



Network of Aquaculture Centres in Asia-Pacific

Aquaclimate Annual Progress Report

2011



March 2011  
2nd year of project  
NACA Secretariat  
Bangkok  
Thailand

Progress Report for the Project, 'Strengthening Adaptive Capacities to the Impacts of Climate Change in Resource-poor Small-scale Aquaculture and Aquatic Resources-dependent Sector in the South and South-east Asian Region'



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## Preparation and scope of the report

This report covers the activities of the “Strengthening Adaptive Capacities to the Impacts of Climate Change in Resource-poor Small-scale Aquaculture and Aquatic Resources-dependent Sector in the South and South-east Asian Region” project from February 2011 to February 2011. This report is an expanded and updated version of the interim report submitted to NORAD mid 2010 that includes activities in the remainder of the reporting period. The report was compiled by Dr Nigel William Abery, project coordinator, and Professor Sena S. De Silva, Director General, NACA.

## 1 Agreements with case study partners

A new agreement was signed with case study national partners (for a case study on culture based fisheries in Sri Lanka) and additional agreements for further work with existing case study national partners (Can Tho University and the Research Institute for Aquaculture #2 in Vietnam) are currently under negotiation.

### 1.1 Kelaniya University

Culture based fisheries (CBF) that are practiced in Sri Lanka and throughout the Asian region are becoming more popular. CBF are a secondary and a non-consumptive user of existing water resources and do not compete with the traditional rice paddy or land or water and thus can be an additional low resource requirement activity with direct benefits to rural communities. The activity which is principally and typically conducted in non-perennial small water bodies are primarily dependent (for stocking, growth period and harvesting) on the rainfall patterns.

In the recent decades, the rainfall patterns have undergone changes and as a result, water scarcity and excess water have become a recurrent problem in crop production in Sri Lanka. CBF can be impacted by the timing of water availability as seed stock production must coincide when the water is available for stocking and in the case of reduced duration of water availability this impacts on the ability of the fish to reach market size.

A contract has been signed between NACA and Kelaniya University, the Sri Lankan partners to collaborate with the Aquaclimate project to implement a study into the impacts of climate change on the CBF production of selected reservoirs in Anuradhapura, Kurinegala, Hambantota, Moneragala, Ratnapura and Puttalam districts in Sri Lanka.

### 1.2 Can Tho University

An agreement between NACA and Can Tho University (**Annex 1**), for the continuation of work on the impacts and adaptation of climate change on Tra catfish and Tiger shrimp farming in the Mekong delta is under negotiation. The agreement is likely to cover work on better management practices in response to climate change, life cycle assessment for catfish aquaculture, modelling of future scenarios of climate change, policy development in response to climate change and dissemination of results. It is expected that the contract will be finalised shortly after the annual project meeting.

### 1.3 Research Institute for Aquaculture #2

An agreement between NACA and the Research Institute for Aquaculture #2 (RIA2) (**Annex 1**), for the continuation of work on the impacts and adaptation of climate change on Tiger shrimp and Tra catfish farming in the Mekong Delta is under negotiation. The agreement is likely to cover work on an improved technical and management package in response to climate change, policy development in response to climate change and dissemination of results. It is expected that the contract will be finalised shortly after the annual project meeting.

## 2 Implementation of case studies

The major component of the project involves implementation of the project case studies. Progress has continued on the case studies in Vietnam and India and started in Sri Lanka. However, progress on the case study in the Philippines is lagging.

### 2.1 Sri Lanka culture based fisheries case study

The Sri Lankan culture based fisheries case study has been initiated in May 2010 and is underway. (**Annex 2** entails the agreement entered to between the GoSL and NACA) The case study is based on hydrological modelling of water resources in reservoirs in combination with fishery information and is heavily reliant on secondary weather, reservoir and catchments data. Already completed is a literature review relevant to culture based fisheries and climate change. 28 reservoirs and the feeding reservoirs to the selected reservoirs have been identified and selected for the case study have been selected and paired with relevant weather collection stations for combining with weather data. The demarcation of catchment is underway. Four identified tanks and the feeder tanks in the cascade were visited and irrigation data and culture based fisheries data was collected.

### 2.2 Vietnam catfish farming case study

#### 2.2.1 Catfish farming data analysis workshop held in Can Tho, Vietnam (24 - 26 Aug 2010/ 7 participants)

A data analysis workshop was held at Can Tho University, Vietnam. Participants at the workshop included the National project partners: Trong Hoang Minh, Vu Nam Sun and Dao Mius Hai from Can Tho University; International partners: Udaya Sekhar Nagothu from Bioforsk; Varunthat Dulyapurk, Methee Kaewnern and Sirisuda Jumnongsong from Kasetsart University.

The data from the expansive farmer survey has been 'cleaned' and verified then analysed and the outlines of several articles were agreed on to be worked on further independently with the intention to present and review them at the 'writeshop' and then submit them for peer review in international journals.

#### 2.2.2 Writeshop – Vietnam catfish farming

Articles about climate change and catfish farming in Vietnam were prepared and reviewed by the members of the Aquaclimate team at a 'writeshop' in Bangkok, Thailand. See section on the writeshop.

## 2.3 Vietnam shrimp farming case study

### 2.3.1 Tiger shrimp farming data analysis workshop held in Ho Chi Minh City, Vietnam (27 - 29 Aug 2010/ 11 participants)

A data analysis workshop was held at the Research Institute for Aquaculture #2 (RIA2). Participants at the workshop included the National project partners: Trong Hoang Minh, Vu Nam Sun and Dao Mius Hai from Can Tho University; Ngo Van Hai, Phan Que Viet, Che Khanh Duy and Pham Ba Vu Tung from Research Institute for Aquaculture #2. International partners: Nigel W. Abery from NACA; Varunthat Dulyapurk, Methee Kaewnern and Sirisuda Jumnongsong from Kasetsart University.

The data from the expansive farmer survey has been 'cleaned' and verified then analysed and the outlines of several articles were agreed on to be worked on further independently with the intention to present and review them at the 'writeshop' and then submit them for peer review in international journals. Other publications have already been published for this case study (see dissemination of results section).

### 2.3.2 Writeshop – Vietnam shrimp farming

Articles about climate change and shrimp farming in Vietnam were prepared and reviewed by the members of the Aquaclimate team at a 'writeshop' in Bangkok, Thailand. See section on the writeshop.

## 2.4 Indian shrimp farming case study

### 2.4.1 Tiger shrimp farming data analysis workshop held in Chennai, India (18-20 Aug 2010/ 15 participants)

A data analysis workshop (Fig 1.) was held at the Central Institute for Brackishwater Aquaculture (CIBA), in Chennai. Participants at the workshop included the National project partners: M. Muralidhar, M. Kumeran, M. Jayanthi, B. Muniyandi and A.G. Ponniah from the Central Institute of Brackishwater Aquaculture (CIBA) and P.V. Givo Prasad and A. Nageswararao team from the National Centre for Sustainable Aquaculture (NaCSA); International partners: Nigel W. Abery from the Network of Aquaculture Centres in Asia-Pacific (NACA); Udaya Sekhar Nagothu, Trond Rafoss from Bioforsk; Varunthat Dulyapurk, Methee Kaewnern, Sirisuda Jumnongsong and Wara Taparhudee from Kasetsart University; and an Invited guest: C.R. Ranganathan from Tamil Nadu Agricultural University.

The data from the expansive shrimp farmer survey (Plate 1) has been 'cleaned' and verified then analysed and the outlines of several articles were agreed on to be worked on further independently with the intention to present and review them at the 'writeshop' and then submit them for peer review in international journals.

### 2.4.2 Writeshop – Indian shrimp farming

Articles about climate change and shrimp farming in India were prepared and reviewed by the members of the Aquaclimate team at a 'writeshop' in Bangkok, Thailand. See section on the writeshop.



Plate 1. Participants analysing data displayed on a screen projector (to left of view) at the data analysis workshop in Chennai,



India.

Plate 2. An enumerator interviewing a small scale shrimp farmer in Andhra Pradesh, India for the Aquaclimate expansive farmer survey.

## 2.5 Philippines brackishwater milkfish pond farming case study

### 2.5.1 Expansive farmer survey

Unfortunately the progress on the Philippines case study appeared to be slow and the reporting is overdue. The national partners, the Bureau of Fisheries and Aquatic Resources (BFAR), do not respond to emails. It appears that the expansive survey may have started but it is unknown if or when it will be completed.

The highlighted sections below was Tabled at the 2<sup>nd</sup> Annual Project Meeting held in Kalawewa, Sri Lanka, 7 to 10<sup>th</sup> March 2011.

The expansive farmer survey was delayed due to the recent political elections but has been completed and the data circulated to project partners.

#### 2.5.1 Workshop for Stakeholder and Institutional Analysis held in Iloilo, Philippines (16 September 2010/8 Participants).

The workshop identified the stakeholders in the milkfish market chain and then undertook an analysis of the sector's key stakeholders, an assessment of their interests, and influence and importance. The participants included Central and Regional Government Departments, farmers, Producer Organisations, Academia, NGOs and was facilitated by Akvaplan-niva. This was undertaken in order to identify the most important stakeholders to target for implementing adaptation measures. The report of the workshop and the results is presently being finalised.

#### 2.5.2 Workshop to identify indicators of Vulnerability held in Iloilo, Philippines (17 and 18 September 2010/ 11 participants).

The objective of the workshop was to develop vulnerability indicators for the effects of climate change on milkfish pond culture in 2 Municipalities on Panay Island, Philippines. The participants included Central and Regional Government Departments, Producer Organisations, Academia, NGOs and was facilitated by Akvaplan-niva. The indicators were selected on the basis of the perceived Climate changes as reported by the farmers in the stakeholder and focus group meetings and the selected questions asked in the Questionnaire survey. The vulnerability indicators were selected by the expert judgement group based on the available data and expert opinions and a weight given to each indicator. The following Indicators were selected for Climate Change vulnerability, Socio-economic vulnerability, Economic vulnerability and Production vulnerability. Weights were then assigned to the chosen indicators according to their importance. The report of the workshop and results is presently being finalised.

#### 2.5.3 Workshop to develop adaptation measures to future predicted Climate Change held in Iloilo, Philippines (2 and 3 February 2011/15 participants).

Using the future climate changes predicted by CSIRO climate model with IPCC scenario B2 (business as usual), the workshop developed future adaptation measures for predicted Climate change in 2020 and 2050. The participants included Central and Regional Government Departments, Research Institutions, Producer Organisations, Academia, NGOs and was facilitated by Akvaplan-niva. Detailed

adaptation measures were developed for Farmers, Science & Technology and for Institutions. Attempts were made to cost the adaptation measures and develop a time scale for their implementation. The report of the workshop and results is presently being finalised.

### 3 Aquaclimate 'writeshop' in Bangkok, Thailand

An Aquaclimate team 'writeshop' was held at the Earnluang room, 3<sup>rd</sup> floor, KU Home, Kasetsart University Campus, Bangkok, Thailand on the 1-3<sup>rd</sup> November 2010. Participants at the writeshop were: Dr Abery, NACA; Dr Dulapurk, Dr Methee, Ms Jumnongsong, KU; Dr Minh CTU; Dr Hai, Mr Tung, RAI2; Dr Muralidhar, Dr Kumeran, CIBA; Dr Sekhar, Bioforsk. At the writeshop 8 articles from the project results were presented and reviewed by the participants, comments and recommendations for further additions or analysis were made and key authors were assigned tasks to attend to the article revisions. Future project activities were also discussed. After the post writeshop revisions two articles have been submitted for peer review in high impact journals and other articles are in draft form but expected to be submitted for peer review in coming months (see dissemination of results section).

## 4 Dissemination of results

### 4.1 Poster presentations

Five posters on climate change impacts and adaptation of small scale farmers were presented at the Global Conference on Aquaculture in Phuket, Thailand by the Aquaclimate project team. The conference is a major conference with a global perspective on Aquaculture that was hosted by NACA, the Food and Agriculture Organisation of the United Nations and the Thai Department of Fisheries.

The four poster presentations were authored and are titled as follows:

- 1) Nigel Abery & Sena De Silva (2010) Strengthening Adaptive Capacities to the Impacts of Climate Change in Resource-poor Small-scale Aquaculture and Aquatic Resources-dependent Sector in the South and South-east Asian Region - "Aquaclimate". *Book of Abstracts, Global Conference on Aquaculture 2010, 22-25 September 2010*. FAO/NACA/Thailand Department of Fisheries. Phuket, Thailand (**Annex 3**).
- 2) Ngo Van Hai, Nguyen Van Hao, Nigel W. Abery & Sena S. De Silva (2010) Perceived impacts and adaption to climate changes in small scale shrimp farming in Ca Mau province, Vietnam *Book of Abstracts, Global Conference on Aquaculture 2010, 22-25 September 2010*. FAO/NACA/Thailand Department of Fisheries. Phuket, Thailand (**Annex4**).
- 3) Pham Ba Vu Tung, Nguyen Van Hao, Nigel W. Abery & Sena S. De Silva (2010) STRENGTHENING ADAPTIVE CAPACITIES TO THE IMPACTS OF CLIMATE CHANGE IN SMALL-SCALE AQUACULTURE Tra Catfish farmer perceptions of climate change impacts in Dong Thap and Vinh Long Provinces, Vietnam. *Book of Abstracts, Global Conference on Aquaculture 2010, 22-25 September 2010*. FAO/NACA/Thailand Department of Fisheries. Phuket, Thailand (**Annex 5**).

- 4) Truong Hoang Minh, Nigel W. Abery, Nguyen Thanh Phuong, Udaya Sekhar Nagothu, Sena S. De Silva (2010) Potential climate change impacts on social vulnerability and adaptive capacity of striped catfish (*Pangasianodon hypophthalmus*) farming community, Mekong Delta, Vietnam. *Book of Abstracts, Global Conference on Aquaculture 2010, 22-25 September 2010*. FAO/NACA/Thailand Department of Fisheries. Phuket, Thailand. (**Annex 6**).
- 5) Varunthat Dulyapurk, Methee Kaewnern, Sirisuda Jumnongsong, Nigel W. Abery and Sena S. De Silva (2010) Catfish farming production model (Mekong Delta, Vietnam) and climate change impact linkages and derivatives. *Book of Abstracts, Global Conference on Aquaculture 2010, 22-25 (Annex 7)*.

Other posters were also presented by Can Tho University (one of the project partners) as follows:

- 1) Lam Truong An, Truong Hoang Minh & Nguyen Thanh Phuong (2010) A Comparison on technical and economic aspects in striped catfish (*Pangasianodon hypophthalmus*) pond culture between freshwater and saline water intrusion zones in the Mekong Delta, Vietnam. National Student's Conference on Aquaculture and Fishery. Can Tho University (26-28 May 2010) (**Annex 8**).
- 2) Truong Hoang Minh, Nguyen Thanh Phuong, Udaya Sekhar Nagothu, Varunthat Dulyapurk, Methee Kaewnern, Sirisuda Jumnongsong, Patrick White, Nigel W. Abery and Sena S. De Silva (2010) Understanding the impacts, vulnerability and adaptive capacity to climate change of catfish (*Pangasianodon hypophthalmus*) pond farmers in the Mekong Delta, Vietnam. International Conference on Environmental and Agricultural sustainability in the Mekong Delta, Can Tho University 25-27 March 2010 (**Annex 9**).

