The Final Technical Report (FTR), is the responsibility of the Project Leader to be sent in electronic version to afgrp@stir.ac.uk and 2 copies of the printed and bound version to the Programme Officer, Institute of Aquaculture, University of Stirling, Stirling. UK FK9 4LA within 60 days of project completion.

****N.B* Please keep report brief and precise, all documents, outputs, dissemination materials can be placed in the Appendices at the discretion of Project Leaders.***

Project reports may differ slightly from each other due to the individual layout of the logical framework, however each FTR should comprise the following core sections:

The Impact of Aquatic Animal Health Strategies on the Livelihoods of Poor People in Asia.

DFID R 8911

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CONTENTS

1. Background to the Project

Describe why there was a need for this project and any previous projects involved in similar areas of research. This leads to the project purpose,

The need for this project arose from the findings of two DFID funded aquatic animal health studies (R7051 & R7463). Project R 7051 introduced the use of epidemiology within aquaculture to identify farm-level risk factors associated with white spot syndrome (WSSV) outbreaks. This virus is one of the most devastating diseases within the shrimp industry and it was found that during outbreaks farmers would emergency harvest unnecessarily, resulting in lost stock, money and time. By using epidemiology as a tool to determine the risk factors associated with disease outbreaks, advice on optimal harvest strategies was provided which enabled shrimp farmers to make informed decisions about their animal stocks. This was the first time an epidemiological longitudinal study had been performed in tropical aquaculture. Project R 7463, investigated the impact of bacterial diseases in freshwater fish farms in Vietnam and Thailand. The farms included in the study were predominantly subsistence based where aquaculture was only part of the livelihood activities undertaken by the family. During a large questionnaire-based study in R 7463 it was found that fish mortalities occurred regularly not only in the more intensive catfish ponds in Thailand as expected and reported but they also occurred in the rural subsistence-type systems. It was found that many rural fish producers in Thailand and Vietnam had no understanding of disease or ill health in fish. Due to this lack of knowledge households were loosing their ability to continue with aquaculture and were consuming fish product of questionable nutritional value. It was clear from these two projects that aquatic animal diseases did affect the ability of participating households to continue practising aquaculture. The main constraint appeared to be lack of knowledge or restricted access to information about aquatic animal health. This was further highlighted at the DFID/FAO/NACA[1] meeting on Primary Aquatic Animal Health Care in Rural Small-scale Aquaculture Development, where the fundamental constraints to sustainable aquaculture within such systems were identified as lack of knowledge, understanding and poor management of risks.

Information on aquatic disease outbreaks together with suggested control or management strategies had been produced from previous projects and disseminated widely using a variety of formats. However, there was scant information available on the development and promotion of aquatic animal health strategies to the poorer users. The previous DFID funded projects identified the need for improved dissemination and access of aquatic animal health information to all end-users, particularly the families with restricted resources considered to be on the fringe of aquaculture production. The incorporation of epidemiological methods with conventional disease diagnoses was identified as an area that had the potential to significantly reduce the impact of aquatic animal disease. By using a multi-disciplinary approach to determine the impact of poor aquatic animal health on the livelihoods of the rural poor the infrastructure for information exchange could be identified, and where appropriate suggestions to improve the flow and exchange of information both up and down stream could be highlighted. It was anticipated that this project would provide information, which would be utilised by the in-country participants to enhance sustainable aquaculture practises and improve livelihood options.

2. Project Purpose

The purpose of the project was to produce, disseminate and evaluate recommendations to enhance the efficacy and uptake of aquatic animal health strategies that are beneficial to poor people within Asia.

3. Research Activities:

Only PHASE 1 of the ACTIVITIES was completed due to a failure to sustain the interdisciplinary collaboration into the second phase.

At the initial project meeting a diagrammatic representation of the basic components of the relationship between aquatic animal health institutes and poor households was produced (Diagram 1). It also identified the various components of the system and provided the template from which all of the project activities followed. Although some of the project activities were separate exercises, it was necessary to combine outputs in order to

[1] DFID = Department for International Development, FAO = Food & Agriculture Organisation, NACA = Network of Aquaculture Centres in Asia.

answer the research questions. As shown in diagram 1, a great deal of crossover was required from each of the activities thus ensuring true integration of the different disciplines. The activities are listed in the box as bullet points.

Diagram 1 Representation of the major elements in the relationship between aquatic animal health institutes and poor households.

