



Seeking Input:

How should FWI proceed with pre-slaughter stunning in India?

By Haven

Update: For more research on what I view as some of the key remaining cruxes, see [here](#).

Note that this doc is linked publicly on our [blog](#).

Summary

- We are interested in developing pre-slaughter stunning in India.
- As there seem to be massive obstacles here, we first funded three foundational research reports in parallel.
- We now have these reports completed, and need to make a decision on whether, and if so how, to proceed.
- We're seeking input from diverse viewpoints to better inform our decision. This is where you come in!
- If you have input, you can give it in a few ways:
 - Comment directly on this doc
 - Send it to Haven, either in text, doc, whatsapp voice memo, etc. form
- Feedback would be most helpful **by Wednesday, June 25**.
- Thank you for helping us make a better decision here!

The Problem

- Farmed fishes in India are currently killed via asphyxiation, which is probably akin to being tortured to death. It seems to take rohu and catla (the relevant species) several hours to die like this.
- This happens to several billion fishes per year in India, as well as to even more in other similar contexts around the world.
- There is currently no technology or incentive for these fishes to be stunned at scale.



Our Solution

- Pre-slaughter stunning in India right now is a longshot, but we wanted to attempt it. It's also something we believe will need to be figured out at some point.
- We could have just started developing stunning tech, but it's unclear why anyone would currently pay the price premium to cover it.¹ So **we thought to do a more foundational research project to first determine whether this was worth proceeding with at all.**
 - This foundational project took the form of an [RFP process](#), where interested teams were encouraged to bid to complete the foundational research we were asking for.

What We've Done

- Through an RFP process, we selected [three teams](#) to tackle this foundational research in parallel (the point here being to maximize the chance of any of them having a breakthrough). These reports are now finished, and you can read them below:

Author/ Report Link	Scope & Methods	Key Findings
Hornbill AgriTech Consultancy	• Desk review of stunning technologies and meat quality literature • 14 interviews with processors, researchers, and NGOs • Two-day Andhra Pradesh field visit	• Lack of consumer awareness and interest in stunning. Domestic seafood (which is almost all fish in India) is deeply price sensitive. • Expensive, inaccessible machines: European stunners are probably too expensive, and have not been validated, for Indian species. • Recommendations: ◦ Partner with a mission-oriented fish cooperative ◦ Consider chill kill, as even though it's not stunning could a) be economically feasible, and b) lead to quicker deaths. ◦ Partner with premium brands to do market research

¹ Note that, due to economic considerations, it probably does not make sense for us to pull an SWP and just buy them the stunner. This is because a) Indian fish supply chains are decentralized, so you'd have to probably have a stunner at each farm of just 50K fishes, and b) electrical stunners aren't yet validated for Indian major carps.



	• Online dip-survey of 60 Indian fish consumers	• Long timelines: They think it will be a 15-25 year journey, and we might as well get started now as the market is unlikely to change anytime soon.
FWI Internal Team	• 35-paper literature review • 24 key-informant interviews • 70 farmer surveys • Multi-state field visits (Andhra Pradesh, J&K, Maharashtra)	• Recommendations: ○ Prioritize exporters, as they may have some interest in more humane practice. ■ Note from HK: I've had our team look into exporters since this report, and they've yet to find many (which is consistent with the data suggesting there are very few for fishes in India). ○ Chemical stunning could also be promising, though it faces hurdles on the consumer and regulatory end.
Murthy & Bardhan Note: This is an academic who did a more local project in his home state of West Bengal.	• 40-paper review on chemical anaesthetics and PK/PD • 4 farmer focus groups (47 total participants) in West Bengal • 9 expert interviews (academics, veterinarians, regulators) • Stakeholder landscape mapping and preliminary regulatory analysis	• Focus on chemical stunning: This report was generally limited in scope to chemical stunning. • Regional focus: It was also limited in scope to just one state, West Bengal, which is one of the largest fish farming states in India. • Importance of freshness: Consumers in India, and particularly in West Bengal, really value freshness, and want to see the fishes alive before they buy them. • Local hesitations with chemical use: Locals are very hesitant about anything involving "chemicals", as it seems like they've been burnt here before. Significant regulatory partnerships and approvals would likely be needed before proceeding here. • Recommendations: They're proposing FWI fund a trial study they would do of stunning tilapia with clove oil. Note: ○ As this study would involve killing fishes, including via asphyxiation for a control group, there are ethical implications of funding this study. ○ It is currently unclear to me what regulatory approval would be required for the use of clove oil, or how this fits in with the concerns about "chemicals" and regulation.



