Draft guidelines for the preparation of TEC Briefs

Summary

- The Technology Executive Committee (TEC), at its 5th and 6th meetings, has been working on preparing policy/technology briefs (TEC Briefs) on various topics. These TEC Briefs will aim at providing information, key messages and/or recommendations to targeted audience on various aspects of technology development and transfer for mitigation and adaptation to climate change.
- In order to ensure consistency and set a professional image for TEC Briefs, the TEC agreed, at its 6th meeting, to have guidelines for the preparation of TEC Briefs.
- This information note contains draft guidelines for the preparation of TEC Briefs, for consideration by the TEC at its 7th meeting.

I. Introduction

A. Background

1. In accordance with its functions and modalities, the TEC developed and agreed, at its 2nd meeting, upon its rolling workplan for 2012–2013. The workplan includes the preparation of an inventory of relevant technology briefs, technical reports and technical papers as one of the tasks to be completed in 2013 and also to produce technical papers on topics to be agreed by the TEC to be carried out in 2013.

2. The TEC, at its 5th and 6th meetings, has been working on preparing policy/technology briefs on various topics. These briefs will aim at providing information, key messages and/or recommendations to targeted audience on various aspects of technology development and transfer for mitigation and adaptation to climate change.

3. The TEC, at its 6th meeting, agreed to call such documents "TEC Briefs". In order to ensure consistency and set a professional image for TEC Briefs, the TEC also agreed to develop guidelines for the preparation of TEC Briefs. The TEC requested the secretariat to prepare such draft guidelines for consideration by the TEC at its 7th meeting.

B. Scope of the information note

4. This information note contains draft guidelines for the preparation of TEC Briefs.

C. Possible action by the Technology Executive Committee

5. The TEC may wish to take into account this information note when considering guidelines for the preparation of TEC Briefs.

6. If agreed upon, the guidelines will be an internal document for the TEC and it will be posted on the dedicated TEC members only page on TT:CLEAR.

II. Approach

7. For the purpose of developing these guidelines, a literature review of existing technology and policy briefs produced by various organizations was conducted with a view to having an understanding of main elements and good practices of policy/technology briefs. Over 100 publicly available policy/technology briefs related to climate change mitigation and adaptation technologies were reviewed.

III. Guidelines for TEC Briefs

8. Annex I to this information note contains draft guidelines for the preparation of TEC Briefs.

Annex I Draft guidelines for the preparation of TEC Briefs

I. General information on briefs

1. A brief is a short document presenting information in a concise, easy-to-understand and visually attractive manner regarding a specific topic. The objective is usually to attract the attention of a targeted audience and convey information, key messages and/or recommendations in an effective manner.

2. In the context of the climate change, technology briefs usually address specific technologies or particular areas of technologies, and are used to inform decision makers about existing technologies, their benefits for the climate, barriers, costs and environmental and social benefits to support them in their decisions to consider certain technologies for mitigation and adaptation to climate change.

3. Policy briefs rather focus on policy guidance for decision/policy-makers as they usually provide information and/or recommendations on measures or actions to be taken to tackle climate change.

4. The style of delivery of a technology/policy brief is to present technical or policy information as an overview so that the targeted audience learns about the most important aspects of the topic being addressed. Unlike elaborate studies or papers that go in-depth into the subject, technology/policy briefs are designed to present the topic in a light and clear way.

5. As technology/policy briefs are generally short concise documents, they often provide links or references to more detailed descriptions of aspects contained in the brief.

II. Guidelines for TEC Briefs

A. Scope of TEC Briefs

6. While the TEC may produce briefs on specific technologies or areas of technologies (technology briefs), it is more likely that the TEC will produce briefs of policy nature (policy briefs), given the policy role of the TEC in the Technology Mechanism.

7. Any brief produced by the TEC will be called a "TEC Brief".

8. TEC Briefs may address technologies for mitigation or adaptation, any aspect of the technology cycle (research and development, demonstration, deployment, diffusion and transfer), and any related tool, approach or process, bearing in mind the wide scope of "technology", i.e. hardware (installations, equipment), software (knowledge and capabilities) and orgware (institutions).

B. Objective and targeted audience

9. The objective and targeted audience of a TEC Brief should be clearly defined before beginning the drafting of the brief, and drafters should always keep these elements in mind when drafting it. The brief has to be drafted through the audience's eyes.