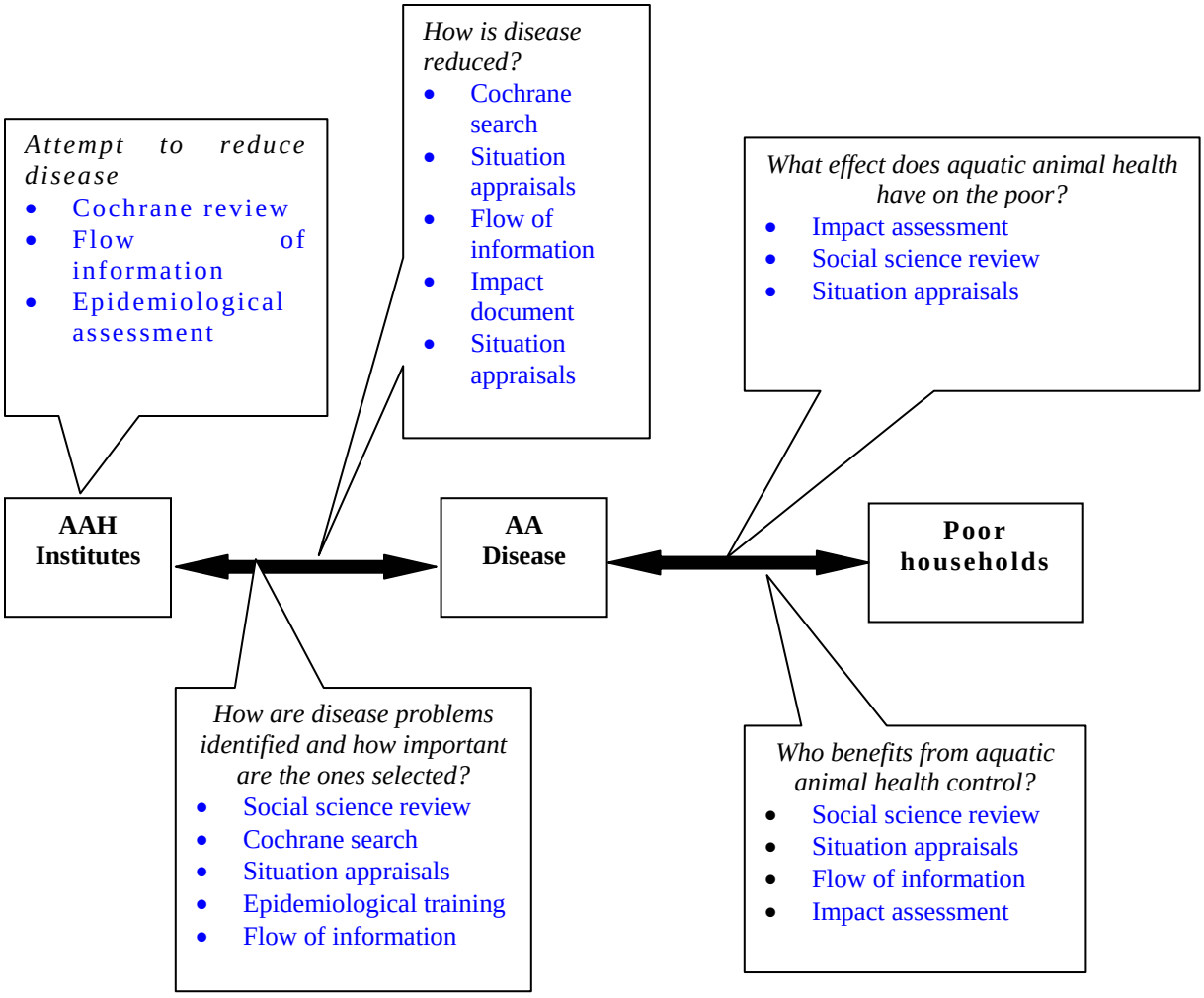


Diagram 1
AAH = Aquatic Animal Health, AA = aquatic animals

The research activities used integrated approaches from the fields of anthropology/social science, biological science, fish health management and epidemiology. The main objective of the research was to examine the relationship between aquatic animal health control and poor households, located in Thailand, Vietnam and India. Existing data on aquatic animal health provision was compiled and examined together with new data collected from field studies. The main research activities in phase 1 were:

3.1 Social literature review

An anthropological literature review to provide an insight into the impact of aquatic animal health (AAH) information on poor peoples' livelihoods. The methods used included a critical review of the theoretical, empirical and comparative literature related to the role of aquaculture and AAH knowledge in poverty reduction (Table 1).

Table 1 Methodology applied during social literature review

Objectives	Key Themes	Sources of Information	Literature Sources
• Produce a critical review • Highlight key issues on technology transfer, impact and uptake of NR research • Provide analytical framework to help review findings from situation appraisals (Activity 5)	• Technology transfer • Institutional frameworks • Concept of knowledge • Relationship between knowledge and practise • Tools for transfer, extension, media and communication • Gender and aquaculture • Vulnerability, risk and decision-making	• Institute of development studies • Poverty research unit at Sussex University • Science Policy Research Unit at Sussex University • Participating Research Institutes • Web-based databases	• Natural resource management policy documents • Poverty reduction strategy papers • Project reports • Anthropology literature (theoretical)

NR = natural resources

3.2 Systematic literature review

To provide a documented search of the published literature looking specifically for aquatic animal health control strategies. This literature review used a recognised systematic method of screening the available literature to provide a review of the affects of AAH interventions on aquaculture production in Asia. A defined protocol was applied using a standardised method in accordance with the Cochrane Review Process[2] (Table 2). This attempted to include as much available information as possible whilst reducing the bias associated with personal interpretation.

Table 2 Systematic Literature Methods

	Definitions used in Cochrane-style review
Participants	• Species (fish, freshwater/brackish water and marine, shrimp and prawn) • Countries (India, Thailand and Vietnam) • Time (1993-2003)
Interventions	• Experiments/manipulations (included nutrition/feed, water quality, temperature or light, genetics, stocking density, poly and monoculture) • Clinical field trials (immunisation and drug trials)
Outcomes	• Production (growth, survival, quality) • Disease prevention (prevalence, incidence and occurrence)
Inclusion criteria	**Any literature included for the review must have:** • Been conducted within India, Thailand or Vietnam. • Provide a description of the methods used. • Should have included a control group within the study. • Should have had demonstrable affect. • Provided statistical analyses.

[2] For more information regarding Cochrane reviews and the processes involved please visit http://www.cochrane.org/reviews/clibintro.htm

Search Strategy Applied	• Published literature (electronic databases from 1993 onwards) • Unpublished (grey literature), inclusive of conference proceedings, internal reports and theses from Research Institutes, Universities and Companies.

3.3 Flow of Information

This activity provided a description of the exchange of aquatic animal health information from and to the participating institutes. A template (Appendix III) of the various areas of interest was produced by the social and aquatic animal health researchers in the UK and partner countries. Through email exchange this was formatted and then used in each of the research institutes to provide details on the flow of information related to aquatic animal health from and to the institutes. A list of key questions were applied throughout this activity to help maintain focus during completion (Box 1).

BOX 1

KEY QUESTIONS

Are poor people involved in aquaculture?

If so, to what extent are they a target group for the research and activities undertaken by the institute?

What are the actual or potential channels through which information flows from the institute to poor people involved in aquaculture and *vice versa*?

In what ways do or could poor people involved in aquaculture benefit from the research and activities done, and knowledge produced by the institute?

Are there ways in which the activities of the institute could have a greater impact on this group?

In total there were nine different areas of interest (Appendix III), which included the participating Institutes, the research activities within the Institutes, the target groups, the education and training conducted within the Institute as well as extension activities. Information on any commercial ventures, dissemination and uptake of information and flow of information from farmers to the Institute was also considered. Data on any consultancies undertaken by staff and policy making and development activities within the Institutes was also provided.

3.4 Impact assessment

This activity documented the abilities and methods available to assess the impact of aquatic animal health on rural livelihoods. This was a desk-based study looking at the available published literature on assessing impact. The methods used were similar to those described for activity 3.1.

3.5 Situation appraisals

This was the collection of new data generated through social and epidemiological methods conducted in Thailand and Vietnam. The main objectives were to assess the role of aquatic animal health within the livelihoods of poor people and investigate the application of any aquatic animal health strategies employed by the poor. This activity had the most integration as in each of the target countries the fieldwork was performed by a anthropologist/social scientists and biological scientists. In Thailand the anthropologist from the UK worked together with UK and Thai biological researchers. In Vietnam, however, the two Vietnamese research institutes (Can Tho and RIA 2) worked together and were able to provide both social and biological expertise. The UK anthropologist performed interpretation of the social/development interviews and worked closely with the biological researchers from the UK, Vietnam and Thailand. Prior to any fieldwork being conducted, discussions about the format and methods available to help evaluate the key questions were performed at each of the participating research institutes with all staff involved with the field work (Table 3).

Table 3 Methods Used and Benefits derived from integrated methods applied during situation appraisals conducted in Thailand and Vietnam.

