Opportunities and Challenges for Solar Aerators in Cambodia

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In recent years, Cambodia's electricity sector has been through outstanding improvements fuelled by the government's success in rapidly expanding access to grid electricity up to 81% of households at the end of 2020. Nonetheless, in light of the relatively high electricity costs, remoteness of farmers and overall low mechanisation of the agriculture sector, solar technologies for productive use have the potential to improve agri-fishery MSMEs competitiveness on the market while reducing their operational costs. This summary provides a short overview of the opportunities and challenges for the adoption of solar aerators in Cambodia.

Starting by looking at the need for aeration…

Aerators are devices used in pond aquaculture to increase oxygen levels in the water. Controlling and improving the oxygenation of the water fosters a healthier environment that will lead to increased fish size and survival rates, thus generating more profits to the fishpond farmer. Aerators are mainly used in intensive cultures as they are mandatory for fish survival beyond a certain fish concentration.

If the technology is still at an early stage of development in Cambodia, the significant growth of the aquaculture sector represents an opportunity for the technology as it holds many benefits that can positively influence its uptake:

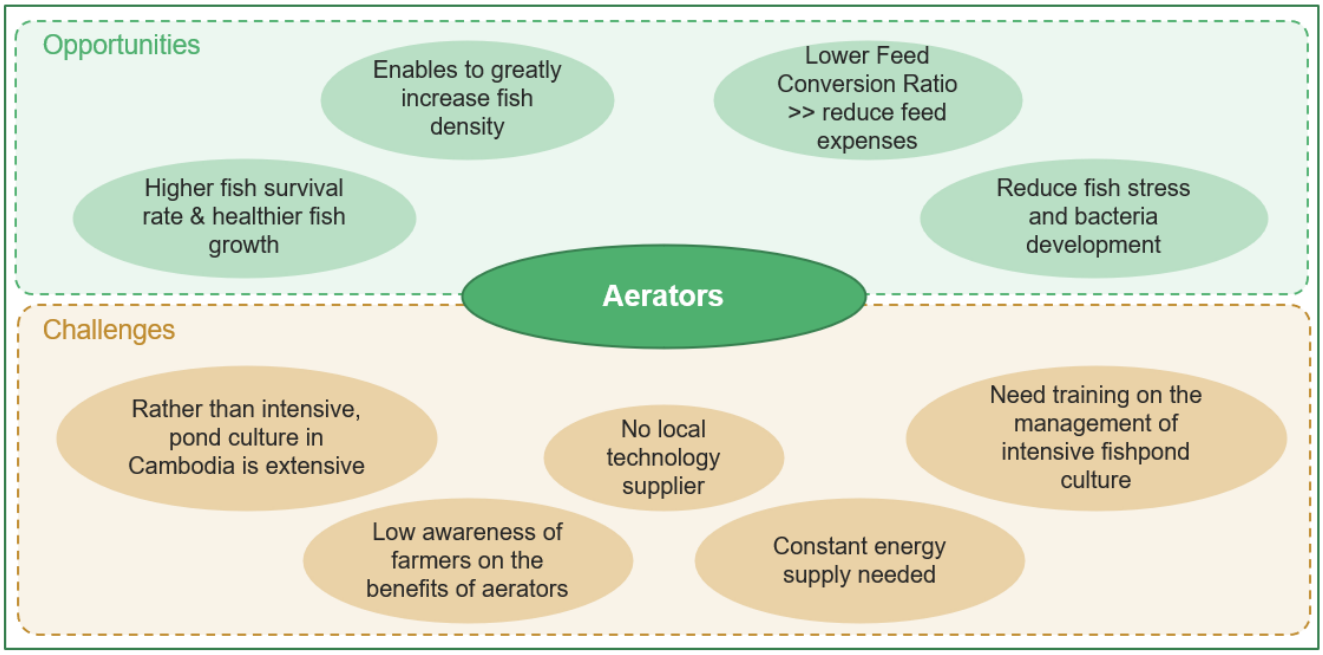
- **Higher fish survival rate and healthier fish growth:** Oxygen depletion is one of the main limiting factors of pond culture as it leads to fish hypoxia, higher stress levels, bacteria and algae development and higher risks of infection. Aerators, as they help increase the dissolved oxygen content of the water, contribute to improved weight gain, reduced stress levels and higher survival rate of the fishes, thus contributing to increase the productivity of fishpond farmers.
- **Lower Feed Conversion Ratio:** Hypoxia has been shown to limit feed consumption due to higher stress and reduced appetite. Low dissolved oxygen concentration can thus limit feed intake to near-maintenance levels (reducing the feed intake used for growth). As such, aeration helps improve feed intake and lower feed conversion ratio (meaning fish convert feed to growth more efficiently). Since feed expenses are the first cost of aquaculture farmers, improving the FCR can have a very positive impact on production.
- **Enables to increase pond density:** introducing aeration enables to increase the intensity of the pond without affecting productivity (which wouldn't be possible without aeration).

