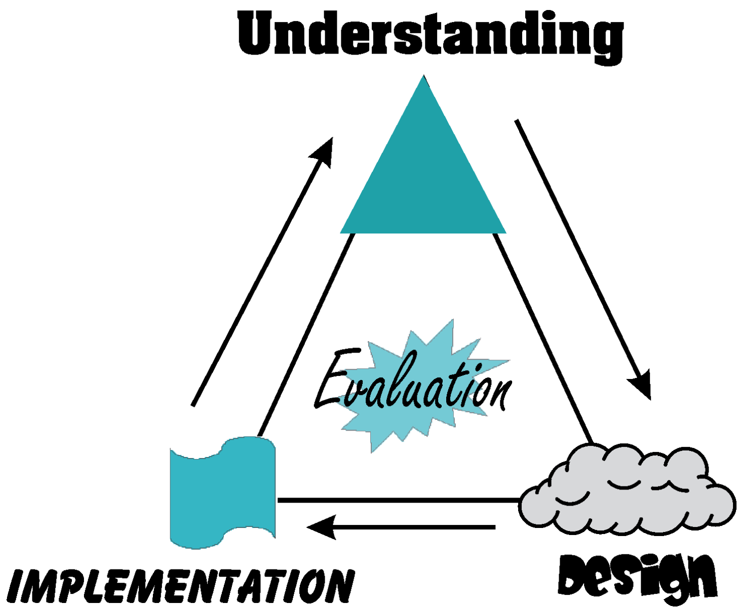
Section 1

Extension theory

We all have a role in providing extension services to the farmers. We all have some technical/scientific background and we all have some extension background. To make sure we are able to provide the best extension to people we need to build our extension capacity.



To assist us to be effective *Penyuluh* we can use a framework to guide our work.

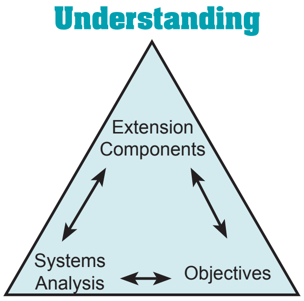


This framework has three parts to it;

Part one – understanding. We should always strive to understand as much as we can about the tambak farmers, where and how they live, what existing extension services and material they have, the socio/political environment of their area and the prevailing environmental conditions (weather, seasons, pollution etc..). We should also be aware of their connections to others in the supply chain.

Part two – Design. Having a good understanding of the systems that prevail allows us to create the best design of products, learning methods and methods to involve people. These designs fall into three categories; information products, methods to assist farmers to learn and process to involve (and therefore motivate) farmers.

Part three – Implementation. To implement an extension program the extension leader needs (and their team) need to be proficient in project management, team development and community development processes.



Understanding

To do this we need to;

1. Undertake a review of the main extension components

2. Be clear about the purpose of the extension activity, and

3. Undertake an analysis of the major systems surrounding the farmer.

1. Extension Components;

The key components of the discipline of extension give the extension person the capacity to make key decisions about how an extension program will be shaped.

- **Learning**

In this section we need to understand components of adult learning, action learning, action research, experiential learning and lifelong learning. We also need to understand how the people we are working with interact wit these types of learning.

- **Forms of extension**

There are four major forms of extension that need to be understood and how each interacts with the people we are working with. These are:

Technology transfer

Problem solving

Education

Community/industry development

- **Participation**

Understanding the forms of participation is of utmost importance to the extenionist. There different forms and 'levels' of participation and the Penyuluhan must be able to understand the ways these are currently happening in the extension system and to be able to strive for the best form of participation that will best serve the clients.

2. Objectives

Using the work of Dr. Claude Bennett we can describe the purpose of the extension program within his 7 tier hierarchy. Of most importance to us are;

- Level 7 End Result,
- Level 6 Practice change
- Level 5 KASA (Knowledge, Attitude, Skill Aspirations).

As Penyuluhan our job is to assist tambak farmers to achieve a better life and realise their dreams. These are the end results that we strive for. We need to be clear about what those dreams are and what is trying to be achieved and let that guide us in our activities at all times.

- **Practice change**

To achieve those dreams there has to be some form of change in what is done at the tambak. These changes in practice that will lead to the use of Best Management Practices in tambaks.

- **Knowledge change**

To use best management practices farmers will need to gain new knowledge and skills about farming, develop an attitude of discipline in the application of BMPs. There may also need to be a shift in the aspirations (dreams) of the farmers.

3. Systems analysis

Using the work Dr. Checkland and others we can describe the situation of the farmers by analysing different systems.

- **Human activity**

This system of human activity looks at what people do. In this case it is how people farm their tambak.

- **Natural systems**

This is the natural systems of the location. This includes weather patterns, seasons, the condition of the water and land and any environmental issues (such as mangroves and pollution).

- **Economic systems**

Producing udang and ikan has an economic system that includes input costs, operational costs and product returns. It also has the capacity to add value post harvest. These costs are all linked to national and international market influences. In addition there are important issues about micro-credit that may be the basis of petani operations. It is important for the Penyuluhan to understand these things and be able to assist the petani to make good decisions about their economics.

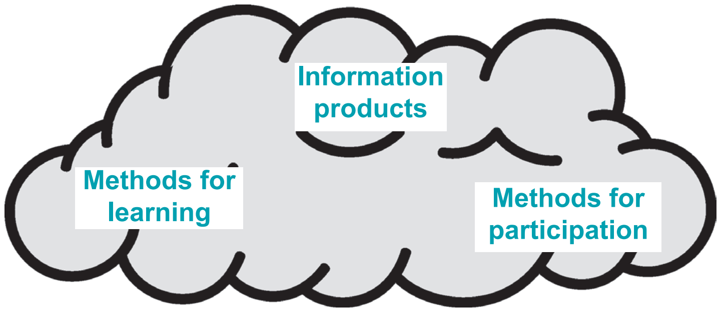
- **Social systems**

Petani are part of a family, desa, kecemantan and kapubatan social order. They also have a religion belief. These things can all influence how a petani operates their tambak. It is important for a Penyuluhan to understand these systems and understand things such as who talks to who, who has influence over who and where information comes from.

- **Extension material already available**

To make sure that the Penyuluhan doesn't repeat things that have already been done and to ensure that they are very knowledgeable about supporting the work of the petani tambak they find all the material that has been produced. They should also find out who else has been doing work with the petani and what sort of work has been done.

Design



Having a good understanding about the situations surrounding petani, the Penyuluhan will be able to design a good program for the program Penyuluhan. This design process will fall into three parts;

1. **Information products**
2. **Methods for learning**
2 **Methods for participation**

1. Information products

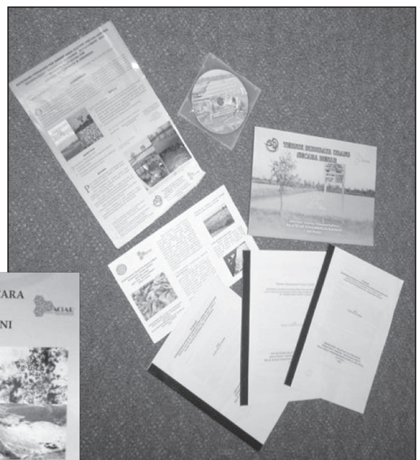
These products will fall into a range of products. Detailed information about how these products need to be designed and produced is included later in this handbook. The products include;

Posters

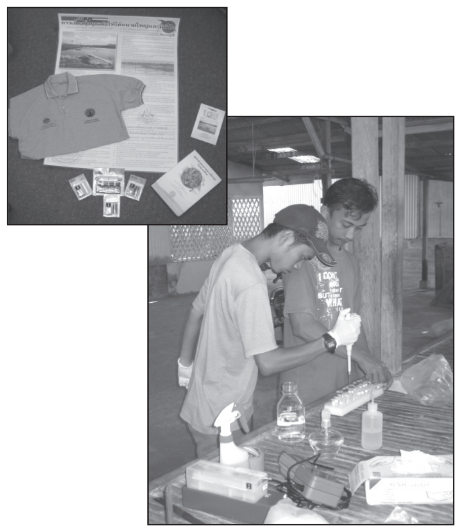
Pamphlets

Books, manuals

CD/VCD/DVD



Promotional material



(newspaper and TV interviews)

2. Methods for learning

To gain more knowledge about tambak the petani will need to learn more about Best Management Practises (BMP). Penyuluhan use three main ways to do this;

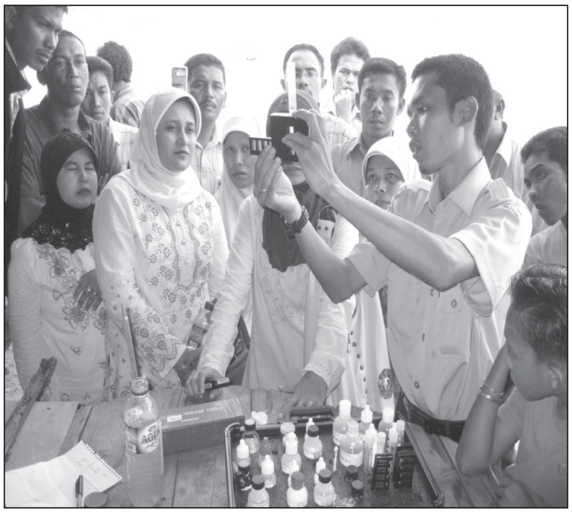
- Presentations
- Workshops
- Meetings

Detailed information about how to best do each of these is later in this handbook.

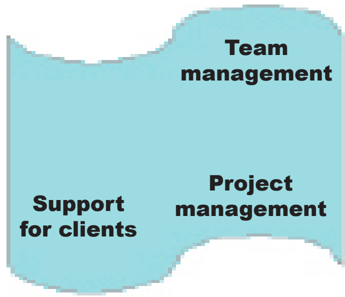
3. Methods for participation

To ensure petani maintain the BMPs, Penyuluhan must provide processes that motivate petani and that allow the new way of doing things to become part of the normal life at the tambak. The Penyuluhan can use the following techniques;

- Meetings
- Focus groups
- Processes for participation



IMPLEMENTATION



Once the design of a program has been completed it is time to apply it. To do this the Penyuluhan needs to able to do three things;

1. **Team management**
2. **Support for clients**
3. **Project management**

1. Team Management

A team is more effective than a single person. A team uses the different strengths people have and blends these into an effective unit. The Penyuluhan should build a team that will, together, work towards helping petani see their dreams. The Penyuluhanan should develop skills in manajemen tim to make sure that the performs well and that the members of the team are well looked after.

2. Support for clients

If the Penyuluhan is working with a village/farmer group then they will need to make sure they look after the group with good processes. It is important that the Penyuluhan does not wrongly interfere with the village way of life or to impose their own values on the people of the village. The Penyuluhan must be a catalyst for change.

3. Project management

The Penyuluhan often has to manage the program in the same way as a project is managed. This means that they may be responsible for purchasing equipment, managing a budget, writing reports and achieving the goals that have been set by the program.

Section 2

How to help people learn

Introduction

Understanding how people learn is an important part of the extensionist's ability to help their clients. Helping people learn helps them to;

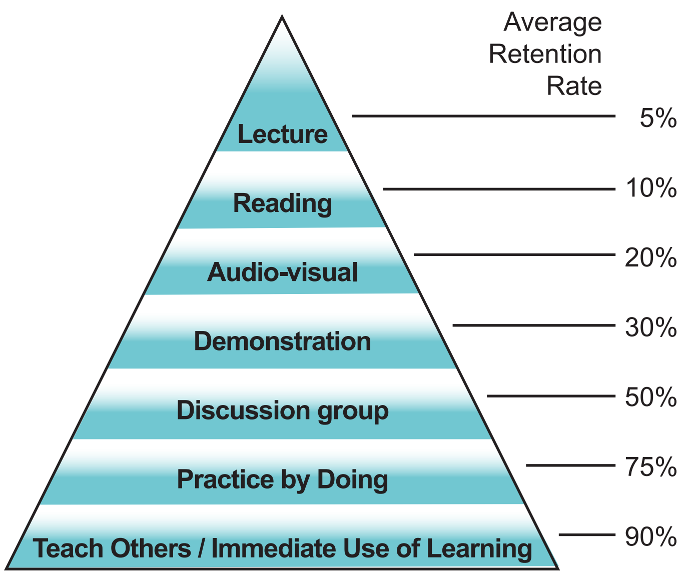
- Be willing to adopt new technology or management practice
- Find solutions to technological or management issues
- Better understand their situation and so enable them to make choices and take action to improve their situation
- Facilitate and stimulate individuals and communities to take the initiative in problem definition and seeking solutions to individual and societal concerns/ opportunities
- Assist in the process of innovation. By creating creative learning environments, being able to facilitate the process of idea to market place and creating network liaisons to assist with finance and financial management

This section is designed to outline issues about how people learn and how that relates to the work of the extensionist.

The learning pyramid

Research has shown that different forms of information dissemination and how different ways of facilitating learning opportunities have different capacities to impart the information and create the ability for clients can retain that information. As you can see from the diagram below the more people are involved in the learning the more they retain.

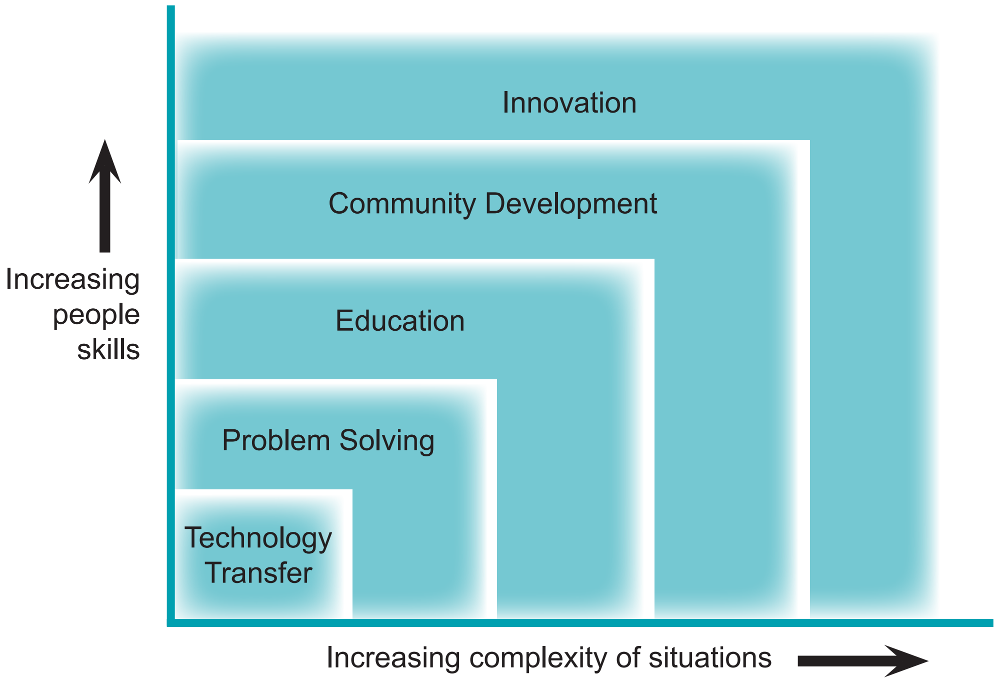
Learning Pyramid



National Training Laboratories - Bethel, Maine
Maryland Student Service Alliance

Extension paradigms and types of learning situations

Extensionists operate in a number of 'paradigms'. This means that they operate in five major areas of work. These ways of working have differing requirements with respect to how much the extensionist must know about working with people. This is directly related to the increasing complexity of the area of work.



Adapted from: Coutts J A, 1994 *"Process Paper Policy and Practice – A case study of the introduction of a formal extension policy in Queensland, Australia 1987-1994"*

Technology Transfer

Extension is a means of pro-actively changing voluntary behaviour in the form of the adoption of new (externally developed, already available and tested) technology or management practice by providing information, opportunity, and persuasion. The assumption is that the scientists or experts have developed solutions to problems or new ways of doing things that, if adopted by farmers or 'users', will improve farm output and living standards. The manner of achieving this change is mainly persuasive by nature, that is, convincing people of the value of adoption by use of extension material, presentations, demonstrations, discussion groups etc.

Problem Solving

Extension is a reactive expert (advisory/ consultancy) function which is a means of assisting individuals to find solutions to technological or management problems which arise and are inhibiting their desired unit performance. The adoption of new technology/ management practices (or the purchase of goods and services provided by the agency) are an indirect, though 'inevitable' consequence of this process.

Education

Extension is a means of pro-active informal education which seeks to assist individuals to better understand their situation and so enable them to make choices and take action to improve their situation. The assumption is that an adult education approach (action learning) both assists people to make better choices, and results in better choices being made.

Human Development

Extension is a means to facilitate and stimulate individuals and communities to take the initiative in problem definition and seeking solutions to individual and societal concerns/ opportunities. The assumption is that given the opportunity and interactive framework, individuals and communities will and can best improve their situation. It encourages people to govern themselves.

Innovation

In a world of ever increasing rate of change new ideas can create a competitive edge to farming practices and products. The extensionist is able to assist in the process of innovation. By creating creative learning environments, being able to facilitate the process of idea to market place and creating network liaisons to assist with finance and financial management, the extensonist can support the development of new practice and product ideas.

What this means for working with shrimp farmers

For the shrimp farming extensionist the type of work associated with each of the paradigms is summarized in the table below.

People skills ↑

Innovation Action learning; on-farm trials
Community development formation / development of farmer groups
Education – VCD, brochures, manuals, on-farm workshops **Awareness** – signage, promotional material, mobile laboratory
Problem solving Advisory service to Dinas, NGOs, farmers, mobile laboratory Disease diagnosis
Technology transfer Soil testing, water quality testing, pond management Seedstock production; high-health seedstock

Adult learning

Adults have specific needs with respect to the way they learn. Extensionists must ensure that any learning events that they facilitate satisfy the following aspects of the adults' learning needs.

- Learners must feel a need to learn.
- The learning environment must be mentally, socially and physically safe.
- Learners must set their own learning goals.
- Learners must participate actively in the learning process.
- Learning must build on, and use, the learne r's experience.
- Learners must see that their learning has been successful.
- Learning must involve effective two-way communication.

Action learning

(*modified from the work of Dr. Bob Dick)*

Action learning can be defined as a process in which people come together more or less regularly to help each other to learn from their experience. In the case of aquaculture in Indonesia these can be farmer groups. The extensionist will be required to assist in farmers coming together at regular times throughout each cropping cycle.

This is a process for drawing learning from experience. The experience is usually drawn from some task assumed by a person or team. In the case this will be the farming, hatcheries or post harvest activities of people involved in the shrimp value chain.

Action research

Action research is a process by which change and understanding can be pursued at the one time. It is usually described as cyclic, with action and critical reflection taking place in turn. The reflection is used to review the previous action and plan the next one.

It is commonly done by a group of people, though sometimes individuals use it to improve their practice. It is not unusual for there to be someone from outside the team who acts as a facilitator.

In action learning, each participant draws different learning from different experiences. This is the type of learning that will occur amongst project staff when you all get together and talk about issues. Farmers and hatchery operators will also learn this way as they work through a cropping cycle and see what is working and what is not.

In action research a team of people draw collective learning from a collective experience. This will occur with farmer groups at farmer group meetings.

Both are cyclic. Both involve action and reflection on that action. All have learning as one of their goals. You might say that experiential learning is the basis for the learning component of both action learning and action research.

Both action learning and action research are intended to improve practice. Action research intends to introduce some change; action learning uses some intended change as a vehicle for learning through reflection.

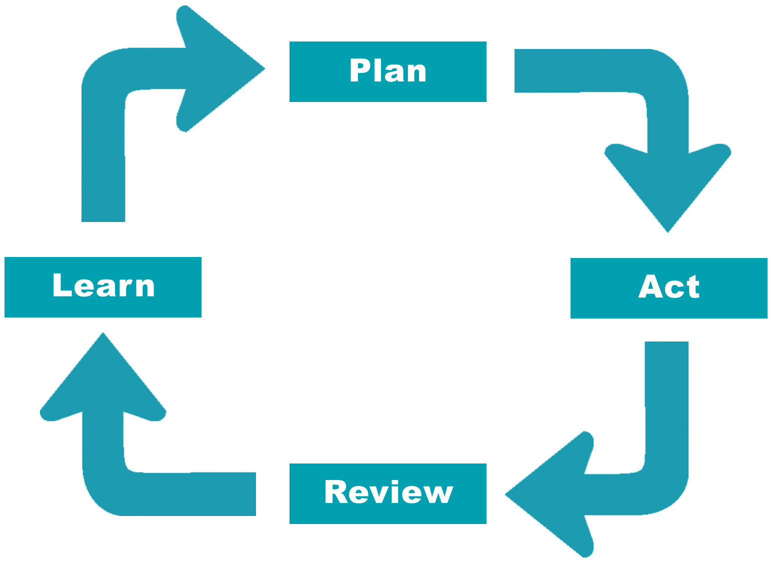
In action research, the learners draw their learning from the same change activity. With the importance of BMPs there is a strong possibility that farmers will have to change the way they farm.

Farmers generally prefer to learn through experiences on their tambak. The penyuluhan needs to be able to provide the action learning and action research processes to help the farmers learn and to change, where appropriate, the way they farm. It is only through the process of seeing where change is necessary that farmers will change their farming.

The important part of this process is the penyuluhan providing the processes for farmers to 'reflect (think about in a logical way)' on what has happened throughout their crop.

The Learning Cycle

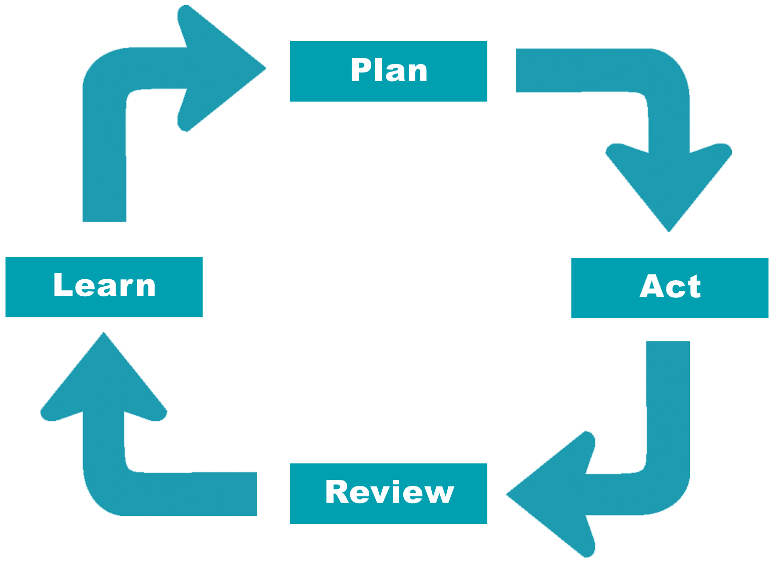
Consider the following simple learning cycle. It appears to capture the main features of action learning and action research.



We can add to this diagram where the penyuluh can intervene to assist petani.

Penyuluh: helps the farmer/s clearly plan for the next crop. This can done at a farmer meeting and then followed up individually at the tambak

Penyuluh: helps identify what has been learned from the experiences and begins to assist in identifying where changes need to be made. Also helps the penyuluhan identify changes to extension material and what new material needs to be produced.

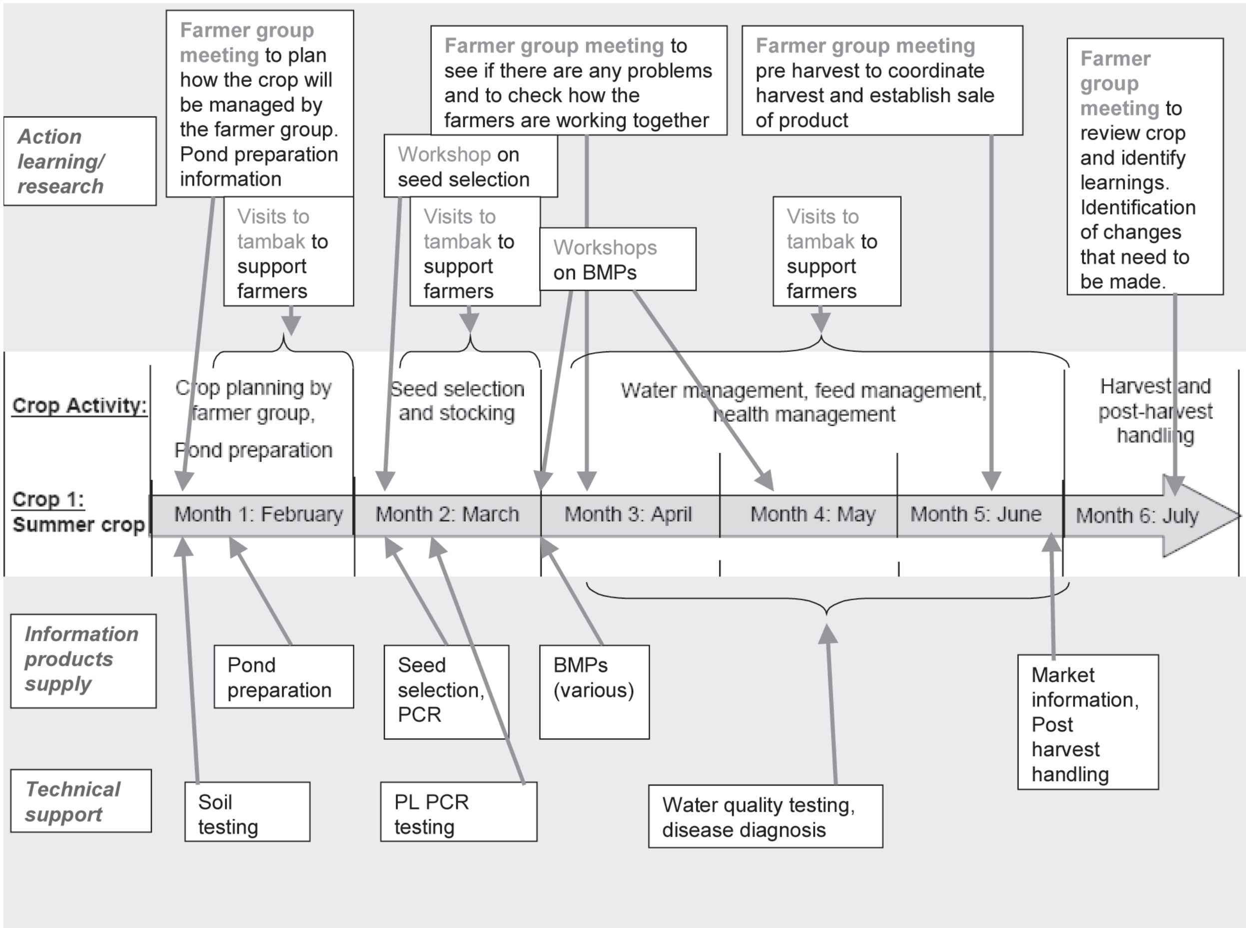


Penyuluh: Can visit throughout the cropping cycle to give advice, help the farmer observe properly.

Penyuluh: Helps the farmer/s organise their information. Also facilitates the process of summarising what has happened. This can be done at farmer meetings.