Methodology	Benefits
Interpretative* (Social/anthropological)	To interpret socio-economic processes, interaction between stakeholders and factors such as motivation and concept of profits, which cannot be measured.
Scientific* (Disease diagnosis/epidemiology)	To provide representative samples of the population and describe trends in the farming systems.
Examples of the methods used	
Social • Household/individual interviews • Village walks • Observational study of group meetings	**Scientific** • Sample framework • Stratified random selection of farming households • Semi-structured questionnaires

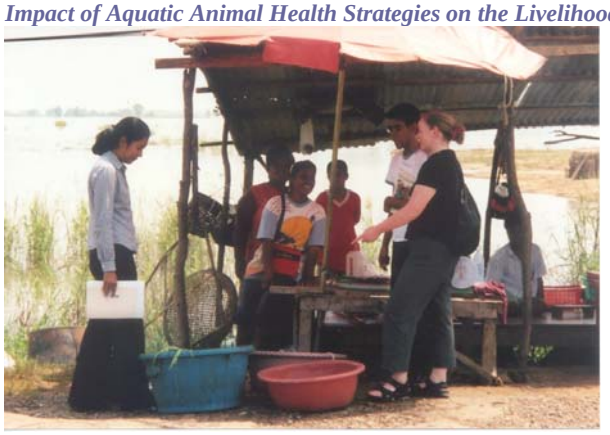
* = terminology provided by UK anthropologist

Although a list of key questions were produced (Appendix VI) a flexible attitude was maintained throughout the fieldwork and amendments made as and when required. A semi-structured questionnaire was produced which focused on generating quantitative information on the aquaculture practises performed in the study sites (Appendix VI). A sample framework (Appendix VI) for the questionnaire was produced to help randomly select the households involved with aquaculture in the study site. The households selected were then interviewed using the questionnaire. This method had been used previously with a high level of success in both DFID funded projects R 7051 and R 7463. Once the selected households were identified all of the team members together with extension officers travelled to the study sites and conducted the interviews with key informants as well as administering the questionnaires. Substitution was not used in the questionnaires. If the selected households did not want to participate or were not found then this was recorded and the team moved on to the next household on the list.

All of the interviews and questionnaires were conducted in native languages by local researchers who had received instruction from the UK anthropologist.

Whilst the interviews were taking place, observational studies were also performed at each household visited. Interviews or discussions were also conducted with other stakeholders involved with aquaculture activities in the area.

The database of preference in Vietnam was SPSS, as the researchers were already using this software. The UK anthropologist performed interpretation of the qualitative data, which was verified/discussed through email exchange with the local interviewers.



All of the interviews were taped and these were later translated into English by local researchers. The questionnaire data was entered into EPI-INFO version 6 and analysed by local staff who had received training previously in DFID funded project R 7463.

3.6 Continued data analyses

Further analyses of the WSSV epidemiological study (DFID R7051) was performed. The aim of this activity was to assist in the production of relevant aquatic animal health strategies for dissemination from the participating institutes. It was envisaged that any strategies produced from the continued data analyses would be used as case control studies in Phase II of the project and would be developed and promoted following guidelines produced from the other activities in the project.

3.7 Epidemiological training assessment

This activity investigated the access to epidemiological training, uptake and application by those involved in aquatic animal health research in Thailand, Vietnam and India. Through previous projects and attendance at training workshops[3] the awareness of epidemiology and associated methods within the aquatic animal research community had increased. However, there was limited information on the application of epidemiology within the field of aquatic animal health research. The study focused only on researchers who were actively involved in aquatic animal health research within the 3 target countries. A questionnaire-based postal survey was conducted. The questionnaire was produced in English as suggested by the project participants. Both open and closed questions were included and the questionnaire was pilot tested and amended prior to distribution. The partner Institutes in each of the three target countries provided the list of participants and all of the people on the list were sent the questionnaire. The questionnaire was divided into sections (Appendix VII, Annex 2) for ease of completion and participants were made aware of the preferred return date. All of the responses were entered into EPI-INFO version 6 and frequency analyses performed.

4. Institutional Linkages

The aquatic animal health partners in the UK and Asia had previously worked together and had formed strong links. Working with AAHRI improved access to other research Institutes/Departments within the Region, working on aquatic animal health research. At the initial project meeting in Bangkok, presentations were made on the project activities to raise awareness of the project with NACA staff (Mr S Wilkinson and Dr M Reantaso) and Dr Graham Haylor of STREAM. This meeting helped raise awareness of the project activities but also identified areas of potential collaboration between NACA, STREAM, and project R 8119, which was managed through email contact with each of these additional partners throughout the project.

New partnerships and links were made between all of the aquatic animal health research Institutes and the Anthropology Unit at Sussex University. The main field activity (3.5) also helped strengthen the links between RIA 2 and CAF, CanTho University. Previously these two Institutes had not worked as partners on the same projects but since the start of the DFID R 8119 project further collaboration has occurred between RIA 2 and CanTho University.

During research activities 3.2 and 3.7, links were established with the principal aquatic animal health researchers in Thailand, Vietnam and India. This was achieved through the Asian partner Institutes and helped raise the profile of the participating Institutes and assisted considerably with the planned dissemination

[3] These were organised by ACIAR for Vietnamese researchers in aquatic animal health.

activities. Furthermore, linkages within the Ministry of Fisheries (MoF Vietnam) and the Department of Fisheries (DoF Thailand) were strengthened and improved during this project as Provincial and District level extension workers were introduced to the project goal and were invited to participate at various levels. This was particularly encouraged through activity 3.5.

Links were established between FAO at the regional office in Bangkok through contact with Dr S Funge-Smith and additional linkages were established with Australian aquaculture researchers, based at Snobbs Creek Research Facility in Victoria, Australia through Ms F Gavine. Both Dr S Funge-Smith and Ms F Gavine were made aware of the project activities and through dialogues conducted in person and through email communication. It was clear from the discussions that similar methods to those being used in DFID R 8119 were being adopted in aquatic research activities within the Asia-Pacific region.

5. Research Outputs

5.1 Social Literature review (see Appendix I)

The social literature review highlighted some limitations of the current provision of AAH expertise, but provided considerable evidence for the interaction between aquatic animal health and the poor. The complete social literature review is included in Appendix I. The main conclusions from the social literature review were:

- Traditional simplistic models of technology transfer continue to dominate the literature and underpin project design but there is a need for new models.
- Aquaculture and NR research tend to prioritise technical information/activities over social research.
- Further attention is required on the gender effects of technical interventions in aquaculture. This was seen as a major issue as women are frequently the primary managers of aquaculture ponds but are often prevented from accessing technical support and credit.
- Motivation, risk management and uncertainty are often neglected in the literature and research concerning aquaculture development.
- Greater research is required on the uptake of technical strategies.

5.2 Systematic Literature review (see Appendix II)

This review was the first systematic literature search conducted on aquatic animal health. It followed defined terms and provided a review of the published literature as well as grey literature from the participating countries. The electronic databases that were included in the search are listed in Table 3, and were those most commonly used within biological literature reviews. They were representative of the databases that the participating countries had access to.

Table 3 Databases searched and key words screened for the Cochrane review

Databases	Key words
Web of Science	Aquatic, Animal, Health Intervention and Asia *
Aquatic Sciences and Fisheries Abstracts	
CAB Direct**	
BIOSIS**	

* = These words were used with their appropriate synonyms and truncation. ** = These are databases specific for abstracts or literature within the life sciences.

