Implementing pre-slaughter stunning for farmed fishes in India

Report prepared for: **Fish Welfare Initiative**

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1. Executive summary

Pre-slaughter stunning is a proven method to reduce the suffering of farmed fishes. India is the world's second largest aquaculture producer, with an estimated population of 3–14 billion fishes. Launching and scaling the adoption of pre-slaughter stunning in India will greatly further the mission undertaken by Fish Welfare Initiative (FWI).

However, doing this is extremely complicated. As on date, there is almost zero adoption of pre-slaughter stunning in India as the barriers to adoption are steep. First, there is little awareness among consumers about animal welfare issues, especially of farmed fishes. Second, even among the small subset of consumers who are aware of animal welfare issues related to farmed fishes, there is almost no willingness to pay premiums for fishes handled in an ethical manner. In general, the market for fish, meat, and seafood is deeply price sensitive, and past attempts by meat brands and retailers to promote messages such as 'antibiotic-free' have shown that consumers are unwilling to pay premiums. Third, the technology needed for pre-slaughter stunning is expensive, with machines manufactured in Europe costing approximately $40,000 (₹34 lakh). This technology has also not yet been tested and validated in Indian conditions for Indian fish varieties such as Indian major carps, the most common types of fishes grown in India. Finally, there is little to no support from governments and policymakers on this issue; we have seen no evidence that this is a priority for state or central governments.

In this challenging context, we conducted this study to establish what it will take to launch and scale pre-slaughter stunning for farmed fishes in India. As part of the study, we interviewed experts in the industry across the value chain, visited aquaculture farms and factories, conducted a dipstick consumer survey, met and interviewed a small set of consumers to gauge their preferences, and reviewed existing literature on this subject (refer to Section 3 under Methodology & approach for details).

The study asked us to answer three questions: target population, barriers and incentives, and pathways to scale. To do this, we segmented the market into 13 target populations and identified four that we believe are the most feasible groups that may be interested in conducting experiments in pre-slaughter stunning. Next, we went deeper into two major barriers: the lack of awareness among consumers and their unwillingness to pay premiums. We also evaluated existing stunning technologies and concluded that all the known technologies are expensive in their current form, with

electrical stunning requiring large capital investments. Manually intensive methods like percussive stunning and Ikejime are not scalable. Finally, we recommend conducting experiments to validate whether the ice slurry chill kill method is suitable for fishes (this method is used extensively for shrimp in India and is considered more humane than asphyxiation).

As next steps, we recommend FWI look into three pilot constructs for the next three years: (i) partnering with a mission-oriented farmer producer company/cooperative; (ii) running on-field trials to measure the efficacy of the ice slurry chill kill method and (if successful) running limited-scale operations with farmer members of Alliance of Responsible Aquaculture; (iii) partnering with premium brands and their network of suppliers to test the receptiveness of premium/affluent customers to fishes labeled as humanely slaughtered. In addition to these short-term initiatives, we recommend that FWI work on two other initiatives in the medium term: (i) building an evidence base to support the claim that stunning improves the quality of meat and (ii) investing in building stunning technologies that are frugal, such as an electrical stunner suited for Indian major carps with a target price of $10,000 (₹8.5 lakh) per machine.

Finally, scaling pre-slaughter stunning in India to its full potential will likely be a 15–25 year journey in India. We take inspiration from the case study of rice fortification in India (which one of our founders has closely been involved with since the initiative's inception), where, after 15 years, the program has scaled to 19% of the target population (refer to Section 7.1 in Case study). The three pilots proposed in this report are a good place to start. They will help validate the technical feasibility of existing stunning methods, quantify any tangible benefits to meat quality from stunning, clarify the actual costs of stunning, and provide real data on consumer reactions to meat that is grown in a humane manner. We believe this is going to be a complex and difficult journey, and it is important that FWI begins in earnest and takes small steps in the short term. Deferring the decision for two or three years is unlikely to help as market conditions are unlikely to change in a major way in that period.

2. Introduction

2.1. Background

Most farmed fishes in India die of asphyxiation, a painful process that can last for 30 minutes. Animal welfare practices that reduce suffering during slaughter are uncommon in India. Farmers do not treat this as a priority, and end consumers are mostly unaware of the level of suffering fishes go through during slaughter.

India is the second largest fish-producing country globally, with 17.55 million metric tonnes of production in 2022–23, of which 75% comes from inland aquaculture (farmed fishes). Separately, FWI estimates there are 3–14 billion farmed fishes in India's aquaculture ponds. Introducing and scaling pre-slaughter stunning in India can substantially further FWI's mission to reduce the suffering of farmed fishes.

2.2. Objective of the study

This study aims to evaluate the feasibility of implementing pre-slaughter stunning for farmed fishes in India by addressing three core questions (as defined in the RFP):

1. **Target populations**: Which stakeholder groups within India's aquaculture sector are most likely to adopt pre-slaughter stunning technology?
2. **Incentives and barriers:** What economic, logistical, cultural, or market-driven factors could incentivize or hinder the adoption of stunning technology?
3. **Pathway to scalability**: What strategies or adjustments will be required to scale stunning technology across the aquaculture industry?

3. Methodology & approach

For this study, we used a mix of four methods to arrive at our conclusions:

1. Key informant interviews
2. Field visits
3. Consumer survey
4. Desk research

We explain our approach under each method in more detail below.

1. Key informant interviews

We interviewed 14 key informants (aka industry experts) to gather qualitative insights on the three research questions. These interviews were mostly conducted over phone or video calls, with some conducted in person. A semi-structured interview guide (see Annex for a draft of the guide) was used to steer the conversation. Questions were modified (wherever relevant) and certain sections were given more emphasis during the interview based on each informant's expertise in the aquaculture value chain.

2. Field visits

We visited aquaculture farms in Eluru and West Godavari districts (near Bhimavaram town) in Andhra Pradesh. Over two days, we visited and interviewed five aquaculture farms, one fish trader, two aquaculture processing plants, three input retailers, one aquaculture-focused analytical laboratory, and one officer of a government agency. We also had the opportunity to meet and interact with program staff members of FWI during the field visits. The primary purpose of these visits was to gain the farmers' interest in adopting stunning, hear from other actors in the supply chain (such as traders), and assess other likely on-ground challenges related to pre-slaughter stunning.

3. Consumer survey

To assess consumer preferences and attitudes toward welfare practices in aquaculture, we conducted a survey with 29 respondents. Of these, 24 completed the survey online via targeted messages and email lists shared with affluent consumers and food industry contacts—primarily based in urban metros such as Bengaluru, Mumbai, and

Delhi—while five supermarket owners were interviewed in person during visits to their stores, with a focus on those catering to premium seafood buyers.

Respondents were selected using purposive sampling aimed at individuals who were either regular buyers of fishes from premium retail platforms or professionals in the culinary space with influence over seafood sourcing decisions. The majority of respondents reported consuming commonly available farmed freshwater fishes, particularly *rohu* and *catla*, along with some exposure to premium marine species like sea bass and snapper, especially among urban consumers and chefs.

The survey specifically targeted affluent consumers with higher disposable incomes and culinary influencers, as they are more likely to value welfare-compliant fishes and be willing to pay a premium. The six-section survey covered purchasing preferences, price sensitivity, welfare awareness, and willingness to pay. A full list of questions is provided in Annex 9.1.2.

4. Desk research

A comprehensive desk review was conducted, covering:

- **Scientific literature** on stunning efficacy, welfare impacts, and quality improvements
    - Peer-reviewed studies on electrical stunning effectiveness in fish welfare
    - Research on the impact of pre-slaughter stunning on fish meat quality
    - Reports from the Food and Agriculture Organization (FAO) on humane slaughter practices
    - Journal articles (in publications such as *Aquaculture*, *Fish Physiology and Biochemistry*, and others) on fishes' stress response to stunning methods
- **Market reports** on Indian aquaculture exports, domestic demand trends, and processing practices
    - Marine Products Export Development Authority (MPEDA) disclosures (obtained via the Right to Information Act)
    - Industry reports on Indian aquaculture growth trends (eg Rabobank, WorldFish)
    - Trade data on Indian seafood exports from government and industry associations
    - National Fisheries Development Board (NFDB) reports on domestic aquaculture development and policy support

- **Regulatory frameworks** governing fish welfare in key export markets
    - European Union regulations on humane fish slaughter (EU Regulation 1099/2009)
    - US FDA and NOAA guidelines on fish processing and welfare
    - Indian domestic policies on aquaculture welfare and slaughter practices
- **Case studies** of the adoption of stunning in western markets and the shrimp sector
    - Adoption of electrical stunning in Norway and Scotland's salmon industries
    - Welfare initiatives in the shrimp sector (such as the Aquaculture Stewardship Council)
    - Reports on industry-led efforts to introduce humane slaughter practices
    - Norwegian Seafood Council Reports on lessons from Norway's adoption of stunning technology

4. Target populations

4.1. Identifying target populations

Different stakeholders have distinct roles to play in the implementation and advocacy of pre-slaughter stunning. We have categorized them into:

- Demand-side stakeholders, ie those who are active in the sales and marketing of farmed fishes to end consumers (exporters, premium direct-to consumer brands, organized retail chains, etc). They are critical for advocating adoption through pressure (eg procurement standards) or policy influence.
- Supply-side stakeholders, ie those who are active in the production and farming of farmed fishes (contract farmers, farmer producer organizations, etc). They represent the primary targets for deploying pre-slaughter stunning equipment.