If we describe a typical cropping cycle then we can identify the learning activities that an extensionist might engage in during that cycle. These we might describe as;

- Action learning/Action research opportunities – **action learning**
- Information/education opportunities – **information product supply**
- Technical transfer and problem solving opportunities – **technical support**



Section 3

Designing an effective brochure and poster

Introduction

Both brochures and posters have an important role in helping farmers and others in the aquaculture supply chain learn more about the best ways to conduct their business. These information products should contain short and very easily understood, well illustrated pieces of information to make the learning process relatively simple and quick.

Step 1. Understanding

It is assumed that the extensionist will already have a deep understanding of the agreed Best Management Practices (BMPs) for the smallholder aquaculture shrimp supply chain. If this isn't the case then the extensionist should either begin to study these BMPs and develop a level of expertise or establish strong alliances with some technicians and scientists who do have this understanding.

For both brochures and posters there are key questions to ask to assist with the final design of the information product. By asking these questions the extensionist will develop a deep understanding of the target group and their needs.

The key questions are;

*Who is this pamphlet meant for***?**

The extensionist deals with a wide range of people in the shrimp supply chain. Whilst it sounds like a simple question, often extensionists don't clearly identify the people who will be using these information products. Some of the potential users may be;

- Scientists
- Farmers (men and women)
- Input suppliers
- Middlemen
- Hatchery operators
- Brood stock suppliers
- Transporters
- People who will be eating the shrimp

For each of these people in the supply chain there may be significant differences between them and others in the supply chain. It is important to identify any specific differences or needs to ensure that these are taken into account in the design of the products.

Sometimes one product may be designed to cover more than one of the member groups in the supply chain. In these cases the design must create a product that will suit everyone.

What do we know about them?

Finding out about the end users of the product means that the extensionist should undertake a significant analysis of the people. Some of the things that should be recorded are;

- What is the average age?
- What is their reading ability?
- Are there any special cultural issues about the group?
- How complex should the information be?
- What is their preferred language?
- Where and when will the products be used?

Another aspect of the target group is to ask if they have specific technical needs. This can be achieved by attending relevant meetings, reading local papers, trade magazines or reports.

What else has been produced to provide information on the same topic?

It may be important to check what else has been produced on the same topic. If there have been other information products are they useful? The extensionist can save money and effort by using existing material if it is suitable. To check if it is suitable the extensionist can apply the same design questions to it as would be applied in designing their own products.

Step 2. Design

Having collected the information about the target group and their needs the extensionist can begin the process of 'Design'.

What are the main points we are trying to get across?

The first thing to be clear about is the purpose of the information product. It is important to firstly be absolutely clear about the main ideas or pieces of information that the product is trying to get pass onto the target group. There are two things to check for this;

- What are the key technical BMPs that will be part of these information products?
- What are the target group's information needs?

Once the extensionist has a clear concept of the answers to these two questions the design process can begin.

At this moment the most important question for the extensionist to ask is,

'In what way will this information improve the target group's business?' If the products are aimed at farmers, then the question becomes 'What will be the benefit to the farmers if they adopt the new way of doing their farming?'

If the extensionist can't answer this question then they will not have a product that will be of use to the farmer. If a farmer cannot see a very clear and beneficial reason for adopting the information they wont do it!

If the extensionist has a clear understanding about what information is needed and what are the direct benefits to the farmer then the creative process of designing the product can be more easily achieved.

The creative process.

The brochure and poster will catch the eye of the farmer and others if the value of its information to the reader is clear. The extensionist should develop a title for the product that reflects this, the title should be focused on the user, not the extensionist or the scientist. A catchy title or slogan for the product will increase its use by the target group.

The pictures used should be local and tell a story. Pictures are very powerful tools for telling stories. For people who are poor readers pictures are the most useful form of communication in a printed product. The extensionist should ensure the pictures are always accurate and depict accurately the story being told. By using pictures that are local the extensionist can show just how relevant the information to the local people.

Diagrams are also very important for communication with poor readers and for reinforcing what has been written in the text. Extensionists should ensure that diagrams are both scientifically accurate and clearly tell the story that is being told.

The logical flow of the information is also important. The information should flow in a logical way throughout the information product. This will ensure that the reader will be able to see logical reasoning for suggested BMPs.

The layout of a brochure and a poster is important and is best done by a qualified graphic artist. Some general rules to follow if you are doing it yourself are;

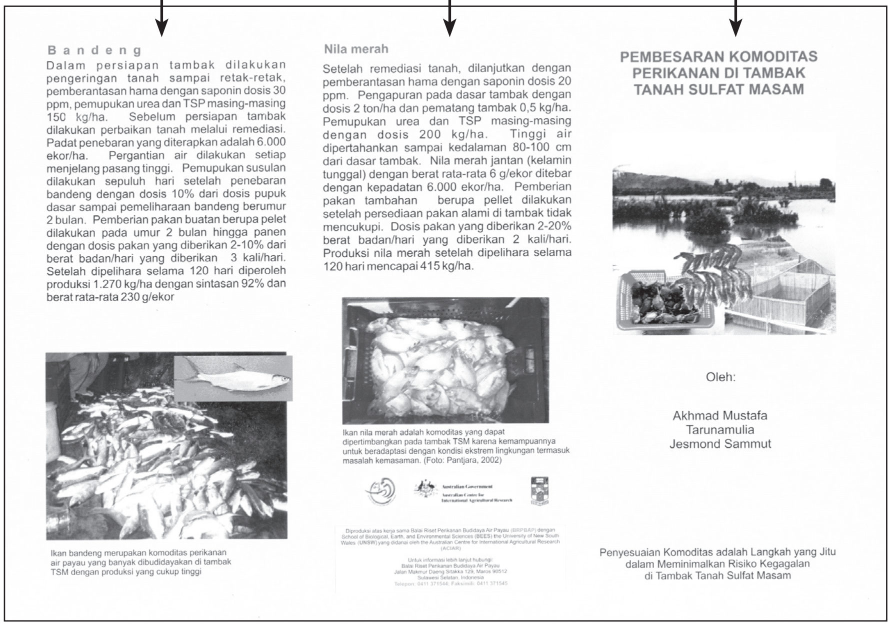
- Use more pictures than words
- Use effective and accurate pictures
- Use appropriate font, both size and type of font. Standard body text fonts such as 'Times New Roman' or 'Arial' are the easiest to read. The size of the font depends upon the design of the poster and brochure.

Layout for brochures is important and getting the front and back section in the right places is sometimes tricky.

The most common brochure is the three fold brochure, which is an A4 page folded into three. Each of the resulting panels can then be used to house the information. A typical the layout is described in the diagram below.

Examples of scanned brochures

Information panel — Back cover panel — Front cover panel



B a n d e n g

Dalam persiapan tambak dilakukan pengeringan tanah sampai retak-retak, pemberantasan hama dengan saponin dosis 30 ppm, pemupukan urea dan TSP masing-masing 150 kg/ha. Sebelum persiapan tambak dilakukan perbaikan tanah melalui remediasi. Padat penebaran yang diterapkan adalah 6.000 ekor/ha. Pergantian air dilakukan setiap menjelang pasang tinggi. Pemupukan susulan dilakukan sepuluh hari setelah penebaran bandeng dengan dosis 10% dari dosis pupuk dasar sampai pemeliharaan bandeng berumur 2 bulan. Pemberian pakan buatan berupa pelet dilakukan pada umur 2 bulan hingga panen dengan dosis pakan yang diberikan 2-10% dari berat badan/hari yang diberikan 3 kali/hari. Setelah dipelihara selama 120 hari diperoleh produksi 1.270 kg/ha dengan sintasan 92% dan berat rata-rata 230 g/ekor

Ikan bandeng merupakan komoditas perikanan air payau yang banyak dibudidayakan di tambak TSM dengan produksi yang cukup tinggi

Nila merah

Setelah remediasi tanah, dilanjutkan dengan pemberantasan hama dengan saponin dosis 20 ppm. Pengapuran pada dasar tambak dengan dosis 2 ton/ha dan pematang tambak 0,5 kg/ha. Pemupukan urea dan TSP masing-masing dengan dosis 200 kg/ha. Tinggi air dipertahankan sampai kedalaman 80-100 cm dari dasar tambak. Nila merah jantan (kelamin tunggal) dengan berat rata-rata 6 g/ekor ditebar dengan kepadatan 6.000 ekor/ha. Pemberian pakan tambahan berupa pellet dilakukan setelah persediaan pakan alami di tambak tidak mencukupi. Dosis pakan yang diberikan 2-20% berat badan/hari yang diberikan 2 kali/hari. Produksi nila merah setelah dipelihara selama 120 hari mencapai 415 kg/ha.

Ikan nila merah adalah komoditas yang dapat dipertimbangkan pada tambak TSM karena kemampuannya untuk beradaptasi dengan kondisi ekstrem lingkungan termasuk masalah kemasaman. (Foto: Pantjara, 2002)

Australian Government
Australian Centre for International Agricultural Research

Diproduksi atas kerja sama Balai Riset Perikanan Budidaya Air Payau (BRPBAP) dengan School of Biological, Earth, and Environmental Sciences (BEES) the University of New South Wales (UNSW) yang didanai oleh the Australian Centre for International Agricultural Research (ACIAR)

Untuk informasi lebih lanjut hubungi:
Balai Riset Perikanan Budidaya Air Payau
Jalan Makmur Daeng Sitakka 129, Maros 90512
Sulawesi Selatan, Indonesia
Telepon: 0411 371544; Faksimili: 0411 371545

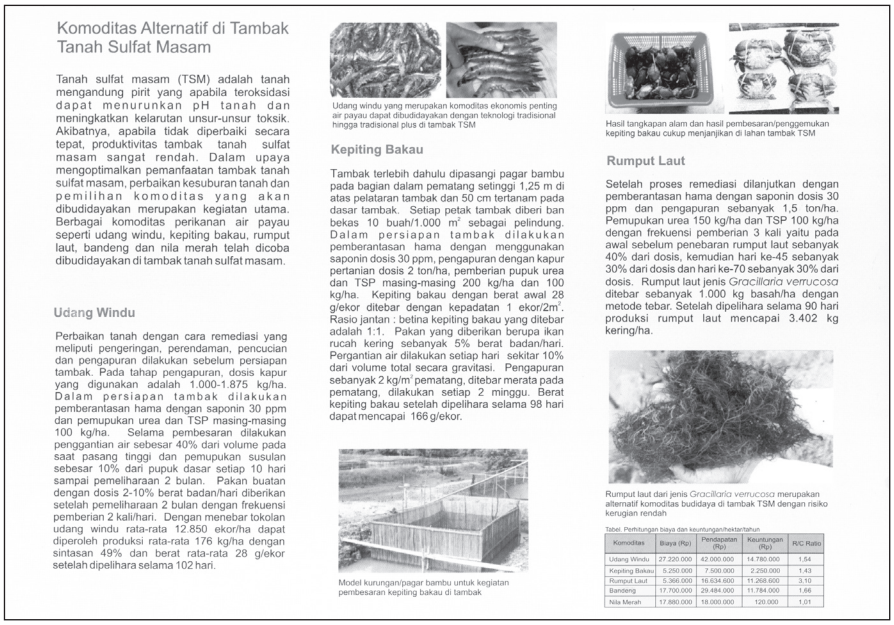
PEMBESARAN KOMODITAS PERIKANAN DI TAMBAK TANAH SULFAT MASAM

Oleh:

Akhmad Mustafa
Tarunamulia
Jesmond Sammut

Penyesuaian Komoditas adalah Langkah yang Jitu dalam Meminimalkan Risiko Kegagalan di Tambak Tanah Sulfat Masam

← Internal information across three panels →



Komoditas Alternatif di Tambak Tanah Sulfat Masam

Tanah sulfat masam (TSM) adalah tanah mengandung pirit yang apabila teroksidasi dapat menurunkan pH tanah dan meningkatkan kelarutan unsur-unsur toksik. Akibatnya, apabila tidak diperbaiki secara tepat, produktivitas tambak tanah sulfat masam sangat rendah. Dalam upaya mengoptimalkan pemanfaatan tambak tanah sulfat masam, perbaikan kesuburan tanah dan pemilihan komoditas yang akan dibudidayakan merupakan kegiatan utama. Berbagai komoditas perikanan air payau seperti udang windu, kepiting bakau, rumput laut, bandeng dan nila merah telah dicoba dibudidayakan di tambak tanah sulfat masam.

Udang Windu

Perbaikan tanah dengan cara remediasi yang meliputi pengeringan, perendaman, pencucian dan pengapuran dilakukan sebelum persiapan tambak. Pada tahap pengapuran, dosis kapur yang digunakan adalah 1.000-1.875 kg/ha. Dalam persiapan tambak dilakukan pemberantasan hama dengan saponin 30 ppm dan pemupukan urea dan TSP masing-masing 100 kg/ha. Selama pembesaran dilakukan penggantian air sebesar 40% dari volume pada saat pasang tinggi dan pemupukan susulan sebesar 10% dari pupuk dasar setiap 10 hari sampai pemeliharaan 2 bulan. Pakan buatan dengan dosis 2-10% berat badan/hari diberikan setelah pemeliharaan 2 bulan dengan frekuensi pemberian 2 kali/hari. Dengan menebar tokolan udang windu rata-rata 12.850 ekor/ha dapat diperoleh produksi rata-rata 176 kg/ha dengan sintasan 49% dan berat rata-rata 28 g/ekor setelah dipelihara selama 102 hari.

Udang windu yang merupakan komoditas ekonomis penting air payau dapat dibudidayakan dengan teknologi tradisional hingga tradisional plus di tambak TSM

Kepiting Bakau

Tambak terlebih dahulu dipasangi pagar bambu pada bagian dalam pematang setinggi 1,25 m di atas pelataran tambak dan 50 cm tertanam pada dasar tambak. Setiap petak tambak diberi ban bekas 10 buah/1.000 m^2 sebagai pelindung. Dalam persiapan tambak dilakukan pemberantasan hama dengan menggunakan saponin dosis 30 ppm, pengapuran dengan kapur pertanian dosis 2 ton/ha, pemberian pupuk urea dan TSP masing-masing 200 kg/ha dan 100 kg/ha. Kepiting bakau dengan berat awal 28 g/ekor ditebar dengan kepadatan 1 ekor/2m^2. Rasio jantan : betina kepiting bakau yang ditebar adalah 1:1. Pakan yang diberikan berupa ikan rucah kering sebanyak 5% berat badan/hari. Pergantian air dilakukan setiap hari sekitar 10% dari volume total secara gravitasi. Pengapuran sebanyak 2 kg/m^2 pematang, ditebar merata pada pematang, dilakukan setiap 2 minggu. Berat kepiting bakau setelah dipelihara selama 98 hari dapat mencapai 166 g/ekor.

Model kurungan/pagar bambu untuk kegiatan pembesaran kepiting bakau di tambak

Hasil tangkapan alam dan hasil pembesaran/penggemukan kepiting bakau cukup menjanjikan di lahan tambak TSM

Rumput Laut

Setelah proses remediasi dilanjutkan dengan pemberantasan hama dengan saponin dosis 30 ppm dan pengapuran sebanyak 1,5 ton/ha. Pemupukan urea 150 kg/ha dan TSP 100 kg/ha dengan frekuensi pemberian 3 kali yaitu pada awal sebelum penebaran rumput laut sebanyak 40% dari dosis, kemudian hari ke-45 sebanyak 30% dari dosis dan hari ke-70 sebanyak 30% dari dosis. Rumput laut jenis *Gracillaria verrucosa* ditebar sebanyak 1.000 kg basah/ha dengan metode tebar. Setelah dipelihara selama 90 hari produksi rumput laut mencapai 3.402 kg kering/ha.

Rumput laut dari jenis *Gracillaria verrucosa* merupakan alternatif komoditas budidaya di tambak TSM dengan risiko kerugian rendah

Tabel. Perhitungan biaya dan keuntungan/hektar/tahun

Komoditas	Biaya (Rp)	Pendapatan (Rp)	Keuntungan (Rp)	R/C Ratio
Udang Windu	27.220.000	42.000.000	14.780.000	1,54
Kepiting Bakau	5.250.000	7.500.000	2.250.000	1,43
Rumput Laut	5.366.000	16.634.600	11.268.600	3,10
Bandeng	17.700.000	29.484.000	11.784.000	1,66
Nila Merah	17.880.000	18.000.000	120.000	1,01

The design of posters is less restricted and can be whatever the extensionist wants. Remember that people will read the poster from a distance and so the font size must be legible from about 2 meters away.

Do not put too much information in either posters and brochures, just put in the important points and enough information to ensure accuracy at the level of the targeted reader.

Thematic colours and/or designs can be used in a suite of brochures that may come from the same office, Department or group. This allows the readers to see that the brochure is part of a larger collection of information products and may encourage the readers to seek other publications.

Other aspects to consider when designing the brochure are;

- Logos of the appropriate organisations that may be involved in the brochure. This involvement may be sponsorship, information supply or the organisation that is putting the brochure out. Often the extensionist may find making the decisions about which logos go onto the brochure a perplexing issue. It is important to make sure that this is thoroughly checked before printing. These logos can be either on the front panel or the back panel of the brochure and are often put on the lower right hand corner of posters, but there are no hard and fast rules about this.
- Recognition of information origins may be important when there is information of scientific nature.
- Contact phone numbers, names and email addresses is also another important thing to have on these publications. Often placed on the back panel of a brochure and in the upper left or bottom right corners of posters, this information allows people to feedback and get in touch if they want to.

Implementation

Distributing brochures

- Handing them out. The extensionist can give brochures to people when they meet. This could occur at meetings, conferences and special events like shrimp farmer meetings.
- Putting them in strategic locations. The extensionist can put the brochures in special holders at strategic locations. These could be in supply shops, at government offices or at the homes of the farmer group leaders.
- Including them in mailings. The extensionist has the opportunity to include brochures in letters. These letters could be letters that the extensionist is sending out, government letters, industry letters or letters from farmer groups.

Distributing posters

- Laminated or not. Posters can be distributed with or without lamination. If the poster is to be placed in a location that gets wet, either from the activity of people there (pond activity, processing factory, hatchery tanks areas, or on broodstock collection boats) or from the weather, then it is a good idea to get the posters laminated. This of course costs a lot more but in the long run is worth it. If these conditions are not an issue then it is usually OK to distribute the posters without the laminiating.
- Posters cost a significant amount and so the placement of a poster is an important issue. Posters should be distributed to the target group and a suggestion should be made as to where the poster should be placed. The extensionist could, for example, suggest that a poster dealing with how to respond to a disease event in the ponds should be placed in the shed by the ponds and in the work shed.

Brochures, posters and workshops

- Brochures and posters can be used effectively as part of workshops. Workshop programs can be built around brochures and posters. It is a good idea for the extensionist to have plenty of these at workshops they are running so that they can distribute them to all participants.

Section 4

How to give an effective presentation

Introduction

When designing a presentation the same basic extension design principles apply;

1. Work out what matters to your clients' and establish the things you need to cover in the talk (understanding)
2. Design your presentation to meet those objectives (designing)
3. Practice giving the presentation (implementation)

Work out what matters

What matters to the audience matters most! So it is important that you know how to make the talk relevant to the needs of your clients. You can do this by a range of processes that gather information about what your clients need. These might include;

- Going to the village and visit the farmers at a meeting and listening and asking them what their issues are;
- Talking to the headman in the village;
- Talking to some the other extentionists in your area;
- Secondary data like newspapers, reports, the Internet may also give you some important information.

When you give your presentation you will have to combine two components

- The oral presentation which means you will have to give the group a talk, and
- The accompanying powerpoint presentation.

Preparing your oral presentation

First of all, *think* about the main points you want to make. The structure of your talk will be:

Introduction

Capture your listeners' attention by beginning with a question, a funny story, a startling comment, or anything that will make them think.

State your purpose; for example:
'I'm going to talk about...'
'This morning I want to explain…'

Present an outline of your talk; for example:
'I will concentrate on the following points: First of all…Then…
This will lead to… And finally…'

The body

Present your main points one by one in logical order. Pause at the end of each point (give people time to take notes, or time to think about what you are saying).

Make it absolutely clear when you move to another point. For example:
'The next point is that ...'
'OK, now I am going to talk about ...'

Use clear examples to illustrate your points.

Use visual aids to make your presentation more interesting (the power point presentation, charts, pictures, demonstrations of equipment, articles relevant to the talk).

Tell them what you want them to know; don't try to tell them everything you know.

The conclusion

Leave your audience with a clear summary of everything you have covered.

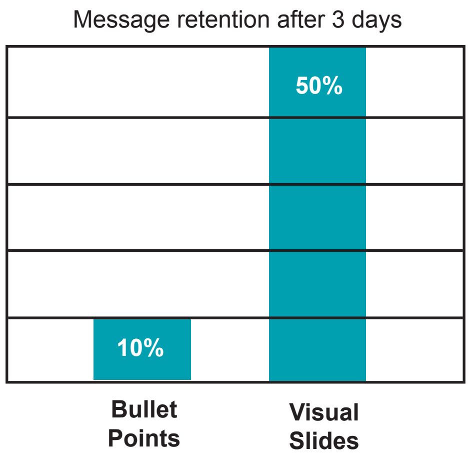
Make it obvious that you have reached the end of the presentation

using phrases like:
'To sum up...'

Restate the purpose of your talk, and say that you have achieved your aim:
'I think you can now see that...'

Thank the audience, and invite questions:
'Thank you. Are there any questions?'

Preparing your powerpoint presentation



During a normal presentation 55% of the information we take in is visual, 38% vocal and only 7% is text. Use visuals (pictures, graphs, tables, props) whenever you can because these will tell the story much more effectively. It is important not to use too many bullet points.

Studies have shown that using visual slides have a dramatic effect on message retention. The effect of using visuals is truly staggering! The old adage that "a picture is worth a thousand words" is as true today as it has always been.

Some key things to remember when designing the PowerPoint presentation are:

- Use bold typeface, and a minimum of size 16 font
- Use no more than seven or eight main points on an overhead
- Using colour, pictures and graphs can make your overheads more interesting
- Make sure you have a title slide with the purpose of your talk and your name on it.
- Have a final slide that says 'Thank You' or something similar.

The audience will only remember three messages

Research has shown that people like to grab information in groups of three. So when you are going to summarise, try to get things into groups of three. Design the PowerPoint slide so that whereever possible there are three points on the slide. Sometimes this isn't possible so don't take this as an absolute rule but rather a guide.

Rehearse, rehearse, and rehearse some more!

The more the extensionist can rehearse the presentation the better the presentation will be. Using colleagues as an audience allows the extensionist the opportunity to not only rehearse the presentation but to also get feedback that will improve the presentation. Doing this also allows colleagues the opportunity to understand what is being done in the field. This can create opportunities for extensionists with other extensionists and with scientists.

Giving your presentation

- Make sure your audience can see the overhead screen. There are two common reasons why audiences fail to see the screen;
  - There is too much light in the room;
  - There are things in the way, like house stumps, large objects or people standing.

- Give your audience time to take notes from your overhead. For each overhead give the group at least 10 seconds to visually register what is on the slide. If there is some writing that needs to be read by the group, read it yourself so that you get an idea of how long you should leave the slide on the screen.
- Throw away your notes because notes destroy eye contact and eye contact is vital in maintaining your audience's attention. Referring to notes also destroys intimacy and spontaneity. This is where rehearsing the presentation becomes vitally important to producing an effective presentation.
- Paint pictures for the audience. The extensionist can create images with words and with pictures. Your personal images enhance your message and create a personal touch to the presentation. As seen earlier, the use of pictures significantly improves the retention of the messages being presented. It is interesting to note that the quality of your support material is interpreted as an indicator of the value of your message and the respect you place on the audience.
- Involve the audience whenever you can. Involvement activities energize your audience and you are adding the sense of touch or feel to aural and visual sensations. Good involvement activities may last from thirty seconds to fifteen minutes
- Help the audience laugh to enhance the presentation. We learn best in moments of enjoyment and it will help localize your material.

Section 5

How to run an effective meeting

Introduction

This section will discusses the different types of meetings the extensionist may be involved in and some ideas about the extensionist's role in those meetings. Some meetings are for very formal occasions and these meetings require specific ways of doing things. This may vary across Indonesia depending upon the province and district because Indonesia is a land rich in different cultures. At other times the extensionist may be involved in a business meeting with farmers and middleman or hatchery operators. In other meetings the extensionist may be involved in discussion meetings that take place within the farmer group.

Here are some of the types of meetings and the possible role that the extensionist may play at that meeting.

Meeting	Example of meeting	Extensionist's possible role
Business meeting	Meeting with middleman to agree on shrimp price	Facilitator to ensure the meeting is done fairly and all participants get a say in what happens. Also can supply market information.
Annual general meeting	Farmer meeting to elect leaders	Facilitator to provide guidance on how the meeting may be designed and to provide assistance through the process.
Discussion group meeting	End of crop farmer meeting	Facilitator to help farmers solve problems and to learn from each other about how to do things better next time. Can provide technical information to assist in the discussions.
Information meetings	Guest speaker from the Government, University or a scientist with information to share.	Facilitator to coordinate the visiting speaker and to act as the 'master of ceremonies' for the talk. It is possible that the extensionist may be the guest speaker and therefore will be supplying the information.

As you can see there are different roles for the extensionist, depending upon which type of meeting it is. Sometimes there is more than one type of meeting combined into the one event. In each of these situations it is important for the extensionist to be clear about their role at the meeting. Mostly the extensionist is a facilitator and not the chairman or the leader of the meeting who is usually one of the farmers and is often the village leader.

This section will focus mainly on the discussion and information type meetings. The extensionist can expect that the village has established its formal processes a long time ago and it is in the interests of the projects that the discussion and information meetings are done well.

What is a facilitator?

A facilitator is someone who can make things easier for the farmers and other groups they might work with and, by using a range of skills and methods, brings out the best in people as they work together to achieve results in interactive events. Facilitators have to be able to cope with uncertainty, knowing that in some discussion group situations things may not turn out as some people may have planned for. The general characteristics of a facilitator are:

- Ability to empathize with people
- Listen well
- Support and counsel others who are having difficulties
- Ability to describe in understandable ways the systems (e.g. BMPs) that are being proposed
- Motivate people
- Raise difficult issues in a productive and safe way for all

The facilitator needs to know:

- The skills necessary to work with groups of people
- How to organize meetings and functions
- How to link or network people
- How to be a neutral observer
- How to record information accurately and quickly in meetings

The key steps to an effective meeting

Below are the key steps to conducting an effective discussion or information meeting. Some aspects of this list will be dealt with in more detail.

Before the meeting

- Check on the agenda of the meeting;
- Read any necessary material in advance to identify the tasks of the meeting and to gain knowledge of the content of the meeting;
- Prepare any information, reports, PowerPoint and oral presentations, brochures or posters;
- Gather together the resources needed at the meeting (computers, data projectors, information material, food or drink needed).
- Organize the recorder.