## 4.2 Oral presentations

An invited guest lecture was presented at the Global Conference on Aquaculture in Phuket, Thailand by the Director General of NACA as follows:

- 1) Sena S. De Silva (2010) Invited Guest lecture III. Coping with climate change: A Real Challenge to Aquaculturists? *Book of Abstracts, Global Conference on Aquaculture 2010, 22-25 September 2010*. FAO/NACA/Thailand Department of Fisheries. Phuket, Thailand. (Plate 3.)  
Available on audio:  
[http://audio.enaca.org/global\\_aquaculture\\_2010/sena\\_de\\_silva\\_climate\\_change.mp3](http://audio.enaca.org/global_aquaculture_2010/sena_de_silva_climate_change.mp3)  
Ppt available on:  
[http://audio.enaca.org/global\\_aquaculture\\_2010/sena\\_de\\_silva\\_climate\\_change.pdf](http://audio.enaca.org/global_aquaculture_2010/sena_de_silva_climate_change.pdf)
- 2) Pham Minh Tien & Truong Hoang Minh (2010) Weather change and saline water intrusion impacts on rotation rice-shrimp (*Penaeus monodon*) farming system in Bac Lieu province, the Mekong Delta. National Student's Conference on Aquaculture and Fishery, Can Tho University (26-28 May 2010).
- 3) Najim, MMN, Wijenayake WMHK, De Silva SS, Amarasinghe, US. (2010). Impact of climate change on culture based fisheries of Sri Lanka- possible adaptations of communities. Second National Symposium on Disaster Risk Reduction and Climate Change Adaptations. 13/14 October 2010, Ministry of Disaster Management and Disaster Management Center, Colombo, Sri Lanka.

- 4) Sena S De Silva was invited to make a presentation at the “side-event’ on Climate Change and Its Impacts on Fisheries and Aquaculture, 03-02-2011, at the 29<sup>th</sup> Meeting of the Committee on Fisheries (COFI),



**Plate 3. Presentation by the Director General of NACA at the Global Conference on Aquaculture at Phuket, Thailand.**

#### **4.3 Published journal articles**

- 1) Lam Truong An, Truong Hoang Minh & Nguyen Thanh Phuong (2010) Comparison of catfish (*Pangasianodon hypophthalmus*) pond culture between freshwater and saline water intrusion areas in the Mekong Delta. *Scientific Journal of Can Tho University*, 347-359, Vol. 14b 2010 (**Annex 10**).
- 2) Pham Minh Tien & Truong Hoang Minh (2010) Weather change and saline water intrusion impacts on rotation rice-shrimp (*Penaeus monodon*) farming system in Bac Lieu province, the Mekong Delta. *Scientific Journal of Can Tho University*, 394-406, Vol. 14b 2010 (**Annex 11**).

#### **4.4 Submitted journal articles**

1. Udaya Sekhar Nagothu, M. Muralidhar, M. Kumaran, B. Muniyandi, Nigel William Abery, N.R.Umesh, K.S.Krishna Prasad, Sena S. De Silva (submitted January 2011) Climate change and shrimp farming in Andhra Pradesh, India: Socio-economics and vulnerability. ***Aquaculture***.
2. Udaya Sekhar Nagothu, Truong Hoang Minh, Nigel William Abery and Sena S. De Silva (submitted January 2011) Vulnerability and adaptation of the striped catfish farming sector in the Mekong Delta, Vietnam to climate change impacts: an evaluation based on socio-economic characteristics and farmer perceptions. ***Journal of Climatic Change***.

#### 4.5 Journal articles in draft

1. M.Muralidhar, M.Kumaran, B.Muniyandi, M.Jayanthi, Nigel William Abery, , N.R.Umesh, A.Nageswara Rao, Sena S. De Silva (in draft) Perceived climate changes, impacts and risk of shrimp farmers in Andhra Pradesh, India.
2. Ngo Van Hai, Nguyen Van Hao, Nigel W. Abery, Sena S. De Silva (in draft) Climate change impacts on small-scale shrimp farming: perceived impacts and potential adaptations of practices in Bac Lieu and Ca Mau provinces, Mekong Delta, Vietnam.

#### 4.6 Theses

- 1) Lam Truong An (2010) Assessment on catfish (*Pangasianodon hypophthalmus*) farmer's perception and adaptation for climate change impacts in the Mekong Delta. MSc. Thesis, Can Tho University. Defended in Sept. 2010. Grade: 9.1/10 (A).
- 2) Pham Minh Tien (2010) Assessment on technical-economic aspects and perception of shrimp-rice rotation farmer's for climate change and saline water intrusion impacts in Bac Lieu province . BSc. Thesis, Can Tho University. Defended in May. 2010. Grade: 9.7/10 (A).

#### 4.7 ASEAN – Republic Of Korea Information Exchange on the Impact of Climate Change in Aquaculture

One member of the Aquaclimate team attended the ASEAN – Republic Of Korea Information Exchange on the Impact of Climate Change in Aquaculture workshop at no cost to the project.

Presenter: Dr Ngo Van Hai, Research Institute for Aquaculture number 2, Vietnam (national partner).

Meeting title: ASEAN –Republic Of Korea Information Exchange on the Impact of Climate Change in Aquaculture

Funding support from National Fisheries Research and Development Institute, Busan, Republic Of Korea, covered all flight, internal travel including field trips, accommodation and a daily subsistence allowance.

Key feedback from the presentation: Was positive. Participants asked questions about shrimp and rice rotation and how they can survive together in one area. Participants asked about farmers support by themselves, from relatives and from bank or local authorities.

Key learning from the meeting: Presentations were technical and non-technical. In each country there is a need to identify CC events and appropriate responses to events. They also want to set up a network between other ASEAN countries and Korea about responding to CC and prioritising responses. Meeting actions suggest that for the network the responsibilities in each country and a donor to support fund for the network need to be found.

## 5 Other project outputs

### 5.1 Memoranda of Cooperation (MOC)

The project is facilitating the continued collaborative work between Kasetsart University, Thailand (International project partner) and Can Tho University, Vietnam (National project partner), with the overall result being a MOC between the two institutions for furthering academic collaboration. Faculty of Fisheries, Kasetsart University and the College of Aquaculture and Fisheries, Can Tho University signed a Memorandum of Cooperation with the with the aim to jointly develop and share technical including the exchange of students, faculty and researchers of both sides. The signing was made on 13 January 2011 at the Faculty of Fisheries, Kasetsart University (Plate 4.)

<http://www.fish.ku.ac.th/Can%20Tho13-01-11/index.html> .



**Plate 4. Associate Prof. Dr Suriyan Tunkijjanukiji (Kasetsart University) and Associate Prof. Dr N.T. Phuong (Can Tho University and member of the Aquaclimate national partner team) at the signing of the MOC between the two organisations.**

### 5.2 Cooperation with international organisations

NACA continues to be involved in the work of PaCFA (Global Partnership for Climate Change, Fisheries and Aquaculture) a consortium of organization, spearheaded by the Department of Fisheries and Aquaculture, FAO, Rome, dedicated to increasing the profile of fisheries and aquaculture in the wake of climate change, develop programs for donor support and coordinate ongoing activities on climate change impacts on the sector (see **Annex 12**).

### 5.3 Capacity building

Statistical analysis training of Vietnamese partners and data analysis workshops for Vietnamese and Indian partners, to build their capacity in analysing data in a more sophisticated manner that can allow for a better understanding of the relationship of climate change with aquaculture farming systems has been undertaken.

Dr. M. Muralidhar, Coordinator, Indian case study attended the Introductory SWAT Workshop on hydrological modelling 1/3 December 2010, IIT, Chennai, organised by Bioforsk under the project ClimaRice II: SWAT modelling and online data base creation.

### 5.4 Doctor of Philosophy student project on impacts and adaptation of tra catfish to climate change

The Vietnamese student (Nguyen Lam Anh) continues to undertake a Ph.D. entitled “Evaluation of the Adaptive Measures for the Striped Catfish Farming Sector in the Mekong Delta, Vietnam for Mitigating Potential Climatic Change Impacts”. Lam Anh is enrolled in Wageningen University under the supervision of Wageningen University and the Network of Aquaculture Centres in Asia-Pacific staff. In 2009 the student spent 6 months at Wageningen undertaking the training and supervision plan (TSP) and finalising the thesis proposal. Training at Wageningen has included:

- + Working with EndNote X on 7 May 2009 (0.3 credits)
- + WIAS Introduction course, May 11-14, 2009 (1.5 credits)
- + WIAS course statistics for the Life Sciences, 28 May- 5 June, 2009 (2 credits)
- + Ethics course: Leaving footprints: Ethical, social and legal issues in connection with the impact of Food production on climate change. Vilnius (Lithuania), August 24-29, 2009 (3 credits)
- + Fourth ALTER-Net Summer School: Biodiversity and Ecosystem Services. 5-17 September 2009, Peyresq, Alpes de Haute-Provence, France (3 credits)

The student has also undertaken a training course on Remote Sensing and GIS relating to Climate change at GIS and Remote sensing Research Center of HCM city Institute of Resources Geography, December 1-9, 2009 (3 credits) in Vietnam. Modelling work to be used for his project is also underway in Vietnam.

Following the thesis proposal in 2010, the student was carry out the study on chapter 2: Estimation of the plausible impacts of climate change on striped catfish aquaculture locations using GIS and also went to WU 3 months following the TSP.

Modelling of the salinity and hydrology is continuing in Vietnam.

## 5.5 Coordination/ collaboration with other projects

The Aquaclimate is collaborating with other relevant projects where synergies occur in order to maximise the benefit to the project. Notable examples of this include collaboration with:

- the stripped catfish better management practices (BMP) project (coordinated by NACA and Fisheries Victoria, Australia), under the auspices of the CARD Program (Cooperation on Agriculture and Rural Development) of the Ministry of Agriculture & Rural Development (MARD), Government of Vietnam and AusAID (Australian Agency for International Development) for the case study on climate change on Tra catfish in Vietnam,
- the National Centre for Sustainable Aquaculture (NaCSA), the extension and implementation arm of the Marine Products Export Development Board (MPEDA), Ministry of Trade and Commerce, of the Government of India, for the case study on tiger shrimp in India, and
- the NACA, FAO and Thailand Department of Fisheries hosted Global Conference on Aquaculture for which climate change impacts on aquaculture was a common theme in many of the plenary lectures, guest lectures and posters (some of which were presented by the project team).

Both the catfish BMP project and catfish climate change case studies are concerned with the same/similar farming systems, farming areas, stakeholders and project staff. This has continued to create significant core knowledge and relationships and generate synergies that have been shared by the project for different specific objectives but with the high level goal of the improving the sustainability of small scale producers in the industry.

Collaborating with NaCSA for the case study about tiger shrimp in India provides a direct link to the farmers through an organisation that they trust and have seen generate significant outcomes in terms of farmer profitability and sustainability. This collaboration will also provide a mechanism to disseminate project results and recommendations directly to the relevant shrimp farmers. NaCSA supports sustainable aquaculture in India by assisting the organisation of farmer societies and improving information exchange, capacity building and the sharing of resources, dissemination of technology and information on better management practices to benefit the marginalised and poor rural aquaculture farmers. NaCSA works at the 'grass roots' or 'coal face' working directly with farmers to achieve this objective. NaCSA began as a project between the Network of Aquaculture Centres in Asia-Pacific (NACA) and the Marine Products Export Development Authority (MPEDA) of India. The objective of the initiative was to reduce the impact of shrimp disease through the implementation of better management practices in small-scale farming clusters. The participating farmers began to realise the improved crop outcomes, market power and profitability and the message spread with farmers from adjacent clusters and villages forming their own associations and adopting better management practices (BMPs). The project was so successful that it became institutionalised as NaCSA. NaCSA was heavily involved in the expansive farmer survey in India and attend the project data analysis workshop.

NACA continues to collaborate with the United Nations' Food and Agriculture Organisation (FAO) on climate change impacts through:

- attendance at expert consultations,

- collaborating on publication of material about the impacts and adaptation of fisheries and aquaculture to climate change as FAO technical reports,
- on invitation has provided the FAO with a concept note for project development in respect to tra catfish farming adaptation to climate change in Vietnam.

## 5.6 Project exposure

The project activities continue to be highlighted on the dedicated project web page of NACA ([www.enaca.org](http://www.enaca.org)), (see Annex 13), with a monthly average hit rate of 10 to 12, 000.

There had been recognition of the expertise generated from this project as also evident by the independent invitations extended to the project coordinator to deliver keynote addresses at the following forthcoming meetings on climate change:

- (a) Regional Workshop on Climate Change and Food Security in the ASEAN+3 countries to be held in Beijing, China from 29 to 31 March 2011 and organized by FAO, the Chinese Academy of Agricultural Sciences, World Meteorological Organization and ASEAN Secretariat (however, this invitation had to be declined in view of the clash of dates with the Second Annual General Meeting to be held in Sri Lanka).
- (b) ASIA PACIFIC FISHERY COMMISSION, Regional consultative workshop, “Implications of climate change on fisheries and aquaculture: challenges for adaptation and mitigation in the Asia-Pacific Region” Kathmandu, Nepal, 24<sup>th</sup> to 26<sup>th</sup> May 2011. The expected keynote presentation is titled, ‘**Implications of climate change on aquaculture-vulnerabilities, adaptations & mitigation: an Asia-Pacific regional perspective**’.

## 6 Summary Table of Travel undertaken

**International travel to attend the Global Aquaculture Conference in Phuket, Thailand, September 2010**

Dr. Ngo Van Hai (RIA2) from Vietnam  
Mr. Ba Vu Tung (RIA2) from Vietnam  
Dr. Truong Hoang Minh (CTU) from Vietnam  
Mr. Patrick White (APN) from France

**International travel to attend the data analysis workshop in Vietnam**

Dr. Nagothu Udaya Sekhar (Bioforsk) from Norway via India  
Dr. Nigel W. Aberly (NACA) from Thailand  
Dr. Varunthat Dulyapurk (KU) from Thailand  
Ms. Sirisuda Jumnongsong (KU) from Thailand  
Dr Methee Kaewnern (KU) from Thailand

**International travel to attend the data analysis workshop in India**

Dr. Nagothu Udaya Sekhar (Bioforsk) from Norway  
Mr. Trond Rafoss (Bioforsk) from Norway  
Dr. Nigel W. Abery (NACA) from Thailand  
Dr. Varunthat Dulyapurk (KU) from Thailand  
Ms. Sirisuda Jumnongsong (KU) from Thailand  
Dr. Methee Kaewnern (KU) from Thailand  
Dr. Wara Taparhudee (KU) from Thailand

**Meetings with Fisheries Victoria climate change staff in Australia**

Dr Nigel W. Abery (NACA) from Thailand

**International travel to attend the writeshop in Thailand**

Dr. Nagothu Udaya Sekhar (Bioforsk) from Norway  
Dr. Ngo Van Hai (RIA2) from Vietnam  
Mr. Ba Vu Tung (RIA2) from Vietnam  
Dr. Truong Hoang Minh (CTU) from Vietnam  
Dr. M.Muralidhar (CIBA) from India  
Dr Kumaram (CIBA) from India

## 7 Summary table of achievements and progress towards planned activities.

Country	Commodity	Activities	Expected start date	Status	Expected completion date	Potential impacts
Vietnam	Tra catfish	Expansive farmer survey	Completed 190 farmers surveyed	Completed	Report: August 2010	Guide development of policy recommendations. Input into future climate change impact models.
Vietnam	Tra catfish	Data cleaning for the catfish survey database.	Completed	Completed	Completed	Lead to analyses that will guide development of policy recommendations
Vietnam	Tra catfish & Tiger shrimp	Statistical analysis training for Vietnamese partners by local specialist (up to \$500USD)	Prior to June 2010	Completed	Completed	Build the capacity of Vietnamese researchers in responding to the impacts of climate change on aquaculture
Vietnam and India	Tra catfish & Tiger shrimp	Four day data analysis workshop with Vietnamese, Indian and international partners	July / August 2010	Completed	Completed	Guide development of policy recommendations
Vietnam and India	Tra catfish & Tiger shrimp	Four days for write shop in Thailand	August / September 2010	Completed	Nov 2010	Guide development of policy recommendations
Vietnam	Tra catfish	Doctor of Philosophy (Vietnamese) student project about the climate change impact on tra catfish in the Mekong delta	April 2009	Initial training undertaken. Data collection underway. Chapter 2 on modelling to be underway	Dec 2013	Build the capacity of Vietnamese researchers in responding to the impacts of climate change on aquaculture
Vietnam	Tra catfish and Tiger shrimp	Contact with modelling agencies in Vietnam to collaborate on modelling of climate change. Inquire for areas/provinces of catfish and shrimp farming.	April/May 2010	Modelling for salinity and flows relevant to both catfish and shrimp is underway.	Completed, modelling work underway awaiting completion to obtain data.	Lead to analyses that will guide development of policy recommendations
Vietnam	Tra catfish	Secondary data analysis of climate/weather and	2009	Majority of data compiled. Analysis yet to be started.	Rescheduled to Aug 2011	Validate earlier work on farmer perceptions.