10. The general audience of TEC Briefs may be very diverse. It can include Parties in general, policy makers in developing and developed countries involved in technology development and transfer and broader climate change policies, intergovernmental

organizations, non-governmental organizations, research and academic institutes, business and industry, etc.

11. The objective of a TEC Brief should be stated at the beginning of the brief, in the introduction section. The targeted audience could also be included along the objective.

C. General features

12. TEC Briefs should be between two and six pages long, ideally no more than four.

13. TEC Briefs may contain a mixture of texts, diagrams, graphs, images, tables, boxes and dot points. It may also contain other elements such as: quotes, references and contact details.

14. For TEC Briefs over four pages, a short summary could be presented at the beginning of the brief. The summary should give the main points that the TEC wants to convey to the targeted audience. The summary should be presented in a clear manner, for example in a box.

D. Structure

15. While keeping some flexibility, the structure of TEC Briefs should be standardized in order to maintain consistency across all TEC Briefs.

16. The standard structure should be:

(a) Title, and optionally, a sub-title

(b) Summary (optionally if the brief is longer than four pages)

(c) Introduction / Objective / Why this TEC Brief?

(d) Main text

(e) Conclusion / Highlights / Key messages / Recommendation

(f) References

(g) Contact

(h) About the Technology Executive Committee

17. While headers in the main text will be specific to the TEC Brief, similar headers should be used across all TEC Briefs for generic sections, as the introduction, conclusion//highlights/key messages/recommendations, reference//contact and the very last section about the TEC.

18. Numbering of headers or paragraphs, and footnotes should be avoided.

E. General drafting principles

1. Introduction

19. This is the first part of TEC Briefs, hence it is of great importance to attract the interest of the to read the brief.

20. While the subject will be specific to the TEC Brief, the style and tone of the introduction should be similar and consistent across all TEC briefs in order to establish a "TEC image".

21. The introduction may be seen as a statement of the context and the issue. The introduction does three things:

(a) It grabs the reader's attention (catchy context to bring up the topic);

(b) It introduces the topic (what the topic is, and for whom);

(c) It says why it is important (why, the rationale).

22. Appendix 1 contains an example of a technology brief produced by another organizations.

2. Main text

23. There are various ways to structure the body of TEC Briefs. However, a few elements are key:

(a) Make sure that the text is structured in a logical manner;

(b) Keep the paragraphs short and restricted to a single idea.

24. The following are drafting tips:

(a) More (sub)headings should be used than in technical papers;

(b) Drafters should re-read each paragraph and ask themselves: "so what?" If it is not obvious what the paragraph is trying to say, it should be rewritten or deleted;

(c) It is important to remember that the audience might not be specialists in the field. The text should be kept simple;

(d) Sentences should be direct, simple and short, and active voice should be used rather than passive voice;

(e) It is often very good to use a picture or graph to show how it looks like or how it is used.

25. If applicable, TEC Briefs should provide information on how to use the information globally or in a regional or national context.

3. Conclusion/highlights/key messages/recommendations

26. This is the last part of TEC Briefs, and it is often the most important one as some readers may only read that part, especially if the brief is long.

27. Various options are possible for the TEC regarding this section, depending on the strength of messages the TEC wants to convey. It could be one of the following or a combination of:

(a) Conclusions;

(b) Highlights;

(c) Key messages;

(d) Recommendations.

28. Regardless of the option taken, there should at least one, in order to conclude the TEC Brief and make a final pitch.

29. The text of this section should be very concise and made of short statements, and should be presented in a clear fashion, e.g. with bullet points, in a box, etc.

4. References

30. All TEC Briefs will contain a very short section to list any relevant documents that provide more information on the topic addressed by the briefs.