At the meeting

- Arrive on time;
- Organize the room in the appropriate manner;
- Turn off mobile phones once the meeting has begun;
- Listen carefully at all times;
- Participate actively in the discussion;
- Communicate and speak clearly;
- Ask questions and speak in a way that improves understanding amongst the group;
- Make accurate notes about dates, times and tasks that are the extensionist's responsibility after the meeting;
- Don't make a speech just to be noticed;
- Avoid private discussions;
- Identify with group problems and energetically seek solutions;
- If you are not leading the meeting be prepared to accept leadership or support roles if asked, or volunteer if there is a need.

After the meeting

- Carry out the tasks that have been identified;
- Complete any project reporting requirements.

How to start a meeting if you are the facilitator

If you are the facilitator there a number of simple steps that will help get the meeting off to a good start.

Briefing the recorder

As a facilitator the extensionist will need someone to assist them in capturing information that comes from the meeting. This person is called the 'recorder'. The role of the recorder is to create a record of the meeting – often called the 'group memory'. This can be done either by writing on a flip chart, overhead transparency or through a data projector. It is important is that the record should be visible to all participants. Another important thing is that the record should be saved, so all pieces of paper should be rolled up and kept, any overhead sheets stored in a folder and regular saving done on the computer. The facilitator and the recorder should have few minutes together to work out how they will work together.

The recorder can be another facilitator, a farmer, a colleague of the facilitator or anyone who is able to write clearly. It is often no a good idea to give this role to the village leader or other important people because they will often rather be part of the participants and be able to have their say freely without being burdened with another role.

Welcome

It is important that the facilitator acknowledges the formal leadership roles and waits until being invited to take over the meeting. Formal 'welcomes' are then important to acknowledge the people who have made the meeting possible and/or have a leadership role in the area (village leaders, bupati, government officials).

Roadmap

Adults like to know what the meeting is going to be about and what they will be doing and whom they will be hearing from during the course of the meeting. The extensionist should outline the agenda and the process that will be followed through the meeting. This will allow people to understand the purpose of the meeting, how they will be participating in the meeting and to also contribute to any adjustments that might be necessary. Because this is like showing the journey of the day it is sometimes referred to as the 'roadmap' of the meeting. This roadmap can be supplied as an agenda or put on a large piece of paper and stuck to the wall.

Boundaries

The extensionist should take a few minutes to identify the things that might create the boundaries for the meeting. These things might be;

- When some people have to leave the meeting;
- If there is another event on during the meeting that others want to go to;
- When lunch, coffee break and prayer times need to be.

Issues

It is often important to allow the participants of the meeting to talk briefly at the start of the meeting about their issues. The extensionist should facilitate this so that each person talks for a short time and that the issue is recorded so that everyone can see it. This will allow people who have a strong idea about things to be comfortable that their issues have been noted by the meeting and that, wherever possible, the issues will be discussed.

Ground rules

To provide guidance to the meeting about how the meeting should be conducted it may be important that the 'ground rules' for the meeting are established at the start of the meeting. These ground rules could be things like;

- Turn mobile phones off;
- Don't chat to others while the speaker is trying to tell the meeting something;
- Talk about the issues, not the people;
- No interrupting each other.

There is no set list of these ground rules and they should be designed for each meeting.

It is also important that the ground rules are checked with the participants because there might be good reasons why the ground rules wont work or that there are other ground rules that should be added.

These ground rules should be put on a large piece of paper and stuck to the wall so everyone can see them and the facilitator can refer to them when necessary.

Setting up the meeting venue

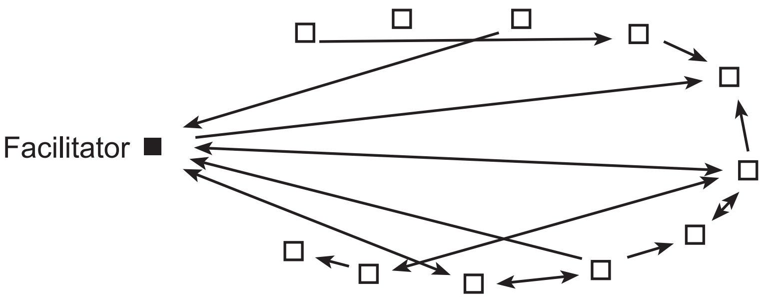
There are a number of ways to set up a venue for a meeting and there are good reasons as to why the venue should be set up in a particular way.

Seating

There are a few ways that chairs can be arranged if chairs are to be used.

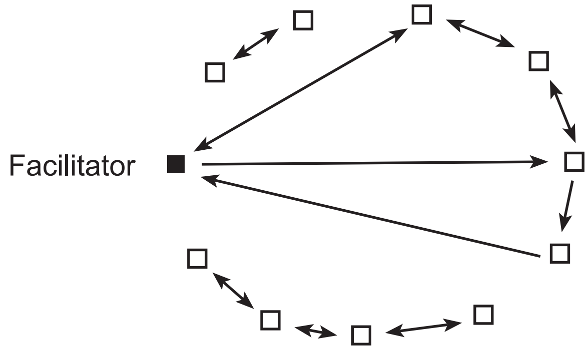
The horseshoe

This arrangement allows good contact between the leader and an individual participant as well as contact between participants. This is a good arrangement for farmer meetings and for information meetings.



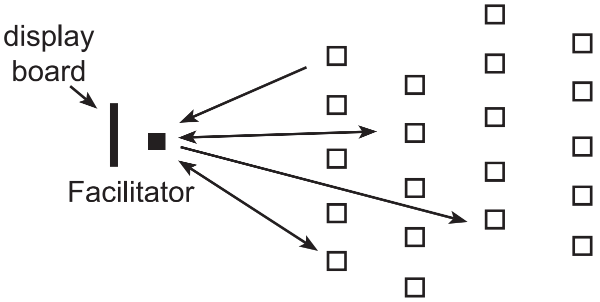
The circle

The circle is excellent for whole group discussion, but does not allow participants to see any display material easily. This is a good arrangement for discussion meetings and particularly good for meetings that are trying to solve problems



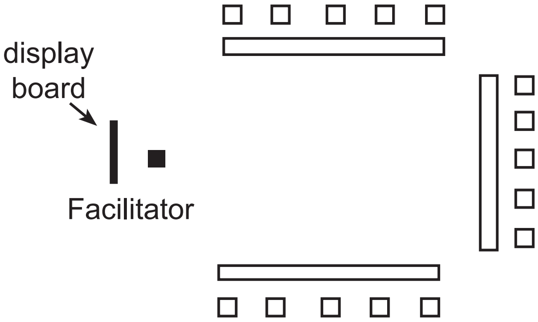
Rows

Rows make it easy for all present to see the leader and the presentations and information material at the front of the room. This arrangement does not allow, however, the participants very much opportunity to interact. This arrangement is good when there are a large number of people or for formal meetings.



'U' shape

This arrangement is a little like the horseshoe but allows for desks or tables to be used. This arrangement allows reasonably free interaction between group members and allows the discussion leader close contact with each person. This arrangement is good for information sharing and the use of visuals, and where people have to take notes.

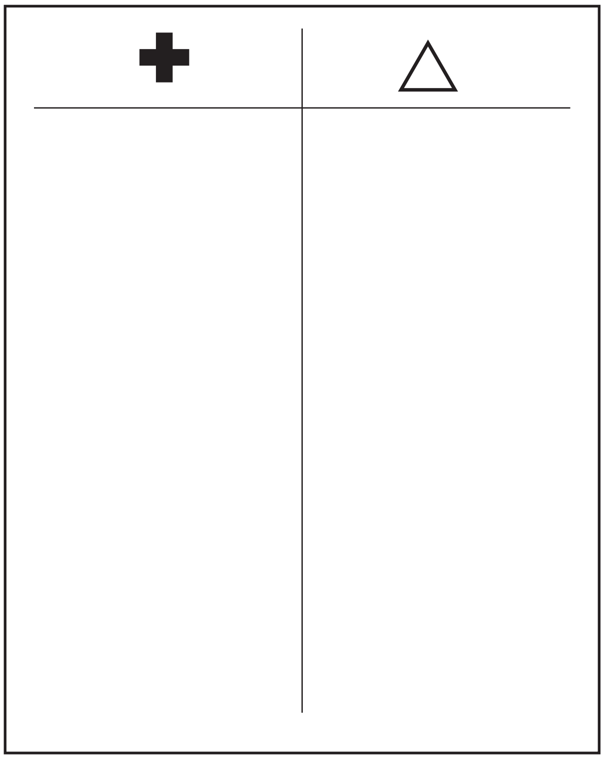


Food/coffee

It is always important to provide some form of food and/or drink for the meeting. A table can be dedicated to setting up hot water, cups and the makings of tea and coffee. The table can also be used if lunch is to be supplied. Making water available by putting bottled around the room is also important.

Closing the meeting

At the close of the meeting the extensionist should give a summary of what the meeting has achieved. The ‘group memory’ will be important for this and provides an accurate basis for such reporting. The extensionist should also be clear about what is to be done after the meeting and who has responsibilities to do things for the group. It may be important that there are some timelines drawn up so that the people who have got to get things done can know when they are supposed to have them done by.



To ensure best practice in the process of facilitating meetings, the extensionist should run a quick process evaluation to establish what worked well during the meeting and what could be done to improve things for next time. This is a positive approach to evaluation and an approach that is focused on continuous improvement. One of the quickest ways of doing this is to use the ‘plus/change’ technique.

The recorder needs a large piece of paper set up with two columns; one is the plus (+) column (what went well?), the other is the change (△) column (what can be changed to improve the process?). The facilitator then gives the participants a few minutes to call these things out and the recorder writes the input into the appropriate column.

Section 6

How to run an effective workshop

Introduction

A workshop can be a very important part of helping farmers understand more about their farming practice. Workshops are used by extensionists in agriculture and aquaculture throughout the world for these purposes and have a high level of learning capacity for farmers.

Workshops can be used to;

- Share new information
- Share and learn new farming practices
- Solve common problems experienced by a farming group
- Plan new cropping programs
- Allow farmers to share each other's experiences

Workshop structure

The overall view of a workshop is much more than the one or more days set aside for when the farmers will be present. For the extensionist the workshop begins often weeks before and doesn't finish until many days afterward.

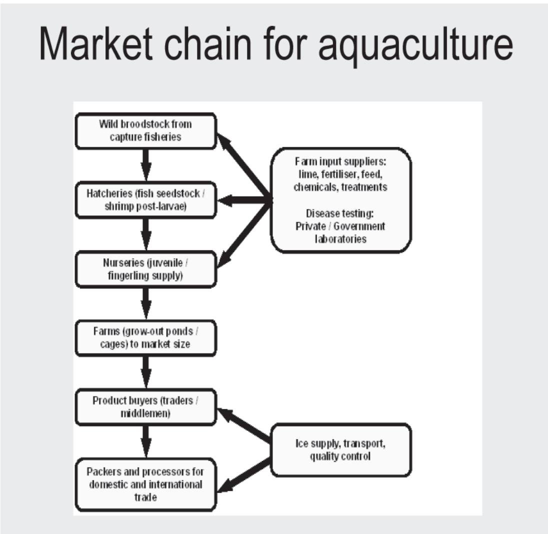
The workshop process can be divided into three major sections;

The Preparation Period	The workshop	The post workshop activities

The preparation period

Identifying the purpose

A workshop will often be a strategic part of a larger project. To this end it is important to identify the purpose of the workshop in that context. The purpose should be able to be identified as matching the parts of the purpose of the larger project and be able to be matched to the needs of the farmers in the area. Sometimes there may be a tendency for some extensionists to conduct workshops on things that they know and not necessarily address either the project or the farmers' needs. For the keen extensionist a grid can be constructed to illustrate the linkages between the key activities t be undertaken in the workshop to the objectives of the project and the needs of the farmers.



Identifying the participants

Often the identification of the audience for the workshop is restricted to the farmers. Sometimes this is short of the mark and it is often a good idea to check the complete supply chain and surrounding sociopolitical network to make sure we don't miss anyone. Often invitations to the workshop are extended to significant people in social and political positions as either a matter of courtesy or in the hope that these people may come and see what the extension effort is achieving. Also there are input suppliers, product handing/transporters, value-adding companies and of course exporters or product suppliers that might have a stack or role in the workshop.

Identifying the participants' needs

Having identified the audience for the workshop it is important that the extensionist is able to identify the needs of that audience to ensure the workshop is relevant and advances the farming process in the social context of the area.

Audience needs fall into groups;

- Information/knowledge: New technologies and information about agricultural products, economics, pest and disease, export requirements and a host of other aspects of the agricultural endeavor are always emerging.
- Practice: New skills in undertaking the production and subsequent product development and marketing are emerging all the time.
- Local issues that are affecting the local farming group.
- Attitudes: Sometimes it is hard to change old ways of doing things. This means that sometimes one of the purposes of the workshop is to try and encourage major shifts in how things are done.

- Attendance: For all workshops the selected audience will have particular needs with respect to their ability to attend the workshop. It is important for the extensionist to know the logistic and financial capacities of the proposed audience. It is no good putting on a workshop in Bali if the local group cannot afford to get there and stay in the local hotels. Equally for international workshops it is sometimes not suitable to hold them in remote under equipped locations.

There is a range of techniques that can be used to identify the needs of the audience including;

- Questionnaires that can be sent out with invitations. These questionnaires can be designed to cover all of the above issues and be accompanied by a return addressed envelope.
- Interviews, either in person or over the phone, with a selected group of potential participants. These can be used to get a clear idea about the issues affecting the area, attitudes of farmers, the range of social interactions that may be needed to be addressed and potential problems that might be encountered in running the workshop.
- Secondary information sources. Newspapers, reports, farmer organisation publications, technical magazines, TV documentaries are all valid sources of information that can help in identifying what is relevant for the farmer group.

In identifying the audience needs is important that the extensionist triangulates data so that it is clear what are 'wants' and what are 'needs'. This means it is often important that all of the above techniques are used and the data compared.

Workshop location

The location of the workshop can often be important to the success of the workshop. If the workshop is going to require access to special facilities (laboratories, ponds, processing factories) then the location needs to ensure this can be achieved with the minimum of travel and expense.

If there is a wide diversity of people coming to the workshop then a central location may be important.

Safety for attendees is important so locations that may be politically, culturally or geographically unsafe for attendees should be avoided.

If the workshop is going to run for more than one day then the workshop location needs to be close to suitable overnight accommodation for participants.

Invitations

Invitations should be sent to the intended audience of the workshop to formally announce the workshop and provide a personal way of informing people about the workshop. The invitation should include;

- The purpose of the workshop
- Why the workshop will be of value to the participant
- Where the workshop will be held (and how to get there)
- When the workshop will be held (include and agenda and timing for activities)
- What to bring to the workshop
- What will be provided
- RSVP date and information requirements (i.e. dietary needs, travel assistance, accommodation assistance).

Advertising

The extensionist may need to advertise the workshop so advertising opportunities may need to be identified. Some of the ways workshops have been advertised include;

- Ads in specific magazines and newspapers, newsletters
- The extensionist making announcements at farmer group meetings and other similar gatherings
- Mailing out an advertising pamphlet
- Encouraging ‘word of mouth’ advertising
- Web based ads in appropriate sites

In all printed information advertising the workshop makes there is a contact name and a phone number, email address or web address for people to connect with.

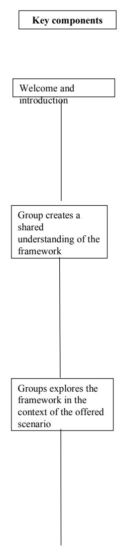
Catering

Most workshops run on the bellies of the participants. This means that a good workshop is able to provide good food for the participants. Usually there needs to be plenty of food for everyone. If the workshop has participants with an array of different religions or beliefs then the correct food for those religions and beliefs needs to be available. It is important to find these things out before hand to allow the caterers the opportunity to prepare the appropriate meals.

Workshop program design – 5 Step Design Model – the 'Process Chart'

This is probably the most important part of the pre workshop process. Having a clear idea of what the broader project objectives are and the needs of the local farmers the extensionist can begin to design the workshop. The design can take five steps to complete;

Step one – key components



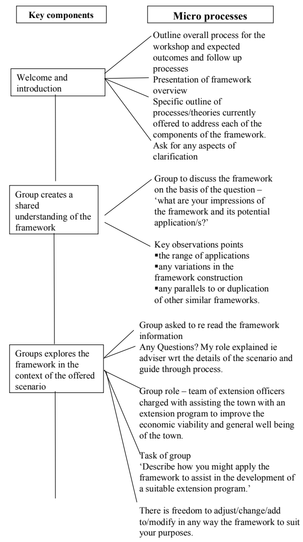
The first step in designing is to identify the key things the workshop must cover. Let us call these the key components of the workshop. Make a list of these components.

Step two – logical flow

Now identify the logical flow of these components, which ones should come before others and what are the interdependencies. Interdependencies are those things that are prerequisites for following key components. If there are no prerequisites then which key components should come before others? List these key components down the middle of a piece of paper in the order you think they should come through the workshop.

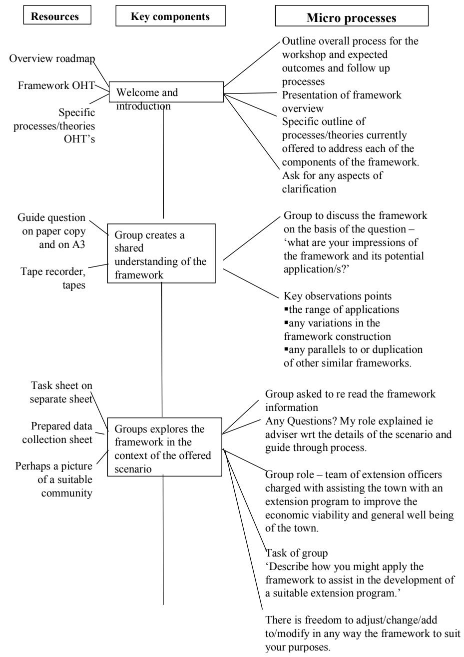
Step three – the micro processes

For each of the key components of the workshop the extensionist should develop an array of small activities that will allow the participants to deal understand the key component. These we call micro processes. On the right hand side of the key component list these micro processes in the order that they will be done during the workshop.



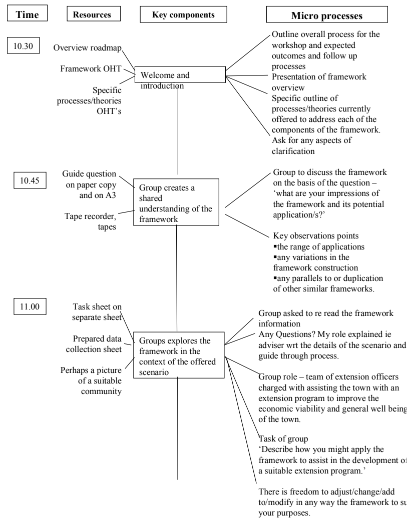
Step four – identifying the resources

To enable the micro processes to be done make a list of the resources that will be required. These resources should be listed on the left hand side of the key component for which the micro processes have been designed. It is often useful to then transfer this list to a master list of resources to enable a full set of required materials for the workshop to be developed. This list of resources should include people (guest speakers, technical assistants, bus drivers etc.) who will be necessary for a successful workshop.



Step Five – timing

On the far left of the paper indicate start time, the time when each of the key components will be dealt with. Indicate lunch and coffee break times and any prayer or other necessary interruptions to the workshop. It is useful to then check that these timings can achievable i.e. can the activities (micro processes) be realistically achieved in the time allocated? The extensionist can then begin to refine the workshop so that it can realistically be achieved in the time allocated.



The workshop

Preparing the location

On the day of the workshop the extensionist should arrive well ahead of the participants. This is because there is usually work to do in getting the venue ready. It is important to attend to the following things

Organizing the room

The extensionist should make a conscious decision about how the room (or other form of location such as pond hut, under a farmer's house, in a tent) should be set up. There are a number of ways to arrange chairs and tables. Other things to consider should be where the public address system should be located, where the coffee and snacks table is, where the greetings table is, location of electronic equipment such as projector and where the speakers should be seated. When setting up the extensionist should always be sure that electric leads are safely protected so that people wont get electrocuted.

It is often useful to sketch the layout of the room so that people who are assisting can follow the plan.

Nametags

It is often useful to have nametags for everyone so that people can greet each other. The simplest way to do this is to have a supply of sticky labels and a thick pen and allow people to write their own names on them. If there is the chance that people can't read and/or write be prepared to help them or think of a way of getting their name on the tag without them having to do it themselves.

Openings and closures

It is important that any workshop is framed within opening and closing sessions. These sessions need not be too long and need only to be as formal as local custom applies.

Opening

Some things to think about including in the opening session are;

- Acknowledgement of local dignitaries, which may include a welcoming statement by one or more important people.
- Establishing a clear direction for the workshop (this is sometimes called 'road mapping' the workshop) with time for breaks and the content of the workshop outlined.
- Time to discuss any logistic issues such as registration, accommodation, meals, transport, (this is sometimes called 'housekeeping')
- It is also useful to identify any significant issues that the participants would like to discuss or particular needs that they might have. This will allow the extensionist to check that they have planned the workshop correctly and that they have covered all of the issues and needs.

Closing

In closing it is useful to summarize what has been achieved at the workshop. This will allow participants to fully appreciate the scope of their learning and to celebrate their successes.

It is also important to allow those who opened the workshop the opportunity to close the workshop. This means that time should be allocated to allow a few short speeches at the end of the workshop.

If possible statements of attendance or certificates can be issued to provide formal recognition of the participants' involvement at the workshop.

Finally it is useful to provide the participants the opportunity to comment on the workshop. Often a small evaluation sheet is provided to allow this to happen and this sheet is useful for the extensionist to improve the workshop process.

Post workshop activities

The workshop process isn't finished at the end of the workshop. After all the participants have departed there are still a number of things that the extensionist must do.

Clean up

Depending on where the workshop was held, it may be important to clean the room, return the chairs, tables and equipment and make sure the location is secure when left.

Follow-up

A follow-up letter to all participants is often useful to allow further contact to be established with them. This contact can be useful for the following reasons;

A way of saying thank you for participating

Evaluative feedback that allows participants to comment further on things that they liked about the workshop and things that they think may be able to be improved.

Information supply to further consolidate the material and learning completed within the workshop and to possibly provide a mechanism for ongoing supply of information.

Every workshop provides a great opportunity for networking. Often the extensionist can facilitate an ongoing network system that will allow the participants to continue communicating with their peers.

Paying the bills

It is often the responsibility of the extensionist to make sure all of the bills are paid and that money allocated by the project is accounted for. Good record keeping is important.

Review and modifications

The last thing that the extensionist should do is to review all of the work in getting the workshop and make changes that will improve the particular workshop or their general capability in running workshops. Where a team of people are working together to run the workshop this process should be done as a group to allow everyone to contribute to the improvements.

The Preparation Period	The workshop	The post workshop activities
Identifying the purpose	Preparing the location	Clean up
Identifying the participants	Nametags	Follow-up
Identifying the participants' needs	Openings and closures	Paying the bills
Workshop location	Evaluation	Review and modifications
Invitations		
Advertising		
Catering		
Workshop program design		

The Process chart

Time	Resources	Key components	Micro processes
10.30	Overview roadmap Framework OHT Specific processes/ theories OHT's	Welcome and introduction	Outline overall process for the workshop and expected outcomes and follow up processes Presentation of framework overview Specific outline of processes/theories currently offered to address each of the components of the framework. Ask for any aspects of clarification
10.45	Guide question on paper copy and on A3 Tape recorder, tapes	Group creates a shared understanding of the framework	Group to discuss the framework on the basis of the question – 'what are your impressions of the framework and its potential application/s?' Key observations points the range of applications any variations in the framework construction any parallels to or duplication of other similar frameworks.
11.00	Task sheet on separate sheet Prepared data collection sheet Perhaps a picture of a suitable community	Groups explores the framework in the context of the offered scenario	Group asked to re read the framework information Any Questions? My role explained ie adviser wrt the details of the scenario and guide through process. Group role – team of extension officers charged with assisting the town with an extension program to improve the economic viability and general well being of the town. Task of group 'Describe how you might apply the framework to assist in the development of a suitable extension program.' There is freedom to adjust/change/add to/ modify in any way the framework to suit your purposes.

The Process chart cont.

Time	Resources	Key components	Micro processes
11.45	Prepared BP sheets	Group summarises their conversation.	Group asked to discuss and record on BP;
12.00		Review of the framework	Bring group out of scenario mode Open plenary session
12.20	Personal reflection sheets	Opportunity for personal reflection	Individuals given personal response sheets to fill.
12.30	Lunch provided	Close	Thank participants for their contribution Outline further processes Invite to lunch

Section 7

How to support a farmer group

Introduction

Farmers throughout the world in all types of farming have found it useful to work together as a group. For shrimp farming in Asia it has been found that the formation of farmer groups has had a great many benefits. Organizing farmer groups at a small village level farmer club/ association/society leads to many benefits to the farmers;

- It allows farmers to discuss the farming situation of the village when they meet;
- It allows farmers to keep up a close vigil on the disease outbreaks in surrounding area;
- Farmers can decide together on the common stocking dates;
- Farmers can agree on seed sources to minimize the seed selection and transport costs;
- Farmers can purchase seed, lime, and other commonly BMP approved crop inputs as a group to minimize the cost of inputs and assure quality of the product;
- Farmer groups can have some basic instruments for soil and water quality (like soil pH meter, pH meter, DO meter, kits for ammonia, alkalinity and other parameters) and even some simple health management kits.
- During harvesting time organizing farmer groups can help in maintaining reasonably good prices for their high quality, chemical residue free shrimp shrimps which has a marketing advantage;
- Farmers can also try to get a premium price in export markets.
- By following the International Principles for Responsible Shrimp Farming long-term benefits to water quality and other environmental aspects of the village will emerge.

(Modified from 'Shrimp Health Management Extension Manual', NACA)

Group Stages

World wide research into farmer groups has identified that groups will go through a number of stages of development. When a group is formed it will usually go through at least four stages and sometimes five. These stages are;

- Forming
- Storming
- Norming
- Performing
- (and sometimes) Dissolving.

Forming

In this stage group members are unsure of how the group should operate and how the members should interact with each other. The group, at this stage needs leadership and guidance. Often the group will be struggling to get a clear idea of the purpose of the group. The extensionist can support the group through this stage by providing good processes for discussion meetings, giving support to the leader, who will often be struggling to bring the group together and providing examples of where other groups have been successful in working together and the benefits they have acheived as a result of their collaboration.

Storming

In this stage often there is interpersonal conflict. This is common and is due to people having different ideas about how the group should operate, some long-term antagonisms between some members and sometimes there are some people who might see the formation of the group as a threat to their farming ro the existing village social structures. The extensionist can help the group here by providing conflict resolution processes, discussion meetings and acting as a mentor for people to help them think through their role in and connection to the group.

Norming

After these interpersonal storms have settled the group will start to develop the structures that will be necessary, the ways they will work together and the tasks that the group will be tackling as part of the farming process. The extensionist can help by providing some ideas from other groups, providing processes for the group to plan their activities and facilitating formal and discussion meetings.