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Country	Commodity	Activities	Expected start date	Status	Expected completion date	Potential impacts
		aquaculture data		Salinity still to be collected. RIA 2 to send all secondary data to CTU for analysis. Initial analyses to be done by CTU. Underway		Input into future climate change impact models. Guide development of policy recommendations
Vietnam	Tra catfish	Model future climate change impacts / scenarios	August 2010	Underway. Work for this activity is in conjunction with the Ph.D. Student working on this topic.	Rescheduled to Sep 2011	e/internet workshop to decide model parameters
Vietnam	Tiger shrimp	Expansive farmer survey	Started	Completed	September 2010	Guide development of policy recommendations. Input into future climate change impact models.
Vietnam	Tiger shrimp	Expansive farmer survey database to be send to KU by CTU and RIA 2 by 17 April		Completed	completed	Lead to analyses that will guide development of policy recommendations
Vietnam	Tiger shrimp	Expansive farmer survey database to be cleaned by KU and sent back by 30 April		Completed	completed	Lead to analyses that will guide development of policy recommendations
Vietnam	Tiger shrimp	Model future climate change impacts / scenarios	July2010	Collecting data to be used in the models	Rescheduled to Sep 2011	Guide development of policy recommendations
Vietnam	Tiger shrimp	Secondary data analysis of climate/weather and aquaculture data	April 2010	Underway rescheduled to Dec 2010	Rescheduled to Aug 2011	
The Philippines	Milkfish	Expansive farmer survey	May 2010	Unsure. Possibly underway. National partner unresponsive.	Unknown, possibility to abandon case study and focus on other case studies.	Guide development of policy recommendations Input into future climate change impact models.

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Country	Commodity	Activities	Expected start date	Status	Expected completion date	Potential impacts
The Philippines	Milkfish	Secondary data analysis	November 2010	Yet to be started	Unknown, possibility to abandon case study and focus on other case studies.	Validate earlier work on farmer perceptions. Input into future climate change impact models. Guide development of policy recommendations
The Philippines	Milkfish	Model future climate change impacts / scenarios	March 2011	Yet to be started	Unknown, possibility to abandon case study and focus on other case studies.	Guide development of policy recommendations
India	Tiger shrimp	Expansive farmer survey	April 2010	Completed.	June 2010	Guide development of policy recommendations. Input into future climate change impact models.
India	Tiger shrimp	CIBA to send dataset to KU by end of June. Data cleaning for the Tiger shrimp survey database.	July	Completed.	Oct 2010	
India	Tiger shrimp	Report on the impact of extreme climatic events on brackishwater aquaculture in India		Report drafted and under revision. CIBA (national partner) administrative approvals slowing down publication of document.	Nov 2010	Guide development of policy recommendations
India	Tiger shrimp	Four to eight page brief on the impacts of extreme climatic events on brackishwater aquaculture in India		Yet to be started due date rescheduled to Dec 2010	Dec 2010	
India	Tiger shrimp	FGD and SW report finalised and published		Completed	June 2010	
India	Tiger shrimp	Technical brief on FGD and SW finalised and published		Yet to be started due date rescheduled to Dec 2010	June 2010	
India	Tiger shrimp	Contact with modelling agencies in India for collection of data.		Yet to be started	June 2010	

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Country	Commodity	Activities	Expected start date	Status	Expected completion date	Potential impacts
India	Tiger shrimp	Analysis of climate and secondary data		Yet to be started due date rescheduled to Dec 2010	November 2010	
India	Tiger shrimp	Modelling of predicted climate change:	June 2010	Yet to be started. Task larger than originally expected. Due date rescheduled to May 2011.	May 2011	
All	All	NACA Aquaclimate webpage development, maintenance and updating	March 2009	Ongoing	Ongoing	Disseminate knowledge to stakeholders and general community
Sri Lanka	Culture based fisheries (mixed finfish species)	Agreements with case study partners	May 2010	Contract signed and activities underway.	End of project	Contributes to implementation of national case studies
Sri Lanka	Culture based fisheries (mixed finfish species)	Literature survey, Selection of reservoirs, Catchment demarcation, Collection of irrigation data, Collection of rainfall data & evaporation data, Collection data related to CBF	June 2010	Yet to be started	In next reporting period	Guide development of policy recommendations
Vietnam	Tiger shrimp	Briefs of FGD and SW to be drafted by NACA and translated into Vietnamese by RIA2	NACA May 2010 RIA2 July 2010	Rescheduled to Dec 2010	NACA completed RIA2 rescheduled to April 2011	
India	Tiger shrimp	Briefs of FGD and SW to be drafted by NACA and translated into Telegu (local language) by CIBA	NACA May 2010 CIBA July 2010	Local partners to take the lead and also translate into local language	Dec 2010	
The Philippines	Milkfish	Briefs of FGD and SW to be drafted by NACA	NACA May 2010		March 2011	
Vietnam	Catfish	Briefs of survey results to be drafted by NACA		Local partners to take the lead and also translate into local language		
Vietnam	Tiger shrimp	Briefs of survey results to be drafted by NACA		Local partners to take the lead and also translate	March 2011	

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Country	Commodity	Activities	Expected start date	Status	Expected completion date	Potential impacts
				into local language		
India	Tiger shrimp	Briefs of survey results to be drafted by NACA		Local partners to take the lead and also translate into local language	March 2011	

## **8 Second annual project meeting**

The above is planned to be held in Kalawewa, Sri Lanka, 7<sup>th</sup> to 10<sup>th</sup> of March, and all the arrangements have been completed thereof. The draft agenda and the relevant information is given in Annex14.

It is expected to evaluate the progress of the project activities and to obtain a feed back on the proposed activities for the coming year at this meeting, when a meeting report of these will be provide

## 9 Looking forward

The project is substantially on track and the team believes considerable achievements have been made. Continuation of planned project activities along with activities agreed at the upcoming annual meeting will progress in the coming year.

The first policy brief on “Aquaculture Technical Brief: Improved extensive shrimp farming in Vietnam” was posted on the NACA web site in Feb. 2011. Based on feedback on this document it will be revised and then used at the forthcoming stakeholder meetings and will also be intimated to the Government of Vietnam for necessary action.

See: <http://www.enaca.org/modules/wfdownloads/singlefile.php?cid=210&lid=1022>

It is expected that many such policy briefs will be developed in due course and will form the basis for stakeholder discussions and intimation to the Government of Vietnam.

## 10 Acknowledgements

The NACA project team would like to thank the project international partners (from Bioforsk, Kasetart University, Akvaplan Niva), national partners (from the Central Institute for Brackishwater Aquaculture, India; Can Tho University and Research Institute for Aquaculture Number 2, Vietnam; and the Bureau of Fisheries and Aquatic Resources, the Philippines), stakeholders representing various local, regional and national agencies from different case study areas who participated in the workshops, surveys, and focus group discussions, other NACA (non-project) staff, F. Brian Davy (International Institute for Sustainable Development) and Fisheries Victoria, Australia.

## 11 List of Annexes

- Annex 1. Agreement between NACA and RIA 2 and Can Tho University
- Annex 2. Agreement entered to between the GoSL and NACA
- Annex 3. Abery and De Silva poster presented at the Global Conference on Aquaculture 2010.
- Annex 4. Hai *et al.* poster presented at the Global Conference on Aquaculture 2010.
- Annex 5. Tung *et al.* poster presented at the Global Conference on Aquaculture 2010.
- Annex 6. Minh *et al.* poster presented at the Global Conference on Aquaculture 2010.
- Annex 7. Dulyapurk *et al.* poster presented at the Global Conference on Aquaculture 2010.
- Annex 8. An *et al.* poster presented at the National Student's Conference on Aquaculture and Fishery 2010.
- Annex 9. Minh *et al.* poster presented at the National Student's Conference on Aquaculture and Fishery 2010.
- Annex 10. An *et al.* article published in Scientific Journal of Can Tho University. 2010.
- Annex 11. Minh *et al.* article published in Scientific Journal of Can Tho University. 2010.
- Annex 12. The first page of the of PaCFA (Global Partnership for Climate Change, Fisheries and Aquaculture)
- Annex 13. Web page of NACA dedicated to project Aquaclimate
- Annex 14. Draft Agenda of the Second Annual Project Meeting

Annex 1. Agreement between NACA and the Research Institute for Aquaculture #2 (RIA 2)



## Network of Aquaculture Centres in Asia-Pacific

**Agreement between the Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand and The Research Institute for Aquaculture No.2, HCMC, Vietnam and Faculty of Fisheries, CanTho University, Vietnam**

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**The following sub-project is a component of the regional project on, 'Strengthening Adaptive Capacities to the Impacts of Climate Change in Resource-poor Small-scale Aquaculture and Aquatic Resources-dependent Sector in the South and South-east Asian Region' under the auspices of a regional project coordinated by NACA and funded by NORAD.**

Under the sub-project *The Research Institute for Aquaculture No.2, HCMC, Vietnam and Faculty of Fisheries, CanTho University, Vietnam* undertakes to perform the tasks therein and will submit the results and relevant reports to the Director General NACA, on the time lines indicated.

Payments: On signing of this agreement NACA will pay 20 % (twenty percent) of the budgeted cost and thereafter on the basis of the deliverables and submission of statements of accounts of expenditure, supported by relevant documents.

The sub-project between NACA and the above institutes will:

- **Undertake work on the following Farming systems:**
  - **Shrimp farming (on-going MRC project) (Soctrang)**
  - **Cat fish farming (Cantho , Angiang, Vinhlong, Dong Thap)**
- **The project will determine the CC scenarios and collate:**
  - **Secondary data (rainfall, water level rise, sea water intrusion)**
  - **climatic data- (Patrick)**
  - **possible training programme on use of data bases**
- **Will assessment potential impacts of climate change for different climate change scenarios (1 yr)**
- **Will conduct surveys on Socio-economic vulnerability assessment/ stakeholder workshop / Focus groups**
  - **Will continue to develop and improve the Work plan on:**
  - **Primary data collection (pilot surveys)/ analyses**
  - **Re-assessment of methodologies**
- **Duration- 6 - 8 months**

The above work plan will be carried out in consultation with NACA (project coordinator- Prof., Sena S De Silva), Akvaplan (Patrick White) and Bioforsk (Dr. Udaya Sekhar), and will liaise with all these organizations through the project implementation, and where appropriate on field visits and data analyses.



**Project team:**

**RIA2:**

Nguyen Van Hao  
Phan Thanh Lam

**CanTho University:**

Nguyen Minh Nien  
Doan Van Bay

**Expected deliverables**

The expected deliverables from the project are likely to be:

- A knowledge on different scenarios on impacts of climate change impacts, for shrimp and catfish farming systems (for purposes of the project, and to make it meaningful and comprehensible, and pragmatic, from the point of view of the farming communities it was decided that the projections, where relevant, should be up to year 2050, but most preferably for the next 20 years).
- A complete data set on farm surveys, inputted into a database and analysed and written up for publication
- Range of adaptation measures to different climatic change elements and suggested improvements to practices and or introduction of new practices to maintain livelihoods of aquatic farming systems
- Relevant workshop reports
- A series of publications and reports and associated dissemination materials targeted at different audiences,

**11.1.1 Primary target sectors and stakeholders**

The final users of the project findings will include:

- Farmers (small-scale aquaculture producers)

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- Policy makers (Ministries and Departments related to Fisheries and Aquaculture)
- Managers
- Regional organizations
- Academia



**The agreed budget for the completion of the above activities is as follows:**

**Equipments**

Desktop computer (high capacity)	unit	0	750	0
GPS	unit	2	300	600

**Literature data collection**

<b>Software</b>				1000
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**Questionnaire study**

Questionnaire data collection	man-day	120	40	4800
Questionnaire data computing and analysis	man-day	60	40	2400
Transportation cost	trip	45	100	4500
Workshop in Vietnam	unit	2	1000	2000
Honorarium	person month	24	200	4800

Unforeseen cost (5% of total)				765
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Overhead cost (5% of total)				765
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Training (if required)				
------------------------	--	--	--	--

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Total      **US\$**  
**21630**



The above agreement is reached between the Network of Aquaculture Centres in Asia-Pacific and The Research Institute for Aquaculture No.2, HCMC, Vietnam and Faculty of Fisheries, CanTho University, Vietnam

Sena S De Silva  
Director General, NACA

Dr. Nguyen Hao  
Director, RIA 2

Date:

Date:

Prof. Nguen T. Phuong  
CanTho University

Date:

**Annex 3. The contract details for the Sri Lankan component as agreed upon by NACA and GoSL.**

**PROJECT CONCEPT FORMAT**

**ERD Reference Number**

*(for ERD use only)*

**Concept ID**

*(For ERD use only)*

**Previous Concept ID (if any)**

*(For ERD use only)*


Please refer “Project Concept Format Filling Guidelines” before continue.