In total 1,141 papers were screened for their potential inclusion in the systematic literature search (Table 4a), however only 32 of them could be included in the review on the basis of the pre-defined inclusion criteria. The number of papers that were identified by all of the databases was low (Table 4a). Each database largely identified a separate subsection of the available literature. This highlighted the risk of missing important information if a literature review relied on a single electronic database. This was a worrying and surprising result as it suggested that published information was not as easily accessible as originally anticipated. The main concern would be for researchers in poorer countries where access to the databases may be limited mostly due to the subscription costs. This finding also suggested that a significant amount of information could easily be missed due to the assumption that all databases produce similar results thus affecting uptake of research findings in AAH, and perhaps leading to repeated research which is a waste of time, money and effort.

Table 4a Electronic Database Search Results - The results and degree of overlapping information.

Database	Total Papers	Repeat[1]	Net Total Papers	Included to Date
Web of Science	198	0	198	23
Aquatic Science and Fisheries Abstracts	473	89	384	27
CAB Direct*	245	43	202	34
BIOSIS*	225	93	132	32
TOTAL	**1141**	**93**	**132**	**32**

1 = the same paper was found in a different database.

In the grey literature a total of 479 articles were reviewed, but out of these only 26 could be included in the systematic review (Table 4b). Only 26 (19%) sources of information from the 3 target countries met the inclusion criteria.

Table 4b Grey Literature Search Results

Source of Information	Number of Contacts	Total number papers to date	Total number of papers included to date
Documents sent	347	46	3
Conference Proceedings	133	88	23
Total	**479**	**136**	**26**

A breakdown of the analysis of the results obtained from both the grey and electronic sources of information demonstrated that research in feed, disease problems/immunostimulants, water quality and other areas were more prevalent compared with genetics, stocking density or polyculture systems (Table 5). This results was expected result as there are many variables within these areas, which complicate the research and often limits the influences which can be drawn. It is only recently that the analytic techniques required to assess stocking density have been applied in UK salmonid[4].

Table 5 Results of Review Analyses of the Different Subject Areas of AAH included in the Review

Source of Information	Water	Feed	Genetics	SD	Polyculture systems	Disease problems /immunostimulants	Others *
WOS	3	5	1	0	2	1	11
ASFA	6	10	1	1	2	2	5
CAB Direct	8	16	0	3	0	3	4
BIOSIS	3	17	1	3	4	1	3
Documents sent	0	0	0	0	0	3	0
Conference proceedings	0	8	0	0	0	14	1
Total	**20**	**56**	**3**	**7**	**8**	**24**	**24**

*= this was any other research carried out and not included in the categories listed.
SD = stocking density

This extensive review (Appendix II) has also demonstrated that there has been to date no randomised double blind field trials of aquatic animal health strategies in the participating countries. The lack of randomised trials has a direct impact on the quality and value of the information on AAH strategies produced and this needs to be addressed internationally.

4

5.3 Flow of Information (see Appendix III and IV)

A great deal of information was accumulated on the activities of the participating institutes and all were found to be involved in research and teaching (Table 6). The amount of research and teaching conducted was reflected in the main activities of each participating Institute (Table 6). It was found that all of the partner institutes had good communications with the extension services and all provided information on aquatic animal health to various end-users (Table 6). Similar resources for funding AAH information dissemination was found in all of the Institutes and well-established processes for disseminating AAH information via a variety of routes was found to be in existence (Table 6). These routes were similar in all of the countries but their relative importance varied between the individual countries. The mechanisms to identify farmers needs and the capacity to monitor uptake of information were also part of each of the Institutes remits but this was particularly strong in India (Table 6). All participants agreed that the existing mechanisms would benefit from improvement and the poverty level of the end users was not necessarily clear.

Table 6 Summary of Results from the Flow of Information Activity

	Aquatic Animal Health Research Institute (AAHRI), Thailand	**Research Institute for Aquaculture N^0 2 (RIA 2), Vietnam**	**College of Aquaculture and Fisheries (CAF), Vietnam**	**College of Fisheries (COF), Mangalore India**
Institute remit	*To conduct research and development on aquatic animal diseases, diagnosis and prevention/control strategies. The Institute has responsibility to provide diagnostic service to farmers and conduct health certification as well as monitor drug and chemical use in aquaculture.*	*To conduct and develop research on aquaculture and aquatic animal health diagnosis and control.*	*To meet the increasing demands of the aquaculture and fisheries services in Mekong Delta, Vietnam.*	*To plan, undertake, aid, promote and co-ordinate education, research and extension in Fisheries science.*
Main activities	• Research • Diagnostic service for farmers • Teaching and training • Provide AAH information • Planning for national AA disease control and prevention • Try to control/monitor drug and chemical use in aquaculture	• Aquatic environment and fisheries resource research and management • Experimental biology • Aquatic animal pathology • Freshwater and marine research • Post-harvest research	• Under and post-graduate education in aquaculture, fisheries management, fish technology and marine biology • Research on aquaculture biotechnology, environment, resource management and marine biodiversity • Transfer of aquaculture and fisheries information	• Teaching • Research • Extension • All in fisheries science
Main research in AAH	• Aquatic animal disease aetiology, prevention and control	• AA disease (aetiology) • Development of diagnosis tools • Identification of risk factors for disease • Production of control/prevention strategies	• Shrimp research • Freshwater (marine) fish • Disease diagnosis	• Fish and shrimp diseases • Diagnostics • Development of probiotics • Biotechnology • Epidemiology
Resource for AAH dissemination	• Diagnostic and technical service	• Central Gov (MoF) • Research projects (all)	• Central Gov. (MoF) • Research projects (all)	• University funds • Research projects

	• Distribution of research results and technical information materials • Production of scientific publications, aquatic animal disease news, newsletters, manual, leaflets and posters • Reference material on diseases • Workshops/training courses	• Extension service network • Private companies	• Provincial Extension Research organisation support (inter and national)	(national, international)
Target groups	Ranked in order of importance • Farmers • Extension/biology staff • Students • Companies	• Aquaculturalists • Extension services • Private companies • Students • Community and Farmers club leaders	Ranked in order of importance • Students • Extension worker • Fish/shrimp farmer • Companies	Ranked in order of importance • Students • Extension services • Farmers, hatcheries, feed and chemical companies • Fishermen, fish processors, fish handlers
Access to rural poor	**Direct** • During routine farm monitoring • During diagnostic service **Indirect** • Company staff • Extension staff • Mass media	• Training courses (all levels) • Demonstration farms • On-site workshops • Monitoring network • Local loudspeaker (village) • Mass media	• Free training courses • Free leaflets/booklets • On-site workshops • Mass media • Loudspeaker • Demonstration farm	**Direct** • Training • Sample testing • Seed screening • Extension services • Student projects/courses **Indirect** • Mass media
Point of contact with farming communities	• Farmers • Extension staff • Company staff • Head of village • President of farming community	• Local extension staff • Farm and community leaders • Feed companies • Farmers	• Predominantly through extension workers, but some direct contact with farmers	• Farm leaders • Consultants • Progressive farmers • Government extension workers • Sales representatives • Hatchery owners