Performing

The group will now begin to act as a group. The group will now have identified tasks and people to do those tasks. The group will now, most likely, have a leader who is ready to guide the group, some tasks that will be underway and some long-term goals about what the group wants to achieve. The extensionist can assist in this phase by providing information, training and logistic support to help the group achieve their set tasks. The extensionist can also help the group leader by being a mentor and coach. Another important function at this point is that the extensionist can provide networking support to the group by introducing the group to government people, suppliers, other groups and scientists.

The extensionist should be aware that the group can (and probably will) go back to earlier stages if things such as personnel, weather and market forces detrimentally impact on the group's cohesion, structure and goals. So if key people such the elected leader, leave the group then the group may revert to the Norming stage or even the storming stage. The extensionist will then have to begin helping the group from this stage again.

Dissolving

Sometimes it is natural for a group to dissolve. If, for example, the aquaculture in the village changes from shrimp to seaweed, then it may be appropriate for the group to disband and a new seaweed group form. This would be unusual but can sometimes happen. In this instance the extensionist can assist the group to recognize that this may be a normal event and that the people in the group can move on to other things.

Stage	Characteristics	Extensionist activity
Forming	Unsure of how the group should operate and how the members should interact with each other. The group, at this stage needs leadership	- Good processes for discussion meetings, - Support to the leader, - Providing examples of where other groups have been successful in working together and the benefits they have got as a result of their collaboration.
Storming	Interpersonal conflict.	Conflict resolution processes, Discussion meetings and Acting as a mentor
Norming	The group will start to develop the structures that will be necessary, the ways they will work together and the tasks that the group will be tackling as part of the farming process	Ideas from other groups, Providing processes for the group to plan their activities and Facilitating formal and discussion meetings
Performing	The group will now begin to act as a group. The group will have identified tasks and who will be the best members to tackle those tasks. The group will now have a leader in place	Providing information, training and logistic support to help the group tasks. The extensionist helps the group leader as a mentor and coach. the extensionist provides networking support to the group.
Dissolving	The group has achieved all goals The group is no longer relevant	Assist the group to recognized that this may be a normal event and Help the people in the group move on to other things.

Learnings from what has happened so far in Asia

There have been some good successes with shrimp farmer groups in Asia and some important lessons have been learnt about how farmer groups best operate and what support an extensionist can provide. What is important to realize is that the ultimate success and sustainability of a farmer group lies within the group and an extensionist should always be striving to make the group self-sustaining.

Guidelines for assisting farmer groups have emerged from work done in Aceh and in India. These guidelines are;

1. Organize the farmer group at village level.

- The farmer group should be formed at village level for self-help and cooperation among local farmers.
- A farmer group should ideally consist about 20-30 farmers.
- Farmer group ideally should have about maximum of 50 hectare tambaks spread in one cluster and sharing same water resources (canal).
- Farmer group should meet at least once a week at a fixed time in a fixed place to discuss the crop activities, problems and solutions.

2. Plan the crop activities well in advance of the start of the cropping season using the farmer group.

- Do only two crops in a year. Summer crop and rainy crop
- Summer season (Temperature > 30 degree celcius) is good for shrimp farming and shrimp should be priority species in summer.
- Avoid shrimp culture during cool and rainy season (August-January) due to more risk of disease and slow growth in shrimps.
- During rainy season priority species should be Milkfish.
- Plan the crop within financial capacity of individual farmers. If a farmer has 5 million Rupaiah, plan the crop activities and crop yield within that available finance.
- Plan the crop within tambak management capacity of individual farmers. If a farmer can spend his full time near the tambak then higher crop yield can be planned. If a farmer can manage the farm on part-time basis, then plan for lower yield.
- From the local experience of farmers, understand the local environmental capacity and plan the crop accordingly.
- Use Crop Calendar system.
- Follow polyculture system with shrimp, milkfish and seaweed to reduce the economic and crop risk.

3. Plan the crop within the financial capacity and tambak management capacity of individual farmers and also consider local environment capacity like water quality and availability in water supply canal etc.

4. Follow the Crop Calendar system.

5. Implement all the tambak activities in disciplined and cooperative manner.
6. Shrimp should be priority species only in summer season. In rainy season Milkfish should be the priority species.

7. Use poly-culture system of shrimp, milkfish and seaweed for better profit and to reduce the crop and economic risk.

8. Adopt Better Management Practices (BMP) for tambak farming

9. Use better practices for crop harvesting and post-harvest handling of shrimp, fish and seaweed.

10. Establish better market access by collaborating with a reliable and good local processor / trader.

11. Maintain a Pond Book to record the daily activities.

Participative action and farmer based research (How to use these guidelines)

Participative action research with farmers on farms will ensure that, because they are involved in the research and the solutions to problems, farmers will be highly likely to adopt new practices. In addition the principles of diffusion have been incorporated to allow for the dissemination and ongoing adoption of new practices.

The objectives of the demonstration programme can generically be described as:

- To demonstrate better farm management practices, giving emphasis to the implementation of agreed BMPs
- To assess the benefits to the farmers from implementing the recommended BMPs.
- To identify problems and constraints in implementing the recommended BMPs.
- To develop a final set of extension guidelines to assist in the implementation of BMPs to a wider array of farmer groups across Indonesia.

The villages have been selected for the projects and within the villages particular ponds of participating farmers will need to be selected. These ponds need to be selected so that;

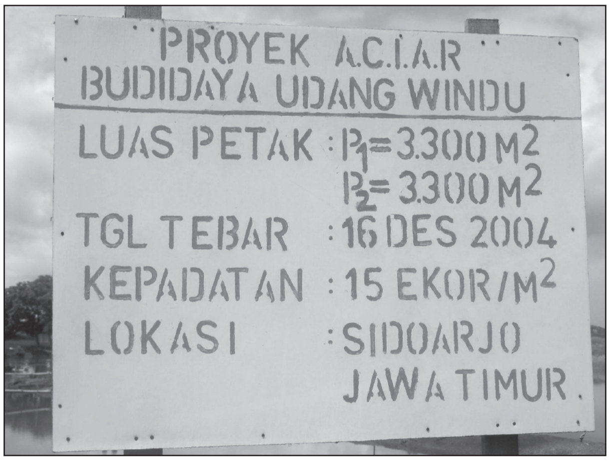
- They provide little chance for the transmission of disease either from animals (birds, crustaceans) or water exchange.
- The farm area should be relatively small with less number of ponds and should represent the farms in study area.
- The farmer should be willing to co-operate with the project during entire crop period.
- The farm should be located in a relatively easily accessible place with reasonably good approach road, so that other farmers can easily access this demonstration farm.
- Farmer should not have any problems in visits by other farmers and in conducting farmer training programs at the demonstration farm site (ideally a respected or “lead” farmer in the area).

After selection of the ponds for demonstration, discussions should be held with each demonstration farmer and the farmers as a group to clarify and agree on the practices to be followed during the demonstration phase. Variations in how the BMPs will need to be activated will occur across the project demonstration areas, so individually designed locations specific interpretations of the BMPs will need to be generated by each farmer group. The key role for the extensionist (and others in the project team) is to facilitate information and discussion meetings with farmers at this stage to allow the group to understand and develop these context specific BMPs.

During each stage of the demonstration programme, the study team worked closely with each farmer to arrive at a consensus for following the farm management practices.

- Stocking time and crop planning
- Pond preparation
- Pond filling and water preparation
- Seed selection and stocking practices
- Water quality management
- Pond bottom soil management
- Feed management
- Shrimp health monitoring
- Handling of disease outbreak situation
- Monitoring of demonstration ponds

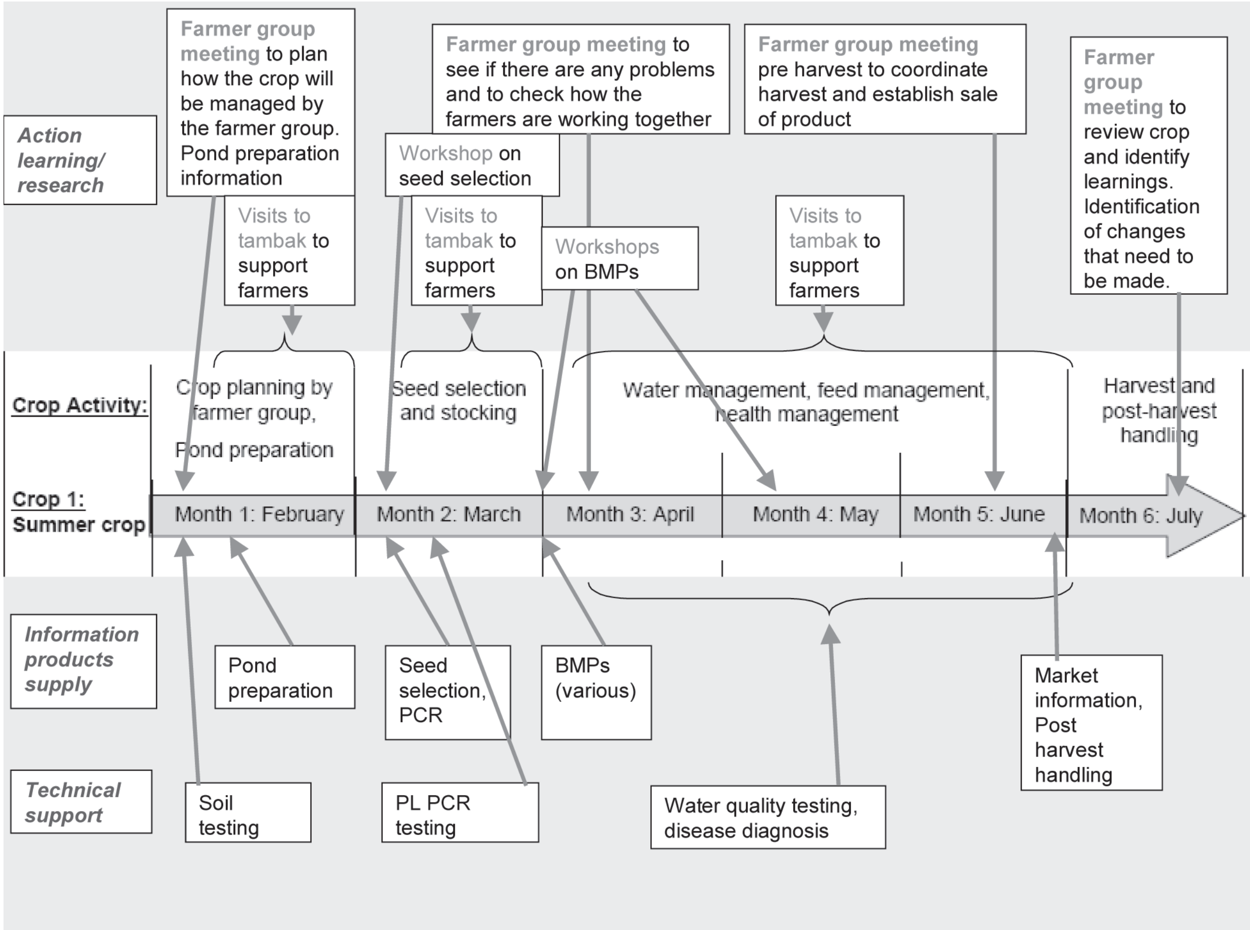
The generic BMPs are outlined in other publications. It is important that the extensionist has a copy of these BMP publications.



Regular training activities at demonstration farms

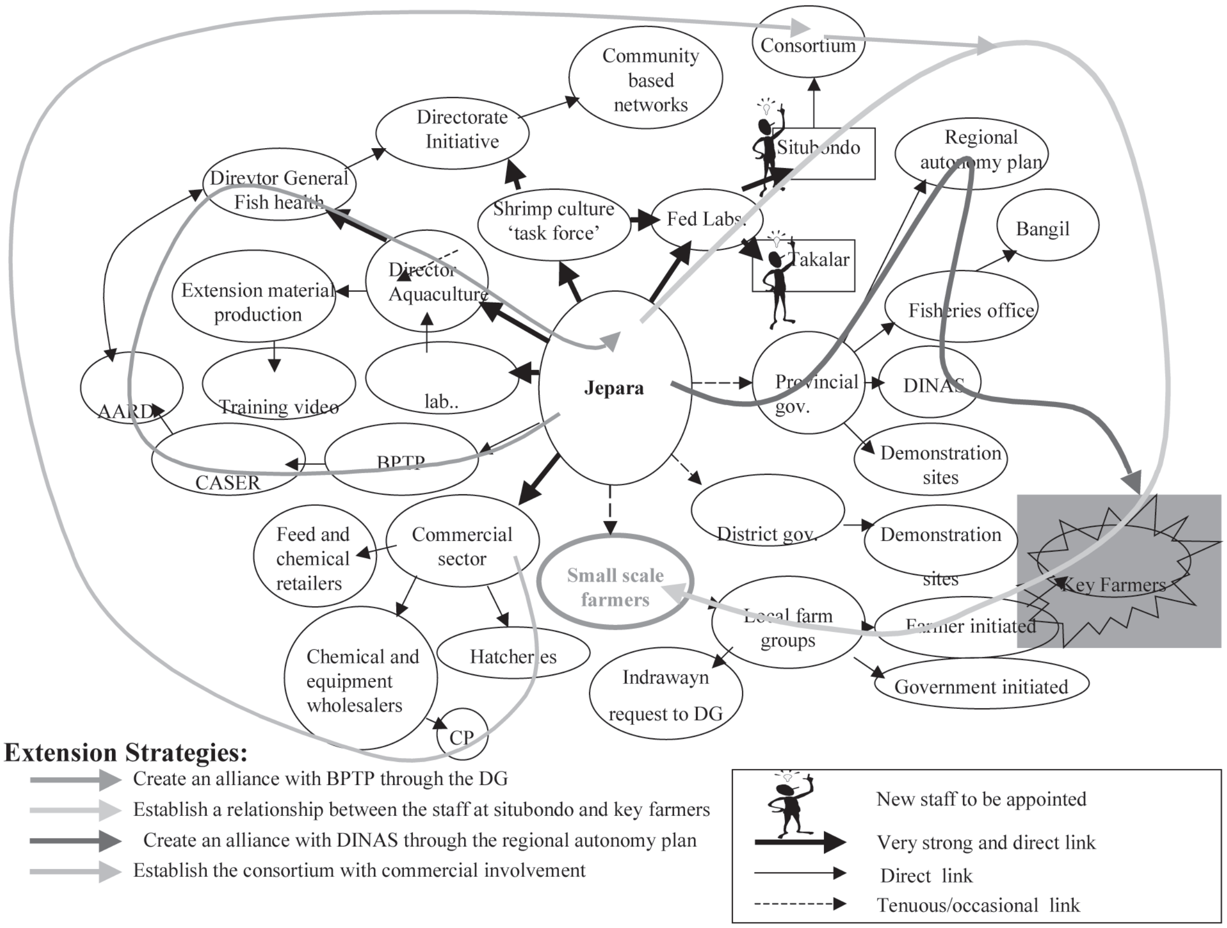
The extensioist will have to assist in organizing regular training programs for local farmers at each of the demonstration sites. Special extension materials in local languages will probably need to be developed to ensure wide dissemination of the message. The overall intention is to pass on the key demonstration messages to local farmers at regular intervals throughout the demonstration. It has been reported that, in other studies, there is a strong interest in the demonstrations in all villages.

A guide to when and what type of extension activities the extensionist needs to undertake is provided in the diagram below.



Systems analysis

It is sometimes useful to do a systems analysis of the farmer group to identify where good communication lines can be developed to share information with local farming community. An example of a systems analysis is below.



Some of the resources that have been used to put this document together

- **'Shrimp Health Management Extension Manual',** Network of Aquaculture Centres in Asia-Pacific
- **Better Management Practices for Tambak Farming in Aceh**, 2007
- **Report On Development, Dissemination And Implementation Of Disease Prevention And Control Practices In Shrimp Farms Of India, (2002-2004),** The Network Of Aquaculture Centres In Asia-Pacific, Bangkok, Thailand

Appendix 22

Indonesia's Farmed-Shrimp Value Chains: Key-Informant Study Report

Final deliverable on Task 2.A (Deliverable 2.A.6)

Task 2.A. is the first task of the shrimp component. The numbering of the task corresponds to the SOW of the IFPRI/NDO contract with CAPAS and the IFPRI/NDO contract with MSU (2009X206MSU)

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December 2009

Indonesia's Farmed-Shrimp Value Chains: Key-Informant Study Report

Executive Summary

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This report presents the findings from a six-month study of farmed-shrimp value chains (VCs) in Lampung and South Sulawesi. The analysis draws on available industry data, previous studies and, most importantly, on 111 interviews with the input suppliers, producers, traders, processors, wholesalers, retailers and exporters who make up the shrimp value chains in these two rapidly expanding productions areas of Indonesia.

Among the aims of this study are to: (1) identify the policy, market and technological innovations influencing the shrimp industry in Indonesia over the past decade; (2) understand how participants all along the supply chain are reacting to these policy changes, market forces and emerging income opportunities; (3) document the structural changes to the evolving shrimp supply chains, including shifts and trends in market power, information flows, chain coordination, and industry relationships; and (4) provide policy guidance on how to maintain competitiveness, increase small farmer participation and enhance the poverty reduction role of shrimp aquaculture.

From a poverty alleviation and small farmer income development viewpoint, the study's initial and most promising finding is the emergence of at least some small farmers who are capable of participating in modernizing supply chains. The study's most worrying finding is that to "play the modernizing game," producers need both market sophistication and scale. The study concludes that small shrimp farmers can participate in modernizing chains, and gain from that participation, by either entering into contract schemes or by starting cooperatives and by making investments in production and traceability capacity.

Background and Overview

Two main types of shrimp are produced in Indonesia: the traditional variety, tiger shrimp (monodon), and the more recent variety, white shrimp (vannamei) which was introduced commercially circa 2004. Tiger shrimp live on the pond floor so volumes and yields are relatively low. White shrimp float throughout the pond, are more resistant to disease, have higher survival rates, tolerate higher stocking densities and grow faster.

Small, medium, and large producers farm shrimp in several organizational arrangements, including independent farmers and contracted farmers. Larvae, feed and other input producers sell direct to farmers or sell via brokers and retailers. Farmers sell to brokers and wholesalers on the spot market or via contracts to large processors like CP, a Thailand based firm that is the largest shrimp processor in the world. Small and medium processors, and even some large processors, buy from the spot market or use dedicated wholesalers to source their shrimp. Processors export about 95% of production, with the small balance sold to domestic retail markets. The export market is regulated by both public standards and by private standards concerning quality, safety, and traceability.

Findings

The following are the main results of the key-informant study. We organize this account by a logical flow that goes from "shocks" to "behavioral changes" to "outcomes" including structural changes and other outcomes.

The essence of our findings is that there was a cascading set of "domino" effects from emergence of disease plus changes in trade regulations, to changes in the farm segment of shrimp variety and production technology, to changes in the input segments to accommodate the input needs from the latter changes, to changes in the wholesale and processing segments to both accommodate the volume increase, interface with the larger farm segments that arose, and to some extent increase traceability. Finally the above set of changes led to concentration (consolidation) in all the segments of the farmed-shrimp chain as well as the emerging modernization of part of the small farmer segment. We proceed to the details of these "dominoes" below.

First, there were three key "shocks" that affected the farmed-shrimp sector in Indonesia in the past decade:

(1) The emergence of disease that struck monodon in the late 1990s/early 2000s, doubling crop failure rates among small farmers from 20% to 40-50%, concomitantly reducing yields;
(2) The emergence of an alternative to monodon with the allowance by GOI of imports of vannamei broodstock in 2004;
(3) The emergence of stricter export requirements by foreign importers in 2004 from increased standards of shrimp food safety and traceability.

Second, in the farm segment, the monodon disease reduced monodon production about 10% over a half decade and, coupled with the ability to get vannamei larvae, led to a shift toward vannamei and a tripling of vannamei output from 2004 to 2008 so that the latter exceeded monodon output by 2009.

Moreover, the production of vannamei "intensively" requires a very different farming technology compared with traditional technology production of monodon. The essential point is that the latter deals with a low density of shrimp on the pond floor, with little burden on the pond in terms of using up oxygen or generating waste, and the few monodon can at first live on naturally occurring feed (algae, insects) in the pond, and then when larger require a small amount of feed. Waste reduction and oxygen needs can be helped by stocking the "upper part" of the pond with milkfish, which can also be sold. But when a farmer switches to vannamei, the whole pond's volume can be filled with far more shrimp, and with that the need for oxygenation, waste removal, and feed use increase greatly. The new farmer of vannamei needs to install 4 aeration machines per ha in the ponds, use "probiotic" and other chemicals to maintain shrimp health, and has to increase 10-fold the feed given to the shrimp. He needs to have more technical knowledge to manage this more intensive operation, and more labor use to tend it and harvest its much greater bounty. To run the aeration machines he must have electricity – from a line erected at some cost from a power grid, and a diesel powered generator for use during power outages. He has to buy the more expensive vannamei larvae, and if he does so from a certified manufacturer in order to please processors who require such documentation, he pays even more. In sum, the “threshold investment” for the jump from monodon to vannamei is expensive, but powerfully productive of greater output.

Third, three processes cascade as domino effects from the decline of output (and increase of risk) of monodon and the shift to vannamei (with its greater cost to undertake both to start and continue, but its lower risk and much greater output), and its attendant needs of more inputs.

The small farm segment then, by the mid to late 2000s, find many small farmers leaving its ranks and abandoning the ponds, and those that stay face and take one of two forks in the road.

The first fork is a path of continuation with monodon, even with its now greater risk and its limitation to sell to modern markets, and an addition of milkfish to shift to safer but less profitable (compared to before) mixed (shrimp/fish) farming. Government and donor projects have focused on supporting the farmers in this path.

The second fork path is a path we call of “modernizing small farmers” who shift to vannamei, and make the requisite investments. In turn, they do this in one of two sub-paths.

The most frequent sub-path has been to enter a contract scheme; the main one that is an explicit contract scheme in Lampung is a “tightly coordinated contract” Much like contracts for broiler chicken or pork production in the US, or vegetable export schemes in Asia or Africa, CP contracts provides inputs to farmers on credit, supervises closely the farmer, and monitors the output applying precise standards. A variant on this is where the farmer even gets on “rent to own” the ponds themselves. There are 1000s of small farmers producing vannamei in Lampung for CP doing this since the mid 2000s. The local term for this is nucleus (the processor) plasma (the strictly coordinated farmers) scheme. Other schemes (such as of Bomar or PT Wahyu Pradan Binamulia in South Sulawesi or Indokom in Lampung) appear to be loosely coordinated and indirect contracting, where the processor has an implicit contract with a lead farmer or wholesaler, who in turn collects from a set of farmers and delivers to the processor. The implicit contract is between the processor and the lead farmers or dedicated wholesalers as “preferred suppliers” who have some incentive for repetitive delivery. The nature of these relations between processors and wholesalers will be explored in our upcoming large-sample trader survey.

The emerging, second sub-path, starting really only two years ago, is where small/medium farmers shift at least partially to vannamei and do so “independently” in the sense that they are not under contract to a trader or a processor. However, they appear to not do it fully independently, as they appear to often be in some functioning marketing or at least input procurement cooperatives. This we observed in the key informant study, but will test it formally with an upcoming large sample farm survey. The cooperatives allow them to buy inputs and sell outputs in the “threshold volumes” or critical masses required by vannamei larvae and feed suppliers and processors. They appear to get technical assistance from input suppliers.

Also, in the farming segment, a set of medium/large scale farmers also entered vannamei production in the mid 2000s and grew rapidly both in the "settled" shrimp areas like Lampung and South Sulawesi, but also into newer areas to get clean water. These farmers populate the "Shrimp Club of Indonesia" and have the substantial capital necessary (often from having outside business or starting therefrom) to make the jump from monodon to vannamei or to just start with vannamei – and do it not with the small/small-medium farmer range of a 1-10 ha with apparently a mean of about 2 ha – but to do it at an average of 7 times that size (15 ha) with even a set of much larger farmers.

The likes of CP and the medium/large farmers mean that, relative to 15 years ago, the shrimp production sector in Indonesia appears to be much more concentrated – both at the farm level because of the emergence of medium/large farmers, but even more at the output supply level as the contracting schemes use coordination and aggregation, either directly or through dedicated wholesalers. As a whole, the coordinated, aggregated, concentrated output supply can be contrasted with the fragmented, spot market, output supply of the traditional monodon sector. The lesson is clear in terms of competitiveness of output supply sectors – and by extension, the competitiveness conferred on the downstream segments, particularly the processors, who rely on or are indeed integrated with the upstream concentrated supply sources. The transaction costs they face are so much lower. That appears to give a fillip to the processes of concentration in the off-farm segments that we trace in the next dominoes.

Third, we found that every off-farm segment is concentrating over the past half decade.

(1) The feed manufacture segment was already concentrated, but in the past five years doubled in volume.
(2) The feed wholesale segment grew in volume but concentrated, with the emergence of medium/large players; there was also some disintermediation as large feed companies sold directly to contract schemes (such as CP where CP's own feed company sold to its own contract farmers) or to medium/large farmers.
(3) The monodon larvae supply segment reduced in volume with some concentration; a similar pattern occurred in monodon wholesale and processing.
(4) The vannamei larvae supply segment emerged but in medium and large companies, not a proliferation of small companies as had been the norm in the monodon larvae segment. These medium and large larvae companies have threshold purchase norms (to control transaction costs), which in turn favors purchase by the schemes, by the medium/large farmers, and by the "modernizing small farmer" cooperatives that could buy a critical mass.
(5) The vannamei wholesale segment emerged and concentrated as processors either dis-intermediated (bought direct either in their own schemes or from medium/large farmers) or tended toward larger, dedicated wholesalers who aggregated for them.
(6) The vannamei processing segment emerged and concentrated as large players like CP, Bomar, Indokom, Wahyu, and perhaps 10 others between the study sites, dominated. This concentration appears due to several factors: (a) the emergence of the traceability requirement especially for the Western European, US, and Japanese markets, meant that processors that had their own contract schemes or a tightly coordinated set of dedicated wholesalers/agents or both, could make a go at demonstrating traceability; (b) it appears that cost competition led to pursuit of

economies of scale; the latter was given a fillip by the massive investments of multinationals like CP and large domestic firms like Bomar.

(7) The domestic segment of shrimp retail has very barely begun to concentrate (with the rise of supermarkets) and is minor (less than 5%) of the domestic market. The 5% of shrimp that is not exported is mainly sold in the usual wetmarkets.

The combined body of field insights suggests that the concentration of the off-farm segments appears to reinforce, and indeed act in a mutually reinforcement cycle, the concentration and technology change at the farmer level. This is a worrisome point. From a poverty alleviation and small farmer income development viewpoint, our most exciting finding is the emergence of the modernizing small farmer. Our most worrying result is that to “play in the vannamei game” one needs sophistication and scale. The small farmer can get those latter via entering contract schemes, our hypothesis on which is that this is a positive move, or they can get it via (1) starting cooperatives and (2) making investments in production and traceability capacity for the modern market. It seems that the central policy and program implication of the study is that helping farmers do those two latter actions is an important way to help small farmers link their economy to the booming aquaculture export market. As of now they face heady constraints of input supply and finance that need to be overcome.

Report Introduction

This report presents the findings of the first task – based on key informant interviews in all segments of the value chains shrimp in two provinces of Indonesia - of the shrimp component of the ACIAR/IFPRI/MSU/CAPAS/Adelaide Project.

