

Management Practices of Peruvian Aquaculture Facilities

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I. Introduction

Aquaculture, also known as fish farming, is projected to be the prime source of seafood by 2030, as the demand for fish grows and wild ocean fish reserves are quickly being depleted.

(WorldBank). On a global scale, provided about 148 million tons of fish in 2010 (FAO).

Although, aquaculture is growing and proving to be a billion dollar industry, it comes with many risks. Aquaculture has become one of the main culprits of the spread of non-native fish. Often aquaculture facilities accidentally release exotic fish into nearby environments and once a fish is introduced and is successful in reproducing itself, it becomes nearly impossible to remove them. Thus, prevention is the best way to mitigate this problem. The purpose of this research was to examine fish farms in Iquitos, Peru in order to determine if they pose a threat to the Peruvian Amazon by spreading exotic species.

Eight fish farms were visited in and around Iquitos during this trip. Each owner or caretaker was surveyed about their respective fish farm. All were asked which species of fish they carried to determine if they were native to the region. If they raised piscivorous fish, they were asked what fish they were being fed to see if exotic species were used to feed them. The fish farmers were asked where they obtain their water and where it is discharged in order to see if fish could escape through water discharge. Every site was toured and the nets and filtration system were photographed in order to determine if the net spacing was small enough to prevent small exotic species from escaping. Exotics that exist either in the wild or in fish farms are tilapia and guppies, because of this fact, these were the two that this study was most interested in.

II. Fish Farms

1. The first fish farm belongs to a private owner, Mr. Manuel Flores who raises gamitana, doncella, cola roja, sabalo, and boca chico, all of which are native to the Peruvian Amazon. This particular fish farm specializes on sabalo because it grows faster than the other fish and local consumers love the taste of it so it is in high demand. According to Mr. Flores, the price of sabalo is better than other fish, however in order for sabalo to reach its final ovulation cycle they require hormones that are costly. Humans must assist in this process because sabalo cannot be bred in captivity without hormonal assistance. It is possible that because of this reason other aquaculturists are hesitant about raising sabalo which keeps the profit margin high. On a national level, all forest fish are in high demand. An advantage of these fish is that they can be exported quickly to Lima, Peru's capital and still be fresh. Although the fish farm claimed to only have native fish in its tanks, an exotic species, the tilapia, was found in the aquaculture tanks. This fish is notorious for its ability to quickly adapt to an area and decimate native populations that have not evolved to withstand it as a predator. The new predatory species may compete with the native species for food and shelter which threatens the incredibly biodiverse regions. Although this fish poses a risk to the natural environment, it may provide economic benefits to a fish farmer. It's a tough fish that can withstand low levels of oxygen, eats almost anything, and can survive in murky and overcrowded tanks. It's one of the easiest fish to raise and can yield profits to the aquaculturist. However, the effects of tilapia escaping into the natural environment would be severe. Preventing the escape

of tilapia must become one of the top priorities of this fish farm if they wish to yield profits while not harming the Peruvian Amazon. Perhaps since this fish farm focuses mainly on native fish, the prevention of the escape of tilapia is not one of their priorities. Tilapia could potentially escape through over flooding or discharged water.

Water is continuously discharged from the aquaculture tanks and into streams and rivers either through purposeful water removal in order to remove dirty water and replace it with clean water, or through over flooding. Since water is constantly removed, the fish farm has a net in order to prevent the escape of their fish, however, the size of the holes of the net were designed to prevent the escape of the native fish, not tilapia which when young, can potentially pass through the net. Buying new netting would greatly reduce the chances of tilapia escaping and would be a much cheaper alternative than removing them once they are introduced into the wild.

2. The second fish farm visited was Fundo Sarita. There they raise 11 paiches that reproduce four times a year. Paiches are a fish species that eat other fish in order to obtain enough protein. The forage fish are ground up with other ingredients such as soy meal and then given to the paiches. The fish farm also has approximately 1000 sabalos and 3000 boca chicos, both of which are native to the Peruvian Amazon. Fundo Sarita was not just a fish farm, but also served as an ordinary farm. There were about 8000 chickens on the land, and some of the chicken coops were on top of the tanks and so eutrophication, the process in which there is too many nutrients which cause plant life to bloom and then die consuming all the oxygen, is a major problem

for this farm. That being said, there were no exotics on their land and so invasive species were not a concern for this farm.