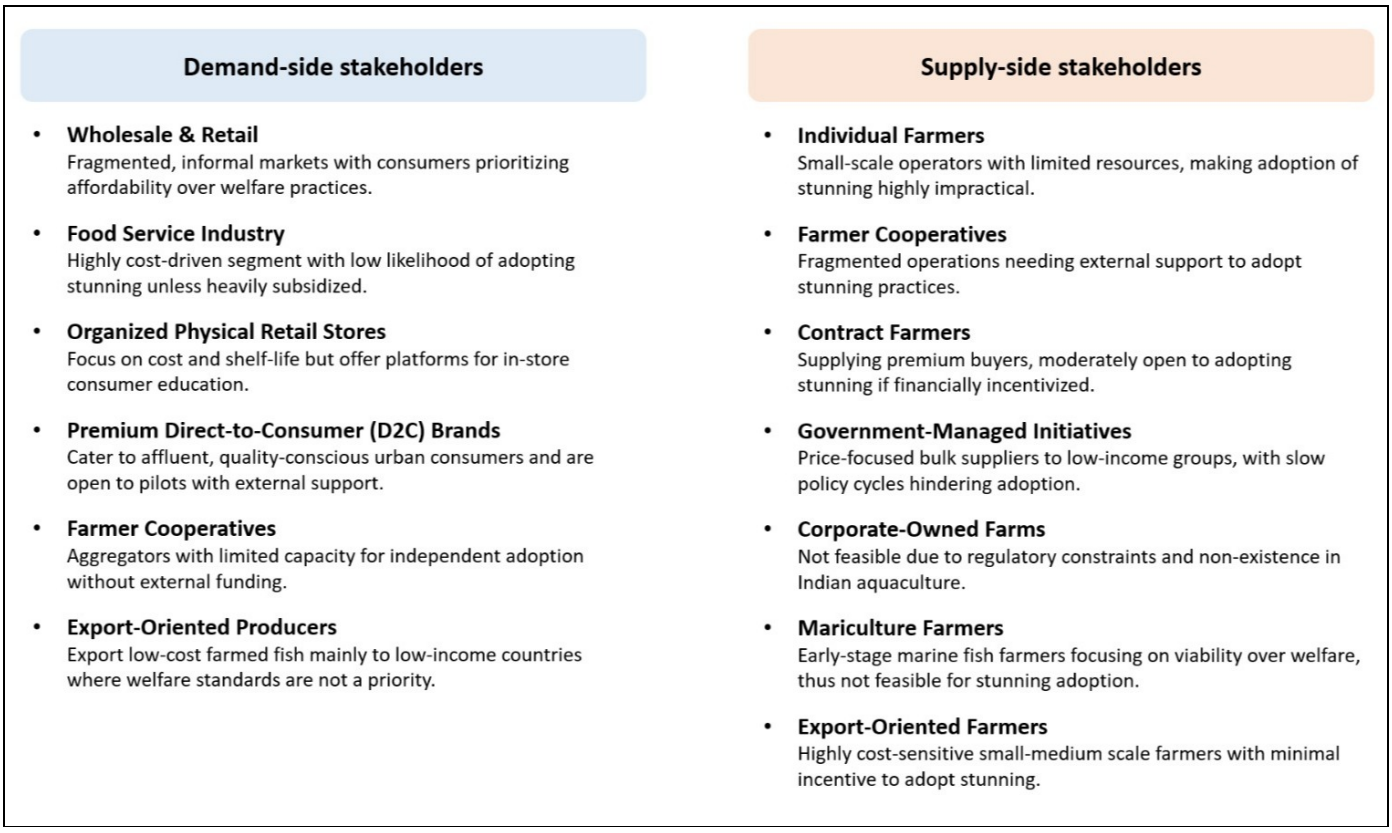

Figure 1: Demand- and supply-side stakeholders

The Indian farmed fishes aquaculture sector was divided into 13 logical segments: six on the demand side (eg retailers, processors, exporters) and seven on the supply side (eg smallholder farmers, large commercial farms, hatcheries). Each segment's annual fish volume was estimated using publicly available data, stakeholder interviews, and the Right to Information petition filed by FWI, with a simplifying assumption of 1 kg per fish to calculate the Total Addressable Market (TAM). These approximate TAM estimates help distinguish larger vs smaller segments for prioritization, although they require refinement for operational decision making.

End consumers and policymakers in themselves were not considered a target population, but were considered important stakeholders in influencing the behavior of stakeholders in target populations.

Prioritizing among target populations

We assessed the feasibility of each of the 13 target populations adopting pre-slaughter stunning. The objective of this exercise was to identify the most suitable target populations to pursue. For this, we looked at the TAM, likely enthusiasm among target populations, and other market dynamics.

4.2. Demand-side stakeholders

1. **Exporters (TAM: 10–12M fishes) → Not feasible**

Description and profile: Exporters are fish processors and factories that are buying fishes from India and exporting it to international markets, including the Middle East, Africa, and neighboring regions (Nepal and China).

Key insights: India exports about 10,000 metric tonnes of farmed fishes annually, according to the MPEDA disclosure from the Right to Information Act petition filed by FWI. Much of this (85%) is exported to low-income countries in Africa where fish welfare standards are not a priority for consumers or regulators. A small fraction (15% or 1,500 metric tonnes) is exported to the Middle East. However, interviews reveal that the end consumers are Indian and Bangladeshi immigrants residing there. Finally, we are aware of a small volume of unrecorded export fish exports to Nepal and China that bypass formal channels and are not published in official statistics records. Again, we do not believe this to be a feasible segment to adopt pre-slaughter stunning.

Conclusion: Given the low export volumes and limited welfare regulation in destination markets, exporters are not a feasible target population for pre-slaughter stunning.

A note on exporters and the marine fish segment

Our starting hypothesis was that exporters to high-income countries like EU member states, the USA, and Japan offer a high-potential target population given the higher awareness among consumers and buyers in these countries, strong regulations on animal welfare, and success stories from organizations such as Shrimp Welfare Project. Official data on exports of fishes from India showed no exports to such high-income countries. We persisted with this line of inquiry in many of our interviews, and the consensus among experts was that there is little to no demand for locally popular varieties like Indian major carps in such high-income markets (as fish preferences are regional in nature). For varieties such as trout and tilapia, which do have ready consumers in such markets, the production base in India is very under-developed, and the primary focus is domestic markets. In one interview, an expert said that the price of fishes in the Indian domestic market is often higher than in global markets, making exports unviable. That said, there is a large export market for marine fishes. However, pre-slaughter stunning for marine fishes is out of the scope of this project given the complexity of installing and operating such stunning equipment on boats and trawlers.

2. **Premium direct-to-consumer (D2C) brands (TAM: 100–150M fishes) → Maybe feasible**

Description and profile: Premium D2C brands are e-commerce or retail platforms that sell high-quality, fresh fishes directly to consumers through online and offline channels. Key players include Fresh2Home, Licious, Nandu's, and ChopServe which cater to quality-conscious urban consumers willing to pay a premium for freshness and reliability.

Key insights: Initial conversations with D2C leaders revealed that consumers are largely unaware of pre-slaughter stunning practices, with past messaging to consumers focusing on aspects such as antibiotic-free chicken. Consumers are more concerned about animal welfare practices that directly impact quality. However, brands are reluctant to charge any premium for meat that is labeled antibiotic-free.

In our conversations, the brands were somewhat open to conducting pilots with

humanely slaughtered fishes, provided they received financial and technical support. They indicated that consumer education campaigns and clear welfare labeling (eg 'humanely slaughtered') could enhance demand but they were unwilling to invest their own resources in this direction. They continued to express skepticism that consumers would pay any premium for such welfare-compliant fishes.

Conclusion: Premium D2C brands are a moderately feasible segment for pre-slaughter stunning pilots, particularly with financial incentives and shared marketing efforts. This segment offers the strongest potential for early adoption as they have the most aware base of affluent consumers.

3. **Organized physical retail stores (TAM: 200–300M fishes) → Maybe feasible**

Description and profile: Organized physical retail stores, including chains such as Reliance Fresh, Nature's Basket, and Spencer's, operate in physical supermarkets and hypermarkets with dedicated fish, meat, and seafood sections. These stores cater to urban consumers and prioritize consistent supply, quality, and wide range. The physical nature of their operations offers opportunities for in-store consumer engagement.

