Vulnerability and adaptation to climate change for milkfish farming in the Philippines: Adaptation measures for small-scale milkfish farmers

Technical brief

Milkfish farm adaptation measures

- STRENGTHEN PERIMETER DYKES: Increasing the strength and height of farm perimeter dykes will help prevent fish escape during intense rainfall, floods, extreme tides, typhoons and storm surge and to cope with rising sea level. It will also assist in mitigating extreme water temperature fluctuations during hot and cold spells. Increasing ease of access to loans or incentives will assist farmers to undertake these improvements.

- INSTALL WAVE BREAKERS: Installation of limestone rip rap or similar wave breakers on seaward perimeter dykes will reduce wave action and erosion, encourage siltation in crevices and allow natural development of mangroves. The local government units should request the Department of Public Works and Highways to install wave breakers. Farmer could share costs but may also need incentives to undertake the improvements. DENR legislation on coastal green belt and BFAR enforcement of mangrove buffer requirements could encourage more comprehensive wave breaker installation. SEAFDEC is suggested to investigate the potential for funding of mangroves through the REDD + programme.

- IMPROVE POND WATER FERTILISATION TECHNIQUES: Pond fertilisation techniques can be improved using both organic and inorganic fertilisers. Research is required to find ways to improve water quality stability during fluctuating climate conditions. Farmers can undertake trials, but there is also need for research on optimal fertilisation rate and nitrogen : phosphorus ratios to increase phytoplankton productivity. Suggested institutions to undertake such research are UPV, SEAFDEC or BFAR Achlan.

- PURCHASE OF EQUIPMENT: The use of pumps may become necessary in deep water ponds for proper water management since the tidal levels may no longer be sufficient to maintain the desired depth whenever needed. Due to the high cost of fuel and energy it would be ideal to develop or adapt cost effective wind operated pumps for this purpose. The use of aerators could ensure better mixing of the pond water and increase dissolved oxygen levels during periods of high water temperature, and allow intensification of the production system. There is a need to develop a loan facility mechanism for the purchase of such equipment through an institution such as LandBank, with a repayment window of one crop duration and a government guarantee on bank collateral needs.

- ADDITIONAL SUPPORT FOR ADAPTATION MEASURES: 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. The farmer needs to be assisted by scientific research and technology development to find solutions that will allow them to adapt to the predicted future climate changes. Concerned institutes need to coordinate their research programmes to assist farmers to adapt to progressive changes.

Milkfish farming and climate change

This technical brief summarises the results from an interdisciplinary study in two municipalities in Panay Island, Philippines, looking at vulnerability to climate change, impacts and adaptation measures for milkfish farmers. The brief provides guidelines for adaptation measure that can be undertaken by the farmers together with institutional, policy, science and technology support required to improve their adaptive capacity to cope with future climate change.

Significance of milkfish farming

Milkfish farmers in the Philippines generally operate in brackish water ponds at the extreme coastal fringe and are reliant on natural resources including wild caught fry. The majority operate ecosystem-based aquaculture, relying on natural pond productivity to feed the fish, which is greatly influenced by the prevailing weather conditions.

The milkfish farming industry in the Philippines and specifically in Iloilo is a significant industry and a substantial source of livelihoods. In 2009 national production was around 220,000 tonnes of which 76,000 tonnes was produced in Region VI. The industry is however facing challenges such as a 4,982 hectare reduction in production area, rising cost of inputs, climatic changes such as sea level rise and natural disasters, which cause stock loss and destruction of farms.

The case study sites chosen were two municipalities located in Iloilo, namely the municipalities of Dumangas and Barotac Nuevo. These municipalities have the highest production of farmed milkfish from brackishwater ponds. Milkfish production in Iloilo province in 2008 was 18,956 tonnes from 11,579 hectares of culture area, of this about 4,500 ha were within Dumangas municipality and 1,799 ha within Barotac Nuevo municipality. In the recent years, typhoons, tidal surge, river flooding and seasonal changes have adversely affected the cropping season, production and wild fry collection.

Farmers from Fishpond Lease Agreement (FLA) farms were selected as the target segment for the study. FLA holders generally have extensive milkfish farms of less than 25 ha and can be considered as small-scale farmers. FLAs are lease agreements over coastal government land for the purpose of fish pond development. FLA entitles the holder certain rights but also comes with certain obligations. FLA entitlements include ability to develop fish ponds and undertake aquaculture activities. FLA obligations include establishing and or maintaining a mangrove buffer zone between the fish ponds and the ocean.

The national partner for the Philippines case study was the Bureau of Fisheries and Aquatic Resources (BFAR), specifically BFAR central office and BFAR Region VI.

Impacts of climate change on milkfish farming

The analysis of the CSIRO climate model for Scenario A2 predict that the predicted mean monthly rainfall on the milkfish farm areas and in the watershed (river flow) are given in the figure below.

The potential consequences of this change in rainfall pattern are that there will be greater river flow in July leading to greater severity of flooding over a larger area than the present time.