What We're Asking of You

1. Review the reports. Ideally read one or all of them, though even just reviewing the summaries above would be helpful.
2. Send Haven feedback on whether, and if so how, we ought to proceed. Feedback can be shared via comments on this doc, written feedback in the [Feedback Section](#) below, direct messages, whatsapp voice memos, etc.
 - a. Feedback would be most helpful by **Wednesday, June 25**.

Strategic Considerations on FWI's end

Counterfactuals

Note that if we *did* choose to proceed with this project, per our strategy of it being a multi-phase project, we'd only commit to the next phase (as listed [here](#), this would just be Phase 2: the development of a TOC and possible target product profile). After this phase, we would have another re-evaluation point, at which point we would have the option of amending or shelving the project.

If we choose to **not** proceed, this would mean:

- We would devote 1-2 FTE more staff time to our other R&D projects, particularly [satellites](#) and [feed fortification](#).
 - In Haven's opinion, as things currently stand both of these projects are more likely to succeed than our stunning project right now.
- We would be in a better position to explore other new R&D ideas, as we had them.

Aside from staff costs, provided that Phase 2 would largely be TOC development before the next reval, there would likely not be significant financial costs here. However, it would be putting us down a road with future potentially very significant financial costs (e.g. tech development).

Short- and Long-Term Strategy

A few considerations:

- **Our 2026 Goal:** As an org, we are really pushing to hit our [2026 goal](#), which means having an intervention that is better than our current best bet (our farm program).



- **Now or later:** As a movement, we believe we will have to develop pre-slaughter stunning for all animals at some point. But is now, in India, that point? Could an increasingly affluent consumer base, and a possible AI revolution, mean that this market is fundamentally better suited to adopt stunning in the next 5 or 10 years? Or is this the sort of problem that will always be extremely difficult, and simply requires committed advocates to spend years working on it in order to make it possible?

Some Options for Proceeding

Just off the top of my (Haven's) head, if we are to proceed, here's a few options I'd be inclined to proceed with:

- Trialing chill kill (probably with ARA farmers). This seems relatively cheap and tractable.
- Funding Dr. Murthy's chemical stunning study.
- New corporate responsibility award: Put out some financial reward for the first Indian company that demonstrates effective stunning of X number of fishes per year, and then just leave it at that.
- Look into the development of mobile electric stunners
- Seek to develop SOPs for manual percussive stunning on farm
- Etc.

Feedback Section

Feel free to add your feedback here! To do so, just create a subheading with your name and feedback.

Reviewer #1

> is this the sort of problem that will always be extremely difficult, and simply requires committed advocates to spend years working on it in order to make it possible?

What was the average GDP per capita in western Europe etc when those countries began implementing stunning before slaughter in industrial production for the first time? How does that GDP per capita compare to India's current GDP per capita?



Reviewer #2

Hi Haven! I hope you're good 😊 ! I saw your post on pre-slaughter stunning. I am NOT AT ALL qualified (no expertise in this domain, etc.), but I worked on a project for the Gates Foundation some years ago and it may be give some food for thoughts. They wanted to do toilets that completely reuse water (to make it decentralized, etc.), [maybe you've heard of it](#). Their approach was (i) a challenge with universities to develop technology (ii) finding a company that would be interested in working on this. Basically my idea would we try to convince a company to do innovation in that space, with the gain for them to get a competitive advantage when this becomes the new standard. (in my case, we reached out to innovation directors of large sanitation companies in Europe, and some were interested). See you!

Reviewer #3

- how difficult/costly is it to get the electric stunners validated for the Indian carp species? without this validation it would be tough to proceed with this as you won't get much support even from within EA
- starting with focusing on exporters intuitively makes sense if their price elasticity isn't as large, i.e. they can spend a few more rupees on humane slaughtering. Especially if locals want to see fishes alive before buying.
- will satellites and feed fortification likely work without additional FTEs? if so, proceed with stunning
- Chill kill seems by far most promising: easy enough, cheap, no concerns about 'chemicals'. Depending on how much this reduces fishes' suffering this seems great
- do you have experiences with awards? before proceeding with this, maybe research into how much customers (local and foreign) would actually care

Reviewer #4

- One option to consider might be this: Focusing on markets where the selling method allows for it. If a percentage of fish is not sold whole you could see if decapitation works, to immobilize them you could consider chemicals or something like [this](#). This might be very messy though. Also I have concerns about the decapitated heads still experiencing pain so I would suggest checking this first.