Key insights: Interviews with retail managers revealed that welfare compliance is not currently a priority for their sourcing teams. Their purchasing decisions are driven by cost and shelf-life considerations, with minimal emphasis on ethical sourcing. However, their physical presence offers a unique platform for consumer education. Through in-store campaigns, labeling, and staff training, these stores could help raise awareness about welfare-compliant fishes. Despite this potential for engagement, the likelihood of retail stores independently adopting stunning is low without external incentives or financial support.

Conclusion: While organized retail stores are unlikely to drive early adoption, they could serve as educational platforms for consumer engagement during pilot phases. The feasibility for stunning adoption in this segment is low, but their potential for consumer outreach makes them relevant.

4. **Food service industry (TAM: 1,700–2,100M fishes) → Not feasible**

Description and profile: The food service industry includes hotels, restaurants, and catering businesses that purchase fishes in bulk from local suppliers and distributors. This segment is diverse and fragmented, ranging from premium hotels and fine-dining restaurants to small roadside eateries. Procurement is generally cost driven, with

limited emphasis on welfare standards.

Key insights: The majority of food service establishments prioritize cost efficiency, sourcing fishes from local vendors at the lowest price, making them unlikely adopters of stunning technology. Even within the niche sub-segment of luxury hotels and fine-dining restaurants (eg Hilton, Marriott, Taj, Oberoi), which often adhere to food safety and sustainability certifications, price remains a primary consideration in procurement. Additionally, our review of procurement and welfare policies from leading hospitality chains found no mention of stunning or other welfare-compliant slaughter practices. For example, the Marriott Responsible Seafood Policy clearly states that the group has banned the serving of endangered or critically threatened marine species such as bluefin tuna, sea turtles, and sharks. In addition, top hotel chains such as Marriott (the world's largest hotel chain) and Hilton have clear commitments to source 100% of their eggs from cage-free sources by 2025. On animal welfare, the most we were able to find was a high-level statement on animal welfare standards, which had nothing specific about fishes or pre-slaughter stunning. Interviews reveal that price is still a major factor among high-end establishments, limiting their willingness to adopt stunning unless subsidized or heavily incentivized.

Conclusion: The food service industry is not a feasible early adopter of stunning due to its cost-focused procurement approach. Even the luxury hotel sub-segment, while more structured, remains highly price sensitive and does not currently incorporate stunning into its welfare or procurement policies.

5. **Traditional wholesale & retail (TAM: 10,000–11,200M fishes) → Not feasible**

Description and profile: Traditional wholesale and retail vendors include fish markets, roadside sellers, and local shops that cater to bulk consumers and price-sensitive individual buyers. These vendors operate in informal, unregulated markets and focus on minimizing costs to remain competitive.

Key insights: The primary driver for this segment is low pricing, with minimal interest in sustainable or welfare-compliant practices. Vendors indicated that customers prioritize affordability over ethical sourcing, making it highly unlikely that they would pay a premium for humanely slaughtered fishes. Additionally, the fragmented and informal nature of this sector makes it difficult to implement and scale new practices. With no clear demand or financial incentive, stunning adoption is not feasible in this segment.

Conclusion: Traditional wholesale and retail vendors do not present a viable target for

early stunning adoption. Their cost-driven operations and low consumer awareness make them an unfeasible segment for promoting welfare practices.

6. **Farmer cooperatives/ quasi-state-owned enterprises (TAM: 50–100M fishes) → Not feasible**

Description and profile: Farmer cooperatives and quasi-state-owned enterprises (SOEs) are local organizations that aggregate supply from small- and medium-scale farmers. They negotiate better rates for farmers and manage input purchasing and distribution operations. Some SOEs also run their own processing and retail units.

Key insights: While cooperatives aggregate supply, they lack the financial and technical capacity to adopt stunning technology independently. Their focus on farmer profitability makes them reluctant to absorb new costs, especially for practices that offer no immediate financial gain. Additionally, since these organizations manage their own supply chains, the complexity of introducing new equipment creates further resistance. Interviews with cooperative representatives revealed that external funding and technical support would be required to make stunning adoption viable.

Conclusion: Farmer cooperatives and SOEs offer limited feasibility for early-stage stunning adoption due to financial and operational constraints. Without significant external support, they are unlikely to pursue welfare-compliant practices.

The **demand-side stakeholder analysis** indicates the following:

- Low to moderately feasible segments:
    - Premium D2C retailers offer the best potential for early stunning adoption.
    - Organized physical retail stores have limited adoption potential but offer opportunities for consumer engagement through in-store promotions.
    - Adoption requires financial support and incentives for customers.

4.3. Supply-side stakeholders

1. **Export-oriented farmers (TAM: 10–12M fishes) → Not feasible**

Description and profile: Export-oriented farmers are typically small- and medium-scale aquaculture operators contracted by exporters or wholesale buyers. Their production is largely volume driven, with a focus on low-cost bulk output. They have minimal value-addition capacity and limited financial margins, making them highly cost sensitive.

Key insights: Export-oriented farmers prioritize low-cost operations and have thin profit margins, making them unwilling to invest in stunning technology. Since their buyers do not demand welfare compliance, there is no external pressure or market differentiation incentive for them to adopt stunning. Even with external financial support, adoption is unlikely due to operational complexity and low technical expertise. However, farmers expressed willingness to adopt stunning if they could secure profitability through premium pricing commitments from exporters or receive guaranteed purchase agreements.

Conclusion: Export-oriented farmers are not feasible for early stunning adoption due to their high price sensitivity, lack of welfare differentiation, and limited technical capacity. Without direct market incentives or external support, scaling stunning in this segment would be highly challenging.

2. **Contract farmers (TAM: 300–450M fishes) → Maybe feasible**

Description and profile: Contract farmers are medium-scale producers that supply to premium partners (eg Licious, FreshToHome, Nandu's, ChopServe) or organized physical retail stores. They already meet the higher quality standards demanded by premium buyers, making them more structured and viable for welfare-compliant practices.

Key insights: Contract farmers demonstrated a moderate willingness to adopt stunning if there is significant end-user demand and a compelling business case with clear financial benefits. Since they already follow stricter quality standards, they are more adaptable to adopting welfare-compliant methods. This segment offers potential for pilot programs with premium D2C brands, which could facilitate co-branded welfare labeling and create market differentiation.

Conclusion: Contract farmers are moderately feasible for early stunning adoption due to their existing quality standards, willingness to experiment, and potential for pilot partnerships. However, adoption would depend heavily on end-user demand and the existence of strong financial incentives.

3. **Corporate-owned farms → Not feasible**

Description and profile: Corporate-owned farms are large-scale aquaculture operations with industrial production capacity. These farms typically have the financial and

technical capacity to adopt stunning technology.

Key insights: Corporate farms are infeasible for stunning adoption in India due to land ceiling laws, which prevent large-scale corporate ownership of aquaculture farms. No corporate-owned aquaculture farms were identified during the research phase, making this segment non-existent in the current landscape.

Conclusion: Corporate farms are not feasible for stunning adoption in India due to their non-existence. Legal restrictions and limited corporate presence in aquaculture render this segment irrelevant.

4. **Farmer cooperatives & producer-owned organizations (TAM: 2,300–2,500M fishes) → Maybe feasible**

Description and profile: Farmer cooperatives and producer-owned organizations are collective groups of small- to medium-scale farmers. They primarily negotiate better rates for input purchases and offer basic extension services. This segment has local market access but limited supply-chain control.

Key insights: Farmer cooperatives have low financial and technical capacity for stunning adoption unless they collectively operate centralized supply chains. Individual farmers within cooperatives lack the financial resources for technological investments. Additionally, cooperatives primarily negotiate rates rather than manage end-to-end operations, limiting their influence over slaughter practices. Adoption would only be viable if cooperatives establish centralized operations with direct supply-chain control.

Conclusion: Farmer cooperatives have low to moderate feasibility for early stunning adoption. Their fragmented operations and limited financial capacity make them challenging to engage. However, with external financial and technical support, this segment could become viable over the long term.

5. **Individual farmers (who are not part of any of the above four populations) (TAM: 6,800–7,200M fishes) → Not feasible**

Description and profile: Individual farmers are small, independent aquaculture operators who are not affiliated with cooperatives, contracts, or corporate farms. They operate in highly fragmented, localized markets, with limited access to technical support or financial resources.

Key insights: Small- and medium-scale individual farmers face significant barriers to

adopting stunning technology due to low financial capacity and lack of technical expertise. Their scale of operations makes it impractical to implement and maintain stunning systems. Although larger individual farmers with greater resources could be slightly more feasible, they remain difficult to reach due to their fragmentation and lack of direct welfare-driven market linkages.

Conclusion: Individual farmers are not feasible for early stunning adoption due to low financial capacity, limited technical expertise, and fragmented operations, making outreach and scaling extremely difficult.

6. **Mariculture farmers (TAM: 100–120M fishes) → Not feasible**

Description and profile: Mariculture farmers engage in caged fish farming (along the coast) of marine fishes. Mariculture is primarily present in small parts of Kerala and Andhra Pradesh. This sector in India is still in the early stages of evolution, with production methods still nascent.

