

Education and Training: Building Capacity in Aquaculture

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Abstract

Education is an ongoing process that is essential for both individual growth and societal progress. It provides people with the necessary skills and knowledge to effectively adapt to their surroundings, influencing their behaviours and personalities in alignment with social expectations. This educational journey is crucial for national advancement, as it strengthens individual capabilities, allowing them to reach specific goals. In the realm of aquaculture, the rapid pace of technological change has highlighted the urgent need for enhanced educational standards among extension workers. As a result, universities, colleges and training institutions play a key role in developing a proficient workforce that can support a sustainable aquaculture and fisheries industry. Various training programs, such as exposure visits, orientation courses and refresher sessions, are being implemented to improve skills across different states in India, where numerous fisheries and polytechnic colleges have been established to aid this mission. This overview emphasizes the importance of education in fostering the skills necessary for sustainable development in aquaculture.

Keywords Aquaculture, Capacity building, Education, Training

1. Introduction

Education is a lifelong journey characterized by the ongoing development and transformation of experiences. It encompasses the skills and abilities that empower individuals to navigate their environment, adapt to it and meet their responsibilities and potential. The primary aim of education is to modify individual behaviour and cultivate their personality in a manner that is both desirable and socially acceptable. Education serves as a catalyst

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for national development by enhancing the capabilities of individuals. Capacity, in this context, refers to the essential skills and resources that individuals or organizations require to accomplish tasks and meets specific objectives. Capacity building involves a range of actions taken by individuals, communities and organizations to enhance their effectiveness in achieving their goals. Education is crucial in fostering, enhancing and reinforcing these capacities, thereby guiding the nation towards a prosperous future (Khan, 2014). The swift progress in aquaculture technologies has highlighted the inadequacy of educational and knowledge levels among many extension workers, necessitating an upgrade. Universities, colleges and training institutions are crucial in fostering a sustainable aquaculture and fisheries sector. Various training initiatives are conducted across all states to enhance skills and competencies essential for promoting sustainable aquaculture development. Existing programs include exposure visits, orientation courses, training sessions and refresher courses. In India, numerous fisheries and polytechnic colleges have been established to cultivate a skilled workforce in aquaculture (Giri, 2017).

2. What is Capacity?

Capacity refers to the ability of nations to address challenges through their human resources, assets, actions and structural frameworks. Capacity encompasses the total potential of individuals, communities, or organizations to fulfil their designated roles in the pursuit of established objectives (Hussein, 2006). Capacity represents the combined efforts and skills of organizations aimed at reaching their goals, whether these are focused internally or externally (Baser and Morgan, 2008). Capacity is characterized by two primary attributes: hard attributes, which consist of personal abilities, skills, resources and infrastructure and soft attributes, which involve beliefs, motivation and self-perception (Hunt, 2005). Capacity is intricately linked to the capabilities and competencies of individuals or organizations, encompassing leadership, conceptual understanding, as well as skills and technical know-how (Stevens, 2014). It involves the evolution of organizations to effectively realize their goals and maintain sustainability over time (Linnell, 2003). Additionally, it signifies the ability of individuals, groups, communities, or organizations to develop and execute sustainable developmental objectives in order to attain specific and chosen goals (Milen, 2001).

The various definitions highlight that capacity carries multiple meanings and interpretations. These differing views suggest that the understanding of capacity is shaped by the users, be they individuals, groups, communities, or organizations, along with the specific contexts in which it is applied, the purposes it serves and the outcomes sought.

3. Capacity Building

The notion of capacity is broad and complex, involving the growth and

improvement of skills and abilities. Capacity refers to the ability to effectively carry out tasks and meet goals (Hilderbrand, 2014). In general, capacity building focuses on enhancing, improving, or reinforcing the capabilities of individuals or organizations to achieve their objectives (Lusthaus *et al.*, 1999). It aims to bolster the skills of individuals within communities and the resources of organizations to effectively manage change in response to shifting demands (Coutts *et al.*, 2005). The primary goal of capacity building is to elevate the capabilities of various entities, including individuals, groups and organizations, enabling them to perform critical tasks, confront immediate challenges and fulfill both present and future requirements impartially (UNESCO, 2006). This process is characterized by collaborative learning, where individuals exchange experiences and insights, with guidance from experts in relevant fields (McKenzie, 2007).