- I was quite optimistic myself about the use of chemical stunning using isoeugenol or [aqui-s](#). The remarks in Murthy & Bardhan re concerns with stunning also make me less optimistic about this.
- If you do decide to try electrical stunning I would suggest getting the transport companies to buy/operate them. This would drastically reduce costs due to the machines being operated multiple times a day.

Tom's Feedback

- I agree that it does not seem we have found a viable channel for electric stunners. We are used to question marks around efficacy, but if people are researching this anyway, I think it is worth waiting it out for that
- I would, before trying ice slurry or chemical stunning, clearly document them out with a ToC and a list of key assumptions and uncertainties.
 - My main concern with ice slurry is whether it will be too hard to get farmers to do it well enough (although they already do it badly now, so maybe we just have to get them to do it better)
 - My main concern with chemical is the ability to do it en-masse (but this sounds like it could be solvable)
- So I think more research is needed, and specifically a proper digging down into the key uncertainties and what would help alleviate them. Not time to close the project yet.

Annika - FWI Intern

How to Proceed

I recommend FWI moves forward with one or both of the following next steps:

1. a chill kill trial in Andhra Pradesh,
2. a scoping/information-gathering project on manual percussive stunning at trout farms in Himachal Pradesh.

I chose these programs because they're well-suited to the Indian context, and they play to the existing strengths of FWI. They are low cost, low tech, and expansions of existing practices, making them familiar and culturally accepted.

Chill Kill Trial in Andhra Pradesh*

**Before running this trial, I recommend reading more into whether chill kill actually reduces suffering.*

Rationale



- Compared to other stunning methods that only render the fishes unconscious temporarily, chill kill theoretically renders them unconscious and kills them, simplifying the process.
- Chill kill would likely work faster on warm-water fishes like IMC than fishes used to cold temperatures.
- Chill kill could plausibly be implemented before the weighing stage — and potentially right when the fishes are taken out of the water if the boats are filled with ice — to reduce the time the fishes spend suffocating.
- Ice is already used to transport the fishes oftentimes, so chill kill would be an expansion of an existing practice.
- Does not require major investments in stunning technologies, making it much cheaper than other methods.
- Easy to run a cheap trial over a relatively short period of time because it does not require a large initial investment.

Questions to Answer Through Trial

- How quickly does this method kill IMC?
- How quickly does this method render IMC unconscious based on biological indicators?
- How easy is it to consistently source large amounts of ice?
- Do ice cubes or flakes work well, or is ice slurry necessary?
- What unexpected barriers to implementation are there out in the field?
- At what stages of the harvesting process would it be possible to implement chill kill?
- Are ARA farmers open to implementing chill kill for most of their fish (even if they continue to take some to wet markets)?

Team

- The R&D team would be responsible for creating a procedure to determine when the fish are dead/unconscious. This procedure could apply in both projects.
- The programs team would be responsible for running this trial.
 - With the 2026 goal being to develop a scalable intervention, we should avoid diverting too many resources from the R&D team. The ARA's work is less important to achieving this goal, and with their existing experience running field programs, they may be able to notice and anticipate problems out in the field.

Barriers & Concerns

- The cultural belief in AP and West Bengal that moving, live fish are more fresh is a major obstacle to implementing stunning or chill kill in these regions.
- A key ethical risk is that it might unintentionally worsen welfare, unless validated in warm-water species like IMC.
- Could lead to blowback from other animal welfare organizations for trying to spread a program that is widely considered unethical.