5. Contact

31. All TEC Briefs will contain a very short section giving contact information for the readers to have more information. The following is proposed:

> The Technology Executive Committee may be contacted through the United Nations Climate Change Secretariat (UNFCCC):
> Martin-Luther-King-Straße 8
> 53175 Bonn, Germany
> Telephone +49. 228. 815 10 00
> Telefax +49. 228. 815 19 99
> secretariat@unfccc.int
> ttclear.unfccc.int

6. About the Technology Executive Committee

32. All TEC Briefs will contain a very short section consisting of a paragraph describing what the TEC is and its role in the Technology Mechanism. The following is proposed:

> The Technology Executive Committee (TEC) is the policy and guidance component of the Technology Mechanism established by the Conference of the Parties (COP) in 2010 by decision 1/CP.16 to facilitate the implementation of enhanced action on technology development and transfer to support action on mitigation and adaptation. Along with the other component of the Technology Mechanism, the Climate Technology Centre and Network, the TEC is mandated to facilitate the effective implementation of the Technology Mechanism.

F. Design aspects

33. In addition to ensuring consistency in the structure and drafting of TEC Briefs, the design and visual aspects are very important to attract potential readers of the briefs. The design may include a TEC logo (or special typography) and a distinctive colour to identify the TEC briefs.

34. Once the final content of a TEC Brief is agreed upon by the TEC, the brief will be formatted by a graphical designer.

G. Database of briefs produced by other organizations

35. The technology/policy briefs reviewed in the preparation of these Guidelines will be made available on TT:CLEAR.

36. Any drafter of TEC Briefs is encouraged to consult several briefs before initiating the preparation of TEC Briefs.

Appendix 1 – Example of a technology brief

(Refer to the attached document).

Vulnerability and adaptation to climate change for shrimp farming in India: Science and technology adaptation solutions

Stakeholder Workshop at Vijayawada, Krishna District, Andhra Pradesh.

Citation: Muralidhar, M., Kumaran, M., Jayanthi, M., Muniyandi, B., Ponniah, A.G., Nagothu, U.S., White, P. and Eknath, A. (2012). Vulnerability and adaptation to climate change for shrimp farming in India: Science and technology adaptation solutions. Aquaclimate Project, Science and Technology Brief, 8 pp.

SCIENCE AND TECHNOLOGY BRIEF

SCIENCE AND TECHNOLOGY NEEDS

- INCREASE ACCURACY IN PREDICTIONS OF WEATHER PARAMETERS AND EXTREME CLIMATIC EVENTS AND DEVELOPING GUIDELINES FOR THE ASSESSMENT OF LIKELY DAMAGE: Forecasts need to be improved to address sudden seasonal shifts and changes and to be downscaled to district and lower administration unit levels. Guidelines have to be developed on damage assessment to aquaculture due to extreme climatic events.
- DEVELOP FORECASTS ON WATER AVAILABILITY IN BOTH FRESH AND BRACKISHWATER BODIES AND CHANGES IN SALINITY REGIMES: Accurate local forecasting will help planners and farmers develop mitigation and adaptation strategies for shrimp farmers.
- IDENTIFY VULNERABLE COASTLINES AND ESTABLISH SUITABLE MANGROVE SPECIES TO PROVIDE SHELTER BELTS AND BARRIERS: Location specific mangroves have to be recommended for plantation as barrier to protect the shrimp farms against cyclones/storm surges and sea level rise.
- IDENTIFY ALTERNATIVE SPECIES THAT CAN TOLERATE EXPECTED ABIOTIC STRESSES SUCH AS SALINITY AND TEMPERATURE VARIATION AS A CONTINGENCY: New culture technologies for alternative species that can tolerate the expected changes in environmental parameters and that can provide diversification options for farmers under different climatic regimes have to be developed.
- MAKE INVESTIGATIONS ON THE SEASONAL CROP PATTERN, ANIMAL BEHAVIOUR, POND DYNAMICS AND ECOSYSTEM IN RELATION TO CLIMATE CHANGE AND EXTREME CLIMATIC EVENTS: Studies on changes in shrimp physiology, pond dynamics and productivity including plankton diversity and water quality parameters as they relate to climate change will assist in giving appropriate crop calendar and management recommendations.
- INVESTIGATE WEATHER ANOMALIES THAT MAY TRIGGER DISEASE OUTBREAKS AND THE IMPACT OF CHANGING SEASONAL PATTERNS ON EMERGENCE OF NEW DISEASES: Disease occurrence patterns are likely to change in relation to changing weather conditions and climate. These changes must be studied in order to develop new management strategies and interventions.
- RESEARCH INTERVENTIONS ON BETTER MANAGEMENT PRACTICES IN THE CONTEXT OF CLIMATE CHANGE: Technologies for engineering structures to strengthen farm peripheral dykes, improved feeding and fertiliser management protocols and similar must be standardised and to be popularised amongst farmers.
- ESTIMATE OF ACTUAL AERATION REQUIREMENTS AND IMPROVE THE EFFICIENCY OF PUMPING AND AERATION: Increasing the efficiency of aerators and pumps and avoiding unnecessary excess energy usage will help in reducing production cost and in decreasing the carbon foot print from shrimp aquaculture.
- DEVELOP LOW FISH MEAL FEED TECHNOLOGY USING PLANT PROTEIN SOURCES: As the availability of fish meal and fish oil is expected to decline, and may also be impacted by climate change, research on alternative protein sources is an immediate requirement for the feed manufacturing industry to reduce the cost of feed.
- DEVELOP AWARENESS MATERIALS ON CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES AND PILOT A CLIMATE CHANGE FIELD SCHOOL CONCEPT: Information on climate change impacts in aquaculture and adaptive measures needs to be made available to all stakeholders and farmers preferably in local languages. The concept of a climate change field school as implemented in other countries should be investigated for implementation in India.