	AAHRI, Thailand	**RIA N^{0}2 Vietnam**	**CAF, Vietnam**	**COF India**
Flow of information from Institute to Poor	**Direct** • Extension staff • Company staff • Head of village • President of farming community **Indirect** • Mass media	**Direct** • Extension services, Company staff, farmers clubs, community leaders, farmers **Indirect** • Extension materials • Mass media	• As described from points of contacts - may be direct or indirect	• Through direct and indirect channels
Beneficiaries of AAH information	• Farmers • Extension/biology staff • Exporters • Students/trainees • Neighbouring countries	• All target groups	• All target groups	• Difficult to quantify • Generally all target groups • Specifically - fish, shrimp farmers and hatchery owners increased understanding of disease process and intervention strategies
Education and training provided	• Basic fish disease diagnosis • Shrimp health management • General AAH and control • Disease treatment • General farm management • For the beneficiaries mentioned	• University lectures • Extension training courses • Large-scale fish or shrimp farmers • Company staff • Scientific advisor/supervisor	• University degree(s) • All aspects of shrimp, fish and artemia culture • All levels of farmers • Extension training	• University degree(s), including tertiary education • Progressive fish farmers • Government officials • Extension workers • Scientists • Bank personnel
Type of extension information disseminated	• Basic disease diagnosis and management • Common disease diagnosis • Control and treatment • Farm management	• Culture techniques (environment and health management) • Disease identification • Main clinical signs of diseases • Risk factors of disease outbreaks • Disease prevention and treatment	• Wide range of information inclusive of water quality, hatchery management, animal culture techniques, disease outbreaks and control, nutrition and drug use in aquaculture	• Aquaculture • Health management • Fisheries resource management • Fish processing technology • Fishing technology • Fish product technology

		• Guideline of drugs and chemical for aquaculture		
	AAHRI, Thailand	**RIA N^{0}2 Vietnam**	**CAF, Vietnam**	**COF India**
Demand for AAH Information	**Demand** • Treatment • Marketing **Awareness** • Direct contact with target groups • Extension services • Private companies	**Demand** • Culture technology • Disease prevention and treatment **Awareness** • Producers • Local farm managers • Monitoring network	**Demand** • Culture techniques • Disease and health management **Awareness** • Extension services • Farmers • Companies	**Demand** • General aquaculture • Specific health management and control **Awareness** • Farmers • Extension services • Officers from developmental departments • Queries received at the Institute
Information from farmers to Institute	• Problems faced by farmers are the priority for research conducted	• Research focused on farmer led problems • Monitoring networks not sufficiently established or effective	• Research focused on practical constraints encountered by farmers • Information mostly from advanced farmer groups	• Most research focused on farm or farmer-based problems • Information received from all level of farmers through both direct and indirect routes.

5.4 Impact assessment (see Appendix V)

The main finding from the literature review produced (Appendix V) was that poverty in the context of the sustainable livelihoods (SL) framework is complex and includes aspects such as vulnerability and lack of opportunity. These and other aspects were considered more reflective processes compared with those associated with more stable states. The results from the literature review showed that the impact of research was so deeply entwined with other influences that it was difficult if not impossible to measure impact within the real world. This was with the exception of specific cases within clearly defined circumstances. The main findings were:

- It is considered impossible to produce precise and 'proven' (quantitative) assessments of the impact of research except in a few very specific situations. Even then, it is probably too complex and too expensive.
- If poverty is defined in terms of a SL approach then research will tend to have a 'softer' focus. This requires a more sensitive and interpretative approach (qualitative) where judgement rather than proof, is central.
- The best approach to assessing the impact of research is through tracing the dissemination of research outputs and identifying where they have had (or have not) had an impact on the poor. This will involve an approach based on interviews, case studies, perhaps oral histories and possibly some quantitative work. What will be crucial here is 'plausibility', where the question would be "*does emerging story make logical sense and ring true to the various stakeholders involved?"* This would involve discussions with those involved, following the route that the information has taken and finding out where the information has and has not reached as well as what it has achieved. Application of this approach would allow a "story" to be produced.
- Straightforward 'participatory' impact assessments will be of limited use by themselves as such methods often fail to address central issues of power, hierarchy and social exclusion.
- In planning future research projects there is a need to develop fuller models of how the proposed research will impact on poverty and much greater specification of the assumptions that link outputs with poverty. For example: G. Balzer and U. Nagel 2003. Log frame Based Impact Monitoring within the CGIAR System. (CGIARhttp://www.cgiar.org/tac/spia0500/balzer.pdf)
- In planning future research projects within development the argument that any 'technical' research project should be preceded by what amounts to an SL research project was raised. This will identify whether or not the preconditions for the successful dissemination of the research exist, and whether or not the outputs of the research project will address real rather than perceived needs. There must to be a demand from the poor and research must address that demand.

5.5 Situation appraisals (see Appendix VI, VII and VIII)

A considerable amount of information was generated and the anthropological and epidemiological approaches were applied in parallel. The approaches integrated well but it was clear that future situation appraisals should be combined with other sources of expertise, e.g. marketing, to ensure completeness of the information collected. The main limiting factor of these exercises was that they only provided a "snap-shot" of the situation at a single time and from a development view point, increased time in the field would be required before a more detailed description of the system status could be produced. Despite the lack of time and resources for the situation appraisals they produced interesting and valuable information on the technical and social aspects of aquaculture in selected locations at that time point. In general it was clear from the research findings that:

1.1 Poor people were directly involved in aquaculture.
1.2 Aquatic animal health problems had a negative effect on the sustainable livelihoods of these people.

Delays experienced during the project with performing the situation appraisals made it impossible for a study to be conducted in India. Hence there was no data collected for the Indian study, and the appraisals were only performed in Thailand and Vietnam. However, the situation in both Thailand and Vietnam was complex and it was not easy to assess the impact on the livelihoods of those affected.

Thailand

Role of aquaculture

The research was conducted in a single province (Pichit). A wide range of freshwater fish farming systems was found within this Province, which reflected the diverse socio-economic status of the households practising aquaculture. A list of the households practising aquaculture within the Province was supplied by the extension services. In total 7,000 families were included in the provincial list and of these 3,000 were considered small-medium scale and 30 were large/commercial ventures. However, it was estimated that another 10,000 families were also involved in fish production but these were not included on any formal list as they were considered as low or no-input fish farms. Therefore, to try to locate households involved with aquaculture using formal lists alone was not considered a robust method of reaching all available households of interest. Nevertheless the fact that not all involved with aquaculture were formally accounted for suggested potential restrictions to resources. Particularly related to information on aquaculture and AAH. They may of course, have received information through other channels e.g. word of mouth from other farmers/neighbours/traders but they would not be included on the official provincial lists, indicative of restricted access to official sources of information.

