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ABSTRACT

Purpose: *This paper discusses how a problem-based learning (PBL) approach can be used effectively to resolve problems in food safety standards being adopted by fish farmers in Bangladesh. Using the example of a Food and Agriculture Organization (FAO) Food Safety Programme, this paper further highlights the potential of PBL to promote the capabilities needed to train multiple stakeholders, including staff working in local, district, and national organisations, and for local fish farmers to apply the FAO Food Safety Code of Practice in their farms.*
Design/Methodology/Approach: *A qualitative intrinsic case study approach with qualitative content analysis of written reports was adopted to assess and provide an in-depth description of the PBL programme, the potential capabilities developed and the impact(s) of the project.*
Findings/Results: *The PBL approach adopted for training multiple stakeholders was based on the teaching learning theory of social constructivism using a cascade model of training. Drawing on these principles, the training has promoted capacity building in the different levels of the cascade model, empowered fish farmers to change their behaviours, and adopt the FAO Food Safety Code of Practice, and enhanced their business quality and performance as well as food safety control. Moreover, the success of the training programme enabled it to be extended to a further 100,000 fish farms, and the same approach has been adopted in other types of farms, such as poultry and crop farms.*
Originality/Value: *This paper provides a clear understanding how a PBL approach is capable of outscalling capacity building and amplifying sustainable impact by developing collaborative partnerships with different actors in the fishery sector to bring positive changes in communities that they support.*
Paper Type: *Case study.*
Keywords: Problem Based Learning, Constructivism, Capacity Building, Food Safety Practices, Improving Stakeholder Benefits in Fishery Value Chains

1. INTRODUCTION :

Bangladesh is one of the world's poorest and most densely populated countries with 172.37 million people living in an area of 1328,68 square kilometers [1]. Accordingly, approximately 63.37% of the population live in rural areas and significantly engage in farming or related activities [2]. In particular, fish is one of the major agricultural crops in the country, which plays an important role in livelihood, nutrition, economy, and employment of the nation [3].

While the country is considered to be one of the world's best-suited fisheries regions [4], food contamination and food adulteration are significant problems. These occur due to the absence of a satisfactory food regulatory and control system, outdated food laws and regulations that do not include recent developments in international standards and agreements. business culture to improve profitability by using easy solutions, and the lack of education and awareness among food producers, food handlers, and consumers [5]. Most importantly, the chronic effects of such events are unlikely to be observed or reported, and the lack of adequate food control system overseen by a competent

authority has implications for food exporters or international buyers. Therefore, the sustainability of fish farm productivity, consumer health, export performance and trade depend on the enforcement of grades and integrated food safety and quality control standards that require further significant improvements in hygienic/food safety practices in fish farming.

Accordingly, there is a need for a strong and competent public health workforce to tackle these problems, where communities are empowered to become partners in food safety issues and promote consumer health. Consequently, providing opportunities to develop capacity and comprehensive networks for concerted actions at local, national, and international levels by sharing knowledge and providing practice-based evidence. Nevertheless, there is little agreement about the role of capacity building, and its elements in ensuring adequate performance on development initiatives, such as projects. Capacity building has been viewed as a precursor to networking and collaboration, and can be applied in changing attitudes related to individual challenges, incapacities, and inadequacies of a person, group, organization, or system [6].

Faced with this situation, the FAO supported the implementation of a Dutch funded project, Improving Food Safety, Quality and Food Control in Bangladesh. The overall aim of the project was to improve consumer health in Bangladesh through a series of activities designed to improve food safety, quality and hygiene, with four activities focused in the development and implementation of:

- (1) Consistent national food safety. quality policies and strategies supported by risk-based food control programmes that address the entire food supply chain;
- (2) Preventive strategies to food safety and quality management that are shared by enhanced education and communication to small and medium-scale food businesses and through innovative public education on food safety, with special attention to rural populations;
- (3) Strengthened risk-based food inspection and enforcement services, implemented by trained, resourced and supervised food and sanitary inspectors;
- (4) Enhanced food analysis capability and capacity, using trained analysts with appropriate sampling and testing equipment

This case study will focus on activity 2, where a Food Safety Programme, including Good. Aquaculture Practices (GAQP) and Good Hygienic Practices (GHP) has been implemented to further strengthen food security through an improved food safety control system, improved public health, and strengthened stakeholder involvement and coordination, leading to enhanced trade in fish and fish products.