Marco's Feedback

Currently, in my opinion **electrical stunning** is not viable for many reasons, but the most important to me... it is still lacking the foundations regarding fish welfare in India. I believe we are far from this, so understanding why to use electrical stunning in species that are commercialised only in India... will be the biggest barrier. But point by point:

- IMC are tagged as low conductivity and robust physiology, meaning that effective stunning can be tricky. To my knowledge, stunning parameters (voltage, frequency, duration) for these species are not known, and European species benchmarks are not translatable to IMC.
 - Electrical stunning depends on efficient current through the fish body and these have a thick epidermal mucus layers, which act as electrical insulators and reduce current penetration decreasing the effectiveness of the electrical shock².
 - Indian major carps have high ischemic tolerance (lack of oxygen) meaning are more resistant to hypoxia and physical stress which might delay loss of consciousness, even when subjected to high voltages (which we even do not know what is high). Jeff Lines³ also say that slower metabolic rates compared to high-performance pelagic fish reduce the efficacy of short-duration electrical stunning. Basically, we do not know nothing to advocate for this method.
 - Body morphology plays a major role in stunning success and IMC are deep-bodied, laterally compressed fish. This anatomy and body composition is not optimal for electric shocks standardization as referred elsewhere⁴.
- I understand that stable electricity is also a problem in several regions, which can both damage fish, and the equipment that is quite expensive.
- I do not believe this to be scalable given the heavy capital requirement.
- European suppliers (e.g., Ace Aquatec, Baader-Linco) have not validated their stunners for Indian carp species or even for most of the warm water species, meaning that it remains a barrier to introduce this in India now.

Regarding **chemical stunning**, I do not trust on it because

- I worked with clove oil in the past, and its effectiveness is highly variable with water temperature, salinity, pH, number of fish, size of fish, etc....

² Robb, D. H. F. & Kestin, S. C. (2002). *Methods used to kill fish: field observations and literature reviewed*. Animal Welfare, 11(3), 269–282.

³ Lines, J. A. & Spence, J. (2012). *Humane harvesting and slaughter of farmed fish*. Reviews in Aquaculture, 4(1), 1–19.

⁴ Kestin, S. C., et al. (1991). The effects of slaughter by removal from water on visual evoked activity in the brain and reflex movement of rainbow trout (*Oncorhynchus mykiss*). Veterinary Record, 137(11), 274–276.



- And even like Murthy said, it is likely that consumers do not trust that in food as well.
- Also, consumers want freshness and clove oil is an additive, that gives a kind of taste and smell to the fish (I know by experience from the time I worked in a fish farm).
- Also, might have health implications for farmers or any worker because it is very smelly that made me almost throw up several times and gives headaches like if you are drugged.
- In the same way as electrical stunning parameters are not known, also the quantity of chemical needed for commercial fish is not known. And commercial fish size changes, so research will need to uncover that for different fish sizes. The thing is, the research will need to compare such method with a control negative, asphyxiation, that might bring issues to FWI if we support such research (just like you said to me for the Turbot).
- Overall, from a welfare standpoint, unknown and uncontrollable water quality parameters, regulatory and ethics, complexity too high and likely practical payoff... due to fish size difference, harvesting procedures, infrastructures, etc make me saying that I do not agree pursuing this method.

About **Ice slurry**, since you have asked me that that my answer is the same. For me, this should be the method to pursue, to improve and to advocate. Why?

- It is the most viable method for the Indian context.
- It is known to reduce suffering as compared with current practices, if done well (good ratio Water/ice, pre-chilling of the stunning water and avoid smash fish in the ice reducing SD).
- It is somehow scalable (more than the other methods), less expensive, it is natural and proven to keep fish quality.
- It will require proper training, SOPs, good ice slurry (and not ice stones).
- Much easier to create or establish farmer cooperatives and retailers partnerships for ice slurry trials.
- Even with this low-tech method the market could start using something like "harvested under improved welfare", likely influencing the consumers to only buy these fish.

So my final opinion is that we should stop pursuing high-tech solutions and focus on groundwork in ice slurry killing. Even if seen as near-term welfare method, it is in my opinion the most close to welfare fish will get at the time of killing.

Reviewer #5



The most important next step is to conduct a detailed evaluation of the chill kill method and test its efficacy as a reasonably humane method of slaughter (it is not perfect, but better than the current alternative of asphyxiation). It is important to test this at various concentrations of ice slurry (we recommended atleast 3x of the current volume that is already used) i.e. 1x of current ice quantity, 2x 3x, 4x, 5x, 6x etc and observe the impact and quantify the cost (and supply chain complexity) of doing this. At >3x ice concentration (vs current concentration) this becomes more complicated to execute from an operations point of view (i.e. that is the amount of slack space available in the incoming truck). Technologically this is the method that offers the best mix of scale vs feasibility. However, a decision on this should be made quickly- preferably within 3-6 months- and come to a consensus quickly if this indeed works as expected or not.