The report proceeds as follows. First, a discussion of method and sample selection and secondary data is presented. Second, the findings from 111 key informant interviews mainly in Lampung, South Sulawesi, and Jakarta are presented. The analysis of the findings focuses on the structure, behavior, and outcomes of each segment of the VC (from input supply to exporter), varying over types of actors; this includes for structure the population of actors and concentration of segment, and the spatiality of actors in the segment; for behavior, this includes their input procurement (arrangements, financing), their production/output and its technology, and their marketing (including its system and institutions); for outcomes, this includes their costs and profits, and resilience. Third, we classify shrimp VCs. It first presents stylized descriptions/mappings of the VCs that are categorized into 3 channels (traditional, modernizing, modern). It then traces their transformation in terms of structure, behavior, and outcomes over the past 5 years.

The information used is from our team's interviews with 111 key informants (shown in Annex 1), done in May/June and in October/November. Preliminary results from the initial interviews issued in three (Reardon et al. 2009a, Reardon et al. 2009b, Yi 2009a) reports. Those served as inputs to conceptualization and planning of this document. The inception plan for the current report was issued in Yi et al. (2009b.)

For background, throughout the report we refer to two varieties of shrimp: (1) the tiger shrimp, "monodon", http://www.fao.org/fishery/species/3405/en , is the variety that dominated both large and small farm production until the early 2000s; it is relatively large, and feeds and lives on the bottom of the pond (and thus pond densities are relatively low); it is the most traditional variety in the local markets in southeast Asia; (2) the vannamei (pacific white shrimp or whiteleg shrimp) http://www.fao.org/fishery/culturedspecies/Litopenaeus_vannamei/en, is a variety of shrimp. Vannamei is native to the eastern Pacific but has become marketed much more recently than the monodon; it was first spawned in aquaculture ponds in Florida in 1973, and was then widely grown in Latin American in the 1970s-1990s, then spread to Asia in the 2000s. The picture, map, and lifecycle and basics of production of vannamei are depicted in a figure taken from the first FAO citation above. It feeds and lives "volumetrically" floating in the full space of the pond, so that densities are much higher in vannamei production.

1. METHODOLOGY & RESEARCH QUESTIONS

1.1. Research Site Selection

The two research sites chosen are Lampung and South Sulawesi. These are two major productions sites for farmed shrimp in Indonesia. While they have many similarities, they also offer opportunity to explore the differences in conditions of the regions and their effects on the sector.

Lampung (Lmp)

Lampung province is the leading producer of shrimp in Indonesia with an annual output of over 131,000 MT. Production in Lampung is undertaken by about 8000 small farmers (with some two-thirds of them in contract on own land or CP land, under contract to a vertically integrated large company, CP Prima (Central Proteina Prima), and the rest is done by medium/large farmers. Technology adoption and modernization in Lampung has been rapid. Farms in Lampung were the first in Indonesia to widely adopt the new (to Indonesia) vannamei become the dominant variety produced in the province (except among the non-contracted small farmers where it is still a minority of their production).

The large and rapid increase in vannamei production has attracted the attention of shrimp feed companies and they have stepped up marketing, extension, and development of shrimp feed. (Vannamei requires feed because it is grown in much higher densities, volumetrically, while monodon is usually produced with traditional techniques with little use of feed and lives on pond floor.) However, unlike provinces like South Sulawesi (SS), in Lampung there are very few government programs for shrimp farming.

Table 1: Lampung Production by Variety (unit: MT)

	2004	2005	2006	2007	2008
Vannamei	32	94,665	123,577	141,914	122,896
Monodon	18,046	19,240	26,104	13,030	8,444
Other	299	351	233	353	540
TOTAL	18,377	114,257	149,903	155,297	131,880

Source: Dinas Perikanan dan Kelautan

South Sulawesi (SS)

South Sulawesi province is a major shrimp production area in Indonesia with an annual production in 2008 estimated to be 17,772 MT. Production is somewhat less concentrated in SS with the presence of over 10,000 smallholder farmers producing a smaller volume than Lampung. Technology adoption and modernization have been much slower than in Lampung, and the monodon variety (the variety used in traditional farms) remains the dominant variety produced in the province. Slow technology adoption combined with industry-wide disease outbreaks in monodon shrimp have lead to a significant decline in production, from 22,861 to

17,773MT over the past 5 years. As a result, the government (and international organizations like ACIAR) has been much more active in SS, compared to Lampung, in executing programs to revitalize the shrimp sector. While not as active as in Lampung, feed companies appear to be intensifying their marketing activities and extension services to farms in SS.

Table 2: SS Production by Variety (unit: MT)

	2004	2005	2006	2007	2008
Vannamei	-	712	795	1,417	3,216
Monodon	19,253	20,622	15,144	12,599	11,263
Other	3,607	2,811	3,475	2,345	3,252
TOTAL	22,861	24,145	19,414	16,361	17,773

Source: Dinas Perikanan dan Kelautan

1.2. VC KI methodology

Task 1 (Key Informant Interviews) consists of two main steps. Step 1 is key meta-informant interviews (reconnaissance), and step 2 is key typal informant interviews.

Step One: Key Meta-Informant Interviews (Reconnaissance)

The purpose of this initial step of the research project was to gain a broad meso level overview of the shrimp sector in Indonesia. In addition to the analysis of secondary data from the government, information gathered from meta-informant (government officials, heads of producer organizations, etc.) interviews were also used to identify the segments in the value chain for shrimp. This first step built on the reconnaissance trips the team took to Lampung and Sulawesi with the initial deliverable reports noted above.

Using this information, the value chain was divided into segments (i.e., input producers, input intermediaries, farmers, output intermediaries (to domestic and export markets), processors, and retailers). To refine the study, each segment was stratified into sub-segments (e.g., small traditional – large intensive), to serve as a "sampling grid" to guide the selection of typal informants to be interviewed (Step Two).

Step Two: Key Typal-Informant Interviews

The "sampling grid" developed in step one was used to select key-typal informants to be interviewed in step two. Multiple informants were chosen from each type category of every segment in the VC. In the farm segment, for example, multiple typal-informants were chosen from the small-traditional type, small-modernizer type, and large-intensive type of farm categories to represent the farm segment as a whole. This selection process was replicated in all the segments.

While this procedure does not produce a representative sample, the stratified selection of actors allows the study to capture the "variance" that exists in each segment. For segments with few actors, the case studies become the main information of the study as the universe is small. Where the universe is large, we have sampled typal segments for these key informant interviews, and to perceive the sampling frame, and then return in the next quarter to do the "trader survey" and the farm survey.

Interviews were structured by an interview guide (See Annex A1). Each typal-informant was asked a set of questions regarding input procurement, production, and marketing activities in addition to questions regarding capital and investments.

Synthesis

Data gathered from meta informants in conjunction with relevant secondary data acquired from the government were used to generate meso-level information and an overview of the shrimp VC in the study sites. Information regarding overall populations, concentration, and some behavior elements were generated from these sources. Data gathered from typal-informants were synthesized to produce summary information regarding each segment and sub-segment in the VC.

1.3. Literature Review

There have been a few value chain studies on Indonesian shrimp (NACA, 2006; IFC, 2006; Development Alternatives, 2006; Oktaviani et al. 2007). These studies have focused primarily on farm production on the one hand and in most cases on the nature of the export market and its requirements on the other, and how the latter challenge the small farmer. The VC study (DAI) was with a very small sample. All the extant VC studies treated very little the input supply segment. Few have treated the output wholesaling and processing segments. The closest to it is Oktaviani et al. (2007) in a survey in 2006 based on small sample interviews with 3 processors, 6 brokers, 12 wholesalers, and 24 traditional small monodon producing farmers in SS.

Moreover, even for the farm segment, the past studies did not stratify (and examine the range of) key informants by type (e.g., vannamei adopters versus non adopters among small farmers, or scale categories of off-farm actors). In the literature to date, there has been little treatment of either the heterogeneity and stratification of small farmers, such as the “modernizer” small farmers (a subset of small farmers that have shifted from traditional to modern production technology), nor has there been treatment of the structural changes afoot in the off-farm segments of the VC (concentration of wholesale, decline in output intermediary populations, etc).

It is thus fair to say that there has been no comprehensive VC key informant study such as the current document, done before.

1.4. Research Questions

The research questions that motivated Task 2.A. (the first task of the shrimp component), corresponding closely to the questions in the interview guide, are presented here:

Structure

1) What is the population and concentration of each actor type in each segment?
2) What is the spatial distribution of actors?
3) How do capital endowments differ for each of the actor types in each segment? What are the threshold investments to modernization?
4) What barriers (input supply, capital, etc.) to modernization do smallholder actors face?

Behavior

1) What volume of each input is used in production?
2) How are inputs procured? (integrated, spot-market, contract, collective) and from whom?
3) What is produced? How much? What are the risks?
4) What is the periodicity of production?

5) How is output marketed? (spot-market, contract, integrated, collective) and to whom?

Outcomes

1) What is the value added/gross margin that is contributed by each actor in each segment?
2) How do margins differ along the VC and within each segment?

2. CONTEXT & POLICY ISSUES

Here we present the development, and policy context of the shrimp industry in Indonesia.

2.1. Rise and Decline of Shrimp Aquaculture

Following the Asian financial crisis in 1997, exchange rates in Indonesia dropped. As a result, the price of exported commodities, like shrimp, spiked to record highs in 1997. This caused super-profits in the export oriented shrimp sector in Lampung and SS, giving rise to a large expansion and intensification of *tambak* (brackish-water pond) from 1997 to 2002.

Rapid expansion and intensification of ponds continued in Lampung and SS until 2002 when farms began experiencing severe problems with mass mortality (crop failure) and low survival rate (low output given successful crop). In SS and Lampung, the drop in profits that resulted caused capital flight in the sector. Large intensive farms, semi-intensive farms, and even processors sold off their land and equipment (aerators, generators, etc) and exited the industry in search of better returns. It appeared in 2002 that the shrimp industry in Lampung and SS were in its final throes.

Government Initiatives

In light of the decline in monodon due to disease and then reduction of production, the government launched a number of programs to revitalize the industry (among small farmers, as large farmers undertook their own revitalization by shifting variety and technology), and set goals to increase production. Government extension, input subsidies, cash transfers, and in-kind transfers of inputs (PL, feed, fertilizer, and pesticide) are all used to help small farmers and increase shrimp production.

However, our initial observations based on the key informants present that hypothesis that the programs were largely unsuccessful in reversing the decline in monodon production by small farmers, and in themselves (the programs) inducing substantial change of technology. In some cases, they may have "crowded out" private sector input supply services. These hypotheses need further careful exploration.

After a policy debate regarding whether imports of broodstock would be a vector for introduction of exotic diseases, Indonesia allowed the import of vannamei broodstock. Our informants note that large companies such as CP Prima and the set of large intensive farmers were the first to adopt the vannamei and were largely successful. Production of vannamei rose very quickly, while monodon output remained stagnant. Table 3 shows that the source of growth in Indonesian shrimp aquaculture has come solely from the increase in vannamei production.

Table 3: Indonesian Shrimp Production by Variety (unit: Metric Ton)

	2004	2005	2006	2007
Vannamei	53,217	103,874	141,649	164,466
Monodon	131,399	134,682	147,867	133,113
Other	53,951	40,983	50,287	32,576
TOTAL	238,567	279,539	339,803	330,155

Source: FAO FishStats

Export Regulations

Shortly following the allowance of broodstock imports by Indonesia, the US and EU increased export regulations and process standards for shrimp: new was the requirement of traceability back to the pond, lab tests for anti-biotic use, processing procedures, among others. These regulations added substantial transaction costs to processors. Compliance with these regulations is a major challenge for processors sourcing from many small farmers. While processing performance (facilities) have apparently been improved to meet regulations, our informants noted that there are still unmet challenges of ensuring traceability and the chain of custody.

3. Summary VC Segment Information

This section presents summarized representation of the VC segments, drawing from information synthesized from key informant interviews

(Note: Unless otherwise noted all output shares exclude CP which constitutes 70% of production in Lampung, and Bomar which makes up 25% in SS.)

3.1. Input Producers

The key input producers covered here are hatcheries and feed mills. These actors produce the key inputs for shrimp farmers and play a crucial role in modernization and intensification of ponds.

Hatcheries

Hatcheries produce PL12 (12 day old post-larva shrimp) in controlled environments. They range from small operations, producing 10 million PL12 per year, to giants like CP, producing 9 billion per year. Table 4, presented below, classifies hatcheries into two categories: small and large hatcheries.

The population of small hatcheries has declined 50% in Lampung, and nearly 70% in SS while large hatcheries have roughly doubled in population in the same period. This is due to factors specific to Lampung and SS.

In Lampung, large intensive farms shifted to the vannamei variety, the PL of which are produced only by large hatcheries. This meant a significant decrease in demand for monodon PL from small hatcheries as their largest consumers shifted varieties.

In SS, with the onset of serious disease problems, government programs, donor projects, and some farmers began to buy more higher-quality certified monodon PL from large hatcheries. This appears to have shifted some PL demand from small hatcheries toward large hatcheries.

Table 4: Hatcheries - Summary Stratification

	Small	Large
Population	Lampung: 60 SS: 120	Lampung: 5 SS: 11
Market Share	Lampung: 60% (15%*) SS: 85%	Lampung: 40% (10%*) SS: 15%
Scale	20 million PL / year	100 million PL / year**
Output	Monodon PL	Lmp: Vannamei PL SS: Monodon / Vannamei PL
Backward	Seldom: Broodstock	Always: Broodstock

Integration		
Certifications	No	Yes
Indoor Production	No	Yes
Forward Integration	Never	Sometimes: Farm
Markets to	PL wholesalers, nurseries, traditional farms	PL wholesalers, nurseries, all farms
Terms of sale	Credit or Cash	Credit or Cash

*Including CP's hatcheries
** Excluding CP's hatcheries

Small Hatchery

Meso

A typical small hatchery operates between 8 and 20 tanks with an average of around 12 tanks producing a total of around 20 million monodon PL annually. The small hatcheries that have expanded have typically done so by sharecropping empty tanks (1 IDR per PL produced) with failed hatcheries, instead of buying more land.

Capital

Small hatcheries typically own a water pump, an electricity generator, a few tanks to culture artemia (larval feed), and a simple water treatment tank. Small hatcheries in Lampung also own trucks used to transport PL directly to buyers, while our informants noted that those in SS do not.

Spatial

Small hatcheries are located in areas with the cleanest ocean water. In Lampung all hatcheries were concentrated in Kalianda. In SS hatcheries were concentrated mostly in Baru and Takalar areas. These areas typically do not have reliable electricity service which means frequent and long lasting power outages. This causes increased fuel expenditures and can result in crop failures.

Technology & Production

The technology for small hatcheries was the same in Lampung and SS. They stock nauplii at the same density, and use the same feed and feeding, chemical regimen, and management practices.

Nauplii (larval shrimp) are the "seed" for PL production, and are bought from nauplii retailers in the area. A nauplii retailer is typically a backward-integrated hatchery that sells nauplii to the surrounding small hatcheries. Artemia and crumble-feed are also bought from a retailer in the area. This retailer is also typically another backward integrated hatchery that imports these inputs in bulk and supplies surrounding small hatcheries.

The cost of production of one PL is 9 – 10 IDR. The cost compostion is shown in Table 5 below.

Table 5: Small Hatchery – Cost Composition

	Percent of cost
Nauplii	10%
Feed	40%
Energy	25%
Labor	10%
Packaging	15%
Total	100%

All inputs are bought on a per-cycle basis. Each cycle of production takes approximately one month, with a total of 9 production cycles per year. Annual production from a typical small hatchery is around 20 million monodon PL.

Marketing

While most PL is sold as PL12, when production exceeds what is demanded, some PL must be kept in inventory longer. This means higher costs of production and older PL are then sold at a loss.

Output price ranges between 12 and 17 IDR with an average of around 14. Transactions are made in cash. Small hatcheries are not certified. Thus, their primary output market is nurseries in production zones.

Notice in Table 6 that only 20% of PL from small hatcheries are sold directly to farmers. This is because farmers typically require only small amounts of PL, so the only farmers who can buy profitably from a hatchery are those located close to small hatcheries.

Table 6: Small Hatchery – Output Marketing by Buyer type

	SS	Lampung
Sold to PL Wholesaler/Retailer	30%	0%
Sold to Nursery	50%	80%
Sold to Farmer	20%	20%

Costs, revenues and gross margins for small hatcheries are depicted in Table 7. The small hatchery sells PL12 at 14 IDR per PL, and the cost of producing one PL is 10 IDR. Those sharecropping make roughly a 25% smaller margin.

Table 7: Small Hatchery – Financial Summary

	Per PL (IDR)	Annual (USD)
Revenues	14	$28,000
Costs	10	$20,000
Gross Margin	4	$8,000

Large Hatcheries

Meso

A large hatchery operates large indoor production facilities. Production ranges between 80 million PL and 600 million PL per year with around 100 million being average. Facilities are owned by the firm and construction and investments are typically partially financed through formal bank loans. While a small hatchery is typically owner-operated, a large hatchery is typically owned by two or three partners, according to our informants.

The population of large hatcheries producing vannamei appears to be increasing as there are vannamei hatcheries currently under construction in both Lampung and SS. In SS, the expansion of large vannamei hatcheries has displaced PL supply from Java, while in Lampung, the expansion of these hatcheries has displaced the PL supply from CP. This appears to have reduced PL costs for farmers.

Capital

In addition to more and larger equipment of the same types utilized by small hatcheries (water pumps, generators, artemia tanks, etc.), large hatcheries have more advanced water treatment facilities, laboratories for tests, and broodstock tanks. Water treatment facilities filter water, sterilize via UV radiation, and control PH and other control points. Laboratories check PL for disease and check water control points. Large hatcheries are also backward-integrated in nauplii production, and they manage their own broodstock.

Spatial

Large hatcheries are located in the same locations as small hatcheries. However, two large hatcheries in Lampung are backward-integrated intensive farms and are located in the intensive shrimp production area and not in the hatchery production area.

Technology & Production

The technology of large hatcheries differs depending on whether the hatchery produces vannamei or monodon variety. While the same inputs are used, the broodstock for vannamei are 4 times as expensive as monodon broodstock and require more technicians to manage them. If producing monodon, large hatcheries buy broodstock from broodstock retailers from Aceh or Pengandaran.

If producing vannamei, broodstock are typically imported from GOI (Government of Indonesia) approved broodstock centers in Hawaii. However, the GOI has recently begun producing vannamei broodstock (*vannamei nusantara*) locally. Large hatcheries require certification and pay premium prices for the best broodstock.

Other inputs like artemia, crumble feed, and chemicals are bought direct from the manufacturing company.

The cost of production of monodon and vannamei PL from a large hatchery is given below in Table 8. It costs 14 IDR to produce one monodon PL and 22 IDR to produce one vannamei PL.

Table 8: Large Hatchery – Cost Composition

	Monodon PL	Vannamei PL
Nauplii (broodstock)	44%	10%
Feed	34%	40%
Energy	6%	10%
Labor	8%	25%

Packaging	8%	10%
Transport	0%	5%

Inputs are bought on a per cycle basis and there are 10 cycles per year. Annual production from a typical large hatchery is around 100 million PL per year.

Marketing

The market for large hatchery output is strong. Large hatcheries producing vannamei are expanding quickly, and those currently producing monodon are beginning to produce small quantities of vannamei. Large hatcheries producing monodon, while not expanding production, appear to be stable.

Large hatcheries producing monodon market 95% of their output to PL wholesalers with only 5% sold to nurseries and farms directly. They rely heavily on these wholesalers to distribute their output and give them a 5% discounted price. Large hatcheries producing vannamei deliver output directly to large-intensive farms or modernizing-small- farm collectives.

In SS, both large monodon and vannamei hatcheries market large amounts outside of the province. They typically market 70% within the province and 30% outside. However, large hatcheries in Lampung market 100% of output within the Lampung province.

The large hatchery sells monodon PL at 18 IDR per PL, and the cost of producing one PL is 14 IDR. Large hatcheries producing vannamei sell PL at 35 IDR with a cost of production of 22 IDR. The costs, revenues and gross margins for large hatcheries are depicted in Table 9.

Table 9: Large Hatchery – Financial Summary (per PL in IDR)

	Monodon	Vannamei
Revenues	18	35
Costs	14	22
Gross Margin	4	13

Feed Mills

Feed mills produce shrimp feed for aquaculture farmers and are operated by large companies that are typically diversified into other kinds of feed (chicken, fish, etc.). Shrimp feed production closely follows total shrimp production in Indonesia. The huge increase in shrimp production brought about by varietal shift by farmers caused tremendous growth in the shrimp feed industry, and they nearly doubled production in the last 5 years.

Meso

There are 13 companies that produce shrimp feed in Indonesia. Some are Indonesian companies, but most are joint ventures with foreign corporations. Feed mills use very similar technology in production and typically buy inputs from the same source. The only major difference between each of the feed companies appears to be the scale of production.

Through-put ranges from 1,500 MT to CP's 150,000 MT. The 5 largest firms control around 95% of the market with CP alone controlling 65% of total production in Indonesia.

Table 10: Feed Mills – Summary Stratification

	Small	Medium	CP Prima
Population	8	4	1
Market Share	5%	25%	65%
Output Volume	1,500 MT /yr	15,000 MT /yr	150,000 MT /yr
Markets to	Large Intensive farms, Modernizer groups, Feed Wholesalers	Large Intensive farms, Modernizer groups, Feed Wholesalers	Large Intensive farms, Modernizer groups, Feed Wholesalers

Capital

Producing shrimp feed is a very capital intensive process that requires specialized feed machines that mix together ingredients and package output. These feed companies also need large storage spaces to hold inventories before shipment and a fleet of trucks to transport output to shrimp production areas.

Technology & Production

According to informants from CP and Samsung, the content of shrimp feed is largely identical across all the different brands. Feed mills use fish meal, corn, soybean, squid liver, binding agents, and other small inputs at roughly similar levels. So feed mills compete more on marketing and logistics strategies than on the content or quality of shrimp feed.

While corn, fish meal, and squid liver can be sourced domestically, soybeans must be imported due to the poor quality of domestically available soybeans. As a result, the cost of producing shrimp feed in Indonesia is significantly higher than competing countries with domestic sources of soybean.

Marketing

Feed mills have their own marketing agents who work in shrimp production areas selling feed. These agents target large intensive farmers with their marketing efforts. Prices are very similar across brands and transactions are done in cash as spot arrangements. While the standard price is 8,800 IDR per kg, standard discounts are given until the price is roughly 8,500 IDR per kg.

In addition to standard discounts off the retail price, feed mills employ aquaculture experts to serve as technical advisors to their customers. Any farmer who buys directly from the feed mill can request a technical advisor to visit his/her ponds once every 6 months. This technical advisor educates farm technicians on the use of feed, chemicals, and other management practices.

While the majority of feed mill output (75%) is sold directly to farms, a significant proportion (25%) is sold through independent feed wholesalers/retailers. Before the vannamei variety was introduced in 2004, the proportion was roughly the opposite of what it is in 2009 (25% direct, 75% through wholesale/retailer).

This change in marketing was caused by the concentration of the farm segment. While intensive farmers' feed consumption went up by a factor of ten over a few years, the small traditional farmers did not increase feed consumption to follow. As a result, feed mills began delivering more and more feed to large intensive farmers directly while the amount sold to small traditional farmers via wholesalers remained stagnant.

Overall financial figures are presented in Table 11 illustrating costs and margins for each kilogram of feed production. This means that profits range (from small feed mills to CP) between 375,000 USD and 37,500,000 USD annually.

Table 11: Feed Mills – Summary Financial (per kilogram in USD)

Revenues	$0.85
Costs	$0.60
Gross Margin	$0.25

3.2. Input Intermediaries

The primary role of the input intermediary is to transport and market farmer inputs. While large farmers deal directly with input producers, small holder farmers who buy small quantities typically do not have direct access like their larger counterparts. The activities and contributions of these input intermediaries are presented here.

Input Wholesaler / Retailers

These actors primarily focus on cost-effective transportation and assembly of inputs, and only secondarily on retailing to farmers.

Table 12: Wholesaler/Retailer – Summary Stratification

	PL Whl/Ret	Small Feed Whl/Ret
Population	SS: 10 Lampung: 0	SS: 15 Lampung: 3
Output	Monodon PL	Feed
Scale	20 million PL sold / year	100 MT / year
Forward Integrated	Traditional Farm	Traditional Farm
Market Share	60% of PL	10% of feed

PL Wholesaler/Retailer

Meso

Currently there are around 10 PL wholesalers in SS. 5 years ago there were 40 operating at about half the scale. Key informants said that the decline in demand for monodon PL caused the segment to shrink and concentrate. There are no PL Wholesaler/Retailers in Lampung because hatcheries deliver and market their output to nurseries and farmers directly.

Capital

These actors have a truck that is used to transport PL. They are frequently forward integrated into small traditional farming.

Technology and Production

This actor type buys PL primarily from large monodon hatcheries (80%), but also buys from small hatcheries as well. Fuel to power vehicles is the only other input used. These actors have preferred relationships with large hatcheries and are able to buy PL for a 5% discount.

A typical shipment of monodon PL is 500,000 PL bought at 18 IDR per PL. The cost to transport this shipment is roughly 300,000 – 600,000 IDR depending on the location with an average of 500,000 IDR. The cost of buying and delivering one PL is then roughly 19 IDR and the composition of costs is depicted in Table 13.

Table 13: PL Wholesaler/Retailer – Cost composition

PL	95%
Transport	5%

Marketing

Output is sold at 20 IDR per PL as spot transactions. Output is sold mostly to nurseries (80%), but is also sold to farmers (20%). This proportion has remained the same over the last 5 years.

PL wholesalers sell a large proportion of PL to areas that are far away from hatcheries because nurseries and farmers located near hatcheries simply source directly. Output is split. 50% of PL is sold within South Sulawesi, and 50% sold to other provinces. But 5 years ago, a higher percentage was sold within South Sulawesi.

Table 14: PL Wholesaler/Retailer – Summary Finances (per PL in IDR)

Revenues	20
Costs	19

Gross Margin	1

Small Feed Wholesaler/Retailer

Meso

The population of small feed wholesaler/retailers have remained roughly the same since 5 years ago, however each of these actors are now trading 50% of their former volumes. Each Feed Wholesaler/Retailer are assigned by the feed mill to operate in a specific delineated area to minimize competition within regions among wholesaler's of the same brand of feed.

Capital

These actors use storage space in their houses to store inventories and typically do not transport output. These actors typically operate small traditional ponds in addition to their feed operations.

Technology and Production

The only input required by this actor is shrimp feed. Shrimp feed is bought directly from a feed mill who transports feed to the wholesaler. This actor has a preferential relationship with the feed mill (much like PL wholesaler with large hatchery), and buys feed at a 12% discount off of the retail price. Transactions are made in cash.

Marketing

These actors sell mostly to feed retailers (70%) and 30% to small traditional farmers directly. Output is sold in cash in spot arrangements. All output is sold within the area the actor is assigned to.