In this regard, this paper will attempt to illustrate how a PBL approach can be used effectively to resolve problems in food safety standards being adopted in communities in order to develop the required competencies for fish farmers within the context of an enlarging Bangladesh.

2. RELATED WORKS :

2.1 Capacity Building:

Capacity building is a multi-dimensional, and dynamic approach that can promote the ability of individuals, organizations or society to identify and implement development objectives or development challenges in a sustainable manner, and perform better by improving skills, knowledge and competences [7]. Consequently, it can potentially offer opportunities for productivity.

Although capacity building through training can be viewed as a central pillar in the development of farmers and farming communities, there is limited research about and/or lack of efforts to assess its short and long-term impacts. The available literature is mainly focused on capacity building elements that influence training outcomes. For example, a previous training programme in agribusiness practices in Ugunja sub-county reported that farmers found the training content, approach, delivery, access to, and quality of capacity building materials to be important to enhance their learning and knowledge transmission [8]. Therefore, suggesting that capacity building through training can potentially change attitudes and support farmers with the required tools to promote production.

This approach can be particularly important for individual farmers in Bangladesh, who are particularly poor, with limited access to resources and income resources, who tend to rely on agriculture for their livelihoods, and are highly dependent on extension services to obtain advice on safer and effective agricultural practices to support their livelihoods. More importantly, it can be potentially applied in fish farming, which is one of the most significant sub-sectors of agriculture that plays a key role in employment, nutrition, foreign earning and socio-economic stability in rural areas of Bangladesh [9].

The FAO conducts capacity building activities for marine, inland fisheries and aquaculture through the provision of training courses and programmes along with partner institutions to fish farmers [10]. FAO have always placed capacity building at the core of their role in reducing hunger worldwide since their inception in 1945. The 2010 review of the FAO approach to capacity building placed a stronger emphasis on the long term impact of their project work on building sustainable change [10]. In 2012, an earlier work by FAO in Uganda [11] targeted the development of a business approach in the aquaculture sector to drive increased profit. Problems reported by the Government included poor record keeping and planning by fish farmers resulting in weak strategic planning to grow the sector. FAO provided a specific capacity building programme targeting increased profit through better business planning. The software tool which enabled the evaluation by the stakeholders of model fish farms highlighted the need for accurate record keeping enabling the benefits of selected interventions to be tracked [11].
Therefore, capacity building in the context of FAO Corporate Strategy is defined as the process where "individuals, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time" [10]. The next section introduces the conceptual and theoretical frameworks underpinning the training program used as a case study for this paper, which was delivered by FAO.

2.2 Conceptual and Theoretical Frameworks:

2.2.1 Problem-based Learning and Constructivism:

Capacity building in the context of fish farming development, may involve interactions between farmers, traders, buyers, input suppliers, government extension services, innovative stakeholders. This will require continuous organizational efforts and interactive learning environment which enables these actors to understand each other to promote knowledge dissemination and skills. Capacity development involves a systemic strategy of learning by doing, which is associated with PBL.

PBL is a pedagogical approach in which students actively learn while being involved in the process of finding solutions to real-world problems that require more research [12]. Here, students are enabled to problem-solve in a collaborative environment, generate mental models for learning, and develop self-directed learning habits through practice and reflection [13]. Therefore, the learning process in a PBL context can be seen as a collaborative, constructive, self-directed, and contextual activity.

The pedagogy of education is associated with theories related to knowledge, how it is transmitted, retained and/or constructed. Such theoretical perspectives can be adopted in other fields, where an element of learning is incorporated. The three main theories that have been applied in the learning context include: behaviorism, cognitivism and constructivism. Behaviorism is centered on human behavior rather than processes within the mind. Accordingly, the learning process is focused on repetition and student response to stimuli [14]. Cognitivism is centered in human cognition, and considers learning as an internal process that happens in the student's mind, such as thinking [15]. Accordingly, new knowledge is developed from prior knowledge, and students need to be actively engaged in order to learn. In education, both behaviorism and cognitivism are teacher-centered approaches, where the teacher sends information to the students [16]. In contrast, constructivism is a student-centered theory in which a student creates own knowledge based on their own experience rather than just passively taking in information [17]. Accordingly, the elements of constructivism is that learning is a collaborative and active approach, which involves a reflective nature relevant to the students who are encouraged to act autonomously and self-directed.

