Diversification of brackishwater aquaculture in Indonesia: tilapia culture in Aceh

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Abstract. Traditional brackishwater aquaculture in Indonesia focuses on production of shrimp and milkfish. However, since the 1990's production of shrimp, particularly *Penaeus monodon*, has become problematic because of the prevalence of white-spot disease. Crop losses due to white-spot disease have limited production of *P. monodon* in traditional tambak throughout Indonesia. Because of this, many tambak have fallen into disuse, or their use is limited. In response, we are developing and trialling diversification options for tambak farmers in Aceh and South Sulawesi. Alternative production options that we are evaluating include Nile tilapia (ikan nila) and soft-shell crab (kepiting lunak) in Aceh, and Nile tilapia, swimming crab (rajungan) and rabbitfish (baronang) in South Sulawesi. In Aceh our main focus has been on Nile tilapia (*Oreochromis niloticus*) culture, either alone or co-cultured with milkfish (*Chanos chanos*). We have undertaken trials with farmers in Samalanga and Jangka (Kab. Bireuen) and Banda Mulia (Kab. Aceh Tamiang). Overall, our trials have shown that tilapia will grow and survive well at salinities below 20 ppt. Above 20 ppt, growth rate is reduced and the fish are prone to bacterial disease. At salinities above 20 ppt, milkfish (bandeng) perform better in ponds than tilapia. Our trials in Aceh have demonstrated that Nile tilapia can provide income to farmers comparable with shrimp culture. Out of a total of 22 trials to date, 9 ponds (41%) have met or exceeded our reference profitability of IDR 1–5 million per hectare per crop. Fourteen ponds (64%) have been 'profitable', i.e. have generated positive economic returns. This figure is similar to the profitability figure for traditional shrimp ponds (64–73%), indicating that Nile tilapia culture in brackishwater ponds provides economic returns similar to traditional shrimp culture. Based on these results, we recommend Nile tilapia culture to farmers whose ponds are <20 ppt. This provides a profitable production option for farmers in areas subject to low salinities, or during the rainy season when salinities are depressed. Because outbreaks of white-spot disease are particularly common and severe during the rainy season, Nile tilapia culture provides a viable option for income generation for Acehnese tambak farmers under conditions where shrimp culture is too risky.
Keywords: Tilapia, milk fish, crab, tambak

Introduction

While brackishwater pond (tambak) aquaculture in Indonesia is an important livelihood activity in coastal areas, many small-scale farmers are struggling to continue farming shrimp. Viral diseases are causing crop losses, input costs (particularly for feed) are rising, and commodity prices for shrimp are declining due to strong competition in a global marketplace. As a result, many farms are out of production or are producing limited quantities of shrimp; recent ACIAR-funded research has revealed that while small-scale shrimp farms predominate in South Sulawesi, they only contribute about 5% of total provincial shrimp production (Yi *et al*., 2010). While some farms have successfully adopted Better Management Practices (BMPs) for shrimp farming to overcome production constraints (ADB *et al*., 2007), successful implementation depends on specific site-related, socio-economic and logistical criteria being met (Padiyar *et al*., in press). A large proportion of farms will not be able to meet the criteria required for shrimp BMP implementation; consequently, these farms must be provided with alternative production strategies if they are to remain (or become) viable.

In response, we are developing and trialling diversification options for tambak farmers in Aceh and South Sulawesi. Alternative production options that we are evaluating include Nile tilapia (ikan nila) and soft-shell crab (kepiting lunak) in Aceh, and Nile tilapia, swimming crab (rajungan) and rabbitfish (baronang) in South Sulawesi. In Aceh our main focus has been on Nile tilapia (*Oreochromis niloticus*) culture, either alone or co-cultured with milkfish (*Chanos chanos*).