In parallel (or after 3-6 months if we discover that ice slurry chill kill is not that promising), the key question is which is the second best tech path to pursue- chemical or electrical? I would think electrical stunning is more promising among the two as a long-term scalable option. Importing 1 stunner as is and tuning and testing it for IMC in 1 location would provide the foundation for future work. This in itself can take 18-24 months given the complexity involved in importing, testing, tuning, and proving results.

Reviewer #6

- I think creating using all the feedback above to generate a list of your key Cruxes, and any evidence for/against them (maybe with a sense of your Credence in the evidence) could be really helpful. So really teasing apart the decision relevant nuances, such as:
 - Electrical Stunning is not validated for Indian Major Carp
 - We have ~X% confidence that with sufficient research electrical stunning could be effective for IMC (rendering unconscious within 1s)
 - Properly implemented ice slurry would reduce suffering (compared to asphyxiation) by ~Xminutes at Ysuffering
 - Even if consumers are relatively unmotivated by animal welfare reasoning, we believe they could pay a price premium of X if properly implemented ice slurry was marketed as improved freshness
 - Even if Ice Slurry is effective in lab-based settings, it's real-world implementation can be very difficult to ensure
 - Incorrectly implemented ice slurry can be worse than asphyxiation?
 - Chemical Stunning...
 - Percussive Stunning...
- (I think Marco's feedback above is actually kinda along the lines of what I'm thinking about with this - but maybe just adding some numbers/colours/a weighted factor model could help to really elucidate the key uncertainties).



- Though agree that even without doing the Cruxes exercise above, that Chill Killing seems the most promising to explore (especially exploring options like [DeepChill](#), which I'm hopeful could get around the issue of ice slurry being implemented unreliably/incorrectly)
- It's a shame that you wouldn't be involved in the development of a new stunner - as I think the animal movement should more involved in the development of the tech innovation's we want to see on farms (rather than industry), but agree that maybe FWI isn't best place for this and maybe this advice is more aimed at orgs working in the European context

Reviewer #7

- I agree with Haven's points on what comes next and think it makes sense to move into a second, more exploratory phase.
- I do think ice slurry sounds like a good next step. My only hesitation is that the fish are still dying from asphyxiation; it's just happening faster. That's still far from ideal, and in other parts of the world (like Europe and North America), this method is really discouraged due to welfare concerns. But, compared to what's happening now (prolonged death in air), I think it's an improvement, and worth exploring further. My biggest concern would be whether it's actually feasible to do this properly: where would all that ice come from? Would it be possible to get the correct amount, keep it cold, and maintain it across the supply chain? Those are the kinds of logistical questions that need to be figured out before going too far with this.
- Like others, I think electrical stunning is too far off at the moment. I've seen it go really badly in practice, and when it doesn't work properly, I'd honestly consider it worse than asphyxiation. I think it makes sense to wait and see how ongoing research plays out, especially in Europe. Once the methods are better validated, and ideally cheaper, it could be worth revisiting. But I wouldn't prioritize it right now.
- I really think AQUI-S is worth looking into. It's easy to use, inexpensive, doesn't irritate handlers, has no smell, and doesn't leave a taste in the meat. Compared to clove oil, which smells awful, causes headaches, and makes the meat taste bad, AQUI-S is way better. I know it's not currently approved in India, but I think there's a real opportunity here. It just got approved in Canada, even though people were using it unofficially for years. That approval was driven by enough studies showing it was safe and effective. Maybe a similar process could happen in India. I don't have experience with Indian regulatory bodies, so I can't speak to how hard that would be, but I definitely think it's worth investigating.
- I also see real value in exploring percussive stunning. It's obviously not going to work at scale, but for small farms or live wet markets, it could be a great option. I was really interested to learn that a lot of people are buying live fish from wet markets



and want to see them alive before buying. That actually opens up a cool opportunity, maybe sellers could be trained to use a captive bolt or compressed air gun stunning at the point of sale. It's simple, humane, and could even be marketed as better for meat quality because the fish would be less stressed. I'd love to see this idea developed more; it feels like there's real potential there.

