



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The evolution and wide adoption of mechanization in traditional land-based (terrestrial) agriculture is common all over the globe, but aquatic agriculture has not received due attention in terms of mechanization or in the design/development of tools/ devices for facilitating aquatic agricultural practices. Following the literature review, it has been found that there is a lack of research in the domain of design intervention for aquatic food-crop cultivation, specifically for harvesting. Hence, the current research is aimed at identifying challenges faced by aquatic farmers in harvesting aquatic food crops (water-chestnut) and providing appropriate/feasible solutions that can enhance productivity and reduce drudgery.

Throughout the harvesting process, farmers remain immersed (up to waist or chest) for 5-6 hours/ day inside stagnant unhygienic water resulting in various health hazards. Farmers encounter major challenges when carrying out agricultural tasks (harvesting) in the waterbody:

- (a) Small boats don't fulfil their purpose in many instances as they hinder task requirements and lead to awkward postures. They preferably make their arrangement of floating structure which always suffers from maintenance and safety issues. As the frugal design adopted by them is not robust and long-lasting, they need to prepare a new one every season.
- (b) Farmers pluck the fruit with bare hands without any plucking aid leading to pain and discomfort in fingers and wrist due to repeated twists and turns of hands during plucking activities. Hand muscles become fatigue and feeling of numbness occurs. Along with it, most of the farmer complained about the sticking of dirt (algae) on the thumb nails.

- (c) Further, prolonged exposure to stagnant and unsanitary water bodies without adequate protective measures. This can lead to various health issues including swelling in limbs, skin infections, bodily discomfort, and injuries.

To address the major challenges faced by the farmers in the harvesting process, three innovative products were developed: a durable floating device made of FRP material, a plucking aid with a reduced thumb bending angle, and a low-cost wader for protection against water insects and unhygienic water contact. These products aimed to facilitate aquatic farmers in the cultivation process and overcome the limitations of traditional practices. User-centred design with the feasibility of local manufacturability/ maintenance was given due importance along with human factors. The developed prototypes were evaluated in terms of usability, user compatibility, affordability, and productivity. All the prototypes were rated high by the targeted users indicating the acceptance of the innovative design.

The current thesis has contributed significantly to address the prevailing research gap concerning the need for design intervention and its implementation to display its effectiveness for aquatic agriculture. The researcher, through the design and development of 3 innovative products (floating device, plucking aid and wader), has demonstrated how the product design strategies differ considerably in view of the aquatic environment of stagnant water and various associated challenges. The novelties of the current research have been described in the discussion section, in bulleted points. Key contribution of the thesis has been described in terms of (a) contribution of knowledge base, (b) methodological perceptive, and (c) contribution to the society.

Product design strategy concerning aquatic agriculture is a prominent contribution in the knowledge domain. The product design strategies for water chestnut harvesting may easily be adopted for any other aquatic food-crops (lotus stem, foxnut, water mimosa, nori, gim, etc.) across different geographic locations. Innovativeness of the developed floating device, and plucking aid is evident from the corresponding patents and design registration. The current thesis has demonstrated that facilitating the harvesting process not only happens (or is possible) through product development directly associated with the harvesting process but it can also be facilitated by developing assistive products that are indirectly associated with the harvesting. This is a unique observation of the current thesis.

It is expected that the current research outcome will be immensely useful to the farmers involved in the cultivation of water-chestnut as well as to the new farmers who want to start cultivation of these crops by utilizing the unused water-bodies. The developed and field-tested assistive products for the farmers were found effective in the harvesting of water-chestnut crops. The current research is novel in the domain of aquatic agriculture as it addresses challenges faced by farmers from the perspective of productivity and OSH by developing context-specific design solutions through a user-centered design approach.