**1. Project Information**

**1.1) Concept Date** 08/02/2010

**1.2) Project Title**

Impact of climate change on culture-based fisheries of seasonal reservoirs in Sri Lanka and resilience capacities of rural communities

**1.3) Thematic Area**

Human Resources Development, Capacity Building and Institutional Strengthening and Poverty Reduction

Human Resources Development, Capacity Building and Institutional Strengthening
Poverty Reduction
Rehabilitation & Reconstruction
Rural & Regional Development
Women & Children Differently Able

**1.4) Total Project Cost in LKR (mn)** Rs. 1.09 million

**1.5) Proposed Duration of the Project**

**(a) Unit :** Months 24

**(b) Duration** 2010 – 2011

**1.6) Sector and Sub sector**

Main Sector	Sub Sector
Agriculture	Livestock Development
	Agriculture Extension / Research
Environment and Natural Resources	Water Resource
	Disaster Management
Fisheries and Aquatic Resources	Inland Fisheries
Health , Nutrition and Social Protection	Social Protection

**1.7) Type of the Proposal**

(Tick one project type only. In case where more than one is involved, indicate the type with the largest component)

- i. Project Type Assistance
  - Goods , Services and Equipment Supply
  - Facilities Construction
  - Both
- ii. Feasibility Study
  - Pre-feasibility / Basic study
  - Feasibility
- iii. Technical Assistance
  - Master Plan for Development
  - Training and Human Resources Development
  - Project Development

**2. Applicant's Information .**

(Consist of brief introduction of the agency that creates and owns the project concept /forwarding ministry/Provincial Councils/stand alone organizations covering Organizational and personnel details)

**2.1) Host Country /Applicant    Government of Sri Lanka**

**2.2) Project Proponent**

- 2.2a ) Name of the Agency: University of Kelaniya
- 2.2b) Address: University of Kelaniya, Kelaniya 11600, Sri Lanka.
- 2.2c) Phone:
- 2.2d) Fax:
- 2.2e) Contact Person
  - i.) Title : Prof/Dr / Rev / Mr / Mrs / Miss
  - ii.) Name: Sarath Amunugama
  - iii.) Designation: The Vice Chancellor
  - iv.) Phone: +94 112914474
  - v.) Fax:
  - vi.) E-mail id: vc@kln.ac.lk

2.2f) Contact Person 2

- i.) Title : ~~Dr / Rev / Mr / Mrs / Miss~~
- ii.) Name M.M.M. Najim
- iii.) Designation Senior Lecturer
- iv.) Phone
- v.) Fax
- vi.) E-mail id [mnajim@kln.ac.lk](mailto:mnajim@kln.ac.lk), [najimhn@yahoo.com](mailto:najimhn@yahoo.com)

2.3) Forwarding Ministry / Provincial Council

- 2.3a ) Name: Ministry of Higher Education
- 2.3b) Address: Ministry of Higher Education, 18, Ward Place, Colombo 7
- 2.3c) Phone: +94 11 2694486/ 2697133/ 2697721/ 2691378
- 2.3d) Fax: +94 11 2697239
- 2.3e) Contact Person 1

- i.) Title : ~~Dr / Rev / Mr / Mrs / Miss~~
- ii.) Name: Rupa Malini Peiris
- iii.) Designation : Secretary, Ministry of Higher Education
- iv.) Phone: +94 11 2696679
- v.) Fax: +94 11 2671355
- vi.) E-mail id: [miofhied@slt.lk](mailto:miofhied@slt.lk)

2.3f) Contact Person 2

- i.) Title : ~~Dr / Rev / Mr / Mrs / Miss / Ms~~
- ii.) Name : P. Ranepura
- iii.) Designation: Additional Secretary, Ministry of Higher Education
- iv.) Phone: +94 11 2688621
- v.) Fax: +94 11 2697239
- vi.) E-mail id : [p\\_ranepura@yahoo.com](mailto:p_ranepura@yahoo.com)

### 3. Project Rationale

(Do not indicate/explain the objective of the project. Answer to each sub section should be in brief.)

#### 3.1) Introduction to the Project

(General sector information and information specific to the area)

Rural Sri Lanka stands on the agriculture-based economy with a long history of over 2000 years. The living example of the agricultural economy is the unique irrigation system developed by forefathers of the country. From the ancient period to present the main objective of the network of the irrigation system is providing water for paddy lands. Since early 1980s, small village reservoirs have been used for Culture-Based Fisheries (CBF) which essentially involves stocking of hatchery reared

fish fingerlings in natural or quasi-natural water bodies for enhancing fish production. CBF is a secondary use of existing water resources benefiting communities in the rural areas (De Silva et al., 2003). The unique feature of CBF is that it is not a competitor with traditional paddy cultivation and as such, it has become increasingly popular among the rural farmer communities.

In India, observed changes include an increase of air temperature, regional monsoon variation, frequent droughts and a regional increase in severe storm incidence in coastal states of India, along with indication of Himalayan glacier recession

The rural agriculture activities and CBF in Sri Lanka are based on the two rainy seasons during April-May and October-December. When the development of CBF is carried out in seasonal reservoirs, one of the major requirements would be to make available fish fingerlings for stocking at the correct time coinciding reservoir filling following intermonsoonal rains in October-December (Figure 1). The time of the onset of the rainfall as well as the duration also alter the traditional crop calendar of farming. Similarly, it can be expected that CBF calendar would also be affected by changes in rainfall patterns. In the recent decades, the rainfall has undergone changes and as a result, water scarcity and excess water have become a recurrent problem in crop production in Sri Lanka (Punyawardene, 2008) and further Jayawardena et al. (2005) has shown the decreasing trend of rainfall in 13 rainfall stations over recent 50 years. Changes in rainfall pattern were observed in Kerala, India as a result of climatic change (Al-Tabbaa & Pal, 2009).

### **3.2) Specific Problem to be Addressed by the Project**

Induced breeding of major carps, rearing of post larvae to fry stage and then to fingerling stage are major pre-stocking activities associated with CBF (Figure 2). In order to produce fish fingerlings for stocking in seasonal reservoirs, it is necessary to predict the rainfall pattern. The absence of sufficient rainfall or shifting of intermonsoonal rains due to climate change might make it difficult to predict timing of reservoir filling to perform fish stocking. Also, gonadal maturity of major carps is seasonal, and evidently is influenced *inter alia* by rainfall patterns. As a result, rural fish farmers might encounter significant financial losses at every stage of CBF.

### 3.3) Mode of Intervention in Terms of this Project (Justification)

There should be a mechanism through which rural communities engaged in CBF can adapt to climate change to overcome unexpected economic losses. Reliable prediction of water availability in village reservoirs is therefore a useful approach for improving resilience of rural communities to climate change.

### 3.4) Composition of Target Beneficiaries/Stakeholders (indicate Gender Ratio)

	Beneficiary / Stakeholder	Description	Gender Ratio	
			Male	Female
1	Fisheries officers		75%	25%
2	Agricultural and land-use managers		75%	25%
3	Policy Makers		75%	25%
4	Fishers		75%	25%
5	Personnel from private sector and industry		50%	50%
6	General public		25%	75%
7	Local Government officials		50%	50%
8	Environmental Officers		75%	25%
9	Pradeshiya Sabha members		75%	25%

### 3.5) Relationship of the Project to Government Policy Framework /Plan

Under the “Ten Year Development Policy Framework of the Fisheries and Aquatic Resources Sector 2007 – 2016”, it has been targeted that inland fisheries and aquaculture production in Sri Lanka be increased from the figure of 36,530 mt in 2006 to 74,450 mt in 2016. To achieve this target of 104% increase of inland fisheries production in the country, the strategies have been identified to develop culture-based fisheries in inland waters.

**Name of the Government Policy Framework /Plan** Ten Year Development Policy Framework of the Fisheries and Aquatic Resources Sector 2007 – 2016

attachments (if any ): A copy of the Ten Year Plan is attached.

### 3.6) Coherence with Sectoral Policies and Strategies

- Increase fish production in minor perennial reservoirs and seasonal tanks through culture based fisheries;
- Increase Indian carp production through stock enhancement programmes in major and medium perennial reservoirs

**Name of the plan** Fisheries Sector Ten Year Plan (2007-2016)

attachments (if any ): As above

**3.7) Considered Project Alternatives and Reasons for Rejection**

(Indicate the identified possible alternatives to achieve the project objectives and explain the reasons for rejecting them)

There are no possible alternatives

**3.8) Whether a Feasibility Study for the Project has been carried out**

Yes  No

If So attach the Feasibility Report .....

**4 Project Objective & Purpose**

(Indicate the main objective and the purpose of the project without adding project justification)

**4.1) Goal of the Proposed Project**

**12 Nos 2 and 3 are the Primary Objectives**

No 4 is the Secondary Objective

(Select and Indicate the Number(s) Pertaining to the Primary Objective and the Secondary Objective from List below)

- 1. Economic Development/Reform for Economic Growth
- 2. Poverty Alleviation
- 3. Social Development
- 4. Environmental Management
- 5. Capacity Building/Institutional Strengthening

**4.2) Purpose of the Project**

To investigate the potential impacts of climate change on CBF in selected small village reservoirs and minor perennial reservoirs.

**5. Project Outputs, Activities and Duration**

**5.1) Expected Project Outputs**

	<b>Output</b>	<b>Unit of Measure</b>	<b>Quantity</b>
<b>1</b>	Development of a model for predicting water availability in village reservoirs for culture-based fisheries development	Model	01
<b>2</b>	Investigation of resilience capacity of rural communities for climate change	No. of communities	28
<b>3</b>	Adoption of more feasible approaches for culture-based fisheries under the constraints of climate change (i.e., shifting rainfall pattern)	No. of communities	18
<b>4</b>	Publication of a guidebook in local language on the resilience of rural communities for climate change	Guide book	01

attachments (if any):

**5.2) Project Activities**

	Activity	Unit of Measure	Quantity
1	Selection of reservoirs	Number of Reservoirs	28
2	Demarcation of catchment landuse	Number of catchments	28
3	Collection of rainfall data	Rainfall stations	About 14
4	Measuring the volume of released irrigation water	Number of Reservoirs	28
5	Hydrological simulation	Number of Reservoirs	28

**5.3) Proposed Duration of the Project**

4.3.a) Unit : Months

4.3.b) Duration 18

**6. Project Location & Land Requirement**

**6.1) Is the Project Location in Islandwide or Area Specific:**

Islandwide   
 Area Specific

**6.2) Total Land Requirement:**

Unit of Measurement : None

Extent .....

**6.3) Specify the Project Location**

(Indicate the place(s) where project activities take place.)

Provide additional description if boundary cannot be demarcated clearly :

Site	Province	District	Division	Location	Land Required ? (Y/N)	Extent
1	North-Central	Anuradhapura		Bulankulama Gambirigaswewa Karambegama Katugampalagama	No	

				Pahalasandalamkulama		
2	Wayamba	Kurinegala		Kumbalporuwa wewa Kekunawa wewa Pahalawewa Wawullewa wewa Mataluwawa wewa	No	
3	Wayamba	Puttalam		Vettamurukkuwa Ramba wewa Daluegama Pahala wewa Polkatu wewa	No	
4	Uva	Moneragala		Dorzer wewa Bodhagama wewa Meegass wewa Galwale wewa	No	
5	Sabaragamuwa	Ratnapura		Mahagalara wewa	No	
6	Southern	Hambantota		Gonnoruwa wewa Kudaindiwewa Lunuveraniya wewa Madagamkadavara wewa Palujadura wewa Svodagama Wewa Weliwewa Wewegama Wewa	No	

**7. Environment and Environment Impact**

**7.1) Please Indicate if any of the Following Land Uses are Within the Project Site or Within 1 km Distance from any Boundary of the Project Site :**

National reserves, Sanctuaries, Forest reserves and proposed forest reserves, National Heritage wilderness areas, Coastal zones, flood areas and flood protection areas, Reserves, Ancient protected monuments, Schools, Religious places and Hospitals

**Yes**, one or more of the above land uses are within the site boundary

**Yes**, one of more of the above land uses are within 1 km of the site boundary

**No**, none of the above land uses are within the project boundary or within a 1 km distance from any boundary of the project site.

If the answer to this question is affirmative, please list land use(s) and provide a map (1:50,000 or smaller scale) showing the project boundary and a distance of 1 km from each boundary.

.....

.....  
 attachments: .....

**7.2) What are the Possible Environment and Natural Resources Constraints to the Existing Activities due to the Proposed Project? None**

**7.3 Indicate which of the Following Resources may be Required for the Project.** If possible, specify quantities and from what sources (i.e., name of source or location if available).

Resource	Required for this Project	Unit of measurement	Extent (if known)	Location (if known)
Surface Water	No			
Groundwater	No			
Quarry Stone or Earth fill	/No			
Energy:	No			
Forests	No			
Other(Specify).....	No			

**7.4) Will the Project Require Relocating 100 or more Families? No**

**7.5) Whether the Project Location is Inside the Costal Buffer Zone? No**

**7.6) Is the Proposed Project a Prescribed Project?** (Please refer to Sri Lanka Government Gazette Extraordinary – 772/22 of 1993.06.24. and the Gazette Extraordinary No 1104/22 of 1999.11.05 You are advised to consult CEA to verify the Prescribed status).

Yes  No

**8. Gender Perspective**

**8.1) Does the Project Identify any Gender Gaps? If so Describe.**

In aquaculture sub-sector, there is no significant gender gap . However, female involvement in the decision making process is very weak.

**8.2) Is there any Strategy in the Project to Address the Gender Imbalances**

In the strategies for the development of inland capture fisheries and fisheries enhancement, as part of the co-management of resource exploitation, the community participation in making management decisions will be sought. The potential of reducing the gender gap through women’s participation in decision making will be addressed adequately. It is well-understood that women’s involvement in decision making with regard to resource management is effective in rural sector of Sri Lanka so that addressing the issue of reducing the existing gender gap in

inland fishing and farming communities will be useful to assure sustainable exploitation of inland fishery resources.

**8.3) Which Project Activities are Designed to Bridge such Gender Gaps and What will be their Impact on Gender Imbalance?**

The females in the rural communities will be actively involved in the culture-based fisheries activities at various stages, especially in the activities related to book-keeping, and financial management. The female members will be encouraged to actively participate in decision making process to face the constraints associated with shifting of rainfall patterns as a result of climate change.

**9. Cost & Financing**

**9.1) Total Project Cost in LKR (mn) 1.09**

**9.2) Cost Components**

Component	Activity	Cost in Local Currency (LKR mn)
1. Data Collection	1.1 Rainfall and other meteorological data (department of meteorological)	0.0724
	1.2 Field data collection (Fuel, Subsistence and overtime)	0.9576
2. Maps and other stationary	2.1 Digital Landuse maps	0.0262
	2.2 Stationary	0.0262
3. Miscellaneous		0.0103
	<b>Total</b>	<b>1.0927</b>

**9.3) Financing Plan**

Financial Source	Cost
	Local Currency (LKR mn)
External Source (NACA, Thailand)	1.0927
Proponent (Implementing Agency) Funding	-
Beneficiary Contribution	-
Consolidated Fund	-
Other (Specify).....	-
<b>Total</b>	<b>1.09</b>

**9.4) Details of Already Offered External Assistance to Projects in the Related Sector in the Last Five Years**

Donor	Related Field	Project Title: Assistance Already Offered	Amount USD (mn)	Year of Commencement	State whether Completed or Ongoing
ACIAR	Inland Fisheries	Management strategies for enhanced fisheries production in Sri Lankan and Australian lakes and reservoirs	0.66	1998	Completed
Asian Development Bank	Inland Fisheries and Aquaculture	Aquatic Resources Development and Quality Improvement Project	30 million	2003	Ongoing (will be concluded in June 2010)
FAO	Aquaculture	Aquaculture development in the Southern Province	0.375 million	2009	2010

## 10. Project Implementation

( If the Project Proponent is the Implementing Agency the Information at 2.2 should Appear Here)

### 10.1) Implementing Agency with Overall Responsibility.

10.1a ) Name of the Agency: University of Kelaniya

10.1b) Address: University of Kelaniya, Kelaniya 11600, Sri Lanka

10.1c) Phone:

10.1d) Fax

10.1e) Contact Person 1

- i.) Title : Prof/~~Dr~~ / Rev / Mr / Mrs / Miss
- ii.) Name: Sarath Amunugama
- iii.) Designation: Vice Chancellor
- iv.) Phone: +94 112914474
- v.) Fax: E-mail id: vc@kln.ac.lk

10.1f) Contact Person 2:

- i.) Title : Dr / ~~Rev~~ / Mr / Mrs / Miss
- ii.) Name: M.M.M. Najim
- iii.) Designation: Senior Lecturer

- iv.) Phone:
- v.) Fax:
- vi.) E-mail id: [mnajim@kln.ac.lk](mailto:mnajim@kln.ac.lk), [najimhn@yahoo.com](mailto:najimhn@yahoo.com)

**10.2) Functions of the Implementing Agency with Overall Responsibility**

Academic institution offering degree programmes, postgraduate degrees, postgraduate diplomas, postgraduate certificate courses, conducting non-graduate diploma and certificate courses; Carrying out pure and applied research on various disciplines.