One interesting finding that had previously been highlighted in project R 7463 was how people described themselves. Many of the households in Pichit province were originally rice farmers and although they were producing oranges/limes and had a fish pond they still considered themselves to be rice farmers.

It soon became clear that "fish farmers" or "aquaculturists" were not good descriptions to use and instead the project focused on households with fish ponds.

It appeared from the Thai study that there was a strong incentive to embrace aquaculture, as part of the household activities. However, the low local market demand for the fish products and input costs required to establish and sustain fish farming contributed towards the lack of uptake of aquaculture as part of the livelihood activities of many rural families in Pichit. In this province, fish farming was only a major livelihood activity for a minority of households as the lack of a local market outlet for products was a major disincentive. In many of the households with subsistence fish farming the original input had come from Government projects promoting aquaculture as a way of providing income and food security.

In general, a sustainable livelihood approach to help reduce poverty or decrease vulnerability and shocks, demands a low-risk/low-input strategy. Previous Government inputs had focused on providing the initial set up of the ponds, perhaps including free seed or donating feed but the species supplied had been hybrid catfish. These are relatively easy fish to produce often requiring low inputs both financial, time and knowledge but the market price for these animals is very variable. Frequently there was over-production from the large commercial farms based in central Thailand and therefore high quality fish products were sold at low prices within the small rural markets with potential benefits for poor consumers.

The application of aquatic animal health strategies

Few if any of the families interviewed that practised fish culture in Pichit applied any animal health management on their farms. It appeared that many families with fishponds did not have access to information from the extension services or commercial companies, predominantly because these families could not be easily located. Therefore they were often not included in meetings and did not receive any advice/guidance. As there was no direct access to information for these households many of the subsistence farms had dead or diseased fish which were removed and discarded or eaten by the family. No records or information about the fish health problems that were experienced in these ponds was available. There was no system or structure to allow any aquatic animal health problems to be identified or confirmed by trained personnel. Therefore there was no true reflection of the status of fish disease problems. Often poor environmental conditions or lack of husbandry skills can exacerbate fish health problems and although fish die it may not be due to a disease outbreak but rather poor water quality or husbandry skills. Families that considered themselves to be fish farmers were more interested, aware of AAH information and had greater incentive to find information on AAH. The also had better access to the local knowledge and resources. It was only these households that applied any form of management strategies to reduce incidence of disease. Rural families with fishponds were often unaware of fish disease or even the fact that fish can get sick. Again this was similar to the findings found in DFID R 7463.

It was found that the cost of pelleted feed and any treatments required was prohibitive for many families afford. One worrying aspect was the increased debt accumulation described by some rural families practising subsistence fish farming. Some households persisted with fish farming and used pelleted feed (costly) and applied many chemical/drug treatments to their fish, with no understanding if either of these things helped the animals. Many families accrued more and more debt through loans, thus increasing their vulnerability.

In this province most of the information on animal health strategies was originally provided through the extension services. This was only provided to the large to medium scale fish farmers that were recognised by the extension officers as actual fish farmers or families with an active role in fish farming. Lack of funds and resources within the extension services was described as one of the main problems in information dissemination. Due to the lack of resources the extension workers relied on the "*trickle down"* method of information dissemination, i.e. they provided information directly to the master farmers and hoped that any information would be passed down through the fish farming community. It was found that wealthier (asset rich and regarded as aquaculturalists) farmers received the information and poorer families did not. Application of many of the strategies were again limited to the wealthier fish farming families mostly due to the financial capital required to implement these strategies.

General findings and recommendations from Thai situation appraisal

- Extension services were overworked and under-resourced. They were aware of poorer families involved with aquaculture but had no resources to assist them. It was considered that the extension services needed to target poorer families more rigorously.
- As well as providing technical advice and guidance, marketing, financial planning and low cost micro-credit programmes should also be integrated together. This would greatly assist rural families in assessing the risk of including fish farming within their livelihood activities.
- Overall farm management advice could be improved if there was more integration between agricultural and aquaculture extension workers.
- Further case studies should be performed in other areas of Thailand.

Vietnam

It was found that shrimp farming in Vietnam was an area of dramatic growth and socio-economic change where the impact of disease outbreaks on production systems was recognised by Vietnamese researchers. Therefore, it was decided that this was a good model to investigate the impact of aquatic animal health in Vietnam.

The situation appraisal in Vietnam took place in Can Duc (Long An Province) and Thanh Quoi and Hoa Tu I (Soc Trang Province). The shrimp farming systems within these areas were described by the Vietnamese partners as small-scale/extensive and improved extensive shrimp ponds.

Role of aquaculture

It was found that in Can Duc most of the aquaculturalists were shrimp farmers, who had been producing shrimp for over 10 years. This area housed one of the shrimp demonstration farms, which was previously sponsored by the Vietnamese Government. Over the previous decade the shrimp farmers had experienced severe disease outbreaks within the farming systems and some of these farms had been involved previously in the DFID project R 7051. Thus from previous project results it was confirmed that disease outbreaks had continued to occur within these farming systems. Hao Tu I, was a site of previous research conducted by the Vietnamese partners (RIA 2) as serious disease outbreaks had occurred in these districts, and 100% of the farmers were producing shrimp. Disease outbreaks in the shrimp had occurred in both areas extension clubs had been formed.

It was found in Can Duoc that shrimp farming had dramatically improved the livelihoods of families participating in this form of aquaculture. This improvement was reflected in the community as there was an improvement in roads, bridges and many new houses had been built. It was found that many of the shrimp farmers still relied heavily on loans to sustain shrimp farming and in recent years disease outbreaks had been an increasing problem for them. Many of the wealthier households interviewed did manage to recover from losses which stemmed from shrimp disease outbreaks as they used profits from previous successful crops to help them recover from this shock. They also had more livelihood activities compared with poorer families and were involved with small businesses, being traders or seed/feed suppliers as well as being able to work elsewhere e.g. in the cities. The poorer shrimp farming families did not have other sources of income and had not diversified their livelihood activities and so when they experienced a disease outbreak with high animal mortalities within a single production cycle their only option was to increase their loans and hence increase their debt.

In Soc Trang it was found that a high number of the successful shrimp farming families lifestyles had improved directly as a consequence of shrimp farming. In general families new to this activity were often most successful in the first year or two and then they experience disease outbreaks and suffered from large losses thus giving them problems in loan repayments.

The application of aquatic animal health strategies

In Can Duoc the extension services were well-organised and training courses on farm management was provided to the key farmers. However, they were aware that the diffusion model (i.e. trickle down system) did not work well and that they needed to address this in some way but again resources were limited. Application of AAH strategies was directly related to access to the information. However the quality of the information should also be considered. Although training courses were provided, the participants were selected and it was not open to all shrimp farmers. Those that had more capital to invest in farm preparation, disease control and water treatment tended to receive AAH information more than the less well resourced shrimp farmers within the areas studied. Training materials and TV programmes were described by many shrimp farmers as "too

technical" and there was a high demand for practical training from the shrimp farmers, where the extension officers suggested more demonstration farms.