Key insights: Mariculture farming is still in the immature, experimental phase, making it unviable for early stunning adoption. Farmers in this sector are focused on viability and yield stability, not welfare practices. Additionally, their limited commercial viability and low production scale reduce the feasibility of introducing welfare technology.

Conclusion: Mariculture farmers are not feasible for early stunning adoption due to the immaturity of the sector, limited commercial viability, and absence of welfare differentiation in their operations.

7. **Government-managed or supported initiatives (TAM: 800–1,000M fishes) → Not feasible**

Description and profile: Government-managed fisheries are involved in bulk distribution programs supplying low-value fishes to low-income populations. These programs are price sensitive and prioritize efficiency over welfare.

Key insights: Government adoption of stunning technology would require multi-year policy cycles, making it a long-term and complex process. Current government programs prioritize low-cost bulk distribution, with no emphasis on welfare. Introducing stunning would increase costs without adding perceived benefits, making it a low-priority consideration.

Conclusion: Government-managed fisheries are not feasible for early stunning adoption

due to long policy cycles, slow decision-making processes, and price-driven procurement with no welfare focus.

The **supply-side stakeholder analysis** indicates the following:

- Low to moderately feasible segments:
    - Contract farmers offer the best potential for early stunning adoption.
    - Farmer cooperatives and producer-owned organizations offer limited potential for adopting stunning.
    - Adoption requires financial support and premium pricing commitments.

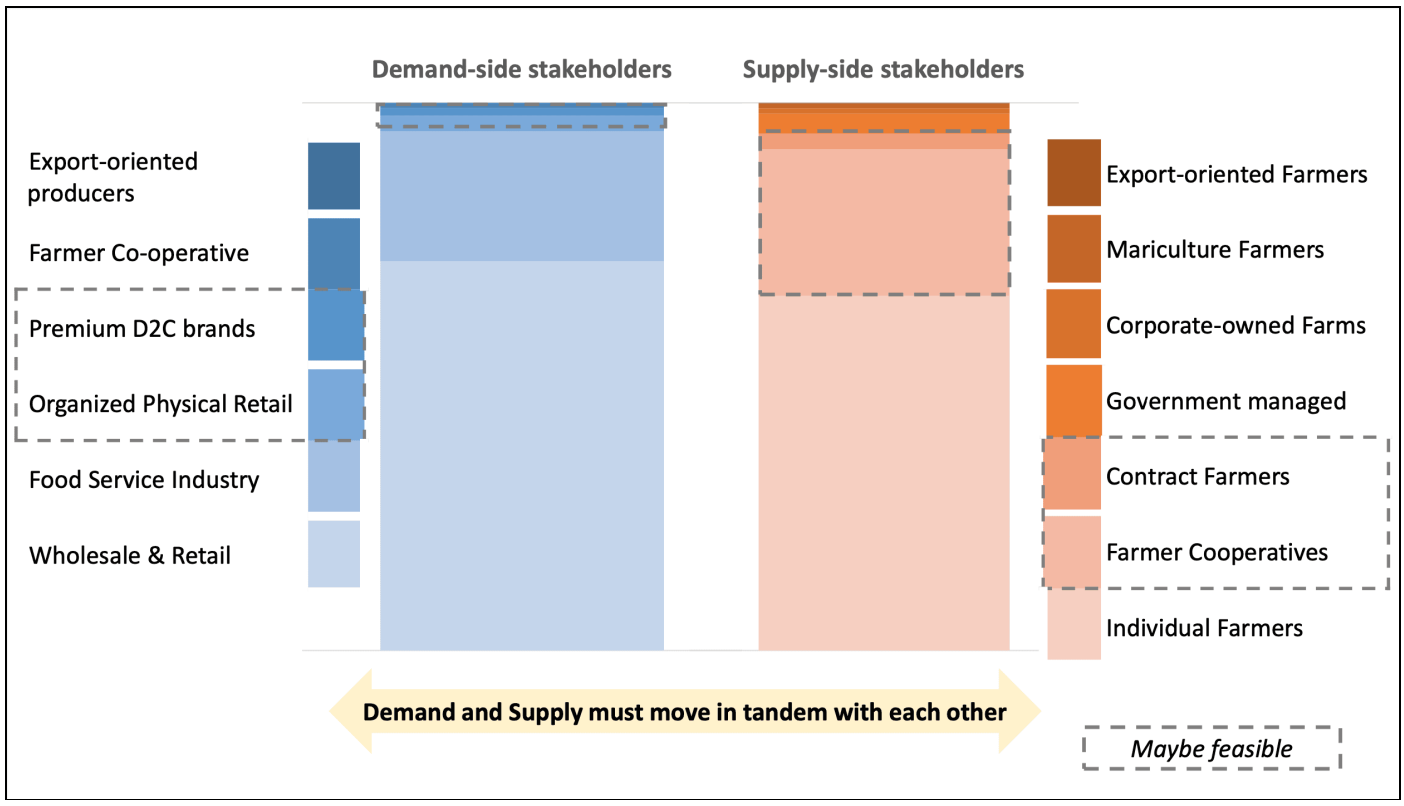

Figure 2:- Demand- and supply-side stakeholders need to move in tandem for stunning to be a scalable and long-term practice

5. Incentives & barriers

5.1. Barrier 1: Consumers are barely aware of animal welfare issues and are not ready to pay for stunning

To understand consumer perception of pre-slaughter stunning and related animal welfare measures, we commissioned a small survey (see Methodology & approach for details on the survey design). The major findings from the survey were:

1. **Online stores are the preferred channel for affluent customers**: 67% of our respondents purchase fishes online given the convenience of this channel.
2. **Consumers, as expected, prioritize quality over welfare:** Per the survey, 92% of consumers prioritize freshness and quality over everything else (important to note that this was a small cohort of affluent customers). More specifically, water quality (83%) and storage conditions (75%) rank high.
3. **Consumers have little to no awareness of welfare practices**: Less than 15% of respondents were familiar with pre-slaughter stunning or any issue related to fish welfare. In some follow-up conversations (conducted with a small sub-sample of consumers), they were surprised to learn about the conditions in which most fishes are reared and slaughtered.
4. **Consumers may be willing to pay a very small premium for welfare-compliant fishes provided they can "see" quality benefits**: When educated about fish welfare issues, only 30–40% of consumers said they may be willing to pay a small 5–10% premium for fishes that were ethically grown and processed. At a >10% premium, there was a sharp drop-off in interest. The willingness to pay was linked with an implicit understanding that compliance with welfare standards improved fish quality. Further, it is important to note that later interviews with D2C brands seem to suggest that this has not been their experience with products that have labels such as antibiotic-free.
5. **Consumers may trust some form of welfare labeling**: Approximately 60% of respondents said they would trust welfare-labeled products more, even without full awareness of stunning. Visual welfare labels (eg certification stamps) significantly increased perceived quality.
6. **Physical retail environments may be more conducive for educating consumers on welfare measures**: Consumers in physical retail stores were more likely to be

influenced by in-store promotions and welfare labeling. Online buyers were less responsive to welfare claims, with price and convenience as the primary factors.

5.2. Barrier 2: Existing stunning technologies have limitations in the Indian context

We assessed five methods of pre-slaughter stunning:

1. **Electrical stunning** where an electric current is passed to the animal's brain to induce a temporary state of unconsciousness. Shrimp Welfare Project has successfully deployed more than five such machines through its partnership with Optimar, a European equipment manufacturer.
2. **Chemical stunning** where a chemical such as clove oil or a water-soluble anaesthetic containing isoeugenol, disrupts the fish's nervous system, inducing sedation and reducing stress before slaughter.
3. **Percussive stunning** where a blow to the skull renders the fish unconscious. FWI's corporate partner SAGE has conducted experiments using this method in the past.
4. **Ikejime** is a Japanese method where a spike is inserted into the hindbrain to cause immediate brain death.
5. **Ice slurry chill kill** where a large volume of ice is applied to reduce the temperature of fishes rapidly and make them insensitive to pain. The existing literature on whether this is a humane method is mixed, with most literature in the developed world classifying this as not humane. However, this method is practised quite commonly in India during shrimp harvest and is accepted by many corporate buyers based here to improve quality and welfare.

Additional methods such as carbon dioxide-based stunning (a variant of chemical stunning) or captive bolt stunning were not considered as *prima facie* they did not appear practical in the Indian context.