**10.3) Implementing Agency /Agencies and Their Functions and Prior Experience with Similar Projects / Activities**

	Implementing Agency/Agencies	12.1 Functions	12.2 Prior Experience
1	University of Kelaniya	Project coordination Field data collection and analysis Report writing Preparing publications	Coordination and Involvement in several foreign-funded multi-disciplinary projects on inland fisheries and aquaculture sectors; Coordination of locally-funded projects
2	Wayamba University of Sri Lanka, Makandura, Gonawila	Field data collection and analysis Report writing Preparing publications	Involvement in several foreign-funded and locally-funded multi-disciplinary projects on inland fisheries and aquaculture sectors
3	Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara.	Field data collection and analysis Report writing Preparing publications	Involvement in several foreign-funded and locally-funded multi-disciplinary projects on inland fisheries and aquaculture sectors

**10.4) Responsibilities of Other Entities (Other Relevant Agency)**

10.5.a) Applicable / Not applicable

10.5.b) Narration

National Aquaculture Development Authority of Sri Lanka will provide necessary support at the field level through its extension arm to carry out this project.

**10.5) Staff Availability for Implementing the Proposed Project (Specify any Additional Staff Required)**

Implementing Agency	No of Staff Members Available
University of Kelaniya	3
Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara.	2
	<b>Additional Staff Required</b>

ANNEX 3

## Strengthening Adaptive Capacities to the Impacts of Climate Change in Resource-poor Small-scale Aquaculture and Aquatic Resources-dependent Sector in the South and South-east Asian Region - "Aquaclimate"

Nigel W. Abery and Sena S. De Silva  
The Network of Aquaculture Centres in Asia-Pacific, Bangkok Thailand




### Background

Scientific evidence of the seriousness of the climate threat to agriculture and other resource-based activities like fisheries and aquaculture is now unambiguous (IPCC, 2007; World Bank 2008).

"Aquaclimate" is a three year project funded by the Norwegian Agency for Development Cooperation (NORAD) and coordinated by NACA.

International project partners of the project are:  
-Biotorsk -the Norwegian Institute for Agricultural and Environmental Research, Ås, Norway  
-Faculty of Fisheries, Kasetsart University  
-Akvaplan-niva AS, Tromsø Norway  
-Department of Primary Industry, Victoria, Australia

The project is mapping farmers' perceptions and attitudes towards prospective climate change impacts and their adaptive capacities to address these impacts and is developing future scenarios based on the current trends, assessing the potential adaptive measures for different aquatic farming systems and will prioritise better management practices, suggest Codes of Practices and improved methodologies for such systems.




### Stripped Catfish – Mekong delta, Vietnam

The National partners for this case study are Can Tho University and Research Institute for Aquaculture #2.

Key recent climate changes that are perceived to impact on catfish farming include: Increasing changeable weather patterns, higher river and canal water level increase & more frequent floods, rainy season starting earlier, increasing salt water intrusion, increase in No. hot days & longer hot season, increase in the number of cold days, increasing incidence of sudden heavy rain, increasing incidence of storms & typhoons.

Key recent impacts include: Stressed, slower growth & diseases, dike erosion, damage to pond facilities, water quality, loss of fish, costly to repair & upgrade dikes, higher production costs due to adaptation, loss of production area & lower productivity, poorer quality of water, poorer quality of flesh and thus lower price, bacterial & viral diseases outbreaks, higher production costs due to the adaptation.

Key adaptation measures include: Better feeds & improve feed nutrition, lime on the slopes of the dikes & liming after draining, salting pond water to help stabilise water quality, upgrade of pond dikes & sluice gates, chemicals for water quality & fish pond dikes & sluice gates, chemicals for water quality & fish health improvement, trees on dikes to strengthen them, better quality seed, change the crop calendar to take into account weather changes, harvest earlier to avoid the higher salinity, change to a different species, better aquaculture planning & aquaculture zoning, new salt tolerant species for culture, select Pangasinanodon hypophthalmus for salt tolerance, develop & produce vaccines against the major diseases.




### Tiger Shrimp – Andhra Pradesh, India (continued...)

Farmer adaptation measures include: adapting to seasonal changes by following better management practices at farm level, supply of electricity for 24 hours, loans and insurance and the construction of flood walls (common dykes) and de-silting and deepening of source water bodies. Technical/scientific adaptive measures: improvement of BMPs, identification of alternate species and development of technology, scientific principles in planning mitigation measures such as mangrove plantations, de-silting and deepening of drains, and construction of flood walls.

Policy adaptation measures: quality input supply, electricity supply, loans and insurance schemes, flood walls construction and mangrove plantations, and efficient forecasting of extreme climatic events.



### Objectives

"Aquaclimate" aims to strengthen the adaptive capacities of rural farming communities to the impacts of climate change. The project focuses on small-scale aquaculture and related sectors that are comprised largely of poor people who depend on aquatic resources for their livelihoods.

- Assess the impacts of climate change on small scale aquaculture sector (environmental and socio-economic) in selected areas and aquatic farming systems
- Assess vulnerability of different aquatic farming systems to climate changes
- Explore potential adaptive measures for different aquatic farming systems
- Prioritise better practices for the most "adaptive" aquatic farming systems
- Develop future scenarios for small-scale aquaculture systems in the south and south-east Asian region (up to 2020).
- Propose risk-mitigating strategies compatible with the scenarios
- Determine awareness/knowledge level, perceptions of risks, attitudes of farmers towards perceived risks from climate change
- Determine risk-management behaviours and strategies of farmers to climate change induced risks
- Develop guidelines for policy measures and decision support tools
- Benchmark adaptive capacities of small farming households
- Develop wider awareness of the results by publishing and disseminating through various sources and networks

### Tiger Shrimp – Ca Mau & Bac Lieu, Vietnam

The National partners for this case study are Can Tho University and Research Institute for Aquaculture #2.

**Brief results summary:**  
Key recent climate changes that are perceived to impact on shrimp farming include: too much rain, high temperature, canal/water/sea level rise, irregular weather and storms.

Key recent impacts include: High water temperature and day night variation, water quality problems, Shrimp stress and disease, Slow growth, Toxic algae blooms, toxic gas, Mass mortality, broken dykes and sluice gates.

Key adaptation measures suggested by farmers include: aquaculture extension activities focusing on disseminating culture techniques appropriate for new climatic conditions, timely weather broadcast on television, with increased frequency and accuracy, agricultural banks or other funding sources to issue long term loans for improving shrimp farming, reforestation of mangrove in coastal areas.




### Culture Based Fisheries – Sri Lanka

The National partner for this case study is the University of Kelaniya

Some small village reservoirs are being used for Culture-Based Fisheries (CBF) which essentially involves stocking of hatchery reared fish fingerlings in natural or quasi-natural water bodies for enhancing fish production. CBF is a secondary use of existing water resources benefiting communities in the rural areas. The unique feature of CBF is that it is not a competitor with traditional paddy cultivation and as such, it has become increasingly popular among the rural farmer communities. CBF are reliant on natural rains to fill the water bodies for stocking, the timing, amount and duration of rains can influence the suitability and stocking/harvesting calendar for CBF water bodies. In the recent decades, rainfall has undergone changes and as a result, water scarcity and excess water have become a recurrent problem in crop production in Sri Lanka. A project has recently been initiated in Sri Lanka to evaluate the impacts of any recent changes in changes in climate on the CBF waterbodies.

### Case Studies

The project is working in four countries: Vietnam, India, Philippines and Sri Lanka. The project case studies are:

- Catfish (Pangasinanodon hypophthalmus) farming in the Mekong Delta, Vietnam
- Extensive tiger shrimp (Penaeus monodon) farming in the Mekong Delta, Vietnam
- Extensive tiger shrimp (Penaeus monodon) farming in Andhra Pradesh, India
- Milkfish (Chanos chanos) farming in Iloilo, the Philippines
- Culture based fisheries in Sri Lanka

The case studies are implemented in collaboration with national partners in each country.

### Tiger Shrimp – Andhra Pradesh, India

The National partners for this case study are the Central Institute for Brackishwater Aquaculture and the National Centre for Sustainable Aquaculture.

**Brief results summary:**  
Key recent climate changes that are perceived to impact on shrimp farming include: seasonal changes, heavy rains, floods and cyclone in inland areas and high temperature, floods, low/un-seasonal rain fall, low temperature, cyclone and low tidal amplitude in coastal areas. The seasonal changes were mainly temperature variations and delay in monsoon. The water inundation in ponds is due to heavy rainfall caused by both floods and cyclone.

Key recent impacts include: Crop season delayed, water quality problems (salinity, pH, oxygen, temperature) resulting in: excess algal bloom development, less feeding, slow growth and extension of culture period, molting problems, low survival, diseases incidence and production losses. Brood stock collection problems; infrastructure problems: Dyke damage due to heavy rain, flood and wind (animals escape, ponds submerged), electricity problems, approach to farm is difficult and water exchange difficulties.




### Future Plans

The project will continue to collect and analyze the data on recent climate change, climatic change model predictions will also be used in conjunction with bio-physical aspects of the case studies aquaculture industry sectors to evaluate future predicted impacts on these communities.

### Project activities

**Activities thus far include:**  
-Farmer and stakeholder focus group discussion meetings to understand perceptions about recent climate changes and responsive adaptation mechanisms for the farming of catfish in Vietnam, shrimp in Vietnam, Milkfish in the Philippines and Shrimp in India case studies.



-An expansive farmer survey of the perceptions of farm socio-economics and the impacts of climate change and adaptation measures done for catfish in Vietnam, Shrimp in Vietnam and shrimp in India.



### Contact information

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ANNEX 4



## Perceived impacts and adaption to climate changes in small scale shrimp farming in Ca Mau province, Vietnam

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<sup>b</sup> Network of Aquaculture Centres in Asia-Pacific (NACA), PO Box 1040, Kasetsart Post office, Bangkok 10903, Thailand



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Introduction



Climate change (CC) is an increasingly urgent problem, particularly for natural resource dependent industries such as agriculture, fisheries and aquaculture. Vietnam is one of the world's most CC affected countries due to its geographical location and long low lying and deltaic coastline. The Mekong Delta of Vietnam is the most affected areas of Vietnam, of which Ca Mau province is a coastal province, where the farmers' livelihood's are mostly dependent on aquaculture and fisheries.

Objectives

An aim of the present study is to map farmers' perceptions and attitudes towards recent CC impacts and their adaptive capacities to address these impacts in Ca Mau province. A profile of perceived recent climate changes and CC impacts on improved extensive shrimp farming systems currently observed by shrimp farmers is given in the present study. The current adaptation measures to CC applied by farmers were also investigated.

Materials and Methods

One hundred improved extensive shrimp farmers in Dam Doi and Cai Nuoc Districts, Ca Mau Province were interviewed from Oct to Dec 2009. The Location of each farm was recorded via a global positioning system.

Five interviewers went to the two selected communes of each district. Each interviewer took one pathway across the commune and randomly entered households/farms. If there was someone or the household head present, who knew most about the farm operation, the interview was carried out. In some cases, when the interviewees could not understand or could not answer the questionnaires clearly, the interviewers discontinued the interview and moved to other farms until getting 100 of interviewed households.

Farming system characteristics

Ca Mau has the largest area of aquaculture in Vietnam with 294,659 ha in 2009, contributed 188,670 tonnes to the national exports of fishery products. Different shrimp culture models are used due to various ecosystems and the socio-economic status of farmers, of which the improved extensive shrimp model is widely applied in Ca Mau Province with 262,735 and 263,853 ha under culture in 2008 and 2009.

Farmer's perceptions about climate change

Although farmers have an average 12 year experience in shrimp culture, their techniques are still poor due to low education of 48, 50 and 2% reaching primary, lower and upper high school levels, respectively, and inappropriate extension methods to their situation. Therefore, the shrimp and crab yields were at low level of 163 and 48 kg/ha/year, respectively.

The farmers' perceptions on CC were vague, but 99, 70, 69, 67 and 66 % of farmers have claimed that sea level rise, irregular weather changes, high temperature, drought and heavy rain, respectively, have affected the most in their farms (Table 1). Although storms were rarely recorded at lowest frequency, their effect on farms was huge even caused 100 % losses because the farmers have no experiences on how to prevent or mitigate the effects from storms due to rare occurred.

Relationships between farmer characteristic and yield

No correlation between the numbers of year's experience and the yield, between the pond size and the yield, nor between the education level and the yield, were found.

Farmer priorities for adaptation

Farmers have heightened the roles of stakeholders on collaboration and coordination to develop appropriate strategies for sustainable shrimp farming. Farmers suggest that the introduction of new species suited to the changing ecology should be considered. Farmers also suggested that i) farmers' perception should be enhanced by training; ii) aquaculture extension activities should focus on disseminating culture techniques appropriate for new climatic conditions; iii) research organisations focus on finding out new species which can adapt to a new changes; iv) weather broadcasts on television should be on time, frequent and accurate; v) banks or other funding sources should have long term loans for improving shrimp farming; vi) reforestation of mangrove should be priority in the coastal areas; vii) other financial and technological supports from various organisations. The farmers were not only concern about the effect from CC to aquaculture, but also the impact from aquaculture to the environment. Consequently, the farmers have also proposed that they need appropriate techniques to improve their products and income without resulting negative impact to the environment.

Conclusion

Although CC events have affected small-scale shrimp farming with losses typically between 10-30% and up to 100% of income in some cases, the farmers do believe that shrimp farming still remains a viable industry in the long term.

Contact information

More information about the project can be found on the Network of Aquaculture Centres in Asia-Pacific website [www.enaca.org/aquaclimate](http://www.enaca.org/aquaclimate)

Table 1: The rankings based on the observation frequency and effect levels

CC events	Percentage of farmers recorded (%)
Sea level rise	99
Irregular weather	70
High temperature	69
Drought	67
Heavy rain	66
Salinity increase	58
Temperature rapid change	42
Low temperature	40
Salinity decrease	27
Storm	8

CC Impacts/ NACA/RIA2/CanTho/ May 09

ANNEX 5


STRENGTHENING ADAPTIVE CAPACITIES TO THE IMPACTS OF CLIMATE CHANGE IN SMALL-SCALE AQUACULTURE


Tra Catfish farmer perceptions of climate change impacts in Dong Thap and Vinh Long Provinces, Vietnam


Pham Ba Vu Tung<sup>a</sup>, Nguyen Van Hao<sup>a</sup>, Nigel W. Abery<sup>b</sup> & Sena S. De Silva<sup>b</sup>

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<sup>b</sup> Network of Aquaculture Centres in Asia-Pacific (NACA), PO Box 1040, Kasetsart Post office, Bangkok 10903, Thailand







Introduction

Aqua Climate

- Tra catfish (*Pangasianodon hypophthalmus*) culture in the Mekong Delta –Important aquaculture Commodity In 2009:
- Production: 1,075,000 tones (Provincial Aquaculture Department, 2009)
- Export: volume of 607,670 tones & value of 1,342,917 USD (VASEP, 2009).
- Tra catfish culture area in Dong Thap province: 1,200 ha and Catfish production: 200,000 tones (VIFEP, 2009)
- Tra catfish culture area in Vinh Long province were 450 ha and Catfish production: 120,000 tones (VIFEP, 2009)

Objectives

- To identify and assess current status of Tra catfish farming in Vinh Long and Dong Thap provinces.
- To initially assess Tra catfish farmers perception on impacts of climate change.

