Intercropping silver pompano and shrimp in India

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Study shows potential for fish production between shrimp crops

Results of this study showed that the silver pompano – a hardy, fast growing marine fish and good market demand – is a good candidate for intercropping at shrimp farms in Northwest India and elsewhere. Source: https://upload.wikimedia.org/wikipedia/commons/a/a4/Trachinotus-Jawa.JPG

Aquaculture in India is predominately based on a few species of major freshwater carps and freshwater prawns, and Pacific white shrimp in saline water systems. Marine finfish culture has great investment potential but its successful and large-scale development is yet to be achieved.

One alternative is to culture marine finfishes in coastal ponds, but most of the coastal ponds are currently devoted to shrimp farming. However, polyculture or an intercrop of marine fishes during a fallow period in shrimp farming would still be an acceptable investment option for entrepreneurs.

The silver pompano (*Trachinotus blochii*) – a marine fish with wide environmental tolerance, fast growth, good market demand and standardized seed production technology – is available in India. The aquaculture of silver pompano has been successfully established in many Asia-Pacific countries like Taiwan and Indonesia. It can be successfully cultured in ponds, tanks and in floating sea cages. The species is pelagic, very active and can acclimate and grow well even at salinities as low as about 8 ppt.

Intercropping is a way to increase diversity, ecological balance and effective utilization of resources. It increases the quantity and quality of products while reducing risk. A fallow period or crop holiday is used in shrimp farming as a preventive measure against host-specific viral diseases. Intercropping with finfish could be an alternative for crop holidays to reduce the build-up of host-specific, shrimp viral pathogens and improve economic performance.

Shrimp farming is practiced along both coasts of India, but the West coast is still under development. There is a hub of shrimp farms in the coastal belts of Gujarat State and activity is expanding. Most new farms are small- to medium-scale (0.25 to 5 hectares) and are restricted to a seasonal production period of six to seven months with a maximum of two crops per year, leaving the farms fallow for five to six months. Even with required pond preparation between cycles, there is still a three- or four-month window for a potential finfish intercrop, which would provide income to farmers and also improve their sustainability.

This article – adapted and summarized from the **original publication** – reports on a farmer-participatory research (FPR) demonstration of silver pompano intercropping with Pacific white shrimp in coastal shrimp ponds, as an alternative to promote aquaculture in India.

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supplied the juvenile pompano. We also thank Mr. Bhadresh Damajibhai Bhutti for allowing the use of his ponds for this study, and anonymous reviewers for their critical and constructive comments.

Study setup

The study was conducted using three small ponds (50 meters x 30 meters x 2.5 meters) at a shrimp farm in Dari, Veraval, Gujarat. Pompano juveniles of 2.8 ± 0.03 cm total length (TL) and weighing 1.6 ± 0.03 grams were sourced from the marine hatchery complex of the Mandapam Regional Centre of the Indian Council of Agricultural Research-Central Marine Fisheries Research Institute (ICAR-CMFRI). These juveniles were first reared in two nursery hapas (1 meter x 1 meter x 1 meter) per pond at a density of 1,000 fishes per cubic meter and with ongoing shrimp grow-out operation. After 45 days of nursery rearing, the stocking density in the nursery hapas was reduced to 500 fishes per cubic meter by installing two more nursery hapas in each pond.

The nursery rearing was continued for another 45 days until the shrimp were harvested and then the pompano were released into the ponds. Fishing nets (30-mm mesh size) were used to reduce the pond dimension to 30 meters x 4 meters x 2.5 meters. The effective stocking density was 10 fishes per cubic meter and a water depth of 1.5 meters maintained throughout the culture operation. The source of water for the ponds were wells and the salinity ranged between 15 and 17 ppt during the culture period.

The fish were fed a commercial, extruded floating pellet feed (Growel Feeds Ltd, Andhra Pradesh, India) during the entire study. Various pellet sizes and formulations were used as the fish grew, and feeding rations were adjusted based on biomass estimated on each sampling days. Mechanical aeration was provided daily for one hour, and water exchanged at 10 percent monthly.

Timelines are significant in assessing the feasibility of any project. In order to work out the most viable and sustainable intercropping seasons, species and culture window, a timeline was designed, considering the overall amount of time fixed (Fig. 1). The concept of intercropping with sustainability was considered as a critical concern.

