Fish scraps to food: new markets in Mexican artisanal fishing communities

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Overview

This study assessed the feasibility of producing aquaculture feed ingredients from the byproducts of small-scale artisanal fisheries in Baja California Sur, Mexico as a means to create ecologically sustainable economic opportunities.

Background

Baja California Sur, Mexico (BCS)

Over 90% of the fisheries in BCS are artisanal, operating on a small scale with limited technology. Artisanal fishing communities are often remote and impoverished, lacking economic opportunities outside of the fishing sector.

In these communities, fish byproducts are usually dumped on land or at sea. There is potential to create economic benefits by collecting, processing, and selling fish scraps in these communities.

Byproducts from filleted Lisa fish (*Mugil spp.*)

What can be made from fish scraps?

Fish Scraps contain valuable proteins, fats, and minerals that are often wasted.

Silage is a fermented fish liquid that prevents spoilage. It is relatively cheap and easy to make on the artisanal scale.

Food production requires inputs of protein and nutrients. Farmed fish in particular often need marine-derived protein.

The need for protein

Aquaculture, or fish farming, is rapidly expanding to meet the growing demand for seafood. Most aquaculture relies on expensive, protein-rich feeds containing:

Fish Meal is traditionally made from ground wild-caught fish like sardines.

Soybean Meal provides protein but lacks the healthy omega-3s in fish meal.

Silage made from fish scraps can replace or supplement these products as a protein input for aquaculture feeds.

Objectives and Methods

Research Question

Is it economically feasible and ecologically sound to produce silage as an aquaculture feed ingredient from artisanal fishery scraps in BCS?

Objective 1: Examine supply of artisanal fishery waste

We analyzed eight years of artisanal catch data to:

1. Estimate the quantity and quality of available waste
2. Investigate spatial and temporal trends in waste production

Objective 2: Determine economic feasibility by port

Determine **Amount** of Waste from Each Species At Each Port → Estimate **Protein** Content of Silage Made From Waste → Calculate **Value** of Silage Based on Protein Content → Subtract **Costs** of Production and Transportation → Feasible if **Profits ≥ 0**

Objective 3: Identify social and ecological considerations

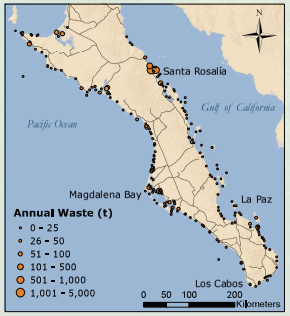
We conducted a qualitative analysis of potential barriers, facilitators, benefits, and consequences of creating new markets for artisanal fishery waste.

Quantitative Results

Objective 1: Examine supply of artisanal fishery waste

On average, over **10,000 metric tons of artisanal fishery waste** are produced each year in BCS. However, the annual waste production is variable and has recently declined.

Distribution of waste

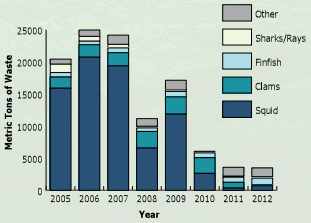


Waste is produced in over 200 artisanal fishing communities in BCS. Santa Rosalía produced high amounts of waste and is a major port for squid landings.

Declining waste production

Squid makes up over 50% of the annual fishery waste produced in BCS. Since 2005, the availability of squid waste has declined due to lower squid landings and changing processing practices.

Annual Waste Production in BCS



Objective 2: Determine economic feasibility by port

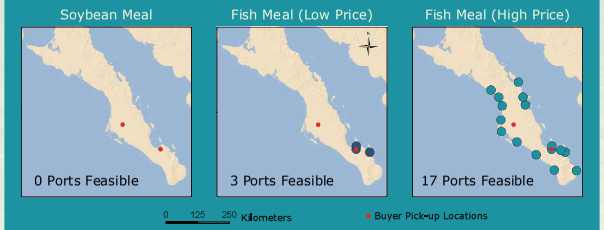
It is **economically feasible** for some ports to produce silage and transport it to a buyer in southern BCS if silage is sold at a price comparable to fish meal but not soybean meal. Additionally, communities with a **consistent supply of high quality waste** are more likely to be feasible. **Transportation costs** greatly impact on feasibility.

$141 as a substitute for **Soybean Meal**

$329 as a substitute for **Fish Meal** (Low Price)

$649 as a substitute for **Fish Meal** (High Price)

Economic Feasibility for Three Substitute Product Valuations



Ports deemed economically feasible are clustered in southern BCS because of their close proximity to buyer pick-up locations, which results in lower transportation costs and higher profits. When silage is valued at a higher fish meal price, ports bring in more revenue and can transport silage from farther away, which results in more economically feasible ports overall.

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Qualitative Results

Objective 3: Identify social and ecological considerations

In addition to the availability of fishery waste, there are many site-specific factors that dictate if silage production will have positive or negative socioeconomic and ecological impacts in fishing communities in BCS.

Socioeconomic considerations

Community Characteristic	Factor Affecting Implementation
Economic Need	Willingness to Participate
Social Capital	Capacity for Cooperation
Community Structure	Viability of Production
Local Demand	Distribution of Economic Benefits

Ecological Impacts

Increasing the value of these sensitive fisheries through profitable silage production may result in:

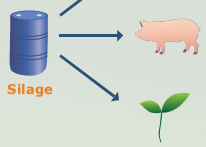
- Increased fishing effort
- Switching target species
- Diverting fish from human consumption to silage
- Use of less selective fishing gear

Therefore, silage production is likely to cause negative ecological impacts unless implemented in areas with well-managed fisheries.

Snapshot of a Fisherman

Santiago is one of the only fishermen who lives in Estero San Vicente year-round. This small community is isolated and Santiago doesn't have access to a car, which could make it difficult to obtain silage production materials or transport silage to potential buyers.

Alternative Uses of Fish Scraps



Aquaculture
Silage can be made into aquaculture feeds onsite by fish farmers at the artisanal scale, bypassing feed producers.

Livestock
Silage can be directly fed to pigs and chickens as well as used strategically to supplement livestock diets when grazing and feed sources are limited.

Agriculture
Silage can also be applied directly to fields as a fertilizer to supplement food production in communities.

Conclusions

- The amount of fishery waste in BCS is variable and has declined from 2005 to 2012.
- This decline was primarily the result of low landings from the squid fishery and changing processing practices.
- Silage production from fish scraps is economically feasible if the product is valued as a substitute for fish meal but not soybean meal.
- Adding value to fishery byproducts may generate perverse incentives that increase bycatch, concentrate fishing effort, and divert fish away from direct human consumption.
- In locations where silage sale to a feed producer is not feasible, alternative local uses of fish scraps in aquaculture, livestock, or agriculture may be possible.

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