Research Methodology

Step 1: Development and design questionnaires.  
Step 2: Pre-test, revise and finalize questionnaires.  
Step 3: Based on list of catfish farmers (692 farmers in Dong Thap and 328 farmers in Vinh Long provinces in 15 May 2009 ) and results of provincial officials interviewing, designed sample frame and sample size. Randomly 53 small-scale tra catfish farmers in Dong Thap province and 25 pangas farmers in Vinh Long province were selected.

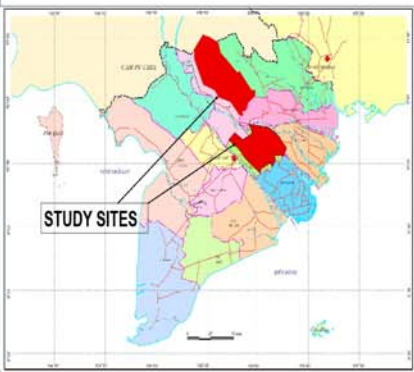
- Interviewers: RIA2 staff and Provincial staff, were trained by supervisors to conduct the climate change questionnaire interviews.

Step 4: Design and development and a database in MS Excell

- Data/information were checked by two supervisors at the same day of survey.
- Data/information were entered/checked into Database.

Step 5: Data analysed using MS Excell/SPSS software.

Study site: Dong Thap & Vinh Long provinces



Results

1. Socio-economic profile of the households

Average household size: **5** people/household

Average labour per household: **3** laborers/ household

Income	Dong Thap N = 53	Vinh Long N = 25	Grand total N = 78
Catfish farm	88.96%	79.00%	85.77%
Rice	1.79%	3.20%	2.24%
Garden	4.81%	6.20%	5.26%
Trading	0.47%	0.40%	0.45%
Other	3.96%	11.20%	6.28%

2. Crop of striped catfish stocking in two provinces

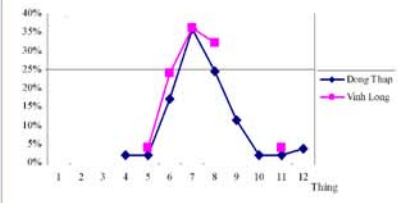


Figure1. Cultured crop of striped catfish stocking

3. Reasons for household economics loss in Tra catfish culture

Information	Dong Thap (N=53)	Vinh Long (N=25)	Grand total (N=78)
Fish diseases	16.98	24.00	19.23
Feed high price	9.43	4.00	7.69
Low market price	62.26	52.00	58.97
Poor quality seed	3.77	0.00	2.56
Without answer	7.55	16.00	10.26

Farmer perceptions of climate change in the past 10 years

	Dong Thap (N=53)	Vinh Long (N=25)	Grand total (N=78)
Very much	78.34%	69.82%	73.77%
Somewhat	18.24%	17.76%	17.98%
None	3.42%	12.42%	8.24%

Farmer concerned the recent extreme weather changes

Concerning Lever	Dong Thap (N=53)	Vinh Long (N=25)	Grand total (N=78)
Very much	83.37%	74.85%	78.80%
Somewhat	16.49%	12.73%	14.48%
None	0.14%	12.42%	6.72%

Percentage of households (HHs) with climate change impact

Climate change Impact	Dong Thap		Vinh Long		Grand total	
	Yes	No	Yes	No	Yes	No
Floods	32.84	67.16	29.76	70.24	31.19	68.81
Irregular weather	58.77	41.23	71.64	28.36	65.66	34.34
Heavy rain	85.53	14.47	95.76	4.24	91.01	8.99
Temperature fluctuation high or low	51.64	48.36	46.48	53.52	48.88	51.12
Salinity	0	100	0	100	0	100
Gradual impact						
Change in temperature very hot very cold	55.14	44.86	25.21	74.79	39.11	60.89
Change in precipitation early rain heavy rain	84.21	15.79	60.42	39.58	71.47	28.53
Change in season timing change	44.03	55.97	58.97	41.03	52.03	47.97
Water pollution	73.38	26.62	35.15	64.85	52.90	47.10
River/canal level rise	34.59	65.41	33.39	66.61	33.95	66.05
Wind change	58.21	41.79	41.09	58.91	49.04	50.96

Percentage of HHs had damage from extreme weather

Ranking	Dong Thap	Vinh Long	Grand total
Fish diseases	67.86	55.56	63.86
High cost	10.71	14.81	12.05
Reduce production	19.64	22.22	20.48
Not effect	1.79	7.41	3.61

Percentage of Households adaptability on climate change impact

	Dong Thap	Vinh Long	Grand total
Upgrading farms	15.63	25.93	18.68
Attending training course	1.56	11.11	4.40
Improve skills management	18.75	3.70	14.29
Changing farming practices	26.56	11.11	21.98
Accept	37.50	48.15	40.66
Improve institutional support	20.39	21.57	20.69
Improve financial support	32.24	31.37	32.02
Improve technical support	28.95	35.29	30.54
Stable market price	18.42	11.76	16.75

Conclusion

Households income from tra catfish farming was negative in Dong thap province and positive in Vinh long province at the last crop. Main reasons were low gate price and fish disease. They need Improve finance and technical support to upgrade farms and changing farming practices.

Further information

More information about the project can be found on the Network of Aquaculture Centres in Asia-Pacific website [www.enaca.org/aquaclimate](http://www.enaca.org/aquaclimate)

ANNEX 6



# Potential climate change impacts on social vulnerability and adaptive capacity of striped catfish (*Pangasianodon hypophthalmus*) farming community, Mekong Delta, Vietnam

Minh H. Truong<sup>1</sup>, Nigel W. Abery<sup>2</sup>, Udaya Sekhar Nagothu<sup>3</sup>, Ranganathan C.R.<sup>1</sup>, Phuong T. Nguyen<sup>1</sup>, Sena S. De Silva<sup>2</sup>

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 Corresponding author: [hminh@ctu.edu.vn](mailto:hminh@ctu.edu.vn)

**Abstract**

The striped catfish (*P. hypophthalmus*) farming industry in the Mekong delta is a billion dollar industry that supports hundreds of thousands of livelihoods and provides affordable food to numerous countries worldwide. The industry has recently been impacted by climate changes, and will continue to be impacted. Farmer and stakeholder perception about climate change, production and socio-economic information was obtained from focus group discussions, a stakeholder workshop and an expansive (190 respondents) farmer survey that was undertaken in the Mekong delta from June to December 2009.

Key recent climate changes identified included: irregular weather patterns, prolonged hot season, early rains, suddenly heavy rain, floods, higher river water level, water quality changes, saline water intrusion, sea level rise and frequent typhoons. These changes have caused major impacts including increasing disease occurrence, lower growth and survival rates, lower production, bad water quality, poorer flesh quality, destruction of the irrigation system, loss of production area, and higher production costs due to increased expenditures on chemicals and drugs, repairing and upgrading dikes, etc.

A social vulnerability indicator was developed from responses to a farmer survey and is composed of social factors that are highly variable across the population of catfish farmers. Significant factors of the indicator includes: size of farm; age; number of farms; percentage of income from catfish farming; education level; trainings attended; experience in fish farming. The indicator is associated with catfish farmers' perceived degree of difficulty in overcoming losses due to the damage from the extreme weather events.

**Introduction**  
 According to IPCC report, most developing countries will be affected seriously by climate change. Vietnam's topography, climate and long coastline makes it particularly vulnerable to climate extremes and natural disasters. Analysis by Dasgupta et al. (2007) suggests that Vietnam is one of world's top five most vulnerable countries to sea level rise and the most vulnerable to climate change impacts in South East Asia. In 2006-2007, different parts of Vietnam experienced typhoons, floods and droughts in an unprecedented manner causing severe losses to property and infrastructure. Both, agriculture and aquaculture sectors suffered seriously due to the extreme weather events impacting livelihoods of small farmers and the poor.

In the Mekong Delta region, striped catfish culture provides livelihoods to thousands of small-scale farming households. The small-scale farmers in general are characterized by restricted access to resources and poor investment capacity. This also makes them vulnerable to natural and economic shocks, and less able to protect themselves and their livelihood assets from various external threats (Nagothu, 2007).

**Methodology**

The study was conducted in five provinces (Can Tho, Dong Thap, Soc Trang, Vinh Long and Tra Vinh) in the Mekong River Delta of Vietnam (MRD). Soc Trang and Tra Vinh are coastal provinces subject to tidal inundation.



Figure 1. Study area

The data and information used in the present study were generated from individual catfish farmers' surveys. A number of statistical methods have been used to test and analyze the data. The variables were ordinal or categorical. Hence to understand the association between them several statistical methods were used. The Chi-Square test for contingency tables was used along with Cramer's V-statistic to determine the extent of correlation or association between the variables. To derive the factors which underlie the vulnerability to climate change, principal component analysis (PCA) was employed using several social variables. All the statistical analyses were done using MATLAB and MS-Excel software packages

**Results**

**The main social characteristics of farmers**

Table 1. Social characteristics of the farmers surveyed

Province	Total	Age (years)				Main Occupation	Number of years in aquaculture			
		< 30	30-45	45-60	> 60		Fish farming	Others	< 5	5-10
Can Tho	10	32	32	8	73	9	28	42	10	2
Dong Thap	82	1	16	30	6	39	14	24	26	2
Soc Trang	53	1	5	8	1	10	5	8	7	0
Tra Vinh	15	0	7	6	2	9	6	6	9	0
Vinh Long	15	4	5	14	2	17	8	14	10	0
Total	190	15	65	90	19	148	42	80	94	12
Percentage to Total	100	8	34	48	10	78	22	42	49	6

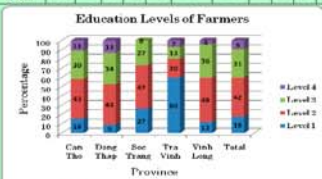


Figure 2. Education level of farmers

**Awareness and perceptions of farmers of relevant climate change issues and perceived risks**

Table 2. Perceptions of farmers about extreme weather and climate change

Province	Observation of changes in the weather (climate or extreme events in the last 10 years (floods, monsoon delays, salt water intrusions etc)			Total
	None	Very much	Somewhat	
Dong Thap	2	41	10	53
Vinh Long	3	18	4	25
Can Tho	20	15	47	82
Tra Vinh	6	0	9	15
Soc Trang	5	0	10	15
Total	36(19)	74(39)	80(42)	190

Table 3. Farmers perceptions about risks due to extreme weather and climate change

Province	Concerns about recent extreme weather events			Total
	Not concerned	Very much	Somewhat	
Dong Thap	1	43	9	53
Vinh Long	3	19	3	25
Can Tho	54	28	0	82
Tra Vinh	15	0	0	15
Soc Trang	9	6	0	15
Total	82(43)	96(51)	12(6)	190

**Impacts to climate change and extreme weather events**

Table 4. Frequency distribution of impact of extreme events classified according to the provinces to which they belong:

	Province to which farmer belongs					Chi-Square Test	Cramer's V
	Dong Thap	Vinh Long	Can Tho	Tra Vinh	Soc Trang		
<b>Impact of Extreme Events</b>							
Not affected	3(2)	2(1)	37 (19)	7(4)	8(4)	30.52, Sig. at 1%	0.444
Affected	50 (26)	23 (12)	45 (24)	6 (4)	7 (4)		
<b>Magnitude of damage of extreme events</b>							
If affected, not serious	5 (3)	6 (3)	45 (24)	6 (4)	12 (6)	58.12, Sig. at 1%	0.391
Somewhat	19 (10)	7 (4)	25 (13)	7 (4)	3 (2)		
Very serious	29 (15)	12 (6)	12 (6)	0 (0)	0 (0)		
<b>Difficulty in overcoming the losses</b>							
Not very serious	9 (5)	6 (3)	58 (31)	11 (6)	10 (5)	70.588, Sig. at 1%	0.458
Somewhat	20 (11)	6 (3)	24 (13)	4 (2)	5 (3)		
Very Serious	29 (15)	13 (7)	0 (0)	0 (0)	0 (0)		
<b>Frequency of Extreme Events</b>							
Less frequent	11 (6)	10 (5)	10 (5)	0 (0)	0 (0)	28.417, Sig. at 1%	0.273
Same as before	13 (7)	6 (3)	13 (7)	4 (2)	4 (2)		
More frequent	29 (15)	9 (5)	63 (33)	11 (6)	11 (6)		

**Adaptation strategies of farmers to climate change induced risks**

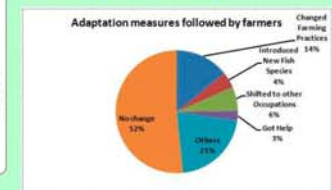


Figure 3. Adaptation measures followed by farmers in the surveyed areas

Table 5. Farmers ranking of agencies that could help in planned adaptation

Agencies	Rank				Total
	1	2	3	4	
DARD (Include Aquaculture & Fisheries)	50	15	1	1	67
DARD	17	8	5	0	30
University/Research Institutes	14	10	16	3	43
Farmers agencies/ groups	12	15	5	4	36
Drug and chemical companies	37	5	3	0	45
Pellet feed companies	17	3	0	0	20
Fish processing companies	2	0	0	0	2

Table 6. Garrett Ranking Selection of Factors

Factor	Rank					Total Garrett Score	Average Score	Rank
	1	2	3	4	5			
DARD	2972	702	44	27	3745	55.9	1	
DARD	1068	398	207	0	1673	55.8	2	
University/Research Institutes	873	441	587	81	1982	46.1	6	
Farmers agencies/ groups	768	696	155	108	1727	48.0	5	
Drug and chemical companies	2079	211	93	0	2383	53.0	4	
Pellet feed companies	1009	124	0	0	1133	56.7	3	

**Social vulnerability/resilience indicators to climate change of surveyed farmers**

Table 7. Social vulnerability indicators

Sl. No.	Indicator Name	First latent vector	Standard Errors	t-value	Component loadings
1	Land-Ownership (X <sub>1</sub> )	-0.0963	0.3052	0.3155	-0.205*
2	Age (X <sub>2</sub> )	0.1008	0.5371	0.1877	-0.036
3	Percentage of Earning members to Household size(X <sub>3</sub> )	-0.4044	0.2965	1.3622	0.437***
4	Number of farms (X <sub>4</sub> )	0.3788	0.2047	1.8505*	-0.365***
5	% income from fish farming(X <sub>5</sub> )	-0.1884	0.3818	0.4935	-0.191*
6	Education-Level (X <sub>6</sub> )	0.4287	0.2173	1.9729*	-0.508***
7	Trainings Attended (X <sub>7</sub> )	0.4584	0.3836	1.1950	-0.529***
8	Experience in Fish Farming (X <sub>8</sub> )	0.4941	0.2282	2.1653*	-0.588***

\*Sig. at 10%; \*\* Sig. at 5% and \*\*\*Sig. at 1% level

**Conclusion & Suggestion**

Farmers' and stakeholder adaptation suggestions include changes to management practices, producing and using good quality seed, developing new/improved culture systems/species, improved infrastructure, livelihood diversification, training and awareness workshops, financial support, and zoning and timing for culture area. Improving adaptive capacity; developing early warning broadcast systems for RLS, flood & supporting small scale farmers with necessary resources.