PBL is a learning approach based on constructivism, where social interaction has a key role in the cognition development of the student. The central element of this theory is that knowledge is "constructed" by the student's cognitive activity (i.e., previous knowledge), which involves ongoing interaction and participation in the community that the student is a member of. Therefore, learning occurs via active engagement in social interaction while participating in a meaningful PBL activity, and so, it can potentially promote lifelong learning that in terms of capacity building is essential. Nevertheless, how the constructivism theory can be translated into practice through PBL to optimize capacity building in the fishery sector, and its impact have not been acknowledged in the literature.

3. OBJECTIVES :

In this paper, we report on and discuss a capacity-building initiative developed within a FAO Food Safety Programme that involved elements of PBL approaches, including the theory of constructivism. This course focused on the Jessore region of Bangladesh to train staff working in local, district, and national organisations, and for local fish farmers to apply the FAO Food Safety Code of Practice in their farms.

4. METHODOLOGY :

4.1 Data collection and data analysis:

This paper conducted a qualitative intrinsic case study approach to obtain an in-depth assessment of and provide an in-depth description about the nature of a single PBL project (the case), its impact, and the value of developing collaborative partnerships in this context. A qualitative analysis is a systematic method for analysing and describing written material [18]. Accordingly, to develop a thorough understanding of the case, multiple sources of information were collected. In particular, archival records about the project including desk audits, reports, and powerPoint presentations were collected to corroborate and enhance the findings of the study.

The following strategies were adopted for data analysis. Firstly, a qualitative content analysis of the written reports using a hybrid approach involving both deductive and inductive approaches was applied to identify, analyze and report patterns within the data [19]. First, a deductive approach based on a PBL existing theory - social constructivism, was used to develop a coding frame with labels and/or definitions related to PBL concepts. This approach allowed to assess the main concepts to be studied in the data, the interrelationships between them, and thus what information should be collected and analyzed [20]. The code frame was created by two researchers. Then, the identified theory-based PBL concepts were reviewed and expanded with keywords inductively derived from the data. This was achieved by repeatedly reviewing and sorting keywords in the text that made explicit references to the nature of the PBL approach, and storing these as recording units with the aid of the NVivo software package.

4.2 The Food Safety Programme Case Study:

4.2.1 Context:

In 2012, FAO with support from the Embassy of the Kingdom of the Netherlands (EKN) implemented a Food Safety Programme - Improving Food Safety, Quality and Food Control in Bangladesh. The aim of this Programme was to create an efficient and well-functioning food safety control system in Bangladesh through improved food safety and reduced incidence of food-born illness within the population, promote stakeholder involvement and coordination, and promote trade in the fishery sector.

Aquaculture has developed significantly as an alternative livelihood for fishermen and farmers in Bangladesh. This programme was implemented in the five coastal districts of Khulna Division: Khluna, Bagerhat, Satkhira, Jessore, and Narail district. In this division, there were approximately half a million people who were directly involved in fisheries, including wild capture and farming. In particular, the southern parts of Khulna (i.e, Satkhira and Bagerhat) are known for the production of Black Tiger shrimp, whereas the northern parts (i.e, Narail and Jessore) are known for the production of freshwater fish and prawn. Jessore is particularly known for its wide availability of freshwater resources and is the center of freshwater aquaculture of Khulna Division. Therefore, aquaculture plays

an important role in providing opportunities for employment and increased income for local communities.

However, tilapia farming in Jessore was suffering from poor business performance, low productivity, inferior product quality, and weak food safety. In response to these local and national aquaculture needs, the FAO implemented a dedicated food safety project focused on supporting the establishment of a strategic approach to resolve the problems in agri-supply chains. In particular, it was focused on multiple angles: national governance, improved aquaculture practices, development of standards, and sustainable development of tilapia farming in Jessore. This paper concentrates on the work of section 7 of the FAO project focused on building the capacity of target stakeholders in creating national sector safe food supply chains.