Reviewer #8

- Based on what I have seen in the reports, I just feel that (i) we haven't identified an appropriate sector which is likely to take on stunning; and (ii) we haven't identified a method of stunning that is considered suitable for the India context.
- Perhaps it's a pessimistic viewpoint, but I believe the various things that need to come together for stunning to be considered feasible are a massive challenge:
 - **Product development:** develop an actual instrument (relevant only for electrical and percussive stunning).
 - **Methodology development:** develop an appropriate methodology that effectively stuns the fish, while—importantly—not harming them (relevant for any form of stunning we take forward).
 - **Stakeholder advocacy:** Considerable advocacy is needed with the relevant players in the field, most specifically, the actors that would actually conduct stunning.
 - **Consumer outreach:** I believe there's a need to change consumers' perceptions so that consumer demand is a driver to change. This, in my mind, directly drives the economics, and that in turn is key to stakeholders being willing to incorporate stunning.
 - I'll ignore policy advocacy, as I don't think we're positioned for that, and it will likely fail given the complexities of India bureaucracy!

Recommendations

- Before moving forward with any form of testing/piloting, I strongly believe that we need to hone in on a specific fish species for which we believe stunning has potential to be incorporated into the value chain. **If we can't identify a specific fish species for which we're confident stunning stands a feasible chance of being taken on by stakeholders, then I recommend pulling the plug on this project (for the time being, at least).**
- For fish sold live, percussive stunning conducted by the seller at the point of sale could be considered, with the following proviso: Would this be considered sufficiently impactful and "transformative" (if sellers already kill the fish quickly once they are sold, this approach may not actually change much)? To answer this, we'd



need to **conduct comprehensive surveys to understand how fish are sold/treated at wet markets.**

- Specific for IMC, chill kill seems to be the only realistic approach to consider. If this is considered to take forward (not my recommendation), there needs to be a **period of engaging the traders—more specifically, the actual stakeholder(s) that would actually implement this at the side of ponds—to understand what is feasible/not feasible from an operations perspective.** The results of those engagements (specifically, is chill kill considered operationally feasible?) should inform a go/no-go to an actual testing phase.

Reviewer #9

I recommend FWI explore stunning through a **proof-of-concept approach in controlled aquaculture systems**, specifically **Recirculating Aquaculture Systems (RAS)** and **Biofloc units**. These setups allow for easier experimentation, lower risk, and higher quality data before attempting broader application in traditional pond systems.

Rather than immediately attempting national implementations or technology-intensive rollouts, I believe that a step-by-step, evidence-first strategy is best aligned with both the realities of the Indian aquaculture landscape and FWI's long-term welfare objectives.

Jennifer's Feedback

Considering that Europe focuses largely on electrical stunning for different species, I don't think there is a strong argument to wait a few more years before FWI or another org starts to work on this in Asia. I am unsure whether FWI is best positioned to do this work but I think the work should start now because I don't think there'll be any breakthrough for the species over here coming from Europe or elsewhere in the West.

Another point in favor of working on this now could be that IMO, having another FTE on the satellite project does not make it more likely to succeed. This extra time may be better spent on another project that could be more promising than stunning but it seems to me that we currently don't have any idea what this "other project" would be.

As such, I would propose to continue with Phase 2 of the project with some slight adaptations from what we laid out in the [blog post](#).

I would get ½ or 1 FTE to do the following tasks with #1 and #2 being done simultaneously and #3 needing #2 to be positive before initiating it.

1. Research the legal compliance and customer perception of clove oil/AQUI-S.



- a. If the above comes back positive, ask Dr. Murthy to develop a protocol to test the effectiveness of clove oil.
 - b. If the protocol looks promising and we'd expect it to yield useful results, commission the study.
2. Define the requirements for effective ice slurry stunning (in theory without an extensive experiment or similar) and, based on these, explore the feasibility of implementing ice slurry stunning in the Indian context.
 - a. This research could include conversations with the team, farmers, and just general logical thinking. The output could be a short document describing how this would need to be implemented and what the main obstacles in the field are. Having this report will be useful in deciding whether it's even worth commissioning the study below.
3. Develop (or have someone knowledgeable develop) a protocol to test the effectiveness of ice slurry stunning for IMC.
 - a. If the protocol looks promising and we'd expect it to yield useful results, commission the study.