Information and advice was exchanged informally between shrimp farmers but there was a need expressed for greater organisation to facilitate farmer-to-farmer learning and uptake. Information on loans and financial support systems also were demanded from the farmers. This would help them make informed decisions and provide assistance when they hit troubled times. It was suggested that starting extension clubs may be a way to assist the shrimp farmers given the limited resources with the extension services.

In Soc Trang the extension services were well organised and very efficient with more than 50 officers employed in the extension division. Although they appeared to have adequate people they did express the need for additional resources to keep up with the demand from the shrimp farmers, particularly for training course in any aspect of shrimp farming. Although the Soc Trang extension department did seem to reach wealthy and poorer shrimp farming families and supplied information to a wide range of households, new shrimp farmers in this area which had not been recognised by the Government as shrimp farmers had no access to training courses, information or loans supplied through the extension department.

5.6 Epidemiological Data Analyses (see Appendix IX)

The results from this activity showed that epidemiological studies should be combined with existing expertise to help provide robust and accurate advice to farmers. Although aquatic animal epidemiology was still relatively "new" area for research within any aquaculture system, strategies for limiting the effect of diseases have clearly been provided from previous projects. A list of the outputs from epidemiology data analyses is provided in Appendix IX.

5.7 Assessment of Epidemiology Training (see Appendix X)

A higher number of researchers working in the field of aquatic animal health were found in Thailand compared with India and Vietnam (Table 7). However, it was suggested that this may not be a true reflection. It could be related to the restructuring process within Vietnam, where they were in the process of generating defined research areas[5]/personnel and Institutes for AAH. In India the length of time required before a permanent place within a research facility can be attained is longer than in Thailand and Vietnam. Good compliance was achieved (Table 7) using the postal questionnaires. The list of AAH researchers produced by the project partners was a balanced overview[6] of those people active within AAH research and covered a wide variety of Institutes/Departments/Universities within each of the participating countries (Table 7).

Table 7 Number of AAH researchers and percentage compliance

	Thailand	India	Vietnam
Number of AAH researchers	54	23	33
Percentage (%) compliance	72	56	54
Number of Institutes/Departments/Universities	26	11	10

This study found that all of the researchers were considered to be active, busy people often with responsibilities in teaching, research and management. The teaching consisted of under graduate, postgraduate as well as others such as farmers and companies. Often AAH researchers were involved more in national funded projects but a high number of them were also involved with on-going international projects. The researchers included in the study covered all areas of AAH.

The awareness of epidemiology within AAH researchers was high in all of the countries, as determined by the number of researchers practising aquatic epidemiology research. Few of these researchers had received any

[5] Some areas of AAH were of more importance than others, e.g. health monitoring, disease diagnosis, testing for use of banned chemicals and antibiotics.

[6] Researchers from all fields of aquatic animal health were included from each of the target countries, thus it appeared to be representative sample.

formal training and most had become aware of epidemiology either through self learning (books, journals, Internet, websites) or through participation in projects and through other colleagues. The lack of formal training was not surprising as only 10 people had attended the first aquatic epidemiology "master class" held in Bangkok in 1996 and of those in attendance only 5 were still involved in aquatic animal research within the participating countries. The main findings from this research were:

- High numbers of researchers were aware of epidemiology tools and methods appropriate for use in AAH research.
- General agreement regarding the benefits of applying aquatic epidemiology methods to help address aquatic animal disease problems.
- Epidemiology methods/tools were being used - principally in research projects.
- Lack of formal training but high demand for training through any methods - on-line, one-to-one tutoring, workshops, etc.

Although many of the questionnaire respondents were happy to try to apply epidemiology methods within their existing AAH research activities, there was a substantial demand for some kind of formal training or information exchange to help researchers apply correct and robust methods.

5.8 Main Project Findings

- Primarily it was concluded that aquatic animal health did matter to poor people. However, poorer communities are affected by the lack of reliable AAH information. Interpretation of the affect of AAH strategies on poor people was not found to be easy to extract by any existing method. Nevertheless it was found that aquaculture producers have increasing vulnerability as a direct result of poor aquatic animal health. Furthermore this vulnerability can be increased if the producers have no direct access to reliable sources of information related to optimal production and reducing risks of poor AAH. The fish producers that were regarded as resource rich had the best access to all information, not only that related to AAH but also to marketing and husbandry management.

- Information exchange occurred between researchers, farmers and extension workers within the target countries. However the project clearly showed where increased effort should be made to improve the exchange of information relating to aquatic animal health. The Thai partners incorporated several of the findings from the project to the National Programme Strategy for Aquaculture. Dr S Chinabut presented the Thai National Programme strategy where some of the weaknesses of the existing infrastructure in Thailand was highlighted (Appendix IV). Implementing the National Strategy is one of the priorities for the Thai Government and some of the activities listed are currently underway. In general, all of the participating Asian Institutes supplied information on AAH and management strategies to end-users but the project raised the awareness of the weaknesses within each of the Institutes when targeting the poor.

- Many challenges were encountered during the project, particularly related to the integration of anthropological and structured scientific disciplines. Although compromises were made and in some cases this worked well, e.g. the situation appraisals, the integration of the different disciplines was problematic and placed strain on many of the partners. This involved increased time and effort by all of the partners to understand the purposes of various activities and the methods used. Further negotiation time would be required for smoother integration of the social and biological aspects and if other disciplined such as marketing and economics were also to be incorporated this would dramatically increase the time required to plan and conduct the studies. Even with the various problems encountered all of the partners made tremendous effort to work together and as shown from phase I of the project all of the activities and outcomes were achieved.

- The impact assessment document raised the suggestion that impact could not be assessed. This was a rather surprising result and provoked a great deal of debate among the partners. Many of the Institutes already performed some kind of impact assessment exercises. Although the general principle that impact cannot be measured or assessed in a livelihood context it was agreed that micro-assessment exercises could be undertaken. These types of exercises still had some relevance and so impact could be assessed in

a specific context. However, it should be appreciated that assessing a livelihoods impact is complex, time consuming and expensive.

- One of the most surprising findings from the project arose from the systematic review undertaken following the Cochrane search strategy. This was the first time an aquatic animal health review of this type had been performed. The lack of tried and tested AAH strategies was surprising but funding for this type of work is relatively non-existent, as they are expensive for funding agencies and are time consuming for the commercial companies. However, this emphasises the need for assessment of the impact of AAH strategies.