The expected outcomes of the Programme were planned to be achieved by developing capacity further in the fisheries subsector by developing a model food chain. This intervention included the following activities and specific actions:

- Develop food safety guidelines for aquaculture GAQP in Bangladesh.
- Train master trainers and subject matter specialists from selected districts in the application of aquaculture GAQP.
- Train 2,500 lead fish farmers in the implementation of aquaculture GAQP.
- Conduct a risk analysis across the fisheries value chain for potential intervention at key points where food safety is compromised and develop information material on best GAQP and GHP.
- Establish a model wholesale fish market (linked to the aforementioned value chains) and demonstrate the implementation of GHP, not only in the market itself, but as a model for the entire length of the respective value chains (from production/capture until the final sale of fish products to the consumer).
- Support the development of business partnerships between Dutch and/or Bangladeshi food processors to strengthen key linkages of the respective fisheries value chains.
- Conduct a risk analysis across the fisheries value chain for potential intervention at key points where food safety is compromised and develop information material on best GAQP and GHP.
- Establish a model wholesale fish market (linked to the aforementioned value chains) and demonstrate the implementation of GHP, not only in the market itself, but as a model for the entire length of the respective value chains (from production/capture until the final sale of fish products to the consumer).
- Support the development of business partnerships between Dutch and/or Bangladeshi food processors to strengthen key linkages of the respective fisheries value chains.

The next section presents the nature of the training programme.

4.2.2 The nature of the training programme:

The strategy of this project involved a four-step process to build safe food supply chains (Figure 1) with the creation of a national food safety plan: (1) build structure, (2) gain trust, (3) build change teams and trust, and (4) build changes and tools.

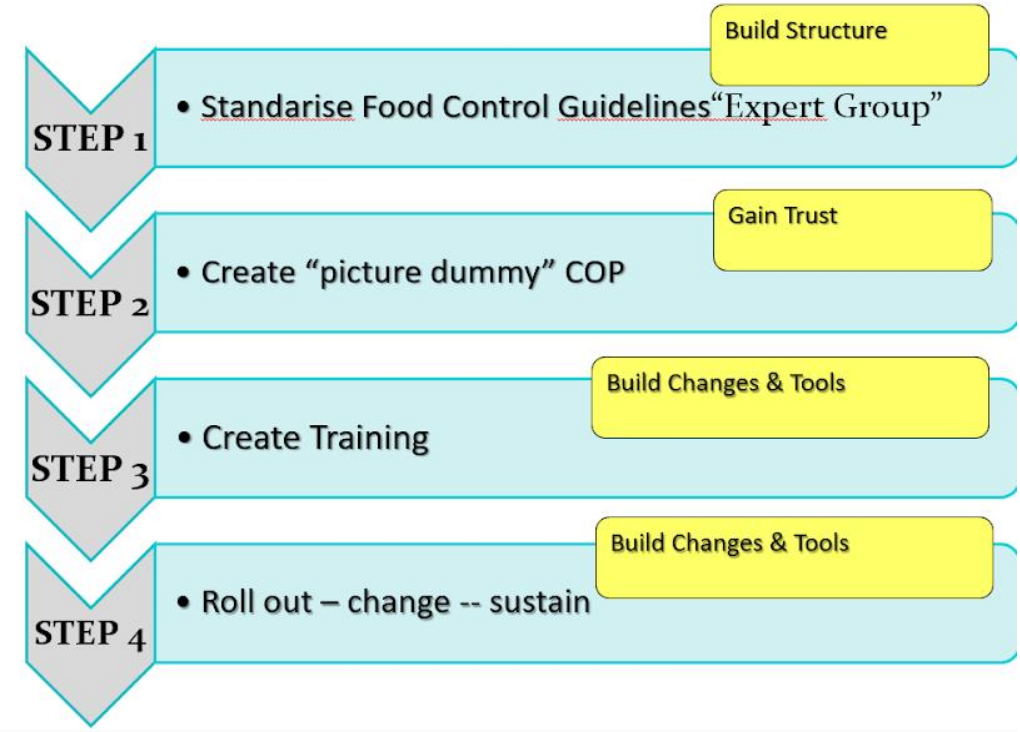

Fig. 1. Strategy for safe food supply

- ***Build Structure*** - This step involved using a collaborative approach to create an expert group with national and international food safety experts from government extension services, private sector agencies and businesses, Bangladesh Food Safety network, NGO's and farmers to standardize national food control guidelines. These were focused on highlighting the economic benefits of food control in each sector as well as giving guidance on the technical areas.
- ***Gain Trust***- This stage involved collaborating with a further working group, including lead trainers to simplify codes of practice into a series of picture-based mental models to build trust with the farmer groups.
- ***Build Change Teams & Tools*** A certified competency-based master training programme was created as step 3 by the expert group involving non-government agencies, fishery department extension staff, industry and selected NGOs with proven credibility.
- ***Build Changes & Tools*** Finally, the final step involved implementing the scale up plan to expand the programme within the fishery sector.