	Electrical stunning	Chemical stunning	Percussive stunning	Ikejime (Japanese method)	Ice slurry chill kill
How humane is this method?	**Very high** Fishes lose consciousness in less than a second	**High** It can take 15–20 minutes for fishes to lose consciousness, after which they are ready for slaughter	**High** Fishes can lose consciousness if performed correctly. However, risks persist if there are human errors	**High** Brain death is almost immediate if performed correctly. However, risks persist if there are human errors	**Low to medium** Fishes can suffer for 2–15 minutes depending on their size and the quantity of ice used
Is this method suitable as it requires limited fixed-cost investment?	**Very low** Requires electrical stunning equipment that can cost as much as $40,000 per installation	**High** Requires large water tanks where chemicals can be added	**Very high** Requires a hammer or similar blunt-force equipment	**Very high** Requires a spike	**Very high** Requires existing crates/totes that are used to carry harvests from the farm to market
Is this method suitable as it requires limited variable cost?	**Medium** The costs of electricity and transport of equipment to the fish farm would add 3–5% of the sale price of Indian	**Medium** The cost of chemical consumables are ~5% of the sale price of Indian major caps	**High** Given the need for highly trained labor and the slow process, it would cost 1–3% of the sale price of Indian major	**High** Given the need for highly trained labor and the slow nature of this process, we believe that this would	**High** The incremental cost of ice would be in the region of 1–3% of the sale price of Indian major carps

	major carps		carps	cost 2–5% of the sale price of Indian major carps	
Is this method scalable?	**Medium** With automated equipment available, it is possible to process large volumes of fishes	**Low** Given the long time it takes, the process is fairly unwieldy and is unlikely to scale	**Low** As this requires skilled labor at large volumes, this process is unlikely to scale	**Low** As this requires skilled labor at large volumes, this process is unlikely to scale	**High** This process is scalable as it expects a larger quantity of ice to be used vs existing methods
How severe are the risks?	**Low** Once the electric current is properly calibrated, we do not see any major risks	**Medium** Finding the right dose for a species is important. Further, these are not approved for use in India	**High** As this is a repetitive manual process, errors can prolong fishes' suffering	**High** As this is a repetitive manual process, errors can prolong fishes' suffering	**Medium** Using less than the recommended quantity of ice can lead to an adverse impact on fish suffering

Table 2: Stunning method comparison

The above table compares the five stunning methods across factors such as humaneness, cost (fixed and variable), scalability, and risks. In summary:

1. **Electrical stunning is the most humane and scalable method, but requires a very high upfront capital cost, and existing technology needs to be validated for Indian conditions**. Electrical stunning requires prior calibration based on fish

species and size, and after that, much of the process is automated and free from human judgement or intervention. However, two important points are to be noted: (i) the fixed upfront cost for stunners is high (about $40,000 or ₹34 lakh) based on our best understanding) and (ii) none of the electrical stunners that are available in Europe are proven to have worked for Indian major carps. Any pilot will require further research, testing, calibration, and fine-tuning of existing stunning equipment when used for Indian major carps. Another factor is the transportability of these stunners to farms during harvest. Finally, we also recommend funding, in the medium to long term, of research and development of a low-cost electrical stunner (with a target cost of less than $10,000 or ₹8.5 lakh) with indigenization of parts and optimized for Indian conditions.

2. **Chemical stunning is not suitable for Indian conditions given the high cost involved and absence of regulatory approval in India**. The use of chemical stunning can cost as much as 5–10% of the farm–gate sale price of Indian major carps. Also, chemical stunning requires the existing harvest process to be re-engineered to stun the fishes in a vat or large container (a process that can take 10–15 minutes). Further, products such as isoeugenol are not approved for use in India. A related point is that the impact on meat quality and the consumer reaction to chemical stunning are unknown (eg whether it makes the fishes smell or taste different).
3. **Percussive stunning and Ikejime are not scalable methods given the need for skilled labor and the high variable costs involved**. We understand FWI has conducted trials and pilots of percussive stunning in the past and they were largely unsuccessful. Ikejime is a more complex variant of percussive stunning, and therefore, we believe it is far less likely to scale.
4. **Chill kill using ice slurry could perhaps be a 'middle ground' solution that balances humane slaughter concerns with cost and feasibility**. While chill kill using ice slurry is not considered a fully humane method (with some experts we interviewed clearly saying this is inhumane), there are clear benefits of this method vs a regular method of asphyxiation. The stress experienced by the fishes is far less, and if the right quantity of ice is used, the process can be more humane. Chill kill is commonly used in the Indian shrimp industry when quality- and welfare-conscious buyers (eg the Walmart Group) insist on this method as part of their product specification. However, there are many differences between shrimps and fishes, and therefore, this method needs to be carefully tested in field trials before making further conclusions. Given that ice slurry is transported to fish farms, harvested fishes are packed in a thin layer of ice slurry. We believe

the 'behavior change' aspect in this method is limited. The amount of ice slurry carried to the harvest site would nearly triple (as per our rough calculations), so there would be a higher cost, of about 1–3% of the farm–gate price of fishes. We propose an on-ground experiment (see Pilot 2) to trial this method and measure the welfare efficacy of this method on Indian major carps.

5.3. Incentive 1: Improved meat quality from pre-slaughter stunning should be the main selling point to consumers

While FWI is taking a lens of improved animal welfare, the most compelling incentive for consumers (from our survey and interviews) to adopt pre-slaughter stunning is the likely improvement in meat quality when fishes are stunned.

A review of scientific literature suggests that pre-slaughter stunning improves meat quality by reducing stress-induced biochemical changes, leading to firmer texture, better color retention, and longer shelf life. Studies indicate that stunned fishes exhibit lower lactic acid build-up and reduced rigor mortis, enhancing the overall eating experience. However, an assessment of the evidence base seems to suggest that this opinion is still limited to the academic sphere, and consumers are certainly not aware of this benefit.

FWI should invest in validating these findings in a real-world setting. One way would be to conduct an experiment with chefs from high-end restaurants and luxury hotels to assess their taste perception of stunned vs non-stunned fishes. The experiment would involve a blind sensory evaluation where chefs compare the texture, taste, and overall appeal of fish fillets sourced using both stunning and non-stunning methods. Further, we suggest that FWI continue this line of inquiry and build the evidence base in all its future pilots in this area (see the section on Pathway to scalability for stunning adoption for details on suggested pilots) as our assessment is that the amount of consumer education needed to build and influence this perception among consumers will be significant.

5.4 Incentive 2: Labeling & certification could nudge consumers to adopt sustainable meat

Labeling and certification is a proven method to drive consumer trust while buying food. The most established label that consumers (among the affluent segment) understand

and trust is 'organic', which is regulated by the government of India with a clear set of standards (NPOP being the Indian organic standard). There are other, less frequently used labels in the Indian context, such as Fairtrade (which is an international standard), Rainforest Alliance, Global GAP (Good Agriculture Practices), and Demeter (for biodynamic farming). However, from our past research, the label that is best understood and trusted by Indian consumers is 'organic'.

In the area of aquaculture, there are many existing standards, including Best Aquaculture Practices and Marine Stewardship Council. While we have not gone into the details of these standards, it is safe to say that Indian consumers have close to zero top-of-mind recall of any of these standards.

In this context, in the medium term, partnering with one such organization to introduce their standards and labeling could be an incentive for consumers. However, it is important that the standards are customized to meet Indian conditions and should be unified into a holistic label that addresses all concerns that customers care about, such as humane growing conditions (eg stocking density), good water quality, no use of antibiotics/no antibiotic residue, and humane slaughter. Again, it is important to note that the use of stunning and humane slaughter is only one part of the consumer consideration set; labeling needs to address all aspects of consumers' concerns.

6. Pathway to scalability for stunning adoption

6.1. Pilot programs (0–3 years)

To test the feasibility of pre-slaughter stunning in India, we recommend launching three pilot programs targeting different stakeholders across the aquaculture value chain. Each pilot will assess critical factors such as operational feasibility, farmer adoption, consumer willingness to pay, and the overall economic viability of humane slaughter practices. These pilots are designed to provide insights into the challenges and opportunities associated with pre-slaughter stunning in the Indian context.

Important caveat: While these pilot programs represent the most feasible approaches for testing pre-slaughter stunning in India, they are not scalable or generally feasible under current conditions. Adoption remains highly challenging due to infrastructural, economic, and behavioral barriers. These pilots aim to identify pathways to overcome these difficulties but should not be viewed as universally applicable solutions at this stage.

Pilot 1: Electric stunning with a mission-driven farmer producer company or farmer cooperative

Objective

To evaluate the adoption of electric stunning technology among small and medium fish farmers by providing free electric stunners and financial incentives.

Location

Farms affiliated with a mission-driven farmer producer organization or FPO in one geography.

Implementation plan

FWI will subsidize the capital cost of electrical stunners (similar to Shrimp Welfare

Project) and train the management of the farmer producer company to handle, operate, and maintain the equipment. The running costs of the equipment (electricity and transport) will be borne by the farmer producer organization. The education of farmers and convincing them to use stunning on their farms will be the responsibility of the partner organization.

Pilot timeline

Months 0–6: Planning & baseline setup
The first step is to identify a mission-driven FPO that is a suitable partner. Then, the location needs to be decided, and baseline assessments on farmer perceptions, meat quality, and local market prices are collected. Simultaneously, a detailed evaluation of existing stunning equipment is needed to identify the most suitable product for Indian major carps and the customizations and setting changes needed for Indian conditions. Additionally, FWI may explore seeking assistance from Shrimp Welfare Project to assess whether that organization's existing stunner technology can be adapted for Indian carp species with minor modifications.