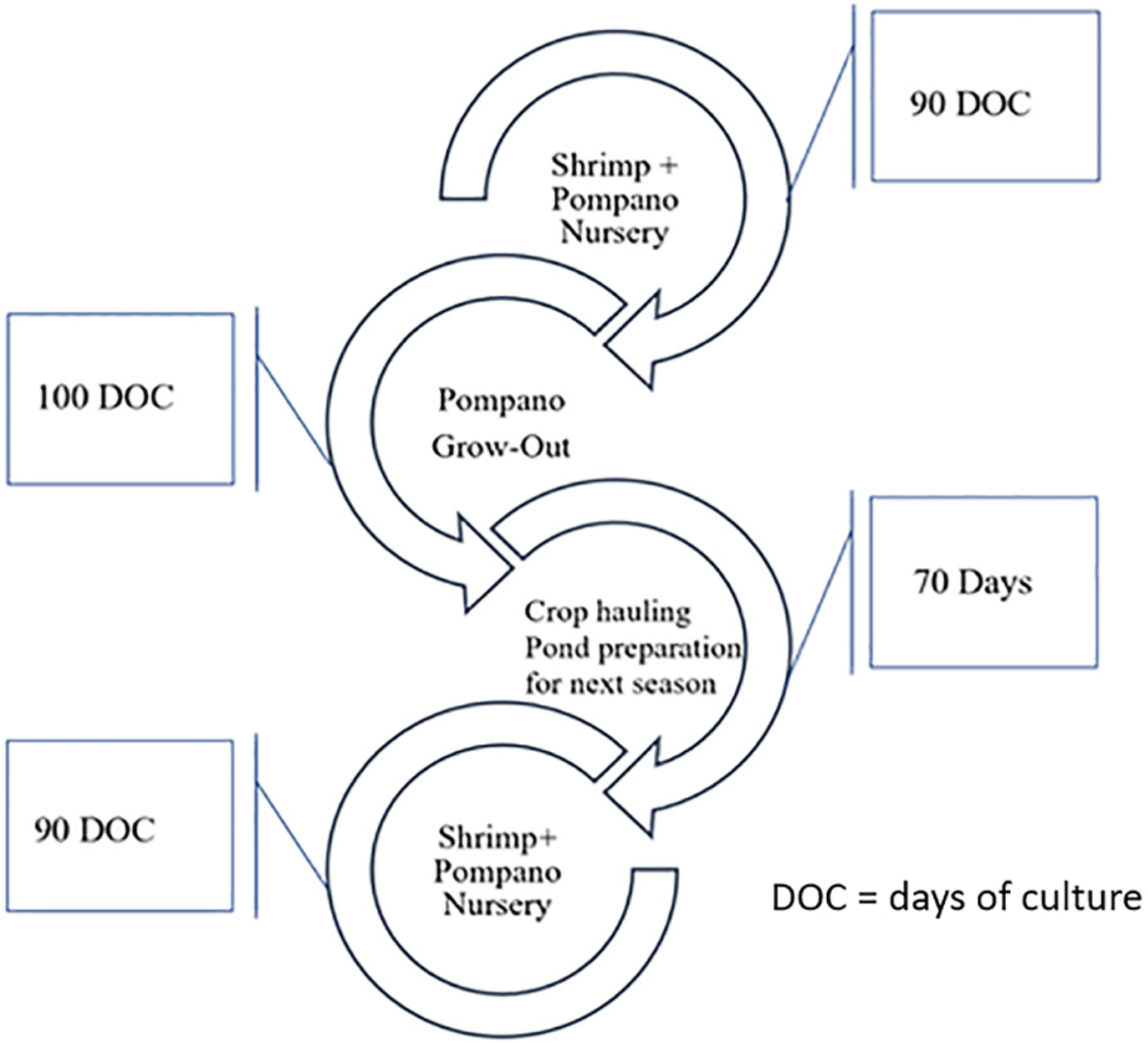

Fig. 1: Schematic pompano intercropping in shrimp farms opted for trial.

For detailed information on the study setup; ponds, nursery rearing and stocking; feed and feed management; farm and grow-out management; data collection and estimation of growth parameters; timelines and statistical analyses, consult the original publication.

Results and discussion

The pompano grew from 40.23 ± 1.40 grams to 256.56 ± 1.08 grams in weight and 12.83 ± 0.19 cm to 25.11 ± 0.09 cm in length during the grow-out period of 100 days. The average length and weight across replicates on all sampling showed no significant differences. The resulting daily weight gain (DWG) and daily length gain (DLG) were 2.16 grams and 0.12 cm, respectively. Relative growth rate (RGR) and specific growth rate (SGR) for weight was 537.80 percent in 100 days and 1.85 percent per day, respectively. Similarly, RGR and SGR for length were 95.69 percent and 0.67 percent per day, respectively, for the 100 days of culture.

Fish growth was not constant throughout the culture period. DWG showed an increasing trend as the culture progressed whereas the reverse trend was observed for RGR and SGR for the weight (Fig. 2). The RGR (L) showed an increasing trend during the initial period of 20 days of culture, and later declined sharply until 30 days of culture. Subsequently, it exhibited a steady increment during the rest of the culture period. On the contrary, the DWG showed an increasing trend, which reached a maximum value at 60 days of culture and later declined for a short period (10 days). The daily growth rate became stable after 80 days of culture.

Fig. 2: Temporal variation of growth indices across the pompano grow-out culture.

An average harvest of 460 kg and revenue of US$1,973 from 120 square meters of water spread area (each replicate) was achieved during the trial. The average operational cost including feed and pompano juveniles was around $1,476 per replicate, with an average profit of $496.80. Production potential of the farm (three grow-out ponds) was estimated at 16.2 tons per cycle (7.2 kg per cycle per cubic meter) with a benefit-cost ratio (BCR), over operational cost) of 1.34. The operational costs other than feed and seed were considered at par with shrimp farm as mentioned by the entrepreneur to calculate the BCR. An additional income for the farm from 100 days pompano intercrop was projected to be around $14,583 (Table 1).