Input Retailers (Feed Retailer & Nurseries)

These actors focus primarily on the output sales of farmer inputs. Each has significant investments into physical structures to hold inventories and market output.

Table 15: Input Retailers – Summary Stratification

	Nursery	Feed Retailer	Large Feed Whl/Ret
Population	SS: 200 Lampung: 50	SS: 75 Lampung: 20	SS: 5 Lampung: 0
Scale	1.2 million PL sold / year	50 MT /year	800 MT /year
Output	Monodon PL	Feed	Feed
Facility	Four 20m x 20m ponds	Shop	Warehouse
Forward Integrated	Traditional Farm	No	Modernizer Farm
Markets to	Traditional Farm	Traditional Farm	Modernizer Farm
Market Share	SS: 40% Lampung: 10%	SS: 30% Lampung: 10%	SS: 10% Lampung: 0%

Nursery

Nurseries take PL12 and hold them in nursery ponds until sold. They are typically sold as PL20 up to PL35 (20-35 day old PL) to local small traditional farmers. Their main function is to assemble product and hold inventories of PL.

Meso

Currently there are about 50 nurseries in Lampung and 200 in SS. The population of nurseries has declined over the last 5 years roughly in proportion to the decline in monodon PL sales. They are located in production areas and are all forward integrated into small traditional farming.

Capital

A nursery has between one and ten 20m x 20m ponds with an average of around 4 ponds. These actors also have small traditional shrimp ponds but their shrimp farms are typically less than 1 ha.

Technology & Production

Nurseries use PL12 and feed in production. These inputs are bought on a per cycle basis and each cycle is roughly 15 to 25 days.

Nurseries that are close to small hatcheries buy PL12 directly for 15 IDR a piece, but must transport it themselves which costs between 3 and 5 IDR per PL depending on the distance. Those further away from hatcheries typically buy from PL wholesalers for 20 IDR a piece. In addition to PL, nurseries also use feed to feed the PL. Feed is bought from a local retailer on a spot arrangement.

Using these inputs, each pond produces around 300,000 PL30 per year bringing total production of an average nursery (with 4 ponds) to be roughly 1.2 million PL30 per year. This is enough PL to support around 20 small farmers in the area.

The cost composition of producing a PL is illustrated in the table below. Note that the cost of PL12 per unit of PL30 produced is higher than the market price of PL12 because 25% of PL die during the production process.

Table 16: Nurseries – Cost Composition (Per PL in IDR)

PL12 (including transport)	27
Feed	1

Marketing

Nursery output is sold for 35 IDR per PL to small traditional farmers in the area. While most transactions are conducted in cash, 20% of customers buy PL on credit from the nursery to be repaid at harvest. However, in the case of a failed crop, the farmer typically does not repay the debt until the next successful harvest. So the nursery is, in effect, bearing a large proportion of the financial risk for farmers who buy on credit.

In addition, the output market of a nursery is small, and is very sensitive to small changes in local market conditions. These actors sell all their output to a total of perhaps 30 different local farmers. So, when government or donor projects provide free or heavily subsidized PL12 from hatcheries, it appears to hinder the business of these actors.

The finances of a typical nursery with 4 ponds are depicted in the table to follow. Note that the annual margin for the nursery is very small. This is because the majority of nursery household income is generated elsewhere, either in shrimp farming, or other farm income.

Table 17: Nursery – Financial Summary

	Per PL produced (in IDR)	Annual (in USD)
Revenues	35	$4,200
Costs	28	$3,360
Gross Margin	7	$840

Small Feed Retailers

Meso

There are many feed retailers in both Lampung and Sulawesi. The population is said to have stayed the same over the past 5 years. However, retailers are now selling significantly less shrimp feed than 5 years ago. These actors are located along near production zones along main roads.

Capital

Small feed retailers are farmer input stores that sell an array of different farmer inputs. These are typically small stalls in a row of shops. Their main business is from the sales of fertilizers and pesticides, but a significant proportion of income is generated from the sale of shrimp feeds.

Technology & Production

Small feed retailers typically get shipments directly from a feed mill. However, some buy shrimp feed from a feed wholesaler/retailer. They buy in cash from suppliers.

Marketing

Small feed retailers sell shrimp feed to small traditional farmers. They sell on spot arrangements dealing only in cash transactions. They sell at retail price. However, these retail shops are a nearby one stop shop for fertilizers and pesticides that farmers use and they appear to have a spatial advantage over the feed wholesaler/retailer.

Large Feed Retailers

Meso

There are currently 5 large feed retailers in Sulawesi and none in Lampung. These actors are all new and have typically started within the last 3 years. These actors operate across the province and have warehouses to store feed near port areas.

Capital

Large feed retailers have a truck to transport feed, and a small warehouse to keep inventories. They are also very knowledgeable on both traditional and modernizer farm technologies. They also have deep financial resources to give significant amount of feed on credit to farmers.

Technology & Production

Large feed retailers get shipments directly from feed mills. They typically get shipments of 20 MT which is temporarily stored in a warehouse until distributed. These actors sell 60 MT per month yielding an annual total of around 720 MT.

This actor also operates around 4 ha of modernizer ponds in cropshare agreements that serve as demonstration ponds to surrounding farmers. While the number of ponds managed by this actor is relatively constant, the location of the ponds shift to whatever new area is identified as a potential place to shift small farmers to semi-intensive vannamei production.

Marketing

Large shrimp retailers sell shrimp feed directly to modernizing-small-farms and modernizer farm collectives. Most shrimp feed is sold in cash, but those who are modernizing their farms typically buy their feed on credit from this retailer.

Large feed retailers double as an aquaculture expert, and they help farmer collectives modernize from small traditional to small modernizing-small-farms. A modernized farm that produces vannamei will consume ten times more feed than a pond employing traditional technology. By giving farmers feed on credit, the feed retailer bears 60% of the cost increase of modernization and is a significant lowering of the barriers to modernization.

Table 18: Feed Retailers – Financial Summary (per kg)

	Small	Large
Revenues	$0.90	$0.90
Costs	$0.88	$0.85
Gross Margin	$0.02	$0.05

How large feed retailers facilitate modernization of traditional small farmers:

First, a suitable site with good access to clean water sources and an initial farmer are selected.

Second, the feed retailer enters into a sharecrop agreement with the initial farmer and together they stock vannamei at low densities (5 per square meter) so that the initial farmer and surrounding farmers can observe the high survival rate and low mass mortality rate of vannamei shrimp.

Third, the feed retailer convinces the pond owner to renovate the pond to accommodate higher stocking densities. This means digging the pond deeper and adding aerators.

Fourth, stocking density is increased to 20 per square meter and sometimes up to 40.

The process is repeated for farmers surrounding the initial farmer. However, the feed retailer does not enter into a sharecrop agreement, and technology is disseminated by the initial farmer. This creates a modernizer farm collective that is now consuming 10 times more feed each and at the same time reaping profits that are 3 times higher.

3.3. Farm

Farms use brackishwater ponds to produce shrimp using PL and feed as the main inputs in production. The two main varieties farmed in Indonesia are monodon and vannamei. Farms are located along low lying coastal areas.

Table 19: Farm – Summary Stratification

	Traditional	Modernizer	Intensive
Land (ha)	2.5	2.5	15
Variety	Monodon	Vannamei	Vannamei
Output /ha/year	400kg 800 kg milkfish	Lmp: 8 MT SS: 4 MT	30 MT
Population	Lmp: 2,500 SS: 10,000	Lmp: 100 (6,100)* SS: 300	Lmp: 47 SS: 11
Output Share	Lmp: 10% SS: 60%	Lmp: 10% SS: 20%	Lmp: 80% SS: 20%

*Including CP Plasma of 6,000 farmers in Lampung Province

Small Traditional Farm

Meso

Traditional farms make up the vast majority of farms in population. However, the low productivity of the traditional technology means they do not make up a proportionate amount of production volume. It appears that the population of traditional farmers has declined 15% in Lampung, and an unknown but large percent in SS. Both sites however communicate a 50 – 60% decline in productivity of traditional ponds since 5 years ago. However, the production of milkfish (an important locally consumed fish) has significantly increased. Milkfish is an important source of income and protein for small traditional farmers. This polyculture system maximizes TFP (Total Factor Productivity) for these farmers and also manages risks in shrimp production (Martinez-Cordero et al., 1999).

Traditional farms are located in rural coastal areas. During the shrimp boom between 1998 and 2002, many farms were built far inland. These farms fill their ponds using water pumped from the watertable, and this is a significant source of contention between aquaculture farmers and other farmers who rely on the groundwater supply for irrigation.

In Lampung province, farms in East Lampung experience severe soil erosion problems. Many farmers have lost over half their farmland to erosion in the last 10 years.

Capital

The size of a traditional farm ranges from .25 – 10 ha with an average of perhaps 2.5 ha. Those who had a significant source of off-farm income typically had more land, while farmers who rely primarily on farm production for their income had smaller plots of land. Farmers who have more than 3 ha own land in multiple locations with each plot being roughly 2 – 3 ha each.

While some farms located near canals and water sources drain and intake water without the use of pumps, most farms employ water pumps to fill ponds with water. This is typically the only working capital owned by the farmer aside from a number of buckets, boxes, and bamboo rigs.

Most farmers have been organized into cooperatives by a government program. However, the only purpose of these cooperatives is to receive subsidized or free inputs from the government and quickly disband after benefits are reaped.

Technology

Farmers use PL, feed, fertilizer, and pesticide as the main inputs in production. Farmers buy fertilizer and pesticide from a local farm input retailer (small feed retailer).

For feed, farmers buy from small or large feed wholesaler/retailers depending on their proximity. These are spot arrangements.

For PL, farmers typically buy PL30 from a local nursery. However a minority of farmers (15%) buy PL12 from PL wholesalers or from hatcheries directly. Farmers prefer to buy PL30 as it is claimed that they have a higher SR compared to PL12 because they are older more mature shrimp. Nurseries also sell PL on credit, to be repaid at harvest, which is also an attractive aspect for farmers.

The main factor in who a farmer buys PL from is distance. Those closest to hatcheries buy PL directly from small hatcheries. Those further away are served by nurseries. Those still further away are served by PL wholesaler/retailers.

Around 10% of farmers receive credit from small shrimp wholesalers to purchase inputs in order to tie the farmer's output to the wholesaler. The credit extended is often administered as an in-kind (in the form of feed or PL) loan but not always.

It costs roughly $1.80 to produce one kg of shrimp, given that the farmer has a successful crop. If calculations are made using expected yields (40% crop failure rate), the price for producing one kg is roughly $3.00. In either case, the cost composition remains the same and is presented in the table below.

Table 20: Small Farmer – Cost Composition (per kg)

PL	20%
Feed	35%
Fertilizer	15%
Labor	20%
Energy	10%

Production

The main output of the small traditional farm is monodon shrimp and milkfish. Shrimp farmers have increased the amount of milkfish produced while reducing the amount of shrimp to offset growing production risks. Their output compositions, 5 years ago, were majority shrimp (3:1 shrimp to milkfish kg ratio). However, farmers are now stocking more milkfish than shrimp.

Generally, there are two methods of shrimp farming that affect the periodicity of input procurement, harvest, and output marketing: selective harvest and full harvest.

In the full harvest system, there are 2 to 2.5 cycles per year. Those near water sources can produce 2.5 cycles, while those away from water sources produce only 2 because of the dry season. In this method, farmers stock all the PL into the ponds at the beginning of the cycle and harvest all the shrimp at the end of the 100 day cycle. This results in large lump sum payments at the end of the cycle and large lump sums need to be paid to start the cycle.

In the partial harvest production system, there is only a single production cycle in one year. In this system, the farmer stocks more PL per ha than normal, but staggers the stocking (once a month) to ensure a steady flow of mature shrimp in the future. Selective harvest also ensures that the farmer will receive the premium price for all shrimp sold. There is more labor involved in harvesting shrimp in this method.

Both production methods are severely affected by disease problems. Farms are said to fail due to disease 40 – 50% of the time. Even if the crop is successful, the survival rate for monodon shrimp can range between 30 – 50% depending on the quality of water and PL. However, crop failures were much less common 10 years ago, and survival rates were 80 – 90% before the outbreak of disease in 2002.

Traditional farmers also produce milkfish. Milkfish are much hardier than shrimp and can live in varying levels of salinity, ph, and do not suffer from the disease problems that run rampant in shrimp. As a result, milkfish provide farmers with a small, but consistent source of income that is independent of shrimp disease outbreaks. Milkfish also serve as natural aerators for the ponds and they consume algae that grow in the pond and require no additional inputs.

Marketing

Most output is marketed on a spot arrangement to one of the small wholesalers located in the area. However, some farmers (10%) are contracted to small wholesalers. Verbal contracts are used to tie farmer output to wholesalers in exchange for credit (either cash or input credits). While the terms of the verbal contract require farmers to sell all output to the credit giving wholesaler, the farmer typically sells only enough shrimp to payoff debts. The remainder of output is sold to wholesalers with the highest price.

There is a price premium of $1 per kilo for shrimp that is produced without pesticides and artificial feeds. This is called "organic" by farmers and "eco-friendly" by the processor sourcing this shrimp. In order to trace this product, the processor uses private extension agents to disseminate this technology and brokers to monitor farmers and to source shrimp (via small wholesaler) for the processor.

Prices of output depend on the size of the shrimp. Standard monodon shrimp (size 20-30) is $5 per kilogram. 2nd size shrimp (size 30-40) is sold at $4.50. Small shrimp is bought at $1.50. On average, a kilogram of harvest shrimp yields a price of $4.70. Given a farmer has two successful harvest and produces 400 kg of shrimp, finances are summarized below.

Table 21: Small Traditional Farm – Financial Summary

	Per Kg	Annual (per ha)
Revenues	$4.70	$1,800
Costs	$3.00	$1,200
Gross Margin	$1.70	$600

Modernizer Farm

Meso

Modernizing-small-farms are a new type of farmer that only began in 2004 (at the earliest) with the introduction of the new vannamei variety. They are traditional farmers that are modernizing by making threshold investments to adopt the more productive vannamei variety. **Most have made this transition within the last 2 years**, and it appears that they are the fastest growing (in population) of the three farm types.

Modernizer farmers are organized into functioning cooperatives. These cooperatives function primarily to buy inputs together and make minimum order requirements from hatcheries and feed companies. They also act to transfer technology to those in close proximity.

Capital

The size of modernizing-small-farms range from 1 to 10 ha with an average of 2.5 ha. Similar to traditional farmers, those with larger sources of alternate income had larger farms. The majority of farmers have around 2 ha, while the larger farmers had around 10 ha.

Like traditional farmers, modernizer farmers also own a water pump. To modernize production, from a traditional to a modern (semi-intensive) pond, the farmer must purchase aerators (4 / ha), a generator, and electricity infrastructure. Some farms substitute the generator and electricity infrastructure for more expensive diesel powered aerators. Total cost to modernize one hectare is approximately $2,800.

Technology

The main inputs for a modernizer farm are PL, feed, electricity. Minor inputs are labor, fertilizer, pesticide, and probiotics bought from farm input stores.

PL is bought as a collective from a large hatchery. There are currently no nurseries or PL wholesalers trading vannamei PL, so farmers must buy in groups to meet minimum orders of 500,000 (note: an intensive farmer will order 2 million PL for just one ha) that comes with delivery to the collective's location. Those who are not in collectives buy together with a nearby intensive farmer**. Access to PL is a major constraint to modernization**. Farmers cannot modernize independently (so far no farmers have been observed to have modernized by themselves).

Feed is bought from a large feed retailer or from feed mills directly. Access to feed is also a constraint to modernization. While in SS, modernizer farmers can buy feed from large feed retailers, there are currently no large feed retailers that serve modernizer farmers in Lampung. Farmers in Lampung make minimum orders of 4 MT of feed by buying as a collective every month or buying with a large intensive farmer nearby. In SS, minimum orders from a feed mill are 20 MT because feed must be shipped from Surabaya (city in Java) in a container that holds 20 MT. No collectives in SS buy directly from the feed mill because the feed retailer holds inventory for them, offers technical advice, and sells feed at roughly the same price.

The cost of producing one kilogram of vannamei shrimp in a modernizer farm is about $2.10 but varies slightly depending on the availability of consistent electricity service.

Table 22: Modernizer Farm – Cost Composition

Feed	60%
PL	15%
Energy	20%

Other	5%

Production

The only output of the modernizer farmer is vannamei shrimp. Vannamei have a much smaller failure rate and much higher survival rate than monodon shrimp. A typical cycle is 100 days to produce size 60 – 70 shrimp. Unlike monodon, the size of shrimp at harvest is consistent. All shrimp are roughly the same size.

Some farmers produce size 100+ shrimp in 2 month's time to market to the domestic market during Ramadan (high prices for small shrimp during that time). If timed well, a farmer can produce three times in a given year, but two is the most common.

One cycle can produce between 1 and 8 MT / ha depending on the stocking density. Modernizer farmers in Lampung used higher densities (and inputs), thus yielding more shrimp. The average yield per ha in one year was around 8 MT in Lampung. In Sulawesi, a typical modernizer ha produced 4 MT.

Farms have a 20% chance of failing, but failure typically does not result in large financial loss. In the case of failure, the output is roughly 200 kg of small shrimp and is sold for a small profit or small loss.

Marketing

Output is sold at $3.50 to a large wholesaler operating in the area. Unlike small traditional farmers, **and we note that this point is for modernizing farms outside schemes of contracts with CP and others**, modernizing-small-farms sell all output on a spot relationship in cash. Market information and transactions are made via cellular phones.

Table 23: Modernizing-small-farms – Financial Summary

	Per Kg	Annual (per ha)
Revenues	$3.50	$14,000
Costs	$2.10	$8,400
Gross Margin	$1.40	$5,600

Large Intensive Farm

Meso

While many of the intensive farmers of today have been in the industry for a long time, many are new investors from outside the shrimp industry. Large intensive farmers in SS are investors diversifying their investments into shrimp farms. In Lampung, most farmers were previously intensive monodon farmers that weathered the storm of monodon disease and shifted to the vannamei variety in 2004.

Capital

The size of an intensive farm ranges from 5 to 100 ha. The mean is approximately 15 ha, but the mode appears to be around 10 ha. To upgrade a modernizer pond to an intensive pond, cement must be added to line the ponds and water treatment ponds or tanks need to be built. In addition, more aerators, larger generators, and a large water pump are required. Total costs of intensification of a pond are $4,800.

Technology

Major inputs to producing shrimp in large intensive farms are PL, feed, and electricity. Minor inputs are fertilizer, pesticides, probiotics, and labor.

Feed and PL are bought directly from their respective producers. Feed mills and hatcheries deliver to the door of intensive farmers as they buy in very large quantities. Large intensive farmers demand certification of vannamei hatcheries, lab tests to ensure disease-free, and expect PL to perform to the statistics (Survival Rate, Average Daily Growth) that the hatcheries claim.

Intensive farmers also receive free technical assistance from extension agents sent by feed mills. They can request this service twice a year.

Production

Intensive farmers produce 30 MT per year from each ha. A 15 ha intensive farm will produce 450 MT annually, and these farms produce size 60 – 70 shrimp. Like modernizer ponds, each intensive pond has roughly a 20% chance of failure. But for intensive farmer whose production costs are higher sell output from failed crop for a loss.

Marketing

Output is sold either to a large wholesaler or a wholesaler/broker. Output is marketed by calling the different wholesalers and selling to whoever has the highest price. Many intensive farmers are certified by GAP. However, this does not translate into higher output prices. This only allows wholesalers who buy from them wider market access.

Table 24: Large Intensive Farm – Financial Summary

	Per Kg	Annual (per ha)
Revenues	$3.50	$105,000
Costs	$3.20	$96,000
Gross Margin	$0.30	$9,000

3.4. Output Intermediaries

There are two stages of output intermediation. Wholesalers are the first stage. They assemble, sort, and market to brokers. Brokers transport output to processors and ensure a consistent supply of raw materials for the processor.

Wholesalers

Wholesalers buy (take possession) of farm output. They grade and sort shrimp and sell shrimp through brokers. There appear to be economies of scale as larger wholesalers are able to reduce per kg cost of shrimp wholesaling.

Table 25: Wholesalers – Summary Stratification

	Small	Medium	Large
Population	Lampung: 50 SS: 250	Lampung: 5 SS: 3	Lampung: 3 SS: 0
Output	Monodon	Monodon / Vannamei	Vannamei
Volume output/yr	40 MT	Lmp: 2,000 MT SS: 500 MT	4,000 MT 16,000 MT brokered
Market Share	Lampung: 10% SS: 60%*	Lampung: 40% SS: 20%*	Lampung: 50%

*Shrimp from intensive farmers are bought by wholesaler/brokers from Java (20% of shrimp)

Small Wholesalers

Meso

Currently there are 50 small wholesalers in Lampung and 250 in SS. The number of small wholesalers has declined along with the production of monodon shrimp in both regions. Small wholesalers are located in farming areas.

Capital

The small wholesaler use their residence as a collection point and temporary storage for shrimp bought from farmers. These wholesalers have a number of Styrofoam boxes and a scale to weigh shrimp. Small wholesalers are also typically small traditional farmers. Many also have nurseries or sell small quantities of feed.

Technology & Production

Small farmers buy only monodon shrimp from local small traditional farmers. Small wholesalers typically have long standing relationships with the farmers in the area and compete with perhaps two to three other wholesalers that are in the immediate vicinity. Each small wholesaler sells at standard prices that are set by the brokers to whom they sell.

Small wholesalers ensure adequate supply of shrimp in two ways: (1) They tie farmer output by giving farmer inputs on credit to be repaid in the form of shrimp sold to the wholesaler; (2) Small wholesalers go around the neighborhood and buy “futures” of shrimp from farmers who appear to have a promising crop after two months of culture. However only 10% of farmers get input on credit from these wholesalers, and less than 5% of farmers sell shrimp "futures". The small wholesaler does not set prices and is ultimately at the mercy of the prices that are set by the broker that buys from them.

Small wholesalers also use ice as an input. Keeping shrimp in ice water causes shrimp to artificially gain weight via osmosis. This increases the weight and thus the price of shrimp output. Shrimp is kept in this state for one to four days for two reasons: (1) At least 50 Kg of shrimp must be assembled before selling to brokers; (2) Increase artificial weight gain of shrimp.

It costs 500 IDR ($0.05) to handle one kg of shrimp before selling to the broker.

Marketing

Monodon shrimp that is larger than size 70 is sold to brokers for 47,000 per kg (average price given size variation). The small wholesaler has a preferred supplier relationship with their broker, and they sell almost exclusively to this broker. Shrimp that are smaller than size 70 are sold to domestic wholesale markets for 15,000 IDR per kg. For Lampung, this wholesale market is in Jakarta, while in SS the wholesaler market is on-island in Makassar. Only about 5% of shrimp is smaller than size 70.

The small wholesaler waits about two to three days until between 50 and 100 kg of shrimp has been assembled. Once enough shrimp has been assembled, it is sold to processors through a broker.

Table 26: Small Wholesaler – Financial summary (per kg monodon)

Revenues	$5.00
Costs	$4.75
Margin	$0.25

Medium & Large Wholesalers

There are 5 medium wholesalers in Lampung and 3 in SS. These are small wholesalers that have modernized and expanded to buy vannamei from modernizer and intensive farms in addition to monodon from traditional small farms. These actors are a new type that have started within the last 5 years. Although there are not may, they control the majority of shrimp traded in Lampung, and they are nearly the majority in SS.

There are three large wholesalers in Lampung and none in SS. These wholesalers trade in very large volume and double as brokers for processors. These actors are also new and have started their business within the last 5 years as well.

Capital

Medium wholesalers in Lampung typically do not own vehicles, while in SS medium wholesalers own one small truck. This is because there is a large network of brokers trading vannamei in Lampung who also transport output, while in SS the network is not yet developed.

Large wholesalers typically have two to three large trucks and rent more if needed. Large wholesalers are all forward integrated intensive farms who market their own output in addition to the output of a select group of other large intensive farms.

Technology & Production

Medium wholesalers function as small wholesalers who have expanded to the vannamei variety. A small proportion of their input is monodon shrimp bought near their base or residence. All costs and volumes are the same as a small wholesaler with respect to their monodon trade. In SS, monodon makes up 10% of total volume traded while in Lampung it makes less than 1%.

However, unlike small wholesalers, medium wholesalers trade vannamei shrimp. Both medium and large wholesalers buy, harvest, sort, and sample output in addition to marketing. This is done because vannamei is a more fragile shrimp once out of water. Vannamei must be harvested, sampled, and iced very quickly to maintain freshness. This requires a big team to harvest.

For a large wholesaler, once shrimp has been harvested and sampled, it is loaded onto the wholesaler's truck and sent to processors. The large wholesaler is a broker (preferred supplier) to multiple processors and sells different sized shrimp to different processors depending on the price.

For medium wholesalers, the shrimp is loaded onto the truck of the broker to whom they are selling the shrimp through. Medium wholesalers organize with brokers on a spot arrangement. Price and volume information is agreed upon over the phone.

Wholesalers use labor to harvest, and ice to keep shrimp fresh during handling. Large wholesalers who also transport output incur roughly 800 IDR per kg to harvest, handle, and transport output to processors. Medium wholesalers incur a cost of around 500 IDR per kg harvested and handled.

Marketing

Large wholesalers sell all their output to processors (very small proportion <5% to supermarkets) while medium wholesalers sell all output to brokers. Both wholesalers aim different sized shrimp to different processors to receive the best price for each size of shrimp. Large shrimp of different sizes are distributed to different processors, and small shrimp 100+ are sent to domestic wholesale markets (this consists of < 5% of farm production and only results from crop failures). Transactions are in cash, and are organized in a spot relationship.

Table 27: Medium and Large Wholesaler – Financial Summary (per kg)

	Medium	Large
Revenues	$3.60	$3.70
Costs	$3.55	$3.60
Gross Margins	$0.05	$0.10

On-market Wholesalers

On-market wholesalers are located in fish markets that trade both small aquaculture shrimp and sea caught shrimp. The number of these wholesalers has increased, but informants state that it is not attributed to the aquaculture shrimp, but increased trade in fish. A typical on-market wholesaler trades roughly 200 MT of shrimp per year and there are a total of 10 in Jakarta (serving Lampung), and 2 in SS.

Capital

These actors have a number of stall locations in the fish market. They also own storage buckets and barrels for various fish and shrimp.

Technology & Production

On-market wholesalers buy from small and medium wholesalers who send output through a transportation service to fish markets. Small shrimp are bought for $1.70 per kg on a spot arrangement with off-market wholesalers. Trades are negotiated via cell phones. It costs roughly $0.05 per kg to keep shrimp to be unloaded from trucks, iced, and sold.

Marketing

Output is sold to small retailers and restaurants for $1.85 per kg of small shrimp (100+).

Table 28: On-Market Wholesaler – Financial Summary

Revenues	$1.85
Costs	$1.80
Gross Margin	$0.05

Brokers

Brokers are preferred suppliers for processors. They typically deal only in monodon as large wholesaler/brokers typically buy and sell all of the vannamei shrimp. These actors ensure a stable supply of shrimp to processors, and disseminate market information between wholesalers and processors.