Tilapia Farm Trials in Aceh

We have undertaken farmer-managed trials with Nile tilapia either alone or co-cultured with milkfish in Samalanga and Jangka (Kab. Bireuen) and in Banda Mulia (Kab. Aceh Tamiang). These trials have demonstrated that tilapia cultured in low-salinity (<20 ppt) brackishwater ponds can provide income to farmers comparable with shrimp culture. Out of a

total of 22 trials in 2010 and 2011, 9 ponds (41%) met or exceeded our reference profitability of IDR 1–5 million per hectare per crop (Fig. 1). Fourteen ponds (64%) have been 'profitable', i.e. have generated positive economic returns. This figure is similar to the profitability figure for traditional shrimp ponds (64–73%), indicating that Nile tilapia culture in brackishwater ponds provides economic returns similar to traditional shrimp culture. At salinities greater than 20 ppt, the growth rate of tilapia is reduced and the fish are prone to bacterial disease. At salinities above 20 ppt, milkfish (bandeng) perform better in ponds than tilapia.

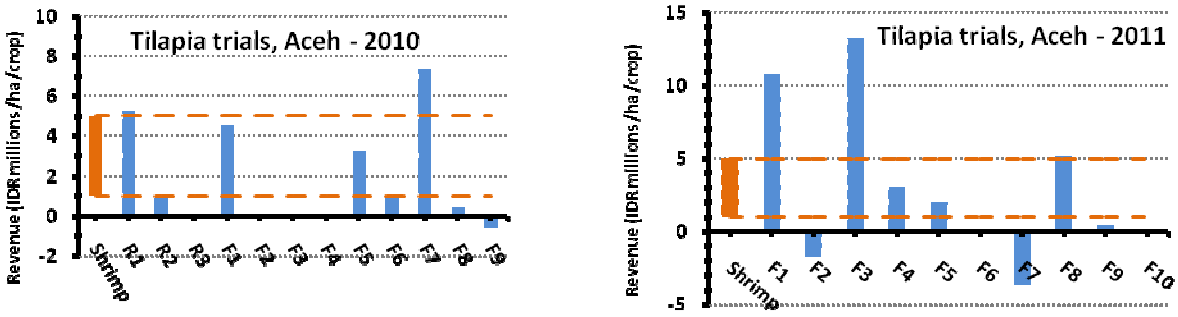

Figure 1. Summary of revenue from Nile tilapia production in research (R) and farmer-managed (F) ponds in Aceh. Orange bar and dotted lines represent the reference for revenue from traditional shrimp culture.

More recent data from trials at Banda Mulia (Aceh Tamiang) showed that, out of 5 participating tilapia farmers, only one failed to make a profit, making a small loss of Rp. 75,000 /ha. (It is suspected that the low production from this pond was the result of theft of the fish prior to harvest). The best result was almost Rp. 15 million /ha, with the remaining 3 farmers earning between Rp. 4.3 and 6.6 million /ha (Fig. 2). So 4 of the 5 farmers involved in this trial met or exceeded our reference value for shrimp culture (1–5 million /ha /crop) (Fig. 2).

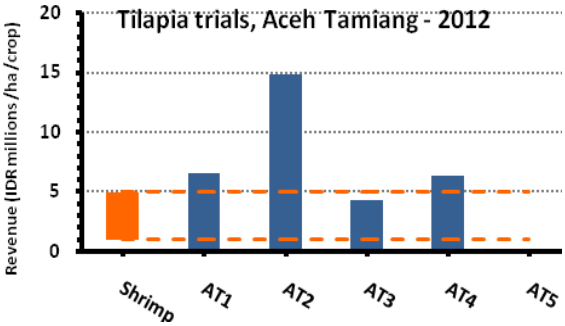

Figure 2. Summary of revenue from Nile tilapia production in farmer-managed ponds in Aceh Tamiang. Orange bar and dotted lines represent the reference for revenue from traditional shrimp culture

Again, these results show that producing tilapia in brackishwater ponds is as profitable as producing shrimp, and in some cases more profitable. FCR's for the 4 successful farmers ranged from 0.44 to 0.55:1. The unsuccessful pond had an FCR of 0.92. Stocking density ranged from 0.7 to 1.0 fish/m2 for 4 ponds. Interestingly, the most profitable pond had a slightly higher stocking density of 1.7 fish/m^2.