Damodaran, intercropping, Table 1

Parameter	Study results	Projected potential
Pond dimensions (3 ponds)	30X4X1.5 meters	50X30X1.5 meters
Fish stocking density (pounds per cubic meter)	10	10
Number of fish stocked	1,872	67,500 (22,500 X 3)
Grow-out size (kg)	0.256	0.250
Survival (%)	96	96
Harvest biomass (kg)	460	16,200 (5,400 X 3)
FCR	1.94	1.94
Selling price (US$/kg)	$4.29	$3.57
Feed cost (US$), total	$961	$33,883
Juvenile fish cost, total	$85.6	$2,996
Other operational costs*	$428.91	$6,433.65
Revenue	$1,972.99	$57,902.85
Profit	$496.82	$14,582.94
Benefit-cost ratio (BCR)	1.34	1.34

Table 1. Operational costs and economics of the trial and projected farm economics.
*Based on the monthly operational cost of the shrimp farm.
Exchange rate used: US$ 1 = Rs. 69.94 INR

An overall fish survival of 89.8 percent was recorded over the entire study period of 190 days (nursery and grow-out). The mean fish survival during the 90-day nursery period in nursery hapas with ongoing shrimp grow-out was as high as 93.6 percent.

The minimal increment of length for the first 10 days of grow-out with rapid weight gain over the same period could be due to space constraint during the nursery time in hapas. This space constraint was alleviated once the fishes were released into the open pond with more space and higher feeding rates.

The uniform size harvest of around 250 grams has strong demand from buyers, especially for restaurants. The pompano harvest coincided with the fishing ban in the region, which offered ample opportunity for even a higher price realization than used for the estimation of the BCR presented. And we believe

these initiatives reduce the risks associated with single-species farming and provide added income in a sustainable manner from existing resources.

The current study was intended to explore the economic viability of silver pompano as an intercrop in small- and medium-size shrimp farms. Intercropping in the farming system increases sustainability and stabilizes a farm's economics by reducing vulnerability to factors like climate change, market instability and disease outbreaks. Through the results obtained from the experimental demonstration and interactions with local entrepreneurs, we propose a strategic timeline for the sustainable intercropping of silver pompano in shrimp farms to make coastal farming a sustainable and farmer-friendly. The three-year cyclic farming model consists of eight grow-out operations (four shrimp and four pompano, alternated) instead of the previous six grow-out operations for shrimps.

Although the proposed model reduces total shrimp production from the farm, the overall production of the farm is increased. In addition, the maintenance and risks during pompano culture will be substantially lower as it is a very sturdy species. In the absence of a crop insurance mechanism in the Indian aquaculture industry, such intercropping models may be an ideal farming practice, especially for small- or medium-scale operations.

Perspectives

Shrimp farming activities along the northwest coast of India is in a developing phase and mostly operate at small to medium-scale, and with a fallow period of minimum of three to four months. This unutilized time offers an opportunity to introduce a sturdy marine finfish as an intercrop in these shrimp ponds.

The silver pompano – with high survival, fast growth rate and shorter grow-out period – was determined to be a suitable candidate, and its economic viability as a shrimp intercrop favors its adoption by the shrimp farmers of the region. The intercrop production could ensure year-round operation of the farms and additional income by utilizing the present fallow period.

This study could be a model for adoption in other southeast Asian countries where crop holidays are practices leaving the farm idle for a part of the year.

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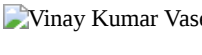
- 

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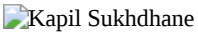
- 

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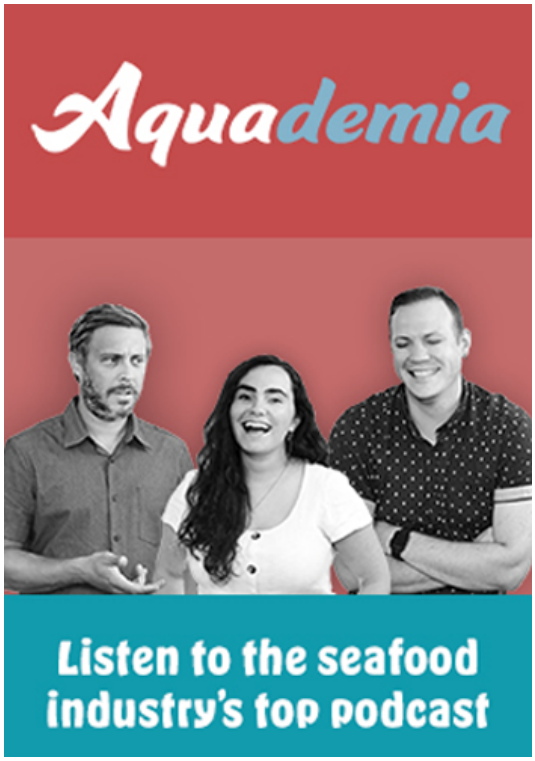

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