Yet, as this technology is relatively new, there are challenges that need to be considered as they might constrain its adoption:

- **Low awareness**. The majority of pond producers in Cambodia operate at sub-optimal levels as their production practices stay very basic. Knowledge is very limited and only 13% of producers have received aquaculture training. As such, even simple practices, such as using lime and fertilizer and controlling predators stay rare. Similarly, most producers don't monitor the quality of their water (only 10% do (CAST, 2019)) and most producers are not aware of the importance of ensuring the oxygenation of the pond water with only 4% using aerators (CAST, 2019). This means that the uptake of aerators will require the training of end-users, especially to ensure that producers don't increase their pond density without having proper farming practices.
- **No local technology supplier.** There are no local suppliers of aerators in Cambodia. Those wanting to purchase aerators have to order from China through Alibaba, or from suppliers in Vietnam/Thailand. However, this results in an accordingly low level of after-sale services and the inability of suppliers to provide capacity building regarding the usage or installation of aerators

- **Pond culture in Cambodia is extensive rather than intensive**. Currently, in Cambodia, the cost of land is lower than that of energy, resulting in a higher prevalence of extensive pond culture rather than intensive pond culture which represents higher risks. Correspondingly, most pond farmers can still operate without aeration.

As such, the market for aerators in Cambodia is still at a very early stage currently. Recommended targets for aeration are **semi-commercial to commercial intensive pond farmers**, especially the beneficiaries of other aquaculture donor programmes such as CAST or CapFish, as well as **hatcheries and nurseries** which have a much higher need for aeration.



Technical considerations

There is a large variety of aeration systems existing. Still, paddlewheel aerators are the most common types of aerators used in pond aquaculture in Southeast Asia. It consists in a waterwheel with paddles, powered by a diesel or electric motor anchored to the pond edge. They are one of the most efficient aerators in terms of efficiency and circulation. Paddlewheel aerators are particularly well suited for larger ponds because they create strong water currents, but smaller paddlewheel aerators can be used effectively in ponds as small as 0.1 ha.



Benefits

- High efficiency in large pond.
- Small investment cost.
- Easy to assemble and to install.
- No significant maintenance.

Constraints

- High power consumption.
- Low efficiency.
- Potential bank erosion.
- Concern of oil contamination

There are noteworthy opportunities to power aerators by making use of solar energy:

i. Aerators require a stable energy supply. Making use of a solar energy allows installing the technology in non-connected areas or in areas where the network is unstable.
ii. It makes use of a cheap, silent and clean energy. It can help save on operating costs especially for those currenly powering their aerators with diesel motors.

Still, using a solar solution comes with several constraints:

i. Solar solutions are less flexible in terms of mobility to access to extended ponds.
ii. Aerators are mostly used at nights, making the energy requirements of the technology ill-fitted with solar. The system architecture would thus have to include batteries

Recommendations – How to increase the adoption of Solar Aerators?

Aerators hold great potential in improving the productivity and income of pond farmers in Cambodia. Yet, there are challenges to overcome to be able to develop such a solar powered solution at scale. Here are a few recommendations to increase the adoption of solar aerators in Cambodia:

- The first step to increase the adoption of the technology will be to improve the local supply, by developing solutions that are be better suited to the needs of farmers in Cambodia.

- Solar aerators can easily be **sold in package** with other solutions, such as solar water pumps, allowing to make the best use of the solar system, especially during the day.

- To facilitate the adoption of solar aerators, innovative models will be needed to increase the visibility of the technologies and decrease barriers to their uptake. First, it is recommended for technology providers to work with intermediaries to **help reach end-users and facilitate the acceptance of the technology** by acting as models, supporting the capacity building of end-users, and advertising, not only the economic aspects of solar aerators, but also other benefits. Such intermediaries can include NGOs, cooperatives, associations, agri-businesses, aggregators or development programs currently working in the aquaculture sector.

- It is important for end-users to optimise the use of the technology. The **provision of trainings** on the use of the technology will be key to ensure that end-users know how to use aerators, but also more generally how to improve their farming practices.

- Finally, it will be important **to introduce end-user financing mechanisms** to mitigate the upfront costs of the solutions. It can be done through partnerships with MFIs, simple financing mechanisms by technology providers themselves (payment terms), or more innovative models such as leasing or contract farming.

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