Table 29: Brokers – Summary Stratification

Population	Lampung: 8 SS: 42
Output	Monodon
Output Volume	200 MT
Buys from	Small (and medium) Wholesalers
Markets to	Processors
Output Share	Lampung: 10% SS: 60%

Meso

There are currently 8 brokers in Lampung and 42 in SS. Both sites have experienced a decline of roughly one third of the population in the past five years and the volume of trade for these actors has also decline by 50%.

Capital

Brokers have two or three trucks that hold 8 MT each. This is the only equipment used by this actor.

Marketing

The broker acquires input from small (and medium) wholesalers, and transports shrimp from the wholesaler to the processor. The broker does not take possession of the good, and is only a facilitator to make transactions between wholesalers and processors. Their main purpose is to ensure adequate supply for a processor.

Shrimp is bought from wholesalers at prices issued by the processors. The broker is paid on a per kilo basis. Brokers receive 800 IDR per kg in Lampung and 1,000 IDR per kg in SS. This is due to longer distances that shrimp is transported in SS. The cost to transport one kg of shrimp in Lampung is, on average, 250 while it is 350 in SS.

Table 30: Brokers – Financial Summary

	Per kg (IDR)	Annual (USD)
Revenues	1,000	$20,000
Costs	350	$7,000
Gross Margin	650	$13,000

3.5. Processors

Processors are the end user in Indonesia of 95% of shrimp produced in Lampung and SS. Processors all belong to the Indonesia Cold Storage Association whose main purpose is lobbying the government for support. They have been successful in lobbying the government to open borders to import cheap raw material, vannamei shrimp broodstock. And they have also successfully lobbied for government programs to increase monodon production. The majority of processors are located near major ports, in particular Jakarta and Surabaya. And there is, of course, the world's largest shrimp producer, CP Prima, located in Lampung province.

Table 31: Processors – Summary Stratification

	Small (1st stage)	Large (1st & 2nd stage)
Population	SS: 5 Lampung: 0	SS: 1 Lampung: 2
Output Volume	1,500 MT / yr	6,000 MT / yr*
Output	Frozen Shrimp (Monodon)	Frozen Shrimp and Cooked shrimp (Monodon & vannamei)
Facility	Processing Plant	Processing Plant w/ 2nd stage processing equip
Backward Integrated	Rarely	Intensive Farm
Markets to	Import Wholesalers	Foreign Supermarkets

*not including CP in estimation

Meso

Generally, there are two types of processors. There are small and large processors. Small processors do only 1st stage processing (peeling, deveining, beheading, freezing) while large processors do both 1st and 2nd stage (breading, cooking, making ready-to-eat product).

Small processors typically process only monodon shrimp while large processors process both monodon and vannamei shrimp. The varietal shift of the farmers has caused further concentration of processors. Processors that are able to process and market vannamei were able to triple production in the last 5 years while those who did not have seen significant production declines.

SS has seen a 50% decline in the population of processors. Processors have declined proportional to the decline in monodon production between 2002 and 2009 as a result of disease outbreaks that are affecting nationwide monodon production. Lampung has seen no growth in the population of processors, but the competition for raw materials has increased as processors from Jakarta have built collection points to streamline logistics to acquire monodon shrimp.

Indokom (a large processor in Lampung) processes roughly 30% of the shrimp produced outside of CP (rest is sent to Jakarta) in Lampung. In SS, Bomar (a large processor in SS) processes roughly the same share of output of SS. These shares have grown due to their ability to shift to and market vannamei shrimp. As a result of the introduction of the vannamei variety and the import of vannamei broodstock from other countries, processors that work with vannamei have doubled or tripled production since 2004. But those who have not adopted vannamei processing have faced more competition in input markets and declining production shares.

Small processors process roughly 60% of shrimp produced in SS. Their share has declined due to the decreasing productivity of small traditional farmers in addition to the relatively fast growth experienced by larger processors that process the new variety.

Both small and large processors faced increased export standards from the EU in 2004. Many processors were blacklisted for non-compliance to EU regulations. Blacklisted companies were forced to market shrimp elsewhere or move to new locations that complied with process and facility requirements exacted by the EU. Further traceability requirements were demanded by the US and EU in 2006, which have significantly increased transaction costs for processors sourcing shrimp from many small farmers. Our informants noted that there are still unmet challenges of ensuring full traceability and the chain of custody of shrimp.

Spatial

Most processors near production zones are small 1st stage processing plants dealing primarily in monodon shrimp. Large processors are typically located in Jakarta or Surabaya near major international ports however there is on located in Lampung and one in SS. Most vannamei shrimp produced in Lampung and SS (70% and 80% respectively) is processed in Jakarta or Surabaya by large processors. However, two processors in our study sites (one in Lampung, one in SS) have expanded to 2nd stage processing. Both processors diversified to more value added produce around 2007.

CP Prima is located in Tulang Bawang in Lampung in a remote river delta used exclusively by CP. The remote location offers relatively cheaper land with access to a clean water source. Here, the processing facility, hatcheries, and contracted farmers are managed and monitored closely in a compound. All contracted and integrated ponds are located within the CP area.

Capital

1st stage processing shrimp is a labor intensive process, but it also requires many refrigeration rooms and processing machines. Each processor typically has a lab for testing different parameters. In addition, processing facilities must be built in accordance with EU regulations if exporting to EU. Heightened regulations from the EU in 2004 required many processors to make expensive renovations or move entirely to new locations.

In addition to equipment and facilities used by 1st stage processing plants, 2nd stage processing plants require additional equipment. Equipment like large cooking, breading, processing machines are all imported from foreign firms. Large processors have only recently begun doing 2nd stage processing, and purchase of 2nd stage machines have been made within the last 4 years in our study sites. Indonesian shrimp industry is currently developing and forward integrating into 2^{nd} stage processing. 2^{nd} stage processing may widen market access as importing countries are reported to be demanding more processed products.

Input Procurement

Raw material (shrimp) is sourced from a network of five to ten preferred brokers. There is a tight organization with brokers. Each broker is paid 1,000 IDR per kg supplied. The standard price for monodon shrimp is $4.70 / kg (average kg of shrimp of assorted size) and $3.80 for vannamei shrimp. Large processors in Lampung and SS also own and operate a network of intensive ponds to supply vannamei shrimp as an input to the processing plant.

For vannamei shrimp, processors buy from large wholesaler cum brokers (preferred suppliers). These actors trade in very large volumes and maintain steady supplies of vannamei shrimp for the processor. Each preferred supplier is allowed to sell to other processor as long as minimum quotas are met.

For monodon shrimp, informants have stated that contract schemes are sometimes used by processors to procure shrimp. For example, Indokom (processor in Lampung) used contract schemes in which they extended credit to the farmer, via a small wholesaler in the production area, if the farmer agreed to sell all output to the processor (ADB, 2006). Very similar schemes have been used in the past by Bomar and Wahyu (processors in SS). However, these types of contracts have declined as farmer's side-selling activities have significantly reduced the profitability of these schemes. While farmers initially complied with contract terms requiring farmers to sell all output to creditor processors, farmers learned to deviate profitably. Farmers began selling only enough shrimp to pay back loans and marketing the rest of the shrimp to other local wholesalers. This made the system unprofitable for processors to administer, and this system has largely been abandoned since.

More common today is an “implicit contract” in which a set of small wholesalers act as preferred suppliers to processors (via broker). They have repeated sales with processors through a long standing relationship with a broker in the area. This set of small wholesalers collects shrimp from farmers through spot and contract arrangements and on-sell to the same processor repeatedly. While deviation from these implicit contracts occur, they are relatively rare and happen only if one processor can offer consistently higher prices over a period of time.

CP has a shrimp procurement system unique in Indonesia (but a common system used in pork and broilers in the US and in vegetable export schemes in various countries) since CP began. They use what is referred to as the “nucleus-plasma” system. In this system, small farmers (plasma) are supplied with all inputs (variable, quasi-fixed, & fixed inputs) on credit from CP (Nucleus) to produce shrimp using the semi-intensive technology. These large loans are paid back in the form of shrimp output at harvest time. Farmers are trained and monitored by CP’s own extension/technical staff. Production technology and management practices are disseminated to contracted farmers in this way, to ensure that grades and standards demanded by CP’s customers are met.

While other contract schemes have faced serious side-selling schemes, it is much less common for CP. CP’s contracted farmers are all located in CP’s compound and it is very difficult to sell and transport shrimp outside the complex without being detected by CP. As a result of their remote location and construction, CPs contracts are more easily enforced and controlled. In order to maintain this control, farmers cannot enter into contracts with CP unless they are located within the compound.

Processors with integrated ponds or CP's contract system are able to maintain chain of custody more easily. They have increased market access as they are able to ensure traceability of their shrimp more easily than those who do not have integrated ponds or contract systems to procure shrimp. As global demand for certified product attributes increase, the ability to trace products will grow in importance as well (Oceanic Développement, 2007).

TEXT BOX:
CP PRIMA
The world's largest shrimp producer, CP Prima, started operations in 1980. PT Proteina Prima was founded by Thai company, Charoen Pokphand, and began as a producer of poultry, shrimp, and fish feeds. In 1990, PT Proteina Prima expanded and vertically integrated by buying or building hatcheries, farm operations, and processing plants to become the integrated company it is today. In 2007, CP Prima acquired Dipasena with funds generated by their IPO, which nearly tripled the number of contracted farms (Kristanto & Wong, 2007).

CP is a unique processor Indonesia that is integrated into PL (hatchery) and feed production. Its particular VC is flexible and able to change quickly as CP has complete control over each segment of the VC. As a result, the introduction of the vannamei allowed CP to dramatically increase market share as their quick adoption (from hatcheries to processing) gave them a clear advantage over processors that rely on more spot market type arrangements to procure shrimp.

Technology & Production

Each processing plant employs between 300 and 1,000 employees (depending on availability of shrimp) to process shrimp. They make up the largest proportion of operational costs for the firm. The cost of processing one kg of shrimp is roughly $1.50. The total costs of producing one kg of headless shrimp are as follows. Note that 30 to 40 percent of shrimp weight is lost in processing.

Table 32: Processor – Cost Composition

	Vannamei	Monodon
Shrimp	80%	82%
Electricity	9%	8%
Labor	9%	8%
Other	2%	2%

Marketing

All output is exported to Japan, EU, or US. The Japanese market is a large market for monodon shrimp, however EU and US have become increasingly larger markets as processors began shifting to vannamei production.

The destination of exports differs widely depending on the processor. Each processor appears to choose specific export destinations to specialize in, and their choice of specialization appears to be independent of scale. Each processor typically exports to each of the three major export destinations: EU, US, and Japan. However, the output shares to destination countries differ depending on the firm's specialization. With the introduction of the cheaper vannamei variety, export shares are reported to have increase to US and EU but it is unclear to what extent this has occurred given the heterogeneity of responses from informants.

But what is clear is that frozen raw shrimp is typically sold to importing companies (export destination wholesalers) at the target destination, while more cooked product is sold directly to supermarket chains at export destinations.

Table 33: Processor – Financial Summary (per kg)

	Vannamei	Monodon
Revenues	$8.05	$9.85
Costs	$7.85	$9.35
Gross Margin	$0.20	$0.50

3.6. Domestic Retail

These actors are located in domestic consumption zones and sell shrimp to final consumers in Indonesia. They range in sales volume from 50 kg to 1,200 kg annually. Shrimp sales are reported to have increased by 30-40%, but aquaculture shrimp still remains over 95% for export.

Vannamei shrimp are cheaper than monodon giving vannamei the edge over monodon for Indonesian consumers. The size attribute does not capture price premiums as effectively as in export markets, making vannamei the preferred variety in domestic markets.

Table 34: Domestic Retail – Summary Stratification

	Small	Supermarket
Population	NA	120
Scale	50 Kg / yr*	1.2 MT / yr*
Output	Vannamei	Vannamei & Monodon
Facility	Small Stand	Supermarket

*Only 30% of volume originates from study sites.

Meso

The population of small retailers is unknown, but what is clear is that these actors have only recently (within the last 4 years) begun selling aquaculture shrimp. These actors are located in local-wetmarkets and sell mostly fish and sea caught shrimp.

Currently, there are around 120 supermarkets that buy aquaculture shrimp from our study sites. Supermarkets started buying shrimp only 3 years ago and have increased volume sold by around 40% since then. However, the amount of aquaculture shrimp from Lampung and SS that is sold in domestic retail channels are small (< 5%)

Vannamei appears to be sold as a cheaper substitute ($4/kg) for wild caught shrimp, while monodon of the largest size (size 10+) is sold as a premium product for $15 per kilo at retailers.

Capital

Small retailers have a stall in the local wet market. And ice boxes to store their products. Supermarkets have refrigerated displays and ice trays to keep shrimp fresh for up to three days, in addition to having a prime location usually within a mall.

Technology & Production

Small retailers buy vannamei shrimp from the wholesale market. These are spot transactions. Small retailers sell only vannamei while supermarkets sell both products (not all supermarkets carry aquaculture shrimp).

Monodon shrimp is bought from a 1st stage processor. But the volume of purchase is very small. Supermarkets get a delivery of 5 kg of shrimp daily (along with other fish) from a preferred processor. Volumes are small but consistent, and the supermarket only buys premium size 10+ shrimp.

Vannamei shrimp is bought from a preferred supplier (a shrimp wholesaler/broker) from a preferred supplier. Minimum volumes are agreed upon and have an implicit contract system of minimum volumes and prices. While most supermarkets do not require farm certification, Carrefour requires farms to be certified by Carrefour's own HQL scheme. Carrefour also requires full traceability to the pond. Small retailers buy small (100+) and normal (70) size shrimp from on-market wholesalers in the area.

Shrimp is kept cold using ice for 3 days. Total handling and display costs is around 3,000 IDR per kg for monodon and 1,000 IDR for the smaller vannamei. Handling and display costs were similar for supermarkets and small traditional retailers.

Table 35: Retailers – Cost Composition

	Vannamei (size: 70)	Monodon (size 10)
Shrimp	$3.50	$11.00
Handling	$0.10	$0.30

Marketing

All output is marketed in cash as spot arrangements. The price of output is 40,000 IDR per kg of size 70 vannamei shrimp and 150,000 IDR per kg of size 10 monodon. Small retailers also sell small vannamei shrimp for $3.00 per kg..

Table 36: Retailers – Financial Summary (per kg)

	Vannamei (size 70)	Monodon (size 10)
Revenues	$4.00	$15.00
Costs	$3.60	$11.30
Gross Margin	$0.40	$3.70

4. VC Taxonomy

4.1. Traditional

The traditional VC is a stagnant VC. This VC only produces and delivers monodon shrimp. This VC is stagnant and declining quickly in production share in each of the study sites. However, the structure of organization has not changed over time. It has simply scaled down in population and in volume flows.

In Lampung less than 2% of shrimp moved through this VC, while five years ago this channel moved up to 10 percent of shrimp. In SS, this VC currently moves 48% of shrimp down from 80% 5 years ago.

Figure 1: Value Chain - Traditional

This VC is a funnel of shrimp. Traditional farmers sell small quantities (< 10 kg) to wholesalers. Small wholesalers send shipments of around 50 kg to brokers. Brokers collect 200 kg to send to processors. The primary activity of output intermediaries in this VC is to assemble enough shrimp to transport cost effectively. As a result, shrimp has to be kept longer which deteriorates quality and increases handling costs.

Also as a result of small shipment sizes, the transaction costs per kg of shrimp is very high compared to that of other VCs. Traceability, for example, is nearly impossible when one shipment of shrimp to a processor contains shrimp from hundreds of farmers.

The small scale of farmers also means that they pay higher prices for inputs such as feed and PL. Small traditional farmers that buy small quantities and are located in remote areas require long VCs to deliver inputs.

Wholesalers and brokers operate on a more rigid structure of preferred supplier relationships. While there are no contracts, either verbal or written, most actors sell repeatedly to the same actor. Generally, mismanagement and production problems appear to be the primary hindrance to growth and efficiency of the sector. The profit incentives appear to be in place for this VC, but technical production issues appear to be hindering its expansion. As a result of the above factors, this VC is the most inefficient in delivering in every aspect that this study will assess the performance of the VC.

Table 37: Value Chain – Traditional – Financial Summary

	Costs (% total cost)	Gross Margin (% total profit)
Farmer	$3.00 (73%)*	$1.70 (65%)
Wholesale	$0.05 (1%)	$0.15 (6%)
Broker	$0.04 (1%)	$0.06 (2%)
Processor	$1.00 (24%)	$0.70 (27%)
TOTAL	**$4.09**	**$2.61**

*Figure is cost per kg of expected output accounting for 40% probability of failure

4.2. "Modernizing VC"

This VC moves only vannamei shrimp. This is a new VC that has emerged within the last 3 years and is still in its early stages of development. It appears to be expanding rapidly and overcoming significant barriers to modernization. Since its beginning (in 2005-2006), it has gone from 0 to 14% of total production in SS and from 0 to 10% (58% counting CP's plasma) in Lampung. This VC is a source of tremendous growth in Indonesian shrimp production.

Figure 2: Value Chain - Modernizing

Unlike the traditional VC, the output intermediaries do not function to assemble output because the farmers harvest enough quantity at once transport profitably. This allows farmers to sell to wholesalers less dependent on geographic location.

Also, as the output intermediaries modernize to market the output of modernizing-small-farms, their main role switches from output assembly to output marketing. The larger shipment allows wholesalers to split the destination of different sized shrimp to capture the highest price for each size of shrimp harvested. Wholesalers, thus, are able to market to different wholesaler/brokers, or off-island brokers depending on their prices. Wholesalers are no longer dependent on brokers to assembly their output to sell profitably.

The majority of vannamei shrimp is sold to off-island processors. Over 70% of vannamei (not counting CP) is sold to processors in Jakarta, while 80% of vannamei (excluding processor production) in SS is sold to processors in Surabaya. As a result of these factors, the VC becomes more efficient compared to the traditional channel.

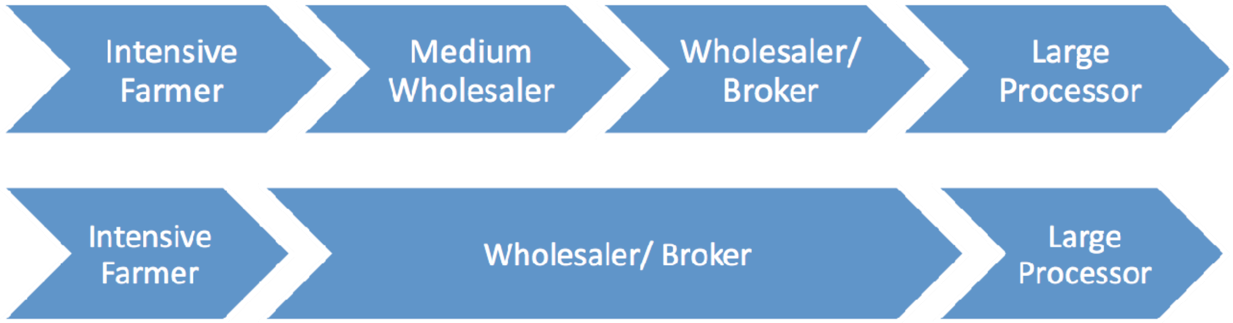
Table 38: Value Chain – Modernizing – Financial Summary

	Costs (% total cost)	Gross Margin (% total profit)
Farmer	$2.10 (66%)	$1.40 (81%)
Wholesale	$0.05 (2%)	$0.05 (3%)
Broker	$0.02 (1%)	$0.03 (2%)
Processor	$1.00 (32%)	$0.25 (14%)
TOTAL	**$3.17**	**$1.73**

4.3. Modern

This VC moves only vannamei shrimp. It consists of only large actors moving large quantities each. This VC has grown in size to moving 80% (excluding CP) in Lampung, and 14% of shrimp in SS. This is a completely new channel in SS, and one that has significantly grown in Lampung within the last 5 years. For the most part, it appears that the VC quickly expanded from 2004 to 2006 and has since leveled off and had a moderate decline in 2008 – 2009 due to the outbreak of disease and deteriorating water quality.

Figure 3: Value Chain - Modern



This VC is very similar to the modernizing VC. However, farmers have an option to sell directly to large wholesalers who broker directly to large processors. Harvesting, handling, and marketing are the major functions of the output intermediary. Again, the majority of vannamei shrimp is sold to off-island processors. Over 70% of vannamei (not counting CP) is sold to processors in Jakarta, while 80% of vannamei (excluding processor production) in SS is sold to processors in Surabaya. Only the modern channel in Lampung delivers shrimp to supermarkets.

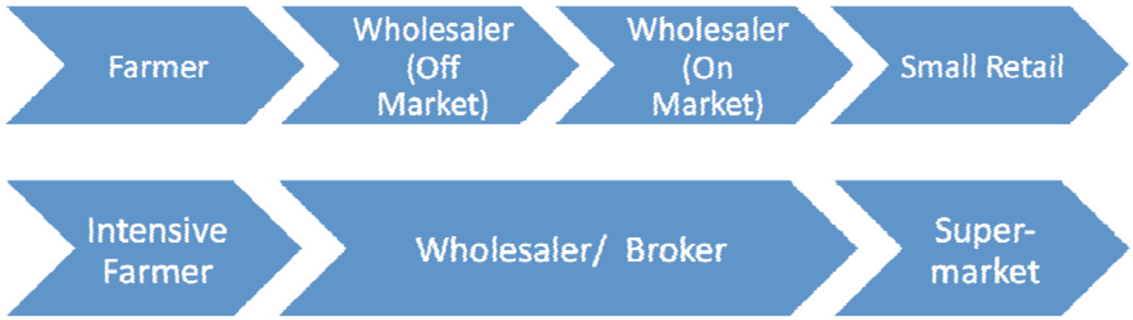
Table 39: Value Chain – Modern – Financial Summary

	Costs (% total cost)	Gross Margin (% total profit)
Farmer	$3.30 (76%)	$0.30 (46%)
Wholesaler/Broker	$0.07 (2%)	$0.10 (15%)
Processor	$1.00 (23%)	$0.25 (38%)
TOTAL	**$4.37**	**$0.65**

4.4. Domestic

This VC moves both vannamei and monodon shrimp. But it is dominated by vannamei shrimp. This VC has grown in the last 5 years fueled by lower prices and growing incomes. It is estimated to move less than 5% of shrimp produced in Lampung and SS.

Figure 4: Value Chain - Domestic



This VC exists as a market for failed shrimp production. Only shrimp harvested too early due to disease problems goes through this VC. The shrimp sent to domestic markets is size 100+. The prices in the domestic market have risen $0.20 per kg which acts to soften the blow of crop failures by farmers.

VC to domestic supermarkets is identical in costs and margins for the modern channel. However, the VC to small domestic retailers is quite different.

Table 40: Value Chain – Domestic – Financial Summary

	Output Price	Costs	Gross Margin
Farmer	$1.50	-	-
Wholesale (off)	$1.75	$0.15	$0.10
Wholesale (on)	$1.85	$0.05	$0.05
Small Retail	$2.25	$0.10	$0.45

REFERENCES

ADB (Asian Development Bank). 2006. *Indonesia: Strategic Vision for Agriculture and Rural Development*. Jakarta: Asian Development Bank.

Development Alternatives Inc. (DAI), 2006. *A Value Chain Assessment of the Aquaculture Sector in Indonesia*. Report to USAID.

Departamen Kelautan dan Perikanan. 2004-2008. *Statistik Perikanan Budidaya Indonesia. Direktorat Jenderal Perikanan Budidaya.* Jakarta, Indonesia

FAO. 2007. FishStat Plus Version 2.3, at www.fao.org/fi/statist/FISOFT/FISHPLUS.asp [accessed December 5, 2009].

International Finance Corporation. 2006 *Improving Indonesia's Competitiveness: Case Study of Textile and Farmed Shrimp Industries.* Washington DC: IFC.
Kristanto, H. and F. Wong. 2007. *Central ProteinaPrima*. Report for PT BNP Paribas Securities Indonesia

Martinez Cordero F., W. Fitzgerald Jr, and P. Leung. 1999. "Evaluation of productivity in extensive aquaculture practices using TFP Index, Sulawesi, Indonesia," *Asian Fisheries Science* 13(1999): 223-234.

NACA. 2006. "Evaluation of the Impact of the Indian Ocean Tsunami and US Anti-dumping Duties on the Shrimp Farming Sector of South and Southeast Asia." Kuala Lumpur: Network of Aquaculture Centers in Asia-Pacific.

Oceanic Développement. 2007. "Specific convention No. 3: rules of origin in preferential trade arrangements: new rules for the fisheries sector" Draft Final Report.

Oktaviani, R., N. Nuryrantono, T. Novianti, M. Irfany. 2007. *Investigation of Contract Farming Options for Shrimp Production.* Report to ACIAR. Bogor: Economics Department, Bogor Agricultural University.
Reardon T., R. Natawidjaja, and D. Yi, 2009a. *Report on Initial Reconnaissance Trip to Bali and Makassar, Indonesia (with a comparison with Lampung) for Shrimp Component*. Report to ACIAR, deliverable on Task 2.A.1. of IFPRI/ACIAR project. June.

Reardon T. and R. Natawidjaja, 2009b. *Report on Initial Reconnaissance Trip to Lampung, Indonesia for Shrimp Component*. Report to ACIAR, deliverable on Task 2.A.1 of IFPRI/ACIAR Project. May.

Yi D., T. Reardon, H. Harahap A. Vebiliyanto, R. Natawidjaja, 2009a. *Inception Plan Document, Shrimp VC KI.* Report to ACIAR, deliverable on Task 2.A.2-4 of IFPRI/ACIAR Project. October.

Yi D., T. Reardon, H. Harahap A. Vebiliyanto, R. Natawidjaja, 2009b. *Report of Second Reconnaissance Trip in Lampung, Makassar, and Jakarta for Shrimp Component*. Report to ACIAR, deliverable on Task 2.A.1 of IFPRI/ACIAR Project. August.