3. Two other farms that were visited on the same day that had very different purposes were the fish farm “Arapima Gigas” named after the fish and an aquaculture facility owned by the National University of the Peruvian Amazon (UNAP) . “Arapima Gigas” served as a tourist attraction and also a zoo. The profits came not only from selling the fish, they had a restaurant on the lands that served fresh fish, and they also had a variety of other terrestrial animals native to the Peruvian Amazon to bring in tourists. The ponds were bigger than most other aquaculture facilities and they only carried local comestible fish. They had an open system where water came in from the rivers to replenish lost water from evaporation and excess water was carried away by nearby creeks. Since they did not feed any invasive species to their fish and they did not carry any invasive species, there was no danger of spreading invasives by this facility.

4. Mr. Mario Azeli is the owner of a small fish farm with only one pond. Mr. Axeli used to raise paiches but due to this farms proximity to the road, noise pollution bothers the fish too much and since the area was small it was too difficult to reproduce them. So he moved to sabalos. He bought about 2,000 of them but due to predators in the water he lost about 500 of them. He diversifies and also had bujurquis (*Cichlasoma amazonarum*) but to a much lesser degree. He states that in the beginning he used to feed them live guppies but now feeds them balanced fish meal pellets. When asked about preventing fish from escaping he stated that he has pipes that help when water

overflows due to rain or flooding but some small fish are able to swim out because he doesn't have nets to prevent fish from escaping because his fish are bigger than the tubes. He doesn't invest in the netting because he finds it troubling to clean and his fish aren't in danger of escaping because they're bigger. Although he doesn't use live fish anymore at that time his fish farm could have accidentally released guppies into the environment. Mr. Azeli also stated that his pond receives its water from a nearby stream and also discharges into another stream. Its connection to the Peruvian Amazon's streams makes it critical that even small ponds like these recognize the dangers of exotics.

5. Another fish farm located near Iquitos' main road on Km 33 is owned by Mr. Jorge. He raises Sabalos and Paiches and feeds them balanced meal pellets. When asked if they feed them guppies he said no because they reproduce too much and consume too much oxygen so exotics were not an issue because he was aware of the effects of these exotic species. This fish farm also receives most of its water from rainwater which also means that it is not connected to another body of water and even if there were exotics introduced they would not escape into a natural system.
6. Then we visited Finca Santa Isabel where the owner had 4 paiches, about 2,000 sabalos and 3,000 boca chicos. They had a total of 6 acres and she fed most of the fish balanced meal. However she did use native forage fish to supplement their diet. However, in the past she used to feed her fish guppies but she said that she stopped because she thinks that the fish became sick. She says that when it rains her ponds sometimes flood and so she has the pipes that drain out water after a certain level but fish can escape through there so in times of heavy rain she adds netting to them. The

nets however had wide holes and if there were exotics it would be easy for them to escape. When she fed her fish guppies there would have been a risk of them escaping. She also mentioned that her fish farm is 10 years old and that since she started it, every two years she clears out all the water in order to clear the bottom of the ponds and make sure that the fish live in a healthy environment. When she first started she was also using guppies. The removal of all the pond water could have also inadvertently released exotics.

7. The last fish farm was called Rancho Karolina located on Kilometer 36 on the main road. The farm had about 9,000 gamitanas. The tanks are closed off by dikes, inside the dike there is a canal which has a net so that excess water can escape but still retain the fish. They have two tanks and there are guppies in the, The owner bought them to feed the fish but he said that the fish don't eat them. The netting on the canals have 1 cm holes which is wide enough for guppies to swim through. Water is discharged into the nearby streams making it easy for guppies to escape.

Each fish farm proved to be unique whether they vary by size or fish that they carry.

However there seems to be certain trends that either facilitate the movement of exotic species or stifle them. Most tanks had some sort of system to drain excess water but inly some of them had nets. Some had exotic species, others still use them and some never did. The reason for not having exotics however was not because of a fear of what would happen if they escaped.

Education on behalf of the ministry of fisheries could be very helpful in ameliorating the situation and to have a more uniform system of defense against exotics.