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**Acknowledgments**

We are grateful to NORAD for funding and technical supports of NACA & CAF/CTU.

ANNEX 7



# Vietnam Catfish Production Function Analysis in Relation to Climate Change Impacts



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**INTRODUCTION:** *Pangasius hypophthalmus* is a freshwater fish native to the Mekong river system that is cultured almost entirely in deep earthen ponds at very high density. The catfish farming industry and associated industries contributes significantly to the livelihoods of the local population in Vietnam. Vietnam, particularly the Mekong delta is highly vulnerable to climate change especially extreme climate events such as cyclones, storms and floods. Since catfish farming in Mekong delta is facing of the impact of climate change, to maintain the catfish farming in Mekong delta, production system in relation to climate change need to be investigated.



**OBJECTIVE:** Main objective of this study is to investigate the Vietnam catfish production function through a partial cost structure by using the 190 catfish farms in the southern part of Vietnam. Along with common catfish farm input structure, this study attempts to incorporate the climate change impacts into model analysis. The technical elasticity which provides the comparative ranking among interesting parameters is calculated.

**MATERIALS AND METHODS:**

In 2009, the 190 Vietnam small-scaled catfish production data had been collected through a survey technique by 5 provinces; Can Tho (82 samples), Dong Thap (53 samples), Vinh Long (25 samples), Soc Trang (15 samples) and Tra Vinh (15 samples), respectively. The selected variables with definition and group are presented in Table 1. Majority of Vietnam catfish farming has been reported as a small-scaled operation.

**General form of production function**

$$O = b_0 + \sum b_j^{PI} P_{jA} + \sum b_j^{PMA} P_{jMA} + \sum b_j^{PIA} P_{jIA} + \sum b_j^{CCI} CCI_j$$

**Elasticity calculation**

$$E_{O, P_{jA}} = b_j^{PI} \frac{P_{jA}}{O}, \quad E_{O, P_{jMA}} = b_j^{PMA} \frac{P_{jMA}}{O}$$

$$E_{O, P_{jIA}} = b_j^{PIA} \frac{P_{jIA}}{O}, \quad E_{O, CCI_j} = b_j^{CCI} \frac{CCI_j}{O}$$

- O = Output in VND (Total revenue)
- b<sub>0</sub> = Constant
- i = input type
- j = Climate change impact type
- PIA = Production system parameter
- PMA = Production management aspect parameter
- PIA = Production input aspect parameter
- CCI = Climate change impact parameter
- E = Elasticity calculation at mean value

Table 1. Selected Variables for the Vietnam Catfish Production System Analysis

PIA: Production System	PMA: Production Management Aspects	PIA: Production Input Aspects	CCI: Climate Change Impact(s)
<ul style="list-style-type: none"> <li>• PA1: Total water area of farm (ha)</li> <li>• PA2: Pond water area (ha)</li> <li>• PA3: Pond depth (m)</li> <li>• PA4: Water depth (m)</li> <li>• PA5: Pond age (year)</li> </ul>	<ul style="list-style-type: none"> <li>• PMA1: Owner's age (year)</li> <li>• PMA2: Number of year in aquaculture (year)</li> <li>• PMA3: Level of education</li> <li>• PMA4: Number of aquaculture related training courses attended (year)</li> <li>• PMA5: Land ownership</li> <li>• PMA6: Income from catfish farming compared to the total household income (%)</li> <li>• PMA7: Survival rate between stocking and harvesting (%)</li> <li>• PMA8: Feed Conversion Ratio (FCR) to the market size</li> <li>• PMA9: Number of Farm(s) owned</li> <li>• PMA10: Total number of pond(s) in a selected survey</li> </ul>	<ul style="list-style-type: none"> <li>• PIA1: Fry stocking density (fry/ha)</li> <li>• PIA2: Commercial feed amount uses (%)</li> <li>• PIA3: Homemade feed amount uses (%)</li> <li>• PIA4: Fry size in depth (cm)</li> <li>• PIA5: Number of fry per pond</li> <li>• PIA6: Total fry expense (VND/pond/crop)</li> <li>• PIA7: Total commercial feed cost (VND/pond/crop)</li> <li>• PIA8: Total homemade feed cost (VND/pond/crop)</li> <li>• PIA9: Total vitamin cost (VND/pond/crop)</li> <li>• PIA10: Total chemical cost (VND/pond/crop)</li> <li>• PIA11: Total drug cost (VND/pond/crop)</li> <li>• PIA12: Total electricity cost (VND/pond/crop)</li> <li>• PIA13: Total temporary labor cost (VND/pond/crop)</li> <li>• PIA14: Total permanent labor cost (VND/pond/crop)</li> <li>• PIA15: Total sediment removal cost (VND/pond/crop)</li> </ul>	<ul style="list-style-type: none"> <li>• CCI1: Climate change impact – Flood (Yes/No)</li> <li>• CCI2: Climate change impact – Irregular weather (Yes/No)</li> <li>• CCI3: Climate change impact – Heavy rain/storm (Yes/No)</li> <li>• CCI4: Climate change impact – Temperature fluctuation (Yes/No)</li> <li>• CCI5: Climate change impact – Salinity (Yes/No)</li> <li>• CCI6: Climate change impact – Others (Yes/No)</li> <li>• CCI7: Climate change gradual impact – Temperature (Yes/No)</li> <li>• CCI8: Climate change gradual impact – Early or Heavy rain (Yes/No)</li> <li>• CCI9: Climate change gradual impact – Change in season timing (Yes/No)</li> <li>• CCI10: Climate change gradual impact – Water pollution (Yes/No)</li> <li>• CCI11: Climate change gradual impact – River/Canal level rise (Yes/No)</li> <li>• CCI12: Climate change gradual impact – Wind change (Yes/No)</li> <li>• CCI13: Climate change gradual impact – Others (Yes/No)</li> </ul>

**RESULTS:**

Table 2. Estimated parameters of Vietnam catfish production function

Parameter	Parameter Value	t-statistics	Std. Error
Constant	-493,383.4	-4.245	116,221.82
PA2: Pond water area (ha)	2,499,812.7	9.382	266,441.82
PIA13: Total temporary labor cost (VND/pond/crop)	0.048	6.546	0.007
PIA7: Total commercial feed cost (VND/pond/crop)	0.0001*	3.898	0.0004*
PIA14: Total permanent labor cost (VND/pond/crop)	0.013	3.517	0.003
PIA11: Total drug cost (VND/pond/crop)	0.004	3.768	0.001
PIA15: Total sediment removal cost (VND/pond/crop)	-0.043	-0.226	0.012
CCI8: Climate change gradual impact – Early or Heavy rain (Yes/No)	290,681.20	3.038	95,687.44

Note: Adj-R<sup>2</sup> = 0.806; a = Approximated value. All estimated coefficient is statistically significant at 0.05.

Table 2 shows a statistically significant (at α = 0.05) parameters estimated through step-wise technique.

Table 3 Elasticity calculation based on a ratio of selected input parameter and catfish output multiplying with the selected input parameter (from Table 2)

Table 3. Elasticity measured at mean calculation and Ranking for Vietnam catfish production function

Ranking	Parameter	Elasticity
1	PA2: Pond water area (ha)	0.50
2	PIA13: Total Temporary labor cost (VND/pond/crop)	0.41
3	PIA7: Total commercial feed cost (VND/pond/crop)	0.26
4	PIA15: Total sediment removal cost (VND/pond/crop)	(0.18)
5	CCI8: Climate change gradual impact – Early or Heavy rain (Yes/No)	0.16
6	PIA14: Total permanent labor cost (VND/pond/crop)	0.14
7	PIA11: Total drug cost (VND/pond/crop)	0.09

Note: () = Negative value

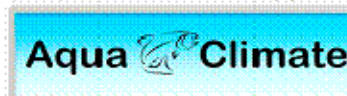
**CONCLUSIONS:** Catfish pond water area with the highest comparative elasticity, among controlled parameters in catfish farming, has a positive statistically significant impact for catfish farming improvement. However, the total temporary labor cost, total commercial feed cost, total permanent labor cost and total drug cost are more likely to be adjustable than the pond water area since they are all categorized as the variable input in the farming system. The optimal Vietnam catfish production cost adjustment has to be recommended in order to reduce a cost of catfish farming and maintain its course of profitability and sustainability. Especially, the total sediment removal cost which has shown a negative sign from the estimation can be optimally reduced to improve the revenue generated from catfish farming. An early or heavy rain as the only climate change impact on catfish production that has been detected with, surprisingly, positive value along with some confirmations from many studies, however [1, 2, 3]. Further studies related with climate change impact on catfish farm which can produce a concrete evident for confirming this result is recommended.

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**ACKNOWLEDGEMENT:**

This study is a part of "Strengthening adaptive capacities to the impacts of climate change in resource-poor small-scale aquaculture and aquatic ecosystem dependent sector in the South and South-East Asian region" or "AquaClimate Project" funded by Norwegian Agency for Development Cooperation (NOVA) and coordinated by Network of Aquaculture Centres in Asia-Pacific (NACA). We also appreciate our Vietnam partners, Cantho University and Research Institute of Aquaculture No.2 (RIA2), for data collection.



September, 2010

ANNEX 8



## SO SÁNH HIỆU QUẢ KINH TẾ - KỸ THUẬT TRONG NUÔI CÁ TRA (*Pangasianodon hypophthalmus*) GIỮA VÙNG NƯỚC NGỌT VÀ VÙNG NHIỄM MẶN Ở ĐỒNG BẰNG SÔNG CỬU LONG

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**Tóm tắt**

Nghiên cứu này đã được thực hiện từ tháng 8/2009 đến tháng 4/2010 thông qua phỏng vấn 82 hộ nuôi ở vùng nước ngọt (Cần Thơ) và 30 hộ nuôi ở khu vực bị nhiễm mặn nhẹ (thuộc tỉnh Trà Vinh và Sóc Trăng). Nghiên cứu này cho thấy diện tích ao nuôi, độ sâu mức nước, mật độ, năng suất và lợi nhuận trong nuôi cá tra ở vùng nước ngọt cao gấp 2 lần so với vùng nhiễm mặn. Các yếu tố ảnh hưởng đến năng suất cá nuôi cũng được xác định trong nghiên cứu này.

**Từ khóa:** Cá tra, *Pangasianodon hypophthalmus*, vùng nhiễm mặn, kỹ thuật, hiệu quả kinh tế

**Giới thiệu**

Từ năm 1997 đến năm 2007, tổng diện tích nuôi cá tra đã tăng 6 lần (đạt khoảng 6.000 ha). Sản lượng cá tra thương phẩm tăng 45 lần, từ 22,5 ngàn tấn lên 1 triệu tấn. Đến năm 2008, đã có 9 tỉnh ở ĐBSCL nuôi cá tra xuất khẩu. Cá Tra được nuôi nhiều nhất ở các tỉnh An Giang, Đồng Tháp, Cần Thơ và Vĩnh Long. Trong những năm gần đây, một số khu vực bị nhiễm mặn nhẹ như Sóc Trăng, Trà Vinh... cũng đã phát triển nuôi đối trọng này.

**Phương pháp nghiên cứu**

Tổng số hộ điều tra 112 hộ: Vùng nước ngọt (NN) (Cần Thơ): 82 hộ; Vùng nhiễm mặn nhẹ (NM) (Trà Vinh và Sóc Trăng): 30 hộ



Địa điểm nghiên cứu

**Kết quả thảo luận**

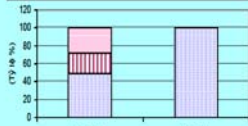
**Khía cạnh kỹ thuật**

**Bảng 1a: Thông số kỹ thuật trong nuôi cá tra**

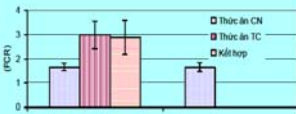
Diễn giải	Vùng NN (n=82)	Vùng NM (n=30)
Diện tích hộ (ha)	0,77±0,64 <sup>a</sup>	0,42±0,44 <sup>b</sup>
Diện tích ao nuôi (ha)	0,36±0,20 <sup>a</sup>	0,22±0,13 <sup>b</sup>
Độ sâu ao (m)	4,69±0,74 <sup>a</sup>	3,75±0,70 <sup>b</sup>
Mức nước (m)	3,89±0,62 <sup>a</sup>	2,94±0,61 <sup>b</sup>
Mật độ (con/m <sup>2</sup> )	54,7±23,64 <sup>a</sup>	30,5±13,3 <sup>b</sup>
Cỡ giống (cao thân) (cm)	1,85±0,68 <sup>a</sup>	1,53±0,35 <sup>a</sup>
Thời gian nuôi (tháng)	8,4±2,6 <sup>a</sup>	6,7±1,7 <sup>b</sup>

**Bảng 1b: Thông số kỹ thuật trong nuôi cá tra**

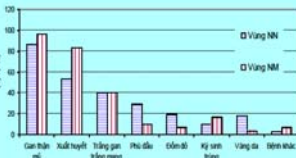
Diễn giải	Vùng NN (n=82)	Vùng NM (n=30)
Tỷ lệ thay nước(%)	39,3±15,9 <sup>a</sup>	42,2±16,8 <sup>a</sup>
Tần suất thay nước (lần/tháng)	30,0±8,6 <sup>a</sup>	27,7±6,0 <sup>a</sup>
Khoảng cách lấy nước (m)	38,8±53,5 <sup>a</sup>	21,2±29,2 <sup>a</sup>
Tỷ lệ sống (%)	71,9±18,7 <sup>a</sup>	80,3±13,7 <sup>b</sup>
Năng suất (tấn/ha/vụ)	416,1±148,5 <sup>a</sup>	208,7±84,6 <sup>b</sup>
Cỡ cá thu hoạch (kg/con)	1,06±0,31 <sup>a</sup>	0,98±0,18 <sup>a</sup>



Tỷ lệ hộ nuôi sử dụng các loại thức ăn



Hệ số tiêu tốn thức ăn của cá tra



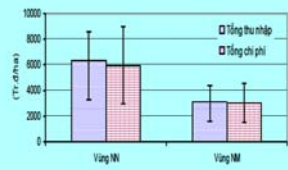
Một số bệnh trên cá tra nuôi

**Khía cạnh kinh tế**

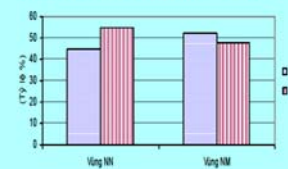
**Bảng 2: Một số chỉ tiêu kinh tế trong nuôi cá tra**

Diễn giải	Vùng NN (n=82)	Vùng NM (n=30)
Tổng chi phí (tr.đ/ha/vụ)	5.957,6±2.996,2 <sup>a</sup>	3.056,4±1.516,4 <sup>b</sup>
Thức ăn (%)	80,8	78,3
Giống (%)	2,0	1,3
Thuốc (%)	2,1	4,2
Lấy vay (%)	4,3	6,5
Tổng thu (tr.đ/ha/vụ)	6.303,8±2.224,8 <sup>a</sup>	3.082,8±1.282,4 <sup>b</sup>
Giá thành (đ/kg cá)	15.264±2.334 <sup>a</sup>	15.072±2.419 <sup>a</sup>
Giá bán bình quân (đ/kg cá)	15.068±806 <sup>a</sup>	14.703±1.229 <sup>a</sup>
Tỷ suất LN	1,00±0,20 <sup>a</sup>	0,99±0,15 <sup>a</sup>
Mức lợi nhuận (tr.đ/ha/vụ)	1.359,0±1.640,7	600,9±631,9
Mức thua lỗ (tr.đ/ha/vụ)	891,8±865,2	501,9±454,0

Ghi chú: Trong các bảng, các giá trị trong cùng 1 hàng có các chữ cái giống nhau thì khác biệt không có ý nghĩa thống kê(p>0,05).