ANNEX A1: Interviewee Sample

Segment (type)	Step	Lampung		South Sulawesi	
		Name	Location	Name	Location
Nauplii Retailer	KI				
		Jajang	Kalianda	Edi	Barru
Hatchery	KI				
Large		Henry	Lampung Selatang	Edi Susanto	Barru
				Benur kita	Barru
Small		Hermanto	Kalianda		
		Mahfud	Kalianda	Fitri	Barru
		Jajang	Kalianda	Darwis	Barru
		Guna Rindu	Kalianda	Amirullah	Barru
		NN	Kalianda		
Large	Recon	Frans	Lampung Selatang	Benur Kita	Barru
				Balai Benih	Barru
Small		Mahfud	Kalianda	NN	Barru
				NN	Barru
Nursery	KI	Tony	Pasir sakti	Basir	Pinrang
		Saipudin	Pasir sakti	Ari	Pinrang
		Imam	Pasir sakti	Haluddin	Maros
				Natsir	Maros
Farm					
Intensive	KI	Cobra	Kalianda	Vincent	Takalar
		Henry	Lampung Selatan	Johan	Takalar
		Suparman	Sriminosari		
Semi intensive		Nuri	Sriminosari	Zaadi	Pare-Pare
		Marsan	Sriminosari	Tahir	Pare-Pare
		Tuti	Sriminosari	Dedi	Barru
Traditional		Edi	Sriminosari	Umar	Pinrang
		Jumar	Sriminosari	H. Alimuddin	Pare- pare
		Tony	Pasir sakti	Ari	Pinrang
		Yanto	Pasir sakti	Basir	Pinrang
		Sumiran	Pasir sakti	Bustami	Pinrang
		Priyono	Pasir Sakti	NN	Takalar
Intensive	Recon	Phillip	Lampung Selatan	Hassan	Barru
		Henry	Lampung Selatan	NN	Barru
		Suparman	Sriminosari		
Semi intensive		Marsan	Sriminosari	Dedi	Makassar

Traditional		Eddi	Sriminosari	NN	Pangkep
Wholesaler	KI				
Small		Mahmud	Sriminosari	H. Alimuddin	Pare - pare
		Sam	Sriminosari	Aswan	Pangkep
		Saipudin	Pasir Sakti	Anwar	Pangkep
		Imam	Pasir Sakti	Roy	Takalar
Medium				Nasir	Makassar
Small	Recon	Mahmud	Sriminosari	Herman	Makassar
				Nasir	Makassar
				Mahmud	Pangkep
Shrimp Feed	KI				
		Denny	Jakarta		
		Denny	Jakarta		
Feed Whl/Ret	KI				
Retailer		NN	Pasir Sakti	NN	Pangkep
Small Whl/Ret		Gapur	Sriminosari	Saruddin	Barru
		Sams	Tj. Karang	Herman	Pangkep
Large Whl/Ret				Dedi	Makassar
	Recon			Dedi	Makassar
Broker	KI	Sumadi	Sriminosari	Hatina	Pinrang
		Son	Sriminosari	Mansyur	Pangkep
Processor	KI	A. Saputra	Tj. Karang	Hasan Wijaja	Makassar
				Sitomas	Makassar
				Herson Sentosa	Makassar
	Recon	A Saputra	Tj. Karang	Tigor	Makassar
Retail	KI				
Large		Makro	Jakarta		
		HyperM	Jakarta		
Small		NN	Jakarta	NN	Makassar
DKP Province	KI			Sulkab	Maros
	Recon	NN	Tj. Karang	NN	Makassar
				NN	Makassar
Balai	KI			Sugeng	Takalar
				Nasir	Pangkep
	Recon			Syarif	Maros
				Nasir	Pangkep
SCI	KI			Saenong	Makassar
		Sekjen	Tj. Karang	Andi Tamsil	
	Recon	Yosef	Tj. Karang	Numerous	Bali
		Ismail	Tj. Karang		
		Iwan	Jakarta		
		Narto	Tj. Karang		
Total interview			52		59

ANNEX A2:Interview Guide

Input Procurement (now and 5 years ago)

Identify all inputs used, and for each input:
[repeat these questions for each input]

1. What is the total volume bought?
2. What is the price?
3. What is the periodicity in the procurement of each input (frequency/time)?
4. What is the location of input providers? What is their type?
5. What are the methods of coordination and terms of sale (spot-market, contract, cooperative, credit, discounts) between farmer and input provider?
6. What are the constraints (if any) to input procurement (minimum order, access, etc)?
7. What are the determinants of quality, method of detection, and price premium?

Identify all production activities, and for each activity (example: prep, growout, harvest, handling, etc)

1. What are all the activities involved in this period?
2. How much own and hired labor is used and at what intervals?
3. How much of each input is used and at what intervals?
4. What are the exogenous shocks and risks in production (i.e.. disease rainfall, temperature, water quality, electricity)?

Output Marketing (now and 5 years ago)
[repeat these questions for each output item]

1. What is the total volume sold?
2. What is the price?
3. What is the periodicity for selling (frequency/time)?
4. Where are the output markets?
5. How much is sold to each type of buying agent (collectors, suppliers, other)?
6. What are the methods of coordination and terms of sale (contract, credit, etc) between farmer and collector/buying agent (wholesale, broker, processor)
7. What are the d determinants of quality, method of detection, and price premium

Capital (now and 5 years ago)

1. Land
    a. How big is the farm?
    b. How much land is in production?
    c. Is the land rented or owned? If rented, what are the terms?
2. Financial
    a. How is the farm financed? Credit?
    b. Does the household have any other sources of income (i.e.: other jobs,

investments)
c. How much and how often is pay received?

3. For each quasi-fixed capital “X” (equipment: machines, trucks, nets, containers, etc): [repeat these questions for each equipment item]

a. What are all the kinds of equipment that the farmer uses?
b. How many X is used?
c. What is the price paid per unit?
d. What is the price to each the unit?

4. Human

a. How many years of experience operating/owning farm?
b. What is the farmer’s highest level of education?
c. Has the farmer had any training in aquaculture?

5. Organizational

a. Is the farmer a part of any relevant organization?
b. If so, what are their activities and objectives?

6. Government

a. What are the relevant regulations and policies?
b. What are the relevant government programs?
c. What is the quality of infrastructure? How has this changed?

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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 = β_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 = β_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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References:

ACIAR. 2007. Improving productivity and profitability of smallholder shrimp aquaculture and related agribusiness in Indonesia. *Project Document, Ref ACIAR FIS/2005/169*. pp 1-3.

Ameur C 1994, *Agricultural extension, a step beyond the next step*, World Bank Publication, Washington DC.

Anderson JR 2007, 'Agricultural advisory services' in Anderson JR (ed), *Innovating through science and technology: a Background paper for the World Development Program 2008*, World Bank, Washington DC, pp. 2-36.

Boomgard P 1987, 'The welfare services in Indonesia 1900-1942', in L Blusse and A Booth (eds.), *India and Indonesia From the 1920s and the 1950s*, Origin Planning, London, pp 57-82.

Briones RM 2008, Post-tsunami livelihoods from coastal aquaculture in the east coast of Aceh - Analytical Report: *Report to FAO, ref. FAO - OSRO/INS/601/ARC 'Rehabilitation and Sustainable Development of Fisheries and Aquaculture Affected by the Tsunami in Aceh Province*, Indonesia', pp. 35.

Herianto AS 2004, 'Determinant factors in the adoption of intensive leaf banana cropping system in a mountainous village of Java: logistic model based on plotwise data', *Journal of Rural Problems* 155 (40/2): 23-33.

Leta R, Murray R, Rola-Rubzen MF 2005, 'Factors constraining extensión workers effectiveness in improving horticultural production: a case study from West Timor Indonesia', *Acta Hort*. (ISHS) 672: 205-210

Nuraini, K, 1977, *Penyuluhan pertanian*, Fakultas Pertanian, Universitas Gadjah Mada (Skripsi - unpublished)

Nurjana ML 2008, Current Situation of Aquaculture in the National Economy: Historical Development of Aquaculture in Indonesia, in (Anonimous), *Eco friendly fish farm management and safe aquaculture production*, Food and Fertilizer Technology Centre for the Asian and Pacific Region, Taiwan. pp. 19 (*http://www.agnet.org/library/vbk/55/)*

Payne G and Payne J 2005, *Key concepts in social research*, Sage Publication Ltd Book, London

Purwanto B 2002, 'Peasant economy and institutional changes in late colonial Indonesia', a Paper presented to "*International conference on economic growth and institutional change in Indonesia in the 19th and 20th centuries*", Amsterdam 25-26 July 2002: 1-23.

Quizon J, Feder G and Murgai R 2001, *Fiscal sustainability of agricultural extension: The case of the farmer field school approach*, Development Research Group, World Bank Technical Paper, The World Bank, Washington DC. pp. 17

Setiawan N 2006, *Perkembangan konsumsi protein hewani di Indonesia: analisis hasil susenas 1999-2004, Fakultas Peternakan*, Universitas Padjadjaran. pp. 15 (unpublished)

Sumintaredja S 2001, *Penyuluhan pertanian*, Yayasan Pengembangan Sinar Tani, Jakarta .

Suryana A and Erwidodo 1996, Agricultural policy reforms in Indonesia: accelerating growth with equity. Food and Fertilizer Technology Centre for the Asian and Pacific Reg, Taiwan. pp. 15 (*http://www.agnet.org/library/eb/434/)*

The World Bank 2002, *World Bank Development Report 2002*: Building institutions for market, Oxford University Press.

Thorbecke E and Pluijm T 1992, *Rural Indonesia: socioeconomic development in a changing environment*, NYU Press, New York.

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Adapting extension approaches to cultural environments in South East Asia: experiences from Laos and Indonesia

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Abstract. This paper describes the author's experience with adapting extension approaches to different cultural and geographical environments in South East Asia. These experiences include assistance with designing, implementing and evaluating government extension programs for livestock and aquaculture in Laos and Indonesia. Funded by the Australian Centre for International Agricultural Research (ACIAR), the work involves 1) researching effective ways to scale out smallholder livestock production in five ethnically diverse provinces of Laos, 2) designing culturally appropriate extension systems for shrimp production in Central Java and South Sulawesi in Indonesia, and 3) conducting and evaluating extension training in both countries. The three key learnings are that adapting extension approaches in South East Asia requires 1) sensitivity to cultural norms and individual household aspirations, 2) close and intensive mentoring of district and provincial extension staff using an action learning process and 3) embedding understanding of extension theory and practice throughout institutions.

Introduction

What do prawns and forages have in common? Not much at all technically, except smallholder farmers in South East Asia depend on shrimp aquaculture and raising livestock for income generation. These enterprises require knowledge of intensive practices to prevent disease, provide optimal nutrition, control breeding, manage waste and market end products. Government extension services can play a key role in facilitating farmer learning of best management practices in South East Asia. However, these services are hampered by top-down institutional structures and government inertia, lack of resources, and poor links between researchers and extensionists (often with limited technical skills). Extension staff often lack participatory skills when working with different cultural groups, further reducing their effectiveness in assisting farmers.

This paper describes the authors experience with adapting extension approaches to different cultural and geographical environments in South East Asia. These experiences include designing, implementing and evaluating government extension programs for livestock and aquaculture in Laos and Indonesia. Funded by the Australian Centre for International Agricultural Research (ACIAR), the work involves researching effective ways to scale out smallholder livestock production in five ethnically diverse provinces of Laos, designing culturally appropriate extension systems for shrimp production in Central Java and South Sulawesi in Indonesia, and conducting and evaluating extension training in both countries. The aim is to facilitate adaptive approaches to extension to suit different social and cultural environments.

The first section of the paper outlines the nature of smallholder farming systems in South East Asia and their precarious links with people's livelihoods. The role of government extension services and donor aid projects is then described including their strengths and weaknesses in assisting rural communities. The third section details the extension research and consultancy work conducted in Lao and Indonesia over the past seven years using examples and vignettes. Finally, lessons are drawn on strategies for adapting extension to different cultural environments including the three key learnings. These are that adapting extension approaches in South East Asia requires sensitivity to cultural norms and individual household aspirations, close and intensive mentoring of district and provincial extension staff using an action learning process, and embedding understanding of extension theory and practice throughout institutions.

Smallholder farming systems in South East Asia

The majority of farmers in countries of South East Asia (for example, Indonesia, Philippines, Vietnam, Cambodia, Laos or Thailand) own and/or manage very small areas of land (up to five hectares). For this reason, farming households are often referred to as 'smallholder farmers' or 'smallholders'. Small holdings are prevalent due to high populations, the constant subdivision of land to family members and government-controlled allocation of land. The main driver is persistent poverty as families struggle to make enough money to buy more land. Sometimes they lose their land to money lenders, banks or corrupt officials. Thus smallholders often live in precarious situations. Their focus is primarily on producing enough food for their families with any surplus being sold or exchanged within villages or at local markets.

Smallholder farming systems traditionally vary according to climatic and soil conditions (for example, growing upland or lowland rice varieties, growing cassava in poor soils or fruit trees in good soils). However, in areas with access to markets, smallholders are increasingly growing cash crops, livestock and fish products. Their land area may not change but they adopt more intensive practices in order to produce higher quantities of produce whilst maintaining quality. The requirement for more inputs, loans or labour can put smallholders at risk if the crop fails or they are unable to repay loans. Inadequate knowledge or experience with new farming systems can often lead to substandard produce, land degradation and system failure over time.

Smallholder families can sometimes end up worse off than before, thereby plunging them further into poverty. Options are to go back to a more subsistence lifestyle (if resources are available and the land is not irreversibly damaged), sell their labour to more wealthy landowners, sell their land and seek off-farm work or keep going in the hope that the next crop will succeed. Of course, some farmers do succeed if they can respond to market signals and learn to adapt or diversify their enterprises (Pretty et al. 2005). The ability to do this requires a combination of inherent business sense, access to a range of technologies and options, good networks and some financial buffering within the household budget (Millar and Photakoun 2008). The extent to which extension services (government, private and non-governmental organisation) assist smallholders in this regard is examined in the next section.

The role of extension services and donor aid projects in assisting smallholder farmers

Government extension services have been present since the post colonial era in South East Asia (1930s). Over the past 70 years there has been a shift away from dealing with large commercial plantations and industries to assisting smallholders as the vast farmer majority in most countries. During the 1970s and 80s, extension services were centralised, unified and delivered in a top down manner (Van den Ban and Samantra 2006). Since then, the growth in development aid from overseas donors has created a desire for more decentralised, participatory or bottom up extension approaches (Race and Millar 2006).

At the same time, smallholder farmers have been drawn into cash economies as their countries develop, creating opportunities to increase income whilst presenting technical, social and environmental challenges. Government research and extension agencies have traditionally worked on transferring information to farmers on what they see as useful technologies to increase productivity and gain access to markets. As farmers engage with markets and industries, the private sector becomes an alternative source of advice and inputs. In contrast, pro-poor rural development has largely been the domain of the non-government sector (Christoplos and Farrington 2004; Van den Ban and Samanta 2006). However, these roles are changing and merging as research and development partnerships are forged (Stelling and Millar 2009).

The strength of government extension services is their mere presence throughout countries and regions of South East Asia. Extension staff can be found in most districts and provinces, albeit in small numbers in remote areas. Government extension services are free and farmers can visit government offices anytime to seek advice or permits. However the ability of extension staff to work effectively with farmers varies considerably. A major constraint is lack of government funding to visit villages or carry out field activities. Staff are often confined to their office carrying out administrative or regulatory duties. Another limitation is the relatively low education level of extensionists in some countries (agricultural high school or low diploma at colleges), and reliance on volunteer or contract staff (Photakoun and Millar 2009).

Government extension services are also hampered by top-down institutional structures and government inertia, ongoing lack of resources, and poor links between researchers and extensionists (often with limited technical skills). Extension staff can lack participatory skills when working with different cultural groups, particularly ethnic minorities who are not well represented in government agencies (see example of working with Hmong farmers in Laos on page 3). Nevertheless, government staff can have strong links with industry groups and can take advantage of donor funding. They have the potential to play a key role in facilitating farmer learning of best management practices in South East Asia.

Private sector extension services can be effective for contracted farmers or to fill niche services not offered by government agencies. In South East Asia, industry extension is present in more built up areas and for smallholders who can afford their services or who are purchasing company inputs. Examples are aquaculture feed companies, animal health service providers and crop fertiliser or chemical companies. Whilst smallholders can increase their production per hectare using private sector extension, if the market or system fails and they need to diversify, they can be left high and dry (see example of shrimp farming in Indonesia on page 4). Non-government extension providers tend to focus on community development, sustainable agriculture and biodiversity conservation projects with smallholder farmers. The strength of development workers is their ability to galvanise communities into action, involve poor households and facilitate credit systems. Their weakness is lack of technical knowledge and skills to assist farmers, although they are increasingly accessing information and contracting government staff to their projects.

Adapting extension approaches to cultural environments in Laos and Indonesia

Since 2002, I have been conducting extension research and training in Laos and Indonesia. Funded by the Australian Centre for International Agricultural Research (ACIAR), the work involves:

9. Researching effective ways to scale out smallholder livestock production in five ethnically diverse provinces of Laos.
10. Designing culturally appropriate extension systems for shrimp production in Central Java and South Sulawesi in Indonesia.
11. Conducting and evaluating extension and social dimensions training to build capacity of ACIAR project leaders and extension staff.

In the vignettes presented below, I describe the process taken to adapt extension approaches in each situation.

Refining extension approaches in the uplands of Laos

From 2002 to 2005 I was involved in the Forage and Livestock Systems Project (FLSP) funded by AusAid and managed by CIAT Asia (International Centre for Agricultural Research). My role was to assist with extension training and evaluate the impacts of extension activities on farmers and staff. When I joined the project, government extension officers assigned to the FLSP had already been establishing forages with target villages and farmers, as well as facilitating livestock groups across five districts in two provinces. The FLSP wanted to accelerate expansion within districts and needed to design, trial and evaluate a range of extension mechanisms to do this. At this stage, staff worked with mainly two ethnic groups, mostly men and more wealthy households who already had livestock and land.

We embarked on training extension staff in how to identify household impacts (positive and negative), how to develop case studies to show other farmers, how to conduct cross village visits and how to facilitate village meetings (Millar et al. 2005). Within two years, the number of households growing and using forages doubled to 1400, serviced by 26 extension staff working in team pairs (Millar and Connell 2009). The AusAid project had done its job in assisting farmers to increase their income and reduce labour by cutting forages and fattening animals. The extension methods had proved do-able and effective in a general sense. However, we had not engaged poorer households or more remote ethnic groups or tailored our extension methods to womens needs.

The Asian Development Bank agreed to fund further expansion of livestock production to three additional provinces targeting the poorest districts, villages and households. A new batch of government extension staff were trained in 2006/7 to use the same extension methods with ex-FLSP staff as their mentors. These new extension officers are working with more Hmong and Khamu farmers in remoter areas. Although most of the staff are lowland Lao (Lao Loum) and cannot speak Hmong or Khamu language, we encouraged them to organise cross visits that focussed on the specific needs of their farmers. In July 2008, district staff took Hmong cattle farmers from Koun district to visit experienced Hmong cattle producers in Nonghet district within the same province. Farmers were able to talk in their own language and find out exactly what to do regarding feeding, vaccination, buying and selling cattle (see Plate 1) Visiting farmers were asked to prepare questions for host farmers beforehand, and a feedback session was held at the end of the day to reflect on what they had learnt by presenting in small groups (new techniques introduced).

A cross visit for women involved in pig production was also held in the same month by staff from another province. Twelve women (mostly Lao Loum and Thai Deng ethnicity) from Huaphan province in the remote north east bordering Vietnam, travelled for a day to reach Pak Ou district in Luang Prabang province. The women host farmers showed them how to make dried stylo meal as a supplement for pig rations, how to prevent diseases and how to raise piglets. A concerted effort was made to keep male extension officers in the background so as not to inhibit the women's discussion (see Plate 2). Female extension officers were chosen to facilitate the field trip as well as group feedback session. Each host farmer was given a gift as appreciation (a suggestion from previous cross visits where attendees felt the host farmers were not adequately thanked or compensated). Additional refinements made to cross visits were reducing the number of people, allowing more time for travel and recovery, focussing on one livestock species and following up farmers after the cross visit.

Plate 1. Hmong farmers in Laos: learning how to fatten cattle for Vietnam markets

Plate 2. Let the women talk! facilitating discussion on pig feeds amongst Lao Loum and Thai Deng women in Laos

Extension approaches are being continually modified as the project scales out to new districts and villages. Case studies are being developed by staff to represent the full range of ethnic groups, wealth status, women and men, livestock types, forage types, feeding methods, economic returns and livelihood benefits. The cultural requirements and information needs of Hmong and Khamu people are being researched and will be incorporated into extension training and approaches. Partnering with NGOs also needs to be considered.

Introducing BMPs to smallholder shrimp farmers in Indonesia

In 2008, I started working with an ACIAR project on improving the productivity and profitability of smallholder shrimp aquaculture and related agribusiness in Indonesia. The shrimp aquaculture industry in South East Asia has suffered severe crop declines due to white spot virus since the mid 1990s. Smallholders have been hit particularly hard as they invest considerable infrastructure in establishing ponds and canal systems. Highly intensive control measures are beyond most smallholders, leaving large producers at a competitive advantage. However, scientists and extensionists in India were able to develop a series of best management practices (BMPs) through collaborative efforts of village groups called 'aquaclubs' and field officers.

The BMPs involve establishing biofilter ponds around infected ponds and stocking them with finfish or virus resistant crabs. The infected ponds are harvested and re-stocked with virus free larvae from hatcheries. The whole process requires collaboration between farmers as they may own only one pond. It also requires constant monitoring of water quality and shrimp health, so it is a lot more complex than growing forages and fattening livestock!! In East Java, Australian scientists worked closely with Indonesian researchers to successfully control white spot in traditional demonstration ponds in one location. However, they needed to see if it would work in other districts so demo ponds have been set up in Central Java and South Sulawesi. A technical officer resides in the village, takes daily measurements and liaises with shrimp farmers regarding pond management and harvesting. Researchers from the provincial aquaculture research station oversee the whole operation. Results have been mixed with a successful harvest in Central Java but failed crops in South Sulawesi, due to environmental conditions.

The missing link in the shrimp project was extension. There was very little engagement of district extension staff (known as Dinas) to enable further trialling of the BMPs with a greater range of farmers. There was also no socio-economic information on the livelihoods of shrimp farmers and factors likely to influence their interest in or use of BMPs. Bring in the social scientists!! A socio-economic survey was designed with rural sociologists from by Gajah Madah and Hasanuddin Universities and conducted with 60 households in each site. The results gave indications of current profitability of shrimp systems, the household economy, awareness and use of basic BMPs, information sources and farmer group characteristics. On the basis of potential farmer interest and the high level of provincial government support, the project has decided to expand operations to another four farmer groups in 2009 to see if the BMP concept has legs (known as proof of delivery).

District extension staff have been trained in the technical and social aspects of implementing BMPs with farmers using a range of extension methods. They will be mentored by provincial coordinators and researchers from the Brackish Water Aquaculture Centre in Central Java. A field guide will be produced as an extension tool. The challenges identified by extension staff are many, including acid sulphate soils, leaky ponds, loss of farmer confidence in shrimp and conversion to growing seaweed, lack of credibility with farmer groups, lack of extension skills, and lack of monitoring equipment. It's a big ask, and we have yet to see if they are up to the challenge. Adaptation of extension approaches will be needed across the different locations, and partnerships formed with the private sector and NGOs as in Aceh. Nevertheless, government officials and scientists think it is worth a try to rebuild the valuable shrimp industry by managing white spot virus using biological control systems.

Plate 3. A shrimp farmer in Indonesia discusses the impact of white spot disease with aquaculture spot disease with aquaculture researchers and extension staff

Plate 4. Aquaculture extension staff identify challenges to introducing BMPs to their shrimp farmers

The new institutional norm: Embedding extension theory and practice into decision making at all levels

Research scientists and policy makers seriously concerned with making a difference to the lives of smallholders through agricultural research and development, need to embrace the social dimensions of their work. People and their institutions come to this realisation at different stages in their careers or projects. Most often it occurs at the point where a technology has been developed in a laboratory or research station, and tested in a few on-farm trials but needs to be applied in different cultural contexts and locations.

What happens next? There is a sudden realisation that a few researchers cannot expand the technology and therefore government or private extension services are needed. So it is either 'handed over' with the expectation that the technology will scale out under its own momentum, or a new project is formed to take it forward. This is where the rubber hits the road. More often than not, the technology goes nowhere due to the institutional constraints outlined in the introduction or lack of understanding of how the technology fits with different smallholder farming systems.

Projects can be designed with an understanding of the social and cultural dimensions of smallholder livelihoods and the extension process needed to work with them. Project leaders and scientists can learn extension theories and methods to deal with social constraints and create opportunities for farmer learning. During 2006 and 2007, myself and a colleague from Charles Sturt University ran a series of training courses for ACIAR project leaders in Laos, Indonesia and Papua New Guinea. The five-day course covered social and community dimensions of implementing agriculture, forestry and fisheries research projects (Race and Millar 2006). Participants learnt to identify the positive and negative impacts of their work on smallholders, how to involve a range of stakeholders using community participation methods, the role of extension and how to evaluate social issues and impacts.

We have worked from the top and from the bottom of institutional levels in South East Asia, but have yet to engage those directly responsible for extension staff. Extension managers at district and provincial levels need to be exposed to the same extension theories and practices bestowed on their staff at training workshops and cultivated in the field.

Conclusion

The three key learnings are that adapting extension approaches in South East Asia requires 1) sensitivity to cultural norms and individual household aspirations, 2) close and intensive mentoring of district and provincial extension staff using an action learning process and 3) embedding understanding of extension theory and practice throughout institutions.

Working in different cultural environments in South East Asia has been an enriching experience and has highlighted to me the importance of being adaptable with extension approaches. We can follow accepted extension principles and methodologies but they still have to be applied to the needs of particular farmers and extension staff. The first step is allowing time to assess the situation before jumping in with grand ideas. Spending time with farmers and villages, talking to extension staff, going out into the field with them, finding out the expectations of managers and project leaders are all paramount steps. Search for cultural understanding and meanings beneath the surface - don't assume anything!

Secondly, work closely with local and provincial extension staff in developing culturally appropriate extension activities with their farmers. Encourage staff to get to know their farmers by working alongside them. Use an action learning approach to plan, do and review all extension activities. Find mentors for new staff and encourage teamwork. Engage managers and decision makers and build their understanding of extension theory and practice. Garnered with these skills and adequate support, extension officers will develop a self motivating confidence which can sustain them, despite constant institutional and budgetary changes.

References

Christoplos, I and Farrington, J 2004, *Poverty, vulnerability and agricultural extension*. Policy reforms in a globalizing world. Oxford University Press. New Delhi.

Millar, J, Photakoun, V, and Connell, J. 2005, *Scaling out impacts: A study of three methods for introducing forage technologies to villages in Lao PDR*. ACIAR Working Paper no 58. Australian Centre for International Agricultural Research, Canberra, ACT. www.aciar.gov.au/publications

Millar, J and Photakoun, V 2008, 'Livestock development and poverty alleviation: Revolution or evolution for upland livelihoods in Lao PDR?' *International Journal of Agricultural Sustainability* Vol 6(1): 89-102.

Millar J, and Connell, J 2009. 'Strategies for scaling out impacts from agricultural systems change: the case of forages and livestock production in Laos.' *Agriculture and Human Values*. (published on line 27 February 2009)

Photakoun, V and Millar, J 2009, Evaluation of capacity building methods for extension professionals. Paper presented at APEN conference 2009, Busselton, WA, Australia.

Pretty, J, Morison, J, and Hine, R 2005. 'Reducing food poverty by increasing agricultural sustainability in developing countries'. In: Pretty, J (ed), *The earthscan reader in sustainable agriculture*. Earthscan, London, pp. 375-398.

Race, D and Millar, J 2008, *Social and Community Dimensions to ACIAR Research*. ACIAR Training Manual. Available at www.aciar.gov.au/publications

Stelling, A and Millar, J 2009, An evaluation of the Legumes for Pigs Project Development Alliance. Report No. 49. Institute of Land, Water and Society, Charles Sturt University, Albury, NSW.

Van den Ban, AW and Samantra RK (eds) 2006, 'Introduction'. In: *Changing Roles of Agricultural Extension in Asian Nations*. BR Publishing Corporation, Delhi pp. 1-20.

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