- To promote the uptake of any AAH strategies produced, the promotional pathways to ensure uptake and application of the strategy have to be taken into consideration. The strategies from individual research projects may not be enough alone for individual dissemination exercises but could perhaps be incorporated into the existing strategies. These would serve the purpose of not only strengthening the existing findings but also provide a means of checking and validating some of the AAH strategies already being used. Promotion of poor quality AAH strategies could be more damaging than providing no strategy at all. Therefore, a means of checking the use of the AAH strategy being disseminated should also be in place within the dissemination and uptake monitoring exercises. The responsibility for this work requires in-depth discussion and as many of the aquaculturalists in Vietnam and Thailand had little contact with researchers, it would suggest that such discussion would be the responsibility of the rural development departments, or their equivalent within the various partner countries. However, the onus would be placed on the researchers and the staff members from the rural development with the extension officers to communicate more effectively to ensure better uptake and check that the AAH strategies are appropriate before they are delivered in any format. With a more structured network and more communication then monitoring impact of the research activities may become easier. This is also something that should be raised at a policy-level within each partner country.

6. Contribution of these Outputs to Developmental Impact

The direct impact for the families engaged in aquaculture will be reduced vulnerability through increased access to improved AAH strategies. The improvement will not only be in the content and quality of the AAH information provided but also in the access, format and source of the information. No attempt was made in the first phase of the project to target the end-user. The first phase was purely understanding the systems and assessing the weaknesses and strengthens within the current AAH activities. As such this has provided information which can be used in a strategic context to improve the beneficial impact of AAH expertise on poor households. The withdrawal of the social science partners prevented the extension of the collaboration between the social and scientific disciplines into the second phase, which made it impossible to implement such strategic activities. However, the information produced from the first phase has a great deal of potential and has already been discussed at Government level in the participating countries. The task remains to identify pathways by which this information can further influence future policy.

Table 8 List of Advantages and Disadvantages of the Approaches Used during R 8119

Advantages	Disadvantage
1. Importance of social complexities related to information access was highlighted through the use of social methods. 2. Integration of structured sampling together with informal interviews provided a more robust data set with better extrapolation potential. 3. Exchange of information on AAH-related activities within the Asian Region from 3 key Institutes, demonstrated strengths and weaknesses of the exchange between farmers and researchers within the partner Institutes. 4. The use of social methods to help evaluate potential problems with AAH information dissemination was provided through the situation appraisals. 5. The rigour of the structured literature review produced two key finding which would not have been apparent using normal literature searches. • highlighted the need for a search in more than one database when searching the published literature for information related to AAH strategies. • identified the absence of field trails related to any existing AAH strategy and the paucity of practical advise resulting from existing AAH research.	1. The interpretative studies required more time in the field than was possible for the time frame of the project, which resulted in no situation appraisals being conducted in India. 2. The opinion-based methods used during the anthropological studies raised concern with the scientific partners, who were more familiar and comfortable with generating fact-based knowledge. The anthropologists were often unable or reluctant to describe their methods and so a great deal of discussion was required to reach some level of understanding by all partners. This disadvantaged some of the studies, as more time was required to discuss the benefits of the various methods used. 3. Introduction of the social methods was new for many of the partners and again, limited information was provided for the initial introduction of such methods. This lack of detail affected the selection of the situation appraisals, particularly in Thailand.

6.1 Areas for further research

1. A study is required to develop a practical system for testing AAH strategies before they are incorporated within the general dissemination activities of the target beneficiaries. Assistance on this would be required from rural development experts as well as those familiar with field/farm testing of strategies and a practical knowledge of fish farming and disease.

2. A study to examine in further depth the reason for the absence of practical AAH advice resulting from research needs to be conducted. This would need to be country-specific.

6.2 Areas for future activities

1. Aquatic epidemiology training

There is an international demand from researchers working in AAH for some form of formal training in aquatic epidemiology. Limited training courses run through ACIAR have been conducted in the past predominantly in Vietnam, however the uptake of the training has not been assessed. There are many reasons for this lack of uptake and application of previous training. It may be that the wrong people were sent on the training courses and as such have had no opportunity to apply epidemiology within their research. Many of the researchers in this project currently using aquatic epidemiology to help solve AAH problems were senior researchers with access to funding sources. One of the future activities should include some form of training in aquatic epidemiology for AAH researchers. The type of training provided should be carefully considered and one option would be to run an on-line distance learning training course. This could include key staff members from the Institute of Aquaculture, Stirling University, the Dept of Veterinary Clinical Science and Animal Husbandry at the University of Liverpool and staff from AusVet Animal Health Services, Australia.

Researchers in all of these places have considerable experience in theoretical and applied aquatic epidemiology and already either conduct or contribute towards animal epidemiology with the veterinary sciences in the UK, EU and Australia.

The course could be divided into two parts. The first would be basic epidemiology with examples from aquaculture and terrestrial animals with some form of examination. If this was passed then participants could then progress onto the second part, which would be designing epidemiological projects and again this, would be assessed. If such a course was recognised by a University then the course could be accredited which would provide an incentive for the participants and would help support their career in AAH. Furthermore through the use of programmes such as WebCT more than just teaching materials could be produced such as discussion forums and dialogues between researchers and key staff members.

The other course of action could be to provide training-of-trainers. This is routinely used in Teacher Training modules run throughout Asia and also in Vietnam has now become one of the standard models for extension workers in agriculture. If key members of staff from each of the participating countries involved (e.g. Thailand, Vietnam and India) were supported and trained through a workshop/course they could then provide the training for the participants who wish to enrol for the distance learning course. This would be a staggered approach but perhaps more sustainable in the long run. This format may also provide some form of internal validation, as it would be relatively easy for the information supplied by the trainers to be checked either in person or through a questionnaire. This may sound more time consuming and initially expensive but it may be more sustainable as each country would then have AAH researchers trained in aquatic epidemiology thus providing in-country expertise which as present is sadly lacking.

2. Social study integration within AAH research

To strengthen the uptake of any research outputs within AAH it is proposed that further studies are conducted where there is more integration of social methodologies within a practical AAH research activity. Although there were some considerable problems with the integration of the social and biological disciplines in this project, it did highlight the benefits of using both methods together to help enhance the production of realistic AAH strategies. Interdisciplinary studies are becoming more common[7] particularly within Asian research, where there is increased awareness of the benefits of doing these types of studies, however, initial meetings at the project planning stage should be attended by individuals from all of the disciplines. Otherwise, the late on-set of some of the research may affect the final research findings.

Integration of the social sciences within AAH research need not be large-scale project, but it is proposed that even small case studies could be performed prior to the start of the main project. It is suggested that with additional funding, these types of small case studies could be used a working examples for others to follow particularly if the methods and results were published in the public domain e.g. through the DFID websites or within the various Institute websites.

3. Production of an on-line journal for AAH researchers

A major deficiency in the current provision of AAH expertise is the development and retention of trained personnel. Currently there is no existing mechanism to develop diagnostic and therapeutic experts in this field. In human and veterinary medicine this is accomplished through intern or houseman positions, however, there are inadequate resources within the field of AAH to support such positions. One option is to develop a repository of expertise in the form of freely available on-line case studies. A feasibility study for such a dissemination mechanism has been funded by DFID AFGRP.

[7] See DFID R 8093 project for examples of where the results were enhanced by combining data supplied from economics, epidemiology, biology and social science.

6. Appendices