Months 6–9: Installation & training
The stunner is ordered and installed at the selected location. FPO staff are trained in handling and maintenance. Parallel farmer education sessions are conducted to build awareness and encourage participation.

Months 9–18: Pilot rollout
Stunning begins in select harvests. Data is collected on machine performance, operational costs, and changes in meat quality. The FPO takes charge of daily operations, with FWI providing technical oversight.

Months 18–24: Evaluation & feedback
Structured farmer feedback is gathered. Meat quality is objectively compared (stunned vs non-stunned), and potential market premiums are explored. Barriers and adoption drivers are identified.

Months 24–30: Scalability assessment
FWI evaluates cost effectiveness, long-term feasibility, and potential for expansion. Technical refinements and operational learnings are documented.

Months 30–36: Reporting & dissemination
Final results are compiled into a case study. FWI hosts knowledge-sharing sessions and

makes recommendations on scale-up potential or decides to close the program.

Expected outcomes & questions to be answered

- **Technical validation**: Do electrical stunners in their current form work for Indian major carps in Indian conditions? What additional measures need to be taken to ensure these stunners function as expected in Indian conditions?
- **Operating cost**: What is the actual operating expenditure incurred in the use, operation, and maintenance of these machines?
- **Meat quality test**: Can we objectively measure and quantify any improvements in the meat quality of electrically stunned fishes?
- **Farmer feedback**: What are the major factors that drive farmer resistance to the use of stunning?
- **Market prices**: In an 18–24 month period, do we observe any premium prices that local markets are willing to pay for stunned fishes?

Estimated program cost

We estimate that setting up a program of this nature would cost approximately $200,000–300,000 (₹1.7–2.5 crore) for a two-year period. This would include the cost of one electric stunner and the human resources to manage this program for two years.

Pilot 2: Ice slurry chill kill validation with Alliance for Responsible Aquaculture farmers

Objective

To test the feasibility and impact of the ice slurry chill kill process as an alternative humane slaughter method.

Location

Existing farms that are part of the Alliance for Responsible Aquaculture in Eluru, Andhra Pradesh.

Implementation plan

To evaluate the practical feasibility and effectiveness of ice slurry chill killing in India, FWI could conduct a controlled on-ground experiment at ARA member farms in Eluru, Andhra Pradesh. The experiment would measure:

- **Time to asphyxiate**: Assess the average time taken for fishes to lose consciousness and asphyxiate in an ice slurry bath.
- **Cost analysis**: Measure the cost per kg of fishes stunned, including ice, labor, and equipment.
- **Welfare impact**: Observe stress indicators (eg movement, gill convulsions) to evaluate welfare level.
- **Logistical feasibility**: Document operational challenges (eg ice handling, storage, and transportation) to assess scalability potential.
- **Data collection**: The results could help quantify the effectiveness of ice slurry stunning in real-world farm conditions, providing valuable insights for future adoption strategies.

If early results on the welfare benefits are positive, we recommend funding the program for a period of one to two years to gather larger datasets on these issues in the ARA farms.

Pilot timeline

Months 0–3: Planning & design

FWI will finalize its partnership with the Alliance for Responsible Aquaculture (ARA) and identify participating farms in Eluru, Andhra Pradesh. An experimental protocol will be developed to assess welfare indicators (eg time to asphyxiate, stress responses), operational logistics, and cost parameters. Equipment procurement and ice supply planning will also begin.

Months 3–6: Training & pilot setup
Farm workers and FWI staff will be trained on humane handling and data collection procedures. Mock trial runs will be conducted to test the protocol and ensure consistency in observations across farms.

Months 6–12: Controlled experiment phase
The field experiment will be launched, testing the method on-site. Key data will be collected on time to loss of consciousness, welfare indicators, and ice usage. Early analysis will help determine if the method meets minimum thresholds for humane slaughter.

Months 12–18: Expanded implementation
If early results are promising, the pilot will scale up across more harvests within the ARA network. This phase will test operational feasibility at a moderate scale and include meat quality comparisons between ice-stunned and traditionally slaughtered fishes.

Months 18–24: Evaluation & recommendations
The final analysis will assess the humaneness, cost effectiveness, and scalability of ice slurry chill killing. The findings will guide whether this method should be recommended as an interim stunning technique or phased out. The results will be shared through internal reporting and discussions with external partners.

Expected outcomes & questions to be answered

- **Humaneness of ice slurry chill killing**: How humane is this method? At what quantity of ice per kg of fishes is this method acceptably humane? Is this method worth pursuing or should we discard this as inhumane?
- **Cost of program**: Once we have reasonable confidence that this method is reasonably humane, what does it cost? Refer to Table 3 below for a rough calculation of how much we expect the method to cost.
- **Meat quality**: Is there any perceptible improvement in meat quality as a result of using this method of slaughter?

Estimated program cost

The cost of running the experiment is likely to be small. To run the program at scale for a period of two years, assuming one million fishes are processed through this method, we expect a program cost of $100,000–200,000 (₹85 lakh–1.7 crore) with $30,000 (₹25 lakh) being the cost of incremental ice slurry and the rest being human resource costs.

Parameter	Value/Calculation
Ice requirement per kg of fishes	0.5 kg of ice per 1 kg of fishes
Ice requirement per ton of fishes	500 kg of ice for 1 ton of fishes
Cost of ice	$16–29 (₹1400–2500) per ton of ice
Cost of 500 kg of ice	$8–15 (₹700–1250)

Table 3: Ice slurry chill kill calculations

Assumption: Weight per fish is assumed to be 1 kg.

Pilot 3: Consumer testing with premium D2C brands

Objective

To evaluate consumer perception, demand, and willingness to pay for humanely slaughtered fishes through premium e-commerce platforms.

Location

In partnership with premium direct-to-consumer brands in one major metropolitan city.

Implementation plan

- **Capital subsidy for stunners**: Fish Welfare Initiative provides a capital subsidy to D2C brands to install electric stunners in their area of procurement. FWI will engage with European stunner manufacturers to custom-develop machines tailored to Indian major carps by reprogramming current settings to suit local species and handling conditions. A specific group of farmers, primarily supplying to the D2C brand, will be selected for implementation. The brand will be responsible for the ongoing operation and maintenance of the equipment.
- **Product development**: Introduce messaging on consumer packaging and on-website communication around labels like 'Humanely slaughtered fishes' and 'Grown with animal welfare standards'. Ensure proper labeling and consumer education about humane slaughter practices.
- **Consumer testing & data collection**:
    - A/B testing: Compare sales performance between regular vs humanely slaughtered fishes.
    - Conduct online surveys and focus groups to measure perceived quality, ethical concern, and pricing acceptability.
    - Analyze repeat purchase behavior to gauge long-term demand.
    - Assess pricing elasticity to determine how much extra consumers are willing to pay. Identify whether humanely slaughtered fishes can be positioned as a premium product with better taste and quality.

Implementation plan

Months 0–3: Partnership finalization & planning
FWI will finalize partnerships with one or more premium D2C brands in a major metro like Bengaluru. Simultaneously, FWI will engage European stunner manufacturers to

customize machines for Indian major carps. A subset of farmers supplying to the D2C brand will be identified for implementation.

Months 3–6: Equipment setup & training
Electric stunners will be installed at the D2C brand's procurement point, and operational teams will be trained on humane handling, usage, and maintenance. The brand will take full ownership of ongoing operations, while FWI supports early-stage troubleshooting.

Months 6–12: Product launch & messaging rollout
Humanely slaughtered fishes will be introduced on the D2C platform with tailored packaging and website messaging and labels. Consumer-facing education will be integrated across channels to build awareness.

Months 12–18: Consumer testing & market feedback
A/B testing will be conducted to compare regular vs humanely slaughtered fish sales. Surveys and focus groups will gauge consumer perception, ethical awareness, and sensitivity to price differences. Repeat purchase behavior will be tracked to assess retention.

Months 18–24: Data analysis & price elasticity testing
Collected data will be analyzed to understand consumer willingness to pay, sales trends, and brand engagement. Controlled adjustments to pricing will help test elasticity and identify if humanely slaughtered fishes can be positioned as a premium offering.

Months 24–30: Evaluation & scaling recommendation
Pilot results will be compiled into an insights report outlining feasibility, pricing impact, and operational learnings. FWI and the D2C partner(s) will assess whether to scale the offering, refine the strategy, or reposition it based on consumer feedback.