Reviewer #10

In light of the above feedback, I strongly support the exploration of percussive stunning machines, as several experts have expressed positive opinions about their potential in the feedback section. However, I would like to highlight specific barriers we must address before percussive stunning can be widely implemented:

1. **Equipment Development:** Developing the appropriate percussive stunning equipment is a significant challenge. Collaboration with research institutes like CIFE (Central Institute of Fisheries Education) or CIFT (Central Institute of Fisheries Technology) could be key to co-developing adaptable equipment that can be used effectively in various market conditions.
2. **Time Management for Traders:** The introduction of percussive stunning equipment will require training and possibly hiring additional staff. I recommend equipping multiple workers with the tools necessary to increase efficiency and reduce time spent on each fish. To ensure compliance, traders could be incentivized, with an incentive of around INR ~500 per person.
3. **Market Compliance:** We need to address potential consumer concerns regarding the visual impacts on fish when using percussive stunning. Increasing market awareness and educating consumers will be crucial in managing perceptions.



Proposed Steps for Percussive Stunning

1. **Equipment Development:** I recommend collaborating with institutions such as CIFE or CIFT to co-develop percussive stunning equipment. Initial testing should involve simulations and on dead fish to validate the effectiveness of the equipment before full-scale implementation.
2. **Time Management for Traders:** Given the potential time constraints faced by traders, I propose providing training to multiple workers per facility to ensure efficient use of the equipment. Additionally, a financial incentive of INR 500 per person could be offered to improve compliance and performance.
3. **Market Compliance:** To address consumer concerns, we will need a comprehensive strategy to inform the market about the benefits and humane nature of percussive stunning. This could involve educational campaigns and demonstrations to counteract any negative perceptions about the visual impact on fish.

Reviewer #11

As a next step, I believe we should continue working on stunning project. My rationale comes from the fact that we're already aware of how fishes are harvested, left to asphyxiate for hours and any kind of intervention here could help a large number of fishes from that intense suffering. Harvest practices are visible and a small intervention here would have a bigger and immediate impact in comparison to other projects/programs. However, if we keep circling around questions like "who should pay for it" and "how it will be implemented," we will just end up stuck in uncertainty.

Methodology-wise:

Electrical Stunning (Rank 4)

High cost, the need for trained personnel, constant monitoring, backup plans if equipment fails during the harvest process, safety issues, and doubts around its effectiveness (even in European contexts) making it difficult to think it's a viable path. But *if* we still want to pursue this:

1. Let companies like Optimar and Ace refine their current devices, addressing more animal welfare concerns. A lower-cost version could come later. Also, this would only make sense if another org was taking the lead on implementing.



2. Explore working with certification agencies like ASC to understand how their stunning requirements apply to the Asian market. Based on that, maybe a new fish-focused certification body could emerge that is more regionally relevant.

Percussive Stunning (Rank 3)

Scaling this methodology is definitely going to be a challenge- precise hits to the fish head are hard to achieve consistently, and consumers may reject fish with visible head damage. Even automated setups would likely cost more than electric stunners. Still, if there's something to work on here, the path could be:

1. Identify states/districts with high reliance on live fish markets. Need to address transport issues first (since they make the fishes survive in low-water conditions and that is already concerning) and then look into manual percussive stunning as a next step for those wet markets.

Chemical Stunning (Rank 2)

Chemical method looks more feasible on paper. Low cost and chemicals like AQUI-S are accepted in some high-income countries. The local rejection mentioned in Dr. Murthy's report could be market-specific (West Bengal's one small part), not Indian context. For example, despite wide awareness that Andhra fish are dipped in [formalin](#), imports into Bengal haven't dropped. The real issue is government regulation. Promotion and framing matter.

Chill Killing (Rank 1)

Not the perfect one, but clearly better than the current asphyxiation method. The concept is already somewhat known in India. Stakeholders understand it helps with shelf life and can fetch better prices. The challenge is that it needs more time, extra staff effort (which often needs to be incentivized), and more resources (ice, larger vehicles, tumblers, etc.). Before scaling this, a clear SOP should be developed, followed by a trial run and connecting it to a buyer/trader.

Final Conclusion:

Test both low-hanging methods: **Chill killing and Chemical stunning** in parallel. FWI's internal team should run the chill killing trials, while Dr. Murthy's university team can handle the chemical side, with FWI checking in regularly.

Rationale: Either both trials fail (in which case we wrap it up with documented reports and let others build/work on this in future), or one or both succeed- which would be a significant step forward for the animal welfare.