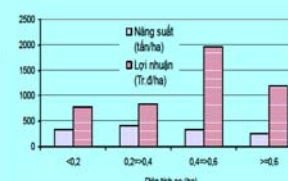
Tổng thu nhập và tổng chi phí trong nuôi cá tra



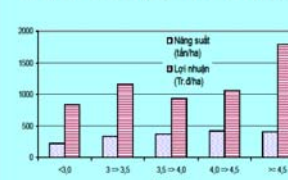
Tỷ lệ hộ nuôi cá tra có lợi và thua lỗ

**Các yếu tố ảnh hưởng đến năng suất cá nuôi**  
**Phương trình tương quan đa biến:**  
 $Y = 160,2 - 144,2 X1 + 35,3 X2 + 2,4 X3 + 23,6 X4 - 15,0 X5 - 2,5 X6 + 0,4 X7 + 0,2 X8$   
 (R = 0,91; R<sup>2</sup> hiệu chỉnh = 0,80; F-Sig. = 0,000)

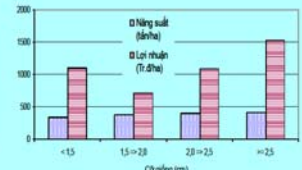
- Trong đó:**  
 Y: Năng suất cá (tấn/ha/vụ);  
 X1: Diện tích ao (ha);  
 X2: Mức nước (m);  
 X3: Mật độ (con/m<sup>2</sup>);  
 X4: Vùng nuôi (0= Vùng NN; 1=Vùng NM);  
 X5: Kích cỡ giống (cm);  
 X6: Tỷ lệ thức ăn CN (%);  
 X7: Lượng thức ăn CN (tấn/ha/vụ);  
 X8: Chi phí thuốc hóa chất (Tr.đ/ha/vụ)



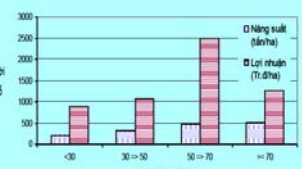
Năng suất và lợi nhuận theo các nhóm diện tích ao



Năng suất và lợi nhuận theo nhóm mức nước



Năng suất và lợi nhuận theo nhóm kích cỡ giống



Năng suất và lợi nhuận theo nhóm mật độ giống

**Kết luận và đề xuất**  
 Diện tích, mức nước ao nuôi, mật độ giống, thời gian nuôi, tỷ lệ sống, năng suất, tổng chi phí và tổng thu nhập ở vùng NN lớn hơn so với vùng NM.

Hiệu quả sản xuất giữa hai vùng là tương đương. Tỷ lệ số hộ có cá bị nhiễm bệnh vùng NN thấp hơn ở vùng NM, đặc biệt là bệnh gan thận mũ và xuất huyết.

Năng suất cá nuôi tương quan chặt với diện tích ao nuôi, mức nước trong ao, vùng nuôi, mật độ và kích cỡ giống.

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ANNEX 9



**CLIMA FISH**

## Understanding the impacts, vulnerability and adaptive capacity to climate change of catfish (*Pangasianodon hypophthalmus*) pond farmers in the Mekong Delta, Vietnam

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### Abstract

Stakeholder analysis & participatory methodologies were applied for assessment on climate changes impacts, vulnerability, adaptive & mitigative capacity of pond catfish farmers in the Mekong Delta in 2009.

Climate changes were addressed as irregular weather patterns, prolonged hot season, early rains, suddenly heavy rain, floods, higher river water level, bad water quality, saline water intrusion, sea level rise (SLR) & typhoons, & CC impact on increasing fish diseases, slower growth, lower survival rates & production, loss of production area in saline water intrusion area, and higher production costs. Adaptation actions & costs and agencies that could help farmers with CC problems. Planners focused on related institution agency roles and responsibilities, zoning, programs and projects.

**Key words:** Catfish, *Pangasianodon hypophthalmus*, climate change impacts, vulnerability, adaptation, perceptions

### Introduction



The Mekong Delta (MD) has a high potential for development of both Agriculture & Aquaculture. The Delta experienced rapid development of aquaculture since the early 90s, given the demand in the domestic and international market. The MOF estimated that by 2010 the aquaculture would contribute to 2.0 mil. tonnes & provide jobs 2 mil. people. Out of this, about 1 mil. tonnes from Catfish farming. Catfish farming developed on a commercial scale in the MD.

However, the Delta region is highly vulnerable to various problems, especially climate changes and extreme weather events. Most serious problems are from changing weather patterns, early rains, higher temperatures, floods, typhoons and salt water intrusion due to sea level rise. At the same it is dominated by small scale farmers who are vulnerable to changes in the climate and extreme weather events.

### Materials and Methods



Figure 1. Study area

### Results and Discussion

**Technical & economic characteristics of catfish farm**

Pond area (ha)	0.3 ± 0.2
Water depth (m)	3.6 ± 0.7
Dike height upper water surface (m)	1.2 ± 0.8
Crop (months)	7 - 9
Stocking density (ind./m <sup>2</sup> )	45 - 50
Yield (ton/ha/crop)	360 ± 162
Total production cost (mil. VND/ha/crop)	5,480 ± 2,670
Production cost per kg of fish (VND/kg/crop)	15,280 ± 2,370
Revenue (mil. VND/ha/crop)	5,344 ± 2,450
Economic loss & profitable farms (%)	55 & 45

**Steps of FGD**

1. Identify the agencies extreme events suffered by farmers
2. Identify the impacts of those extreme events
3. Action taken by farmers to deal with or rectify the problem
4. Estimate of costs to deal with the problem
5. Which agency help farmers in future extreme events

**Climate change perception**

- Increasing changeable weather patterns
- Higher river and canal water level increase & more frequent floods
- Rainy season starting earlier
- Increasing salt water intrusion
- Increase in No. hot days & longer hot season
- Increase in the number of cold days
- Increasing incidence of sudden heavy rain
- Increasing incidence of storms & typhoons

**Impacts**

- Stressed, slower growth & diseases
- Dike erosion, damage to pond facilities, water quality, loss of fish, costly to repair & upgrade dikes (14-15 mil VND/ha)
- Higher production costs due to adaptation
- Loss of production area & lower productivity
- Poorer quality of water
- Poorer quality of flesh → lower price
- Bacterial & viral diseases outbreaks
- Higher production costs due to the adaptation

**Adaptive capacity**

- Use of better feeds & improve feed nutrition to improve growth rate (adding Vitamin C & digestive probiotics)
- Use of lime on the slopes of the dikes & lining after draining
- Add salt to the pond water to help stabilise water quality
- Upgrade of pond dikes & sluice gates
- Use chemicals & probiotics for water quality & fish health improvement
- Planting trees on dikes to strengthen them
- Purchase better quality seed
- Change the crop calendar to take into account weather changes
- Harvest earlier to avoid the higher salinity to change to a different species
- Need for better aquaculture planning & aquaculture zoning
- Need study on potential new salt tolerant species for culture
- Need to select *Pangasius* for salt tolerance
- Develop & produce vaccines against the major diseases

**Physical:** damage to pond facilities, loss of production area (saline intrusion), damage to the irrigation water supply & discharge system. Further adaptation on climate changes, both farmers & managers improve in the irrigation supply canal system to bring freshwater to the pond area in the long term, build up dykes to protect farms from floods.

**Biological & environmental:** abnormal fish behaviour & fish become stressed leading to decreased growth rate, increased diseases, parasite problems & mortality, lower productivity, poorer flesh quality. Change in water quality (low pH & higher turbidity levels, increased salinity, high ammonia, build up of toxic substances, increase in water pollution). Zoning aquaculture areas & research on suitable species that can be grown in saline water; supply fry & fingerling free of diseases, effective vaccines & drugs for diseases treatment. Selective breeding to solve the problems of reduced fish growth rate; improving technology & farm management to control production costs.

**Economic:** higher operational costs due to the need to repair & upgrade dikes & sluice gates, adaptation measures, expenditure on medication & chemicals used; loss of production & lower market price due to lower flesh quality.

### Conclusion

Overall, stakeholders perceived climate change as a threat to catfish farming. Though farmers have started to adapt to the extreme weather events, their socio-economic context makes them vulnerable to climate variability. Stakeholders priority to improve the adaptive capacity through strengthening the current culture systems, producing good quality fry, funding support in the event of losses, training of farmers to promote awareness & improve adaptive capacity, developing early warning broadcast systems for RLS, flood & supporting small scale farmers with necessary resources.

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### Acknowledgments

We are grateful to NORAD for funding and technical supports of NACA & CAF-CTU.

Stakeholder analysis & participatory methods, farmer interviews were applied in this study.

**Focus group discussion (FGD)**

- Duration: 1 hour
- Location: village
- Facilitator: scientist

**FGD meetings**

- Group 1: Catfish farmers
- Group 2: various government agencies
- Group 3: commercial companies, scientific staff and other stakeholders



Figure 2. Stakeholder workshop in CTU

**ANNEX 10**

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**Trường Đại học Cần Thơ**  
**CAN THO UNIVERSITY**

*Nguyễn Hồng Anh*

**TẠP CHÍ KHOA HỌC**

**Journal of Science**  
**ISSN: 1859 - 2333**

**Số định kỳ 14b năm 2010**  
**Volume: 14b - 2010**

**ANNEX 11**

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**Trường Đại học Cần Thơ**  
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**TẠP CHÍ KHOA HỌC**

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ANNEX 12

## Fisheries and Aquaculture in a Changing Climate

Climate change impacts such as more frequent and severe floods and droughts will affect the food and water security of many people. The impact of climate change on aquatic ecosystems, fisheries and aquaculture, however, is not as well known. This policy brief, a joint partnership between several agencies, highlights this issue to ensure that decision makers and climate change negotiators consider aquatic ecosystems, fisheries and aquaculture at the UNFCCC COP-15 in Copenhagen, December 2009.

The build-up of carbon dioxide and other greenhouse gases in the atmosphere [1] is changing several of the features of the Earth's climate, oceans, coasts and freshwater ecosystems that affect fisheries and aquaculture - air and sea surface temperatures, rainfall, sea level, acidity of the ocean, wind patterns, and the intensity of tropical cyclones.



Climate change is modifying the distribution and productivity of marine and freshwater species and is already affecting biological processes and altering food webs. The consequences for sustainability of aquatic ecosystems, fisheries and aquaculture, and the people that depend on them, are uncertain.

Fishers, fish farmers and coastal inhabitants will bear the full force of these impacts through less stable livelihoods, changes in the availability and quality of fish for food, and rising risks to their health, safety and homes. Many fisheries-dependent communities already live a precarious and vulnerable existence because of poverty, lack of social services and essential infrastructure. The fragility of these communities is further undermined by overexploited fishery resources and degraded ecosystems. The implications of climate change for food security and livelihoods in small island states and many developing countries are profound.



## ANNEX 13



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2010.pdf

Annex 14. Draft Agenda, Second Annual Project Meeting



**Second Annual Meeting of the Aqua Climate – Norad Project: March 07<sup>th</sup> to 10<sup>th</sup>, 2011**

**National Inland Fisheries and Aquaculture Training Institute (Nifati)  
Kalawewa, Sri Lanka**

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**DRAFT AGENDA**

**Day 01: 06<sup>th</sup> March 2011:**

Arrival of participants in Colombo, Sri Lanka; travel to Kalawewa, North central Province (approximately 0330 hrs) by road

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**Day 02: 07<sup>th</sup> March 2011:**

Expected to reach Kalawewa in the early hours of 07<sup>th</sup> March

**AM:** rest

**PM:** Visit (a) Aukuna Buddha Statue (<http://www.aukanabuddha.info/>)  
(b) Minneriya National Park  
(<http://www.mysrilankaholidays.com/minneriya-national-park.html>)



Accommodation: National Aquaculture Development Authority (NAqDA), Training Center

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**Day 03: 08<sup>th</sup> March 2011:**

0800-0820: Opening remarks: Chairman, NAqDA

0820-0830: Remarks by Prof. Miao Weimin, FAO Aquaculture Officer, RAP< Bangkok

0830-0900: Purposes and expectations of the workshop: Sena S De Silva

0900-0930: Election of Chair; Introduction of Participants

**0930-1000: Tea/ Coffee Break**

1000-1025: Striped catfish (*Pangasianodon hypophthalmus*) production and farmer's perception on climate change impacts in the lower Mekong Delta, Vietnam- **Truong Hoang Minh**

1025-1050: Impact of climate change on the production efficiency of pangasius farms in the Mekong delta, Vietnam- **Pham Ba Vu Tung**

1050-1115: Vietnam catfish production function analysis in relation to climate change impacts- **Varunthat Dulyapurk (Methee Kaewnern & Sirisuda Jumnongsong)**

1115-1140: Salinity intrusion as a results of sea level rise scenarios in the Mekong delta, Vietnam and potential impacts on aquaculture- **Nguyen Lam Anh**

1140-1205: Impact of climate change on culture based fisheries in seasonal reservoirs of Sri Lanka- **Najim, M.M.M.**

1205-1230: Wrap up on presentations

**1230-1400: Lunch Break**

1400-1425: Perceived climate changes, impacts and risks by shrimp farmers in Andhra Pradesh, India – **M. Muralidhar**

1425-1450: Climate change and shrimp farming in India - Adaptation and mitigation measures – **M.Kumaran**

1450-1515: Climate change impacts on small scale aquaculture: socio economic vulnerability and stakeholder adaptation-**Udaya Sekhar Nagothu**

**1515-1535: Tea/ Coffee Break**

1535-1600: Use of GIS to develop future Climate change scenarios (2020 and 2050) and recommend adaptation measures- **Patrick White**

1600-1625: Adapted Life Cycle Analysis methodology to benchmark case study culture systems- **Patrick White**

1625-1730: General Discussion

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**Day 04: 09<sup>th</sup> March 2011:**

0630-0730 Visit fish landing site (Kalawewa Reservoir)

0830-0900: Summary of achievements to date

0930-1030: Evaluation of achievements to date: **Geoff Gooley**

**1030-1100: Tea/ Coffee break**

1100-1130: Finalization of Work Plan

1130-1230: Brief on Phase 2 proposal- **Sena S De Silva**

**1230-1400: Lunch**

- 1430: Climb Dambulla Rock Temple  
 1730: Leave for Colombo Air Port (all Asian flights will leave in the early hours of the 10th)



## Participant List

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