Capacity building is characterized not by the specific tools or personnel utilized, but rather by its goals and objectives, which aim to enhance individual skills and ensure the long-term viability of institutions. This process focuses on improving competencies, problem-solving skills (Low and Davenport, 2002), self-confidence and decision-making abilities. It is an ongoing journey through which individuals, communities and organizations develop their capacity to recognize challenges, devise strategies and tackle developmental issues. The primary aim of capacity building is to cultivate and reinforce skills, foster positive relationships and instill empowering values that enable individuals, groups and organizations to enhance their performance and meet established goals over time. This enduring process allows individuals, as well as governmental and non-governmental organizations, to systematically inspire, motivate and advance their skills and capabilities.

4. Levels of Capacity Building: Research Shows that Capacity Building Functions on Three Distinct Levels

4.1. Individual Level

Individuals serve as the essential building blocks of organizations and societies, forming the initial layer of capacity. For these entities to progress and succeed, it is crucial to nurture skilled, knowledgeable and experienced individuals. At this foundational level, capacity building emphasizes the growth and improvement of individual competencies. The discussion highlights the significance of existing knowledge and skills, along with the necessary conditions for individuals to participate in learning and adaptation processes (Khan, 2014).

This foundational approach is characterized by a demand-driven learning model that encourages the exchange and acquisition of knowledge and experiences. It fosters active involvement in community initiatives, on-the-job training, mentoring and other effective educational strategies that empower individuals, positioning them in a central and proactive role (Khan, 2014).

Often referred to as human resources development, the individual level

primarily aims to develop competent managers and decision-makers. It seeks to motivate individuals to embrace positive and constructive attitudes, as well as innovative strategies to improve their organizations. Furthermore, it focuses on enhancing leadership abilities, refining training and facilitation skills and strengthening advocacy, technical and management competencies (Adhikari *et al.*, 2007).

At the individual level, capacity building encompasses all necessary measures to develop skilled, qualified and motivated personnel across organizations. These measures include training and education, effective organizational management, staffing and creating a supportive environment within the organizations.

4.2. Institutional/ Organizational Level

The institutional or organizational level serves as the intermediary stage in capacity building. It encompasses a range of elements including procedures, policies, regulations, systems and the prevailing organizational culture. The combined capabilities and efforts of individuals play a crucial role in enhancing the overall capacity of the organization or institution (Khan, 2014). This stage emphasizes the enhancement of existing institutions and the facilitation of support to develop effective policies, frameworks, management practices and revenue oversight mechanisms. The initiative entails modernizing current institutions and aiding in the formulation of robust policies, structures, efficient management practices and revenue control systems (Khan, 2014). At this point, capacity building can improve multiple facets, such as leadership, governance, the development of mission and strategy, advocacy, management and administration, program design and execution, income generation, fundraising, partnerships, evaluation, policymaking, marketing, as well as planning and positioning (Linnell, 2003).

4.3. Societal Level

The final tier of capacity building pertains to society itself, a level that has often been overlooked for many years. Traditionally, the focus has been on capacity building at the individual and institutional levels, with the prevailing belief that improvements at these levels would naturally lead to societal advancement. However, this perspective is misguided. Transformation and change at the societal level are complex processes influenced by various factors that impact individuals and organizations, which collectively shape society. Additionally, societal values, customs, traditions, laws, policies, governance systems and political frameworks directly affect the capacity of individuals and organizations to grow and thrive in the future. Effective capacity building within society requires the establishment of a public administration that is interactive, responsive and accountable, one that learns from its experiences and integrates community feedback (Khan, 2014).

All tiers of capacity building hold equal importance and are deeply interconnected. Any changes or disruptions at one level will inevitably affect the others. For example, a thriving educational system depends on qualified

and experienced teachers, principals and subject matter experts at the individual level. It also necessitates efficient processes, a comprehensive curriculum, effective teaching strategies and well-defined policies at the institutional level. Additionally, it must tackle critical societal challenges, including the promotion of a strong value system and civic responsibility, at the societal level. A system may have capable educators, but if it operates within a society that undervalues education, its effectiveness is compromised.