SHRIMP FARMING AND CLIMATE CHANGE

This brief summarises the results from the interdisciplinary and multi stakeholder participatory study conducted within the Aquaclimate project in Krishna District, Andhra Pradesh, India, looking at the impacts of climate change and adaptation measures in the shrimp farming sector. The brief based on scientific analysis and stakeholders inputs, further provides science and technology solutions to be undertaken for improving farmers' adaptive capacity to climate change.

Impacts of climate change on shrimp farming

The study area is vulnerable to sea level rise in future and has been included under high-risk category. The coastal areas have experienced many weather related impacts in recent years, including the most severe drought in 50 years which occurred early- to mid-2009, followed by a severe once in a century flood event in the Krishna River during October 2009. These extreme weather events had severe consequences including heavy economic losses to shrimp farmers in the state.

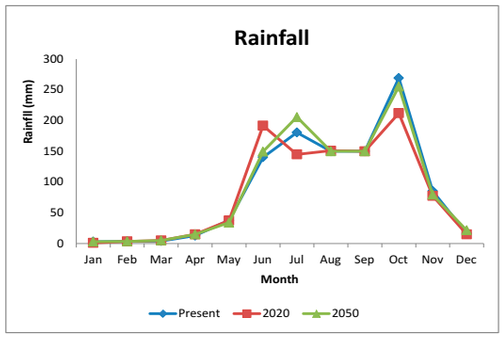
Farmers and stakeholders in the study area perceived that climate change had induced extreme weather events such as drought, storms and floods and variations in climatic parameters such as temperature and rainfall, which posed a threat to shrimp farming and would potentially lead to production losses. Variability in the amount of rainfall under different scenarios of monsoon and changes in temperature could negatively impact aquaculture through changes in water quality and greater incidence of disease.

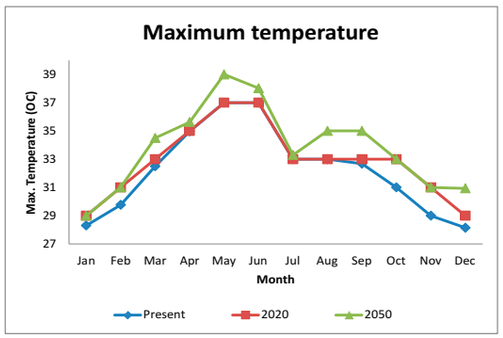
The impacts of climate change on shrimp farming could occur directly or indirectly and cannot be attributed to one single factor of climate change. The likelihood and consequence ratings for each climate change event as expressed by stakeholders consulted during the project indicated that floods and seasonal weather variations pose the highest risks to shrimp farming, with heavy rain and cyclones considered a medium risk.