Performance metrics

- **Consumer willingness to pay**: Measure the **price premium consumers** are willing to accept
- **Sales performance:** Compare **sales volume and revenue** of stunned vs non-stunned fishes
- **Brand engagement**: Track **consumer feedback and repeat purchases**
- **Pricing elasticity**: Assess how pricing impacts **demand and profitability**

Expected outcomes & questions to be answered

- **Validate electrical stunning technology** and whether it works as expected in Indian conditions
- **Real consumer feedback** on humane slaughter preferences and feedback on whether stunning improves meat quality
- **Understanding of premium pricing potential** and its negative impact on sales

6.2. Intermediate plan (4–6 years)

In addition to the three pilot programs described above, FWI should consider engaging in these additional areas in the medium term:

1. **Building consumer awareness on the benefits of stunning**. We have described this in more detail in Section 5.3. related to incentives. We have suggested that in the short term, FWI invest in building the evidence base to educate customers that stunning improves fish quality. Once this is well established, FWI can consider investing in consumer education on this issue. It is important to note that building consumer awareness at scale is expensive, and this is a decision that should be taken after further analysis once the preconditions are in place.
2. **Developing low-cost technology alternatives**. In the immediate term, FWI should work with existing stunning technologies imported from abroad to get started. However, as the foundation for stunning adoption is laid, there should also be investments in developing affordable stunning technologies (eg electrical stunners that are mobile and suited for Indian major carps, and cost less than $10,000 or ₹8.5 lakh).
3. **Engagement with government and policymakers**. While we remain skeptical of the government's intent to introduce legislation related to stunning in India, we also admit that we did not cover a wide spectrum of policy and government officials in our key informant list. However, the shrimp industry in India, with a much more evolved export industry worth more than $5 billion (₹42,000 crore) in revenue, still has not fully adopted stunning and there is no concerted effort by MPEDA or government bodies to introduce it. However, government and policymakers are critical for scale in the long term, so we recommend that FWI continue to engage with state government officials in one or two states constantly sharing progress about their work in stunning.

7. Case study: Scaling rice fortification in India

The adoption of pre-slaughter stunning in Indian aquaculture will likely face challenges similar to those experienced during the **rice fortification program**, which aimed to combat malnutrition by introducing fortified rice kernels (FRKs) into the rice distributed through the government programs such as the Public Distribution System (PDS). Despite being a **government-backed initiative**, the program faced significant **scaling barriers**, requiring **over a decade of sustained effort** to gain partial nationwide adoption.

7.1. Key insights from rice fortification adoption

7.1.1 Time-intensive scaling & fragmented expansion

The rice fortification program underwent **three phases over 12 years**[1] before achieving partial scalability:

- **Pilot phase (2012–2016)**:
  - Small-scale pilots were conducted across **five states**, reaching **~1.5M beneficiaries**
  - Adoption remained low due to **limited awareness and operational inefficiencies**
- **Expansion phase (2017–2020)**:
  - Scaling efforts expanded to **15 states**, covering **~17M beneficiaries**
  - Despite broader adoption, the initiative still required **extensive financial and logistical support**
- **Partial nationwide rollout (2021–2024)**:
  - Even after 12 years, fortification reached only **60% of India's Public Distribution System (PDS)**
  - As of **2024**, it covers **~154M beneficiaries** (out of 800M eligible) – a **partial adoption rate of ~19%**

[1] Pre-pilot phase lasted seven years, from 2005 till 2012, which included clinical trials to generate scientific evidence of the health benefits of fortified rice and small demonstration pilots in school meals; feasibility studies of extrusion; and blending technologies.

Parallel for stunning adoption:
Stunning adoption will likely follow a **similar multi-year trajectory**, requiring **pilot programs, financial backing, and continuous awareness-building** before achieving meaningful scale.

7.1.2. Financial & infrastructure barriers

Rice fortification faced **significant cost and infrastructure challenges**, making large-scale adoption difficult:

- **High initial capital costs**:
    - Installing extruder at rice millers or at a centralized facility to make FRKs costs ($45,000–1.6 million or ₹38 lakh–13.6 crore) and blending units (for mixing FRKs in rice) cost **$18,000–36,000 (₹15–30 lakh)** per rice mill.
    - Only **10% of mills had the financial capacity** to invest in the required equipment without government subsidies.
- **Continuing production costs**:
    - Fortifying rice added **₹1.5–₹2.5/kg** to the cost, making it economically unviable for most producers without subsidies.
    - The government had to introduce a **30–50% subsidy** to offset fortification costs.
- **Supply-chain bottlenecks:**
    - Delays in **equipment procurement**[2] and a lack of qualified technical support teams slowed adoption.
    - FRK distribution and blending required **specialized storage and transport systems**, increasing logistical costs.

Parallel for stunning adoption:
Fish stunning will face **similar cost and infrastructure barriers**, such as:

- **High upfront costs** of electric stunners ($30,000–40,000 or ₹25–34 lakh per unit) or any other stunning setup
- **Continuing operational costs**, including maintenance and staff training
- **Supply-chain modifications** for humane handling and slaughter practices

[2]Extruders were typically imported from China while the blenders were locally manufactured. Currently there are 400 extruders and 18,000 blenders in the country.

7.1.3. Resistance from industry stakeholders

Rice millers, processors, and distributors **initially resisted fortification** due to perceived cost burdens and operational complexities

- **Low willingness to invest**:
    - Only **15–20%** of rice millers voluntarily adopted fortification during the early expansion phase.
    - Adoption only accelerated after **mandatory government regulations** were introduced.
- **Consumer apathy**:
    - Despite proven nutritional benefits, consumer demand for fortified rice remained low.
    - **<10% of consumers** were willing to pay extra for fortified rice in early adoption stages.
- **Logistical challenges**:
    - Government procurement programs lacked **consistent monitoring**, leading to **quality inconsistencies** and rejection of fortified rice batches.

Parallel for stunning adoption:

- Stunning will face **farmer resistance** due to perceived cost burdens.
- **Low consumer awareness** of welfare practices will limit willingness to pay.
- **Logistical challenges** (eg equipment availability, handling standards) will slow scaling efforts.

7.2. Key lessons for stunning adoption

The **scaling challenges faced by rice fortification in India** offer valuable parallels for **stunning adoption** in aquaculture. Similar to the **gradual uptake of extrusion technology** in rice mills, scaling stunning will require **multi-phase efforts** over a 15–20 year horizon, involving **regulatory changes, industry adoption, infrastructure development, and consumer awareness**.

Drawing from the rice fortification journey, **FWI can expect** the following phases and challenges when introducing stunning in India's aquaculture sector:

7.2.1. Industry awareness, pilot, & adoption (short term: 1–5 years)

In the initial years, FWI needs to focus on **industry engagement and pilot scaling**.

Key lessons from rice fortification:

- **Awareness & training programs**:
    - Rice fortification required **large-scale awareness and training programs** to educate millers and consumers.
    - FWI will need **awareness campaigns** targeting farmers, processors, and retailers, highlighting the benefits of stunning.
- **Partnerships with key players**:
    - The government partnered with **large food companies** to introduce fortified rice in bulk supply chains.
    - FWI should **collaborate with premium D2C brands** and large aquaculture firms to pilot stunning.
- **Pilot expansion**:
    - Rice fortification pilots expanded from **five to 15 states** before achieving broader adoption.
    - FWI should **scale pilot programs gradually**, collecting impact data to refine and expand adoption strategies.

7.2.2. Regulatory & policy framework (mid term: 5–10 years)

Once industry awareness and adoption are in place, the next phase involves a focus on **scientific validation and policy advocacy** to build a foundation for stunning adoption.

Key lessons from rice fortification:

- **Scientific validation:**
    - Rice fortification required **scientific trials** to validate extrusion technology and its nutritional benefits.
    - Similarly, FWI will need **scientific studies on stunning efficiency**, impact on fish welfare, and product quality improvements.
- **Regulatory engagement**:
    - Rice fortification involved extensive **collaboration with government bodies** (eg FSSAI) to create fortification standards.
    - FWI will need to **work with regulatory bodies** (eg National Fisheries

Development Board, FSSAI) to establish humane slaughter guidelines.

- **Financial support for early adoption**:
    - Rice fortification relied on **government subsidies** to incentivize millers to adopt extrusion technology.
    - FWI will need to offer **financial incentives** (eg free stunners or purchase guarantees) to encourage early adoption.

7.2.3. Consumer demand & market shift (mid to long term: 5–15 years)

To enable market shift, FWI will need to focus on **creating consumer demand** and making welfare standards a **mainstream purchasing criterion**.

Key lessons from rice fortification:

- **Labeling & certification**:
    - Rice fortification introduced '**F+' labels** to differentiate fortified rice.
    - FWI should develop **'Humanely processed' certification labels** for stunned fishes to build consumer trust.
- **Retail & supermarket partnerships**:
    - Fortified rice reached consumers through **retail chains and public distribution programs**.
    - FWI should **partner with premium retailers and food service chains** to promote humanely slaughtered fishes.
- **Export market opportunities**:
    - Rice fortification leveraged **exports to international markets** to drive higher standards.
    - FWI should **target export markets** where welfare standards are already prioritized (eg Europe) to create external demand pressure.

7.2.4. Infrastructure development (long term: 10–15 years)

In the final phase, to enable **cost-effective scaling**, FWI will need to focus on **localising stunning technology and building supporting infrastructure**.