Overall, farmer response to the trials has been positive in Aceh and in South Sulawesi. Several farmers in Aceh are now alternating cropping shrimp (dry season) with tilapia (wet season) to reduce the risks of wet-season disease outbreaks in shrimp. Farmers in South Sulawesi have formed a farmer group, supported by project participants, to provide support to new tilapia farmers and provide a resource for the more widespread introduction of tilapia culture.

Comparison of Tilapia Strains in Brackishwater Ponds

In Indonesia there are a variety of selectively-bred Nile tilapia strains available to farmers, and to compare the performance of some of these strains in brackishwater conditions the Brackishwater Aquaculture Development Centre Takalar undertook an evaluation of four strains in a brackishwater pond at Maros Regency, South Sulawesi. Although the 'Red' strain grew best in these conditions, red tilapia bring a lower market price than 'black' tilapia in local markets in Aceh and South Sulawesi. Consequently, the best-

performing 'black' tilapia strain – in this trial a GESIT × GIFT cross – gave the best economic performance.

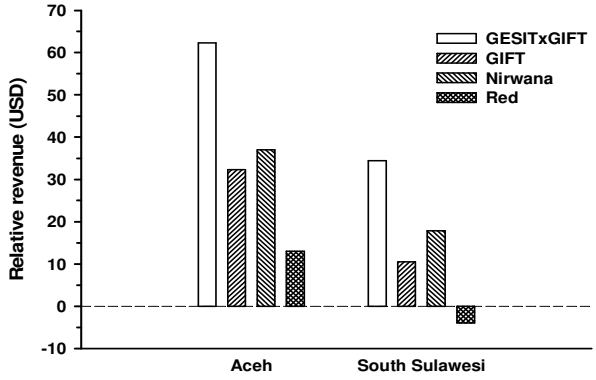

Figure 3. Comparison of relative revenue from culturing 1,000 fingerlings of four strains of Nile tilapia cultured in brackishwater ponds in Aceh and South Sulawesi (US dollar equivalent at nominal exchange rate of IDR 9,000 = USD 1.00). Note that these provide a relative measure of revenue and do not represent true revenue to farmers.

Other commodities

In South Sulawesi we are trialling other commodities that potentially have application in Aceh. *Caulerpa* is a genus of edible seaweeds that are used as food in parts of Asia (mainly the Philippines and parts of Indonesia) and in the Pacific Islands region. In South Sulawesi at least two species of *Caulerpa* (*C. lentillifera* and *C. racemosa*) are farmed in brackishwater ponds. Ponds used for farming *Caulerpa* must have high salinity (>30 ppt). *Caulerpa* is a popular vegetable in South Sulawesi, where it is known as *lawi-lawi*. Because of the very low production costs, *Caulerpa* farming is very profitable for brackishwater pond farmers in South Sulawesi. Trials with culturing the swimming crab *Portunus pelagicus* (*rajungan*) in brackishwater ponds have not demostrated good profitability because of the high cost of hatchery-produced crablets, and limited harvest due to cannibalism and technical problems harvesting the crabs from the ponds. Although growth rate of the crabs is good, it is very difficult to harvest them from traditional ponds, most of which cannot be properly drained.

Future research

Tilapia culture in brackishwater ponds in Aceh shows considerable promise. To support the continued development of brackishwater tilapia culture, our ongoing research will include: (a) Developing farmer-managed nursery systems;(b) Evaluating the potential for the aquatic weed *Cabomba* as a food source for Nile tilapia;(c) Comparing production performance in Nile tilapia strains available in Aceh in brackishwater pond culture.

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