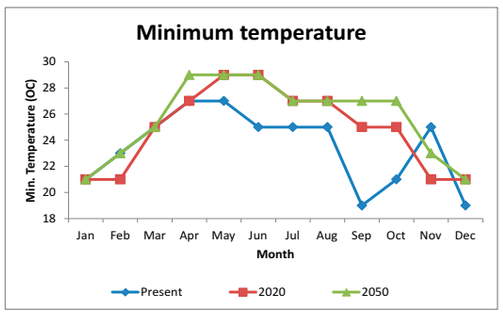
Irregular seasonal variations affect water salinity, pH, oxygen levels resulting in higher disease incidence, lower feed intake and slower growth. Heavy rainfall causes a reduction in salinity, pH fluctuations, reduced dissolved oxygen and higher disease incidence. High temperature results in increased pH and salinity, low water availability in source waters and a decline in dissolved oxygen levels and algal bloom development. Flooding is associated with water pollution and an increase in viral infections and death of shrimps due to rapid oxygen depletion. Cyclones with heavy rains lead to flooding and cause contamination across the ponds.

The predicted future climatic scenarios for 2020 and 2050 indicated that the average maximum and minimum temperatures will increase throughout the year and the rainfall is not expected to change much from the presents level.

The current knowledge of the impacts of climate change on shrimp farming is insufficient to fully inform mitigation and adaptation measures for farmers. There is an immediate need to find science







and technology solutions to improve the adaptive capacity of farmers and to provide climate resilient production strategies.

The Aquaclimate Project is a three year initiative to strengthen the adaptive capacities of rural farming communities to the impacts of climate change. The project focuses on small-scale aquaculture in Vietnam, the Philippines, India and Srilanka. This brief provides a summary of the project's work with tiger shrimp farmers in the Indian case study area, Krishna District in Andhra Pradesh. It highlights the science and technology solution to be undertaken for improving farmers adaptive capacity and to sustain the industry and its contribution to the livelihoods of poor farmers and food security. The project was coordinated by the Network of Aquaculture Centres in Asia-Pacific and funded by the Ministry of Foreign Affairs, Norway, through the Royal Norwegian Embassy, Bangkok; and undertaken by international partners Bioforsk (Norway), Akvaplan-niva (Norway), Kasetsart University (Thailand) and local case study partners. The local partners for the tiger shrimp case study were the Central Institute of Brackishwater Aquaculture of the Indian Council of Agricultural Research, in conjunction with National Centre for Sustainable Aquaculture, affiliated with the Marine Products Export Development Authority.

SCIENCE & TECHNOLOGY

Farmers can adapt to small changes in weather patterns and short term gradual climate change but they are not prepared for rapid changes or long term continuous climate change. Farmers need to be assisted by scientific research and technology development to find solutions that will allow them to adapt to the predicted future climate change.

There is a need for scientific research to understand the underlying biological processes that are affecting productivity due to climate change and develop potential solutions for farmers. In addition, there is a need for scientific research to accurately understand climate change and its potential impacts to support the decision making by central, regional and local governments.

The new adaptation technologies will need to be cost effective, environmentally sustainable, culturally compatible and socially acceptable. The technologies will also need to be implemented which will require widespread technology transfer supported by effective institutions, both formal and informal. Funding will need to be identified to support the necessary research and technology development.

The role of science and technology

Scientific research and technology development can play a strong role to support farmers in developing new adaptation measures to predicted future climate change as well as developing standardised methodology for assessing socio-economic vulnerability of communities and culture systems, and developing adaptation measures.

Science and technology solutions

Even if new technologies are devised, and are suitable for local conditions, it can be difficult for the poorer farmers to adopt them. With small farm sizes and limited access to credit, they may have neither the ability nor the inclination to invest in new technology.

Whatever the envisaged levels of technology, it is clear that there is a need to devise national strategy for adaptation, assessing the communities and the locations at greatest risk and planning appropriately. Scientific forecasts and warnings may not yet provide the level of precision desired by many planners, but they portray with certainty a rapidly warming world with consequences that globally, and for most sectors, are largely negative. A new climate is on the way. Adaptation is not a choice, it is a necessity.

Technologies for adaptation

Many of these technologies are already available and widely used and it should be possible to adapt to some extent by modifying or extending existing technologies. These measures are mainly refinement of the existing or innovation of new technologies to adapt the shrimp farming to the forthcoming climate change events. The important measures are improvement of better management practices, identification of alternate species for aquaculture and the development of technology, scientific principles in planning mitigation measures such as mangrove plantations, de-silting and deepening of drains, and construction of flood walls.