5. RESULTS :

5.1 Elements of PBL in the Training Programme:

PBL and constructivism were applied in the programme by adopting the following approaches.

Identify the problem(s):

Firstly, the problem was identified. The export potential of Bangladesh was not being fully used due to non-compliance with food safety and quality standards from fish farmers. Moreover, there was a lack of a food control system that was being overseen by a competent authority. Consequently, these issues had implications between food exporters, importers, and consumers where they were reluctant to take imports, and created a lack of confidence that the products consumed were safe. Therefore, the lack of adoption of food safety standards by the fish farmers was identified as a problem by the FAO, and used as the basis of the PBL approach to create the programme.

Identify potential solution(s):

The presentation of a real-world problem was the starting point of learning. Here, a food safety expert group with previous knowledge about the problem was brought to standardize the national food control

guidelines. In particular, they discussed between themselves about the problems within food safety and control, which enabled them to reach an agreement about the guidelines' content. These discussions involved brainstorming ideas, assessing the problem at hand, evaluating the importance of different pieces of information, and deciding which information should be used to solve the problem to aid the subsequent action plan. The use of cross-disciplinary knowledge was a key feature in this PBL approach, where the solution of the problem was created by taking into consideration knowledge from various key actors. This group dynamic activity created a learning environment, where learning was facilitated and created space to reflect and share insights into the potentials and constraints that farmers were facing in adopting the food safety standards (i.e., analysing the cause-effect relationship of the problem). Following this participatory process, key challenges faced by fish farmers on food safety and control were identified. In particular, the current codes of practice were too complex for farmers to understand. Therefore, the potential solution for this problem was to create food safety codes of practice that were easily understood by fish farmers.

Develop the learning programme:

The programme was developed based on the main problems identified. Here, capacity building was developed by using a cascade model of training including a network of change agents, composed of 98 master trainers, 300 lead trainers and 1500 lead farmers, who completed a certified award. The model was applied to deliver training to different stakeholders at several levels until it reached the final target group - fish farmers. Therefore, expertise and newly acquired knowledge was diffused through the system. Figure 2 depicts the different layers of the cascade model of training for this programme.

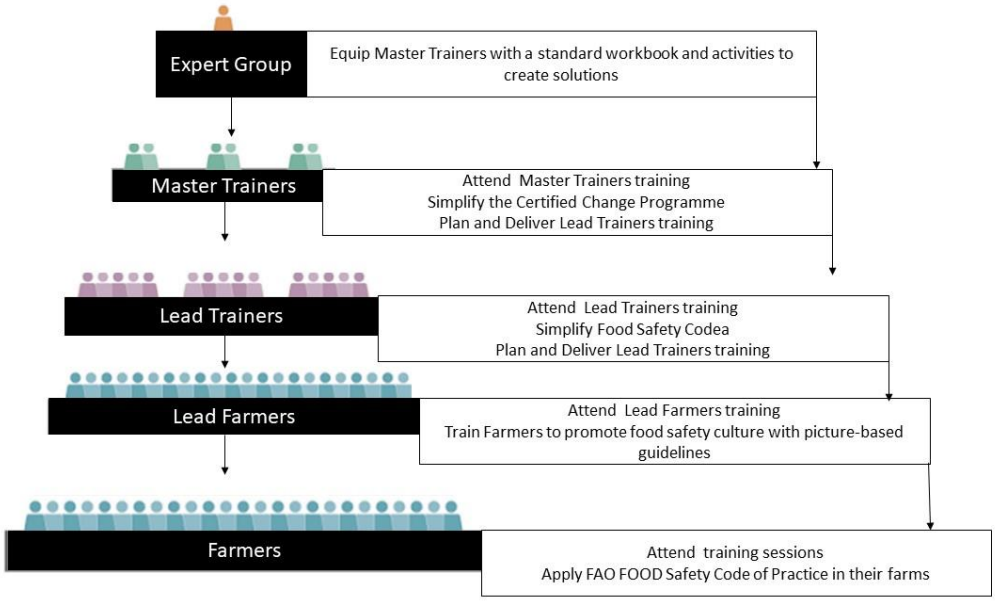

Fig. 2. Cascade model of training

Firstly, the Expert Group created a standard workbook at level 4 (first year degree level) based on a range of activities to be completed by the Master Trainers. These activities included the Master Trainers creating solutions for safety problems on a farm based on case studies, designing simple food safety codes of practice, checking any codes that were pro-poor, creating quizzes and fun tasks to transfer knowledge, design simple training activities, and then delivering their activity to other trainers and receiving feedback.