Key lessons from rice fortification:

- **Local manufacturing of equipment**:
    - Rice fortification required **local manufacturing of extrusion technology** to reduce costs and support scale.

    - FWI should **localize the production of electric stunners** to reduce dependence on imported equipment (currently priced at $30,000–40,000 or ₹2–3 million)
- **Centralized processing units:**
    - Rice fortification introduced **centralized blending units** to reduce the cost burden on individual millers.
    - FWI should consider **centralized stunning units** where small-scale farmers can access stunning services without direct investment.

8. Recommendations on next steps

Building on the analysis of target populations, barriers, technology options, and implementation pilots, we recommend a phased and pragmatic approach to enable the adoption of pre-slaughter stunning in India. These steps span across short-, medium-, and long-term horizons and reflect the complexity and systemic nature of the challenge.

A. Immediate priorities (0–3 years)

1. Launch three feasibility pilots

- **Pilot with a Farmer Producer Organization** to validate electric stunning technology, understand farmer behavior, and quantify changes in meat quality.
- **Pilot the ice slurry chill kill method** with ARA farms to assess welfare outcomes, costs, and logistical feasibility for wider adoption.
- **Pilot with premium D2C brands** to evaluate consumer willingness to pay, branding strategies, and operational fit for humanely slaughtered fishes.

2. Engage European manufacturers and technology adaptation

- Partner with equipment manufacturers and Shrimp Welfare Project to customize existing stunners for Indian major carps and Indian field conditions.

3. Build a stronger evidence base

- Run controlled experiments on stunning efficacy, meat quality improvement, and consumer perception through A/B testing and chef evaluations.
- Validate and publish scientific findings to build credibility with policy and industry stakeholders.

4. Clarify regulatory landscape

- Begin informal engagement with MPEDA, NFDB, and state fisheries departments

to initiate dialogue on humane slaughter.

- Position FWI as a knowledge partner to shape future policy guidelines around stunning.

9. Annexes & references

9.1. Annexes

9.1.1. Interview questionnaire

Objective:
To gather qualitative insights from key stakeholders regarding the feasibility, challenges, and potential pathways for pre-slaughter stunning adoption in India.

Respondent segments:

- **Farmers**: Contract farmers, cooperative members, and independent farmers
- **Processors & distributors**: Processing companies, cold-chain distributors, and aggregators
- **Government & policy experts**: Representatives from government agencies
- **Technology providers**: Stunning technology vendors and solution providers

Key themes & sample questions

1. Target population analysis

- **Objective**: Identify willingness and feasibility of adoption
- **Farmers**:
    - Are you aware of pre-slaughter stunning practices?
    - What are your primary concerns regarding stunning adoption?
    - Would you be willing to adopt stunning if financial or technical support is provided?
    - What would make stunning adoption feasible for you (eg price guarantees, subsidies)?
- **Processors & distributors**:
    - Do you currently process or distribute fishes that follow welfare standards?
    - Would you consider sourcing from farmers using stunning if there were market incentives?
    - What certification or labeling practices would make you consider welfare-compliant fishes?

- **Government & policy experts**:
    - Are there any current or upcoming regulations regarding fish welfare or stunning in India?
    - What incentives or policies could encourage farmers to adopt stunning?
    - Are there specific welfare certification schemes in place?
- **Technology providers**:
    - What is the estimated cost and scalability of your stunning solution?
    - What technical challenges do you foresee in implementing stunning at small and medium farms?
    - Have you conducted any trials in Indian aquaculture settings?

2. Barriers & incentives

- **Objective**: Identify challenges and drivers for adoption
- **Farmers**:
    - What are the biggest financial or operational barriers preventing you from adopting stunning?
    - Would government subsidies or financial support encourage you to implement stunning?
    - How much of a price premium would motivate you to adopt humane practices?
- **Processors & distributors**:
    - Are there any economic or logistical barriers preventing you from sourcing welfare-compliant fishes?
    - Would clearer welfare labeling or certification influence your purchasing decisions?
    - Would consumer marketing or awareness campaigns make you more likely to buy welfare-compliant fishes?
- **Government & policy experts**:
    - What regulatory changes or financial incentives would encourage adoption?
    - Are there any existing models of financial support (eg subsidies, tax incentives) for fish welfare?
- **Technology providers**:
    - What operational barriers exist for stunning implementation?
    - What type of training or capacity-building programs would be required for successful adoption?

3. Pathway to scalability

- **Objective**: Identify strategies for scaling stunning adoption
- **Farmers**:
    - What support would you need to continue using stunning after a pilot project ends?
    - Would collective models (eg cooperatives) help reduce costs and drive adoption?
- **Processors & distributors**:
    - Would you be willing to pay a price premium for welfare-compliant fishes in the long term?
    - What certification or third-party validation would make you more confident in sourcing welfare-compliant fishes?
- **Government & policy experts**:
    - What policy interventions could scale stunning adoption across the industry?
    - How could the government facilitate industry-wide welfare improvements?
- **Technology providers**:
    - What is the minimum scale required for stunning technology to be cost effective?
    - Could shared or cooperative ownership models make stunning technology more accessible?

9.1.2. Survey flow

Objective:
To quantitatively measure consumer awareness, preferences, and willingness to pay (WTP) for welfare-compliant fishes, as well as to gather insights from B2B clients (retailers, restaurants, hotels) on their demand for such products.

Target audiences:

- **End consumers**: Urban fish consumers in metro cities (Bengaluru, Mumbai, Delhi, Hyderabad, Chennai)
- **Exporters**: Export-oriented farms and distributors
- **B2B clients**: Hotels, restaurants, and retail chains

Survey flow:

1. **Current consumption behavior**:
    - Frequency of fish consumption
    - Preferred sources (retail, online, restaurant)
    - Willingness to pay for higher quality or premium fishes
2. **Awareness of humane slaughter practices**:
    - Awareness of stunning or humane slaughter methods
    - Importance of fish welfare in purchasing decisions
3. **Willingness to pay (WTP) analysis**:
    - Would you pay 5%, 10%, or 15% more for welfare-compliant fishes?
    - Would clear welfare labeling influence your purchasing decision?
    - Preference for branded, welfare-compliant certification
4. **Perceived benefits of welfare-compliant fishes**:
    - Do you perceive welfare-compliant fishes as healthier, fresher, or better quality?
    - Willingness to recommend or repurchase
5. **Marketing & labeling preferences**:
    - Labeling preferences (eg 'humanely slaughtered', 'welfare certified').
    - Communication channels influencing purchase (eg in-store, online, social media).

9.1.3. Field visit checklists

- **Pond and farm assessment:**
    - **Location**: Andhra Pradesh
    - **Parameters monitored**:
        - Farm size and production volume
        - Current slaughter methods used
        - Willingness to adopt stunning technology
        - Infrastructure feasibility for stunning implementation

9.2. References

1. Literature & research sources

- **FWI reports**:
    - FWI's internal research on fish welfare practices
    - Benchmarking reports on humane slaughter techniques
- **Academic publications**:
    - Fish slaughter and welfare standards in aquaculture
    - Impact of pre-slaughter stunning on fish quality and shelf life
- **Industry reports**:
    - MPEDA export data and market insights
    - Global seafood industry reports on welfare standards

2. Expert interviews & quotes

- **Key informants**:
    - Industry experts, processors, and fish farmers
    - Representatives from premium D2C brands and retailers
- **Notable quotes**:
    - "Stunning significantly improves fish quality, making it more competitive in export markets."
    - "Consumer awareness of fish welfare is low, but premium brands can drive early adoption."
    - "The lack of regulatory mandates is a key barrier to industry-wide adoption."

3. Regulatory & policy references

- **Indian regulatory sources**:
    - **MPEDA (Marine Products Export Development Authority)** → Export statistics and market insights
    - **FSSAI (Food Safety and Standards Authority of India)** → Food safety guidelines
- **Global regulatory sources**:
    - **EU Directive 1099/2009:** Welfare regulations for slaughter
    - **World Organisation for Animal Health (OIE):** Aquatic animal welfare standards

4. External data & reports

- **Market data**:
  - Seafood export statistics from MPEDA
  - Consumer insights from market research firms
- **Financial estimates**:
  - Stunning technology costs from industry vendors

5. Links

- https://dof.gov.in/sites/default/files/2024-07/Annual_Report_2023-24_English.pdf
- https://www.fishwelfareinitiative.org/india-scoping
- https://files.fwi.fish/Stunning%20RFP.pdf
- https://serve360.marriott.com/wp-content/uploads/2019/05/Responsible-Seafood-Position-Statement2.pdf
- https://serve360.marriott.com/wp-content/uploads/2019/05/Animal-Welfare-Position-Statement2.pdf
- https://www.fishwelfareinitiative.org/post/sage-stunning

9.3. List of tables & figures

Figure 1: Demand- and supply-side stakeholders

Figure 2: Demand- and supply-side stakeholders need to move in tandem for stunning to be a scalable and long-term practice

Table 2: Stunning method comparison

Table 3: Ice slurry chill kill calculations