The model predicts that the minimum monthly mean temperature for Barotac Nuevo and Dumangas in 2020 will increase by 0.75°C in January and from July to November; and that there will be an increase in 1.2°C in May and December.

Predictions for 2050 are that there will be an increase in minimum mean monthly temperatures of 1 to 1.5°C in January and from July to November; and there will be an increase of 2°C in May and December.

The consequence for milkfish pond culture should be positive as higher minimum pond water temperatures will improve growth rate, food conversion ratio and pond productivity during the colder seasons. The difference in minimum average monthly water temperature will be relatively consistent, however the increase above 2000 temperatures will vary monthly, with higher than average temperatures in May, June and December and lower than average temperatures in February and March.

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 Sri Lanka. This brief provides a summary of the project's work with milkfish farmers in the Barotac Nuevo and Dumangas areas. It highlights the policy implications, research agenda and on farm adaptations that will be required 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, Thailand. The project was undertaken by international partners Bioforsk, Norway, Akvaplan-niva Norway, Kasetsart University, Thailand, in conjunction with the Bureau of Fisheries and Aquatic Resources, Philippines.

Figure 1. Predicted variations in minimum mean monthly temperature for 2020 and 2050.

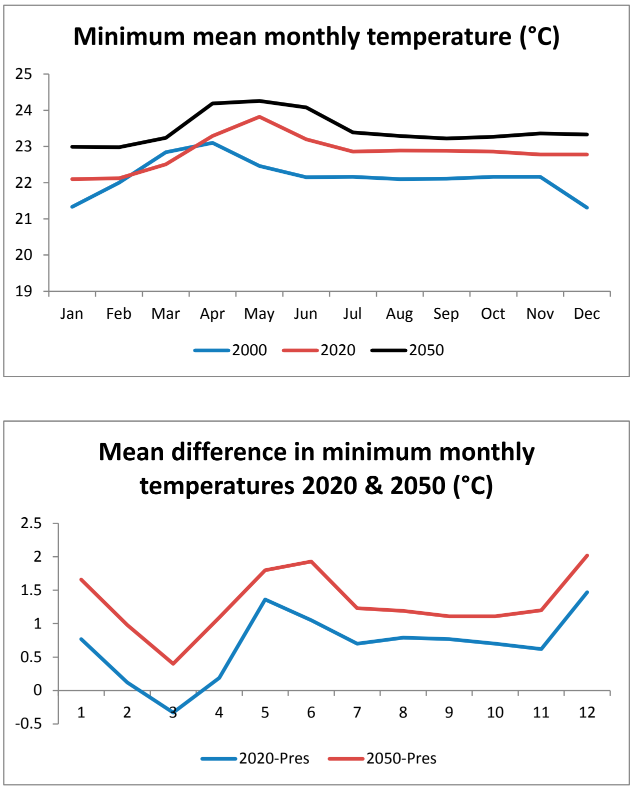
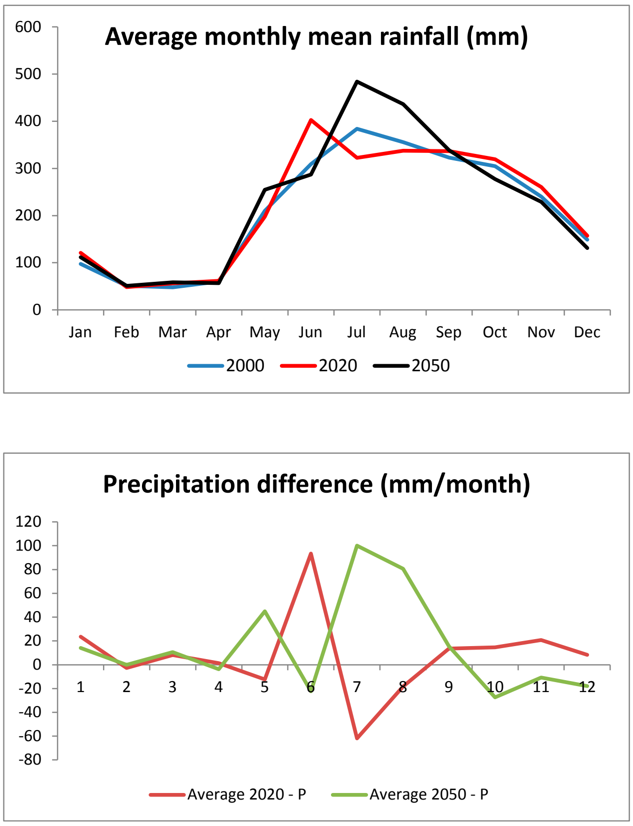


Figure 2. Predicted variations in mean monthly rainfall on the ponds and watershed 2020 & 2050.