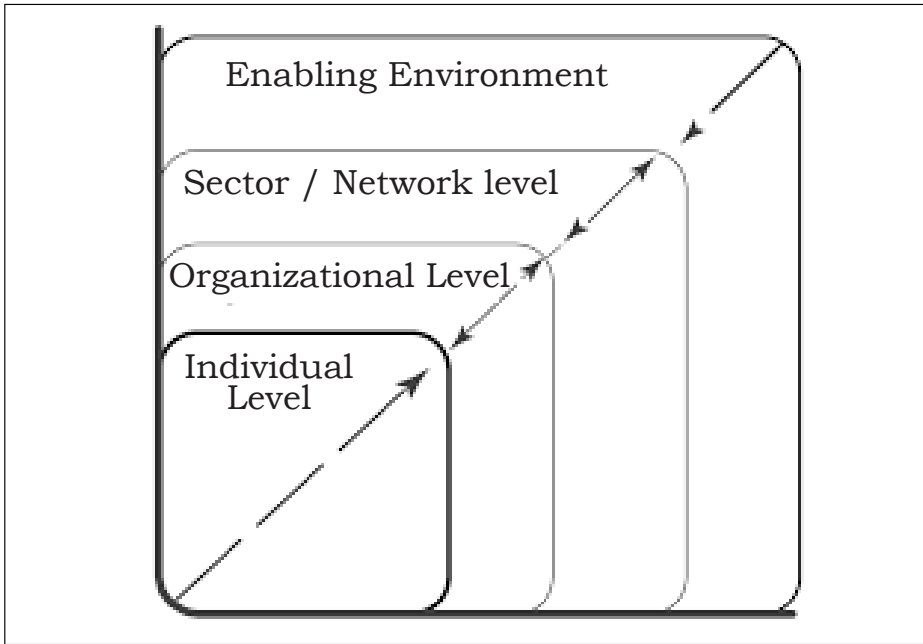


Figure 1: Levels of capacity building (Source: FAO, 2005, Appendix 1), adapted from Bolger (2000)

5. Education's Role in Capacity Building

Capacity building is a continuous effort focused on improving the skills and abilities of individuals, organizations and institutions, rather than a singular event. It primarily involves internal development, which can be further enhanced through external support.

The focus of capacity building is on addressing the current realities rather than ideal scenarios. It emphasizes the importance of leveraging and reinforcing existing strengths. However, significant and transformative changes may be necessary in response to evolving needs and circumstances. Capacity building not only aims to enhance performance but also to promote job satisfaction and self-confidence. A critical component of this process is developing the ability to manage a fresh and demanding assignment that arises from change (World Health Organization, 2001).

Education plays a vital role in identifying the pressing needs and challenges faced by society as a whole. Once accurate information is gathered, operational capacity can be restored, enabling the workforce to effectively utilize available resources. Institutional capacity is then built upon the desired changes in behaviour. The subsequent phase of education involves bolstering human resource capacity by evaluating its limitations and addressing them, while simultaneously expanding and solidifying operational capabilities, ensuring comprehensive support from all stakeholders. Ultimately, the progressive enhancement of institutional capacity contributes to the establishment of a positive and accepted societal framework.

6. Future Expectations, Issues and Opportunities

6.1. Human Capacity Building (HCD)

Aquaculture is projected to continue its expansion, leading to an increased global reliance on this industry for fish production. This sector will encounter a combination of emerging and persistent opportunities and challenges, especially in domains like production efficiency, sustainability, quality and safety. It remains uncertain whether professionals in this field will have the requisite skills to capitalize on these opportunities, address the challenges and manage potential obstacles.

At this critical juncture in the development of modern aquaculture, the roles of education and research are expected to be vital in building human capacity. These sectors provide the foundational expertise necessary for innovative, knowledge-based aquaculture initiatives. Educational and research institutions should assess the extent to which their aquaculture programs and research initiatives emphasize large-scale, intensive farming technologies in contrast to small-scale, less intensive methods that are often more appropriate for numerous impoverished and small-scale farmers. Furthermore, they should assess their effectiveness in addressing environmental and sustainability issues while balancing research that tackles current challenges with that which prepares for future developments in aquaculture (Williams *et al.*, 2010).

Issue 1: Accelerated human capacity development is essential to address the demands of swift advancements in aquaculture

The swift advancement of aquaculture has generated an immediate and increasing demand for the enhancement of aquaculture skills and knowledge. It is essential to uphold the quality of HCD while doing so efficiently, particularly by utilizing new media for effective delivery (Williams *et al.*, 2010).

Opportunity 1.1: Establish priorities for HCD

The advancement of aquaculture towards greater efficiency, sustainability and safety necessitates a deeper knowledge base. Consequently, the aquaculture industry must address the increasing demand for human capacity development (HCD) by providing broader access to training and education at more advanced levels, particularly for critical subsectors. What

strategies can be implemented to fulfil this HCD demand? How can we ensure the quality of training and education remains high and what measures can be taken to overcome language barriers in enhancing human capacity?