Secondly, the Master Trainers trained Lead Trainers. This team shortened and simplified the certified change programme for the next level of the programme delivery. Master Trainers were primarily policy level Government officers who would help create the national guidelines along with expert extension officers, industry personnel working with suppliers, NGO's with a food safety background

from the Bangladesh Food Safety Network, Solidaridad NGO (Dutch FAO Partner), and FAO national experts and international consultants. The curriculum material covered the level 3 programme in Food Safety Hazard Analysis Critical Control Point (HACCP)- which was based on change. The curriculum also covered the UK adult learning qualification (PTTLS) designed to enable trainers to upskill adult learners.

Thirdly, Lead Trainers trained the Lead Farmers in the implementation of food safety codes which were then simplified and used with actual farmers in participatory extension approaches such as "farmer field schools". In particular, the Lead Farmers facilitated the selection of activities/strategies to enhance learning for farmers. Learning was enhanced as the training material became simpler and more business focused.

Then, Lead Farmers trained Farmers to promote food safety culture by demonstrating safe food production and consumption practices on good business practice. Every participating farmer was given the picture-based booklet free of cost.

Finally, Fish Farmers attended the training sessions, and applied the food standard guide in their farms. Here, farmers were able to gradually build knowledge, experience and integrate new information that was introduced in bite-size chunks to ensure that they were given time to digest, reflect and embed the information in their farms.

Therefore, the following principles of PBL were applied in the training process within each layer of the training cascade:

- People learned by doing
- People brought experience, knowledge, and skills into learning situations
- The trainers in each layer were not the ultimate experts, learning was drawn on the experience of the group
- Learning was relevant and goal orientated, where people were more likely to apply new knowledge in their current context

These principles correlate with the theory of social constructivism that states that learning is developed and influenced by social interactions in meaningful contexts [21]. Accordingly, the programme provided an excellent opportunity for collaborative inquiry and learning during the identification of the problem and subsequent solutions. Here, the joint efforts from national and international actors created ownership and partnership, and thus promoted the likelihood of achieving impact, and strengthening national capacities. Moreover, it facilitated the concept of long-term commitment between actors to create a community of practice [22].

In particular, by presenting a real life problem, these actors were involved in considerable open discussions, negotiations and reflections, where their distinct opinions and assumptions were continuously challenged by the PBL activities. These discussions highlighted the power relationships among stakeholders, and the skills required to obtain a shared understanding and consensus. Consequently, this made them better learners, key drivers of change and increased the likelihood of them becoming key *"resources"* to their country. This also promoted capacity building in communication skills, problem solving and leadership skills.

All the trainers in this programme were seen as facilitators as their role was to guide the learning process of others without lecturing. This ensured their personal understanding of knowledge and skills necessary to tackle the problem, while developing their capacity to present teaching materials and activities that were suitable for the social and cultural backgrounds of the participants. Here, the respect across actors was modelled, where their experience and knowledge for each task was recognized, and their value was acknowledged, Consequently, this created a safe, non-judgemental learning environment where every actor had the same value regardless of their title, and thus they were more likely to apply the same attitude when they communicated around the programme. This approach further supported Vygotsky's social constructivism concept of the "zone of proximal development",

where learners' mental functions must be enhanced during collaborative activities with the help of more experienced individuals [17]. Accordingly, the learner internalises what has been taught, including the tactics applied on these interactions to convey a concept, and learns the ability to apply similar tasks independently. Therefore, cascade modelling of training was also a significant approach to learning and interacting with each other.

Monitoring and Evaluation of the Programme

The capability of fish farmers adopting safe food practices and their performance after receiving the training was monitored and evaluated by the following approaches:

Firstly, 3500 farmers completed a baseline survey, where their existing capability and performance was assessed by using farm record books [23]. Then, the subsequent farm visits analysed their performance after the training was conducted by using a hand-held diagnostic tool to capture the