SCIENCE & TECHNOLOGY ADAPTATION MEASURES

Increase accuracy in predictions of weather parameters and extreme climatic events and developing guidelines for the assessment of likely damage

Presently the available climate change forecasts on weather parameters are average monthly values and available for larger geographical areas. There are no proper guidelines for the assessment of damage with respect to the infrastructure and standing crop during extreme climatic events. This information will be useful to link with the district level weather data generated by the India Meteorological Department to give agro-advisory services to the farmers.

- Forecasts on temperature and precipitation have to address the seasonal shifts and sudden changes and to be downscaled to district and lower administration unit levels.
- Guidelines for the assessment of likely damage due to extreme climatic events should be developed.

Develop forecasts on water availability in both fresh and brackishwater bodies and changes in salinity regimes

It is predicted that changes in availability and quality of source water including the salinity profile in relation to weather parameters will affect shrimp production.

- Provide forecasts on source water quantity and quality to help planners and farmers to develop mitigation and adaptation strategies.

Identify vulnerable coastlines and establish suitable mangroves species to provide shelter belts and barriers

It is essential to identify vulnerable areas of coast line where aquaculture may be affected by extreme weather events so as to plan effective mitigation measures. There are instances of degeneration of mangrove plantations on river banks and coastal areas due to incorrect choice of mangrove species. Therefore there is a need for research to identify the correct species for planting and for creating defence structures to protect vulnerable coastal areas against cyclones and storm surges.

- Undertake GIS analysis of storm surge vulnerability along the coast to identify vulnerable coastlines and most suitable areas for mangrove planting.
- Research on the vulnerability, bathymetry and topography slope analysis, fetch and wind /wave analysis to assist in the identification of areas most suitable for mangrove planting.
- Research institutes with the help of the M.S. Swaminathan Research Foundation should identify suitable mangrove species in the buffer zone between the shrimp farms and on the river beds along the coast.
- Appropriate coastal defense structures should be designed with the assitance of the Engineering Departments in reputed Institutes.

Identify alternative species that can tolerate expected abiotic stresses such as salinity and temperature variation as a contingency

It is forecast that pond water temperatures will increase and pond salinity will fluctuate more widely. Larger saline areas are expected to increase under climate change scenarios. Studies by the Central Institute for Brackishwater Aquaculture indicate that land shaping after Cyclone Aila in West Bengal provided aquaculture livelihood opportunities to the agricultural farmers whose lands had become saline. The shrimp species *Litopenaeus vannamei* is already being cultured over a wide range of salinities from very low to hyper saline waters, though their growth is suboptimal at both extremes. Fresh water species such as the Indian Major Carps are being cultured under low salinities. Paddy cum fish culture should be encouraged in line with predicted climate change.

- Investigate saline tolerant paddy varieties suitable for integration with aquaculture species.
- In cyclone affected areas, explore tidal inundated sites which cannot be used for agriculture for possible utilisation in brackishwater aquaculture.
- New culture technologies for alternative species that can tolerate the expected changes in environmental parameters and that can provide diversification options for farmers under different climatic regimes have to be developed.
- Proposed crop calendar activities should be provided by Government for the adaptation by the farmers.

Make investigations on the seasonal crop pattern, animal behaviour, pond dynamics and ecosystem in relation to climate change and extreme climatic events

It is predicted that changes in temperature and rainfall patterns will affect the productivity of ponds and changes in water quality through the variation in salinity, pH and oxygen levels. High temperatures also prolong the crop duration due to low feed intake and poor growth. The quality of water sources may also be affected and it is necessary to understand the basic principles underlying these aspects. Research Institutes with the help of fisheries colleges and the Department of Fisheries should undertake research on the following aspects in relation to climate change:

- Physiological aspects of shrimp behaviour in terms of feeding metabolism and reproduction.
- Tidal amplitude and changes in water source quantity and quality parameters and pond

water parameters through water quality monitoring in selected areas to identify seasonal variations and to correlate with the changes in weather patterns.

- Pond dynamics and productivity including plankton diversity.
- Impact of high temperature and rainfall on shrimp productivity.

Investigate weather anomalies that may trigger disease outbreaks and the impact of changing seasonal patterns on emergence of new diseases

A rapid change in water quality and weather parameters can lead to a higher incidence of disease. Hence, disease occurrence patterns in relation to changing weather conditions should be studied in order to understand the mechanisms underlying the incidence of existing and emerging diseases.