Targeted training and the dissemination of technology can significantly enhance the relevance and accessibility of aquaculture knowledge, ultimately leading to greater efficiency, sustainability and profitability within the sector. It is essential that new technologies align with the future needs of the industry and are easily accessible. Identifying and addressing the requirements of aquaculture operators within research frameworks is crucial, as is ensuring that the outcomes of new technologies reach farmers and other stakeholders in the supply chain promptly.

These issues present a substantial agenda for human capacity development (HCD) and are already central to the priorities of government policies, extension services and research institutions. The manner in which these agencies prioritize aquaculture programs can inform the establishment of HCD priorities. Research and development strategies, along with methods for technology dissemination, have been structured through the priority-setting and demonstration initiatives of specialized aquaculture organizations such as SEAFDEC/AQD and NACA, in collaboration with their partner centres of excellence. These organizations leverage aquaculture products and aquatic ecosystems as core components of their planning frameworks. They outline the pathways for technology transfer and adoption while evaluating client needs and collecting feedback.

This commodity-centric approach, paired with tracking systems from “farm to fork” and “fork to farm,” aims to ensure effectiveness throughout the entire value chain. Training needs assessments can be performed for particular commodities and production systems, as well as more broadly for environmental, social, food and market requirements. Strategies for the dissemination of new technologies, particularly in fish breeding and farming systems, are customized for different client segments, such as hatcheries and farmers. The findings are shared through a variety of tailored publications that are easily accessible online, in addition to being presented at both commodity-specific and general conferences and training events, which frequently include trade exhibitions (Williams *et al.*, 2010).

Opportunity 1.2: Foster collaboration and align efforts among institutions to tackle the key priorities

The swift advancement of aquaculture is closely tied to innovation and the availability of both practical and theoretical knowledge on a collective scale. Training and education in aquaculture must strike a balance between multidisciplinary approaches and specialization, as well as between foundational and advanced knowledge. As the technological intricacies of aquaculture grow, the development of a comprehensive curriculum necessitates the integration of expertise from various regions and countries. This need has been acknowledged in Europe through initiatives like the

AQUA-TNET network, as well as efforts by the FAO and China, which are focusing on developing nations by establishing a new trust-funded training centre for aquaculture in China. Nonetheless, further collaboration is essential, particularly because the uneven growth of aquaculture sectors across different regions has led to increasing tension between the demand for well-trained professionals in some areas and the declining number of students in others. The need for transnational knowledge and skilled labour has prompted a rising trend in aquaculture education programs to depend on the mobility of students and teaching staff to access the necessary expertise that cannot be fully developed internally. However, before such mobility can be fully realized to enhance transparent and accessible education, two significant challenges must be addressed: the differences in educational systems and the barriers posed by language.

Disparities in educational systems are tackled through two primary approaches: harmonization and accreditation. Harmonization involves the alignment of educational systems to establish a cohesive framework that facilitates the seamless transfer of complete or partial educational programs. It is essential to understand that harmonization does not equate to uniformity; rather, it promotes the richness of diverse educational offerings while working to eliminate barriers that hinder learners from accessing a variety of transnational programs. Accreditation serves as the second essential component for ensuring transparency and accessibility among different educational programs. This procedure entails an autonomous organization, either governmental or non-governmental, performing quality assurance and certification of educational programs in accordance with widely recognized standards. Without proper accreditation, universities and other higher education institutions are unable to confer diplomas for curricula that are completed in whole or in part at other institutions. The accreditation process involves a multifaceted evaluation that encompasses various aspects of the program, including its coherence, structure, objectives, outcomes and assessment methods. Additionally, it examines the institution itself, focusing on elements such as faculty qualifications, infrastructure and available facilities, as well as factors related to students, including selection criteria, admission processes, tutoring and support services. In disciplines like engineering and medicine, both international and national accreditation frameworks exist to uphold consistent standards across these fields. These quality standards facilitate the integration of courses both regionally and globally, thereby promoting student mobility and enhancing the relevance of educational qualifications (Williams *et al.*, 2010).

Opportunity 1.3: Tackle the obstacles in communication

Language barriers present significant challenges, as they can hinder access to resources unless translations are provided and they may also involve sensitive issues related to cultural identity. There is no straightforward, universal solution to address these barriers. Effective strategies must be locally tailored, incorporating (i) the use of a “lingua franca” (potentially

English and/or Chinese in the context of aquaculture) and (ii) the integration of language training into educational programs. These language challenges are particularly pronounced in higher education, while vocational, professional education and informal learning tend to be less affected, they typically concentrate on the regional employment landscape and function in the native language (Williams *et al.*, 2010).