Milkfish farm adaptation measures

Strengthening perimeter dykes

Sea level will rise by at least 16 cm by 2050, possibly as much as 30cm. This will lead to higher tides and make the coast more prone to storm surge. Peak rainfall will also increase by 20% leading to increased incidence and depth of flooding. Increasing the strength and height of perimeter dykes will help to prevent fish escape during intense rainfall, flood, storm surge or extreme tides and will reduce the risk of damage to farm infrastructure during storms and typhoons.

There is a need to increase the height of the dike by 0.5 metres and to strengthen the dike by increasing the width of main perimeter dykes. The estimated cost for this is around PhP 1,000 per meter length of the dyke. For this to be implemented there need to be loans or preferably incentives made available for the farmers. Higher dikes together with sea level rise will allow deeper water depth and this will allow farmers to move to the plankton method of milkfish production. It will also allow the pond water depth to be increased which is an adaptation measure for cold and hot spells.

Install wave breakers

Increased sea level rise together with increasing frequency and intensity of storms will cause stronger wave action and storm surges along the coast. This will cause erosion and damage to outer dykes.

Installation of wave breakers such as limestone rip rap on seaward dykes can reduce the impacts of wave action, encourage siltation and allow natural development of mangroves. This will reduce erosion and increase the resistance of dykes to storms, encourage development of a natural mangrove fringe or buffer on seaward facing dykes and reduce the impact of storm surge.

There is a need for research on engineering design, for example the optimum height and width, distance from shore and life span. While farmers can share costs they also need incentives from the Department of Public Works and Highways to encourage wave breaker installation. DENR legislation on coastal green belts, together with BFAR enforcement of mangrove buffer requirements in farm lease agreement areas could encourage comprehensive wave breaker installation. SEAFDEC is suggested to investigate the potential for funding of mangroves through the REDD + programme.

However, allowing natural development of mangroves in spaces to be created by putting up wavebreakers in front of the dikes maybe too slow. Furthermore many if not most of the fishponds may have exceeded their limits by encroaching into the subtidal foreshore area. It could be more advisable to enforce the buffer zone by sacrificing the outermost pond by partially breaching the outer perimeter dike to allow for free tidal flow so that the original perimeter dike will become the wave breaker. Then the space between the original dike and the new dike could be used as a mangrove zone.

Improve pond water fertilisation techniques

Increasing daily temperature fluctuations together with increasing water quality fluctuation due to increased incidence of heavy rainfall affects pond productivity on which the milkfish depend. Improving pond productivity through fertilisation and improving water stability will increase fish productivity and reduce fish stress.

There is a need to improve pond fertilisation techniques using both organic and inorganic fertilisation and to test the efficacy of probiotics to improve water quality stability during fluctuating climate conditions.

Improving pond fertilisation techniques is always advisable but this should also be done in deep water ponds for plankton culture not just for lablab culture. Furthermore, the new technique should focus on achieving an optimal N : P ratio rather than merely blind fertiliaation. The CRSP project already has devised a method for freshwater fishponds which enables farmers to determine the deficiency using simple bioassay techniques that does not require laboratory analysis.

Some of this research and testing can be undertaken directly by farmers but there is a need for research to be undertaken on optimal fertilisation rate and N:P ratio to encourage chlorophyte productivity. Suggested institutions to undertake the research are UPV, SEAFDEC or BFAR Achlan.

Purchase of equipment

Higher and stronger pond dykes and deeper ponds will help to prevent fish escape due to dyke damage and help to improve water quality stability and fish productivity. Improved fish productivity will also help the farmers to be more profitable and so be more resilient to cope with climate change. This will require investment in pumps to maintain water depth and aerators to increase productivity.

The use of pumps may become necessary in deep water ponds for proper water management since the tidal levels may no longer be sufficient to maintain the desired depth whenever needed. Due to the high cost of fuel and energy it will be ideal to develop cost effective wind operated pumps (or adapt existing designs) for this purpose.

Purchase and use of water pumps for pumping water into ponds is required to:

- Increase pond depth and increase water exchange (mitigate water temperature fluctuations).
- Maintain water depth during low tides.
- Maintain water temperature during cold spells.
- Maintain oxygen levels during hot spells.

Purchase and use of aerators is required to:

- Increase water mixing for better productivity.
- Increase oxygenation during hot spells or during the night.

There is a need to develop a loan facility mechanism for the purchase of equipment through an institution such as LandBank with a repayment window of one crop duration and a government guarantee on bank collateral needs.

Additional support for adaptation measures

While 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. The farmer needs to be assisted by scientific research and technology development to find solutions that will allow them to adapt to the predicted future climate changes.

Summary of recommendations for key stakeholders

Stakeholder group	Recommendations
Farmers	Undertake pond deepening and dike strengthening and heightening
Scientific research and technology transfer Institutes	Research improved water fertilisation techniques
Local government units	Coordinate climate change adaptation with disaster relief management Install coastal protection measures such as wave breakers and mangrove planting
Private sector (Insurance companies and commercial banks)	Provide crop insurance policy Facilitate credit for small scale farmers