- Conduct epidemological investigations to understand the relationship between weather disturbances and diseases incidence.
- Research Institutes in association with other organisations should arrange regular monitoring of pathogens and shrimp disease outbreaks and provide recommendations on prevention and treatment to the farmers.

Research interventions on better management practices in the context of climate change

The effectiveness of existing BMPs in the context of climate change needs to be investigated, with specific reference to developing new BMPs such as pond designs to withstand extreme climatic events, forecast changes in water quality and increased disease incidence due to weather disturbances. Such BMPs need to be popularized as adaptive measures among the farmers. Research Institutes in association with the National Centre for Sustainable Aquaculture and fisheries colleges should undertake these studies on the following areas:

- Standardisation of feeding practices and fertiliser management and liming protocols.
- Maintenance of water levels and topping -up.
- Oxygen enhancers.
- Engineering farm design with reference to site specific calamities and natural disasters.
- Reservoir maintenance and water treatment.

Estimate of actual aeration requirements and improve the efficiency of pumping and aeration

Pumping and aeration are required to maintain water level and quality parameters in acceptable ranges. The need for top up or water exchange varies with temperature, rainfall and weather conditions. Similarly more aeration is required during cloudy days or under heavy rainfall. Studies by the Central Institute for Brackishwater Aquaculture have indicated that farmers are using more aeration than is actually required. The energy consumption for the operation of motor pumps and aerators are high and contribute to high power consumption.

- Estimate the actual aeration requirement to avoid unecessary and excessive use of aerators.
- Improve the efficiency of aerators and pumps through mechanical interventions by Aquaculture Engineering Departments. This will help in reducing the production cost for farmers and also in decreasing the carbon foot print from shrimp aquaculture.

Development of low fish meal feed technology using plant protein sources

The availability of fish meal and fish oil is expected to decline due to competition from other sectors and supplies may also be affected by climate change. Alternative protein sources must be found to meet the growing requirements of the feed manufacturing industry and to reduce the cost of feed.

- Intensify research on development of low fish meal feed technology using plan protein sources and popularisation of this feed technology among farming communities.

Develop awareness materials on climate change impacts and adaptation measures and pilot a climate change field school concept

There is a lack of awareness and understanding on climate change by shrimp farmers particularly of predicted future climate change and potential adaptation measures.

- Research Institutes with the help of other organizations should collect science based resource materials and then prepare training materials on present and future predicted climate change, potential adaptation and mitigation measures for aquaculture.
- The training materials should be preferably translated into local languages and made available to all stakeholders. The training materials should be updated regularly as climate science research and lessons learned from adaptation measures developed elsewhere are developing rapidly.
- Research Institutes should arrange 'train the trainer' programmes aimed at trainers/ technicians who in turn will train farmers (actual operators and caretakers).
- Pilot the Climate Field School concept being followed in other countries such as the Philippines, and improve based on feedback from participants.

SUMMARY OF RECOMMENDATIONS FOR KEY STAKEHOLDERS

Stakeholder group	Recommendations
Government Research Institutes such as the Central Institute of Brackishwater Aquaculture, State Institute of Fisheries Technology, Fisheries Colleges, Aquaculture Engineering Department at IIT.	Undertake specific research in relation to climate change on: • Pond dynamics and productivity • Water quality changes and monitoring • Low fish meal feed technology using plant protein sources • Location specific culture technologies such as diversification of suitable economic and viable species under different climatic regimes • Interventions on better management practices in the context of climate change • Improving the pumping and aeration efficiency • Epidemological investigations on new disease incidence • Identifying suitable mangrove species for bio-shields and buffer zone • Identifying vulnerable coastal areas for aquaculture
Forecasting organisations such as the Indian Meteorological Department and Central Water Commission	• Accurate predictions on seasonal shift and sudden changes in weather parameters and water availability in source waters • Downscaling of predictions to district level
Research Institutes and Fisheries Colleges	• Development of training curriculums, and training materials and facilitating training and capacity building for fisheries extension officers and technical consultants
Training Institutes such as Regional Fisheries Training Colleges, M.S. Swaminathan Research Foundation, National Centre for Sustainable Aquaculture.	• Undertake training courses on adaptation and mitigation measures to increase the adaptation capacity of farmers