Issue 2: Aquaculture education must engage top talent and equip them for successful careers in the field

In the past ten years, the global economic expansion has posed challenges for aquaculture programs in attracting students, particularly the most talented individuals. Even in regions like China, where enrolment has surged, many graduates tend to seek employment outside the aquaculture field or find it difficult to enter the industry without significant financial resources. While some of the previously mentioned accreditation and mobility strategies could enhance student recruitment and retention, there remains a pressing need to develop educational frameworks that align with the social needs and ambitions of today's top students, especially in the face of strong competition from other appealing sectors. Two potential strategies include tailoring courses to the rural environments where aquaculture is practiced and actively promoting the advantages of the field to high school students (Williams *et al.*, 2010).

Opportunity 2.1: Extend aquaculture education and training programs to rural communities

Aquaculture is predominantly practiced in rural regions; however, numerous higher education institutions are situated in urban centres, exposing students to city life and career opportunities. Other educational sectors facing comparable issues, like the recruitment of qualified doctors and professionals for rural service, have discovered that graduates from provincial universities are significantly more inclined to pursue careers in rural areas compared to those who studied in urban environments.

Opportunity 2.2: Develop and promote a favourable perception of aquaculture

The perception and future opportunities within the aquaculture industry require significant enhancement. In numerous countries, the media tends to focus more on the adverse effects of aquaculture rather than its benefits. To address this issue, the sector must implement effective media outreach strategies and educational institutions specializing in aquaculture should play a proactive role in this initiative.

Opportunity 2.3: Develop initiatives to nurture emerging aquaculture researchers

In numerous countries, the race to attract young talent is intense across various economic sectors. Aquaculture research institutions need to create appealing initiatives to attract and retain top-tier young researchers over the long term, utilizing scholarships and research opportunities, funding,

mentorship and opportunities for professional growth (Williams *et al.*, 2010).

Issue 3: Aquaculture education requires an increased emphasis on social science content

Students participating in higher education aquaculture programs frequently have limited exposure to social sciences, encompassing gender analysis techniques and management competencies. This gap restricts their capacity to grasp the comprehensive nature of challenges impacting aquaculture development. There is an urgent need for core curricula that equip all students with a diverse set of essential social science skills and knowledge (Williams *et al.*, 2010).

Opportunity 3.1: Enhance the integration of social science topics within aquaculture curricula

The FAO HCD Strategic Framework highlights the essential importance of social science expertise, allocating one of its three categories of knowledge and skills specifically to societal competencies. It also highlights the necessity of integrating various knowledge and skills areas. Consequently, students lacking a background in social sciences may find themselves at a disadvantage when operating at advanced levels within the sector, as these roles demand the ability to synthesize skills and knowledge from all three groupings. In the realm of aquaculture, essential social science competencies and insights include community mobilization and engagement, along with management and administration, which includes economics, finance and corporate social responsibility, conflict resolution and problem-solving, effective governance, environmental consciousness, sustainable trade practices, information and communication skills and social literacy with an emphasis on gender considerations (FAO, 2005).

7. Conclusion

In summary, education is essential for the continuous development of capacity within the aquaculture sector, addressing both present challenges and future needs. As the industry grows, there is an increasing demand for improved human capacity development (HCD) to provide individuals and organizations with the skills and knowledge necessary for achieving efficiency, sustainability and safety. By focusing on specialized training, encouraging collaboration among institutions and overcoming communication obstacles, stakeholders can establish a strong educational framework that enhances accessibility and relevance.

Moreover, attracting and retaining skilled students is vital for the sector's future, which requires initiatives to link aquaculture education with rural communities, enhance the industry's public perception and support emerging researchers. It is equally crucial to incorporate social sciences into aquaculture programs, ensuring that graduates are equipped with the varied skill sets needed to address the complexities of the industry.

Ultimately, a strategic emphasis on these opportunities will not only

strengthen individual and institutional capabilities but also foster a sustainable and prosperous aquaculture sector, capable of addressing global food security challenges and adapting to changing environmental conditions. By adopting a comprehensive approach to education and capacity building, stakeholders can cultivate a supportive societal framework that encourages growth and innovation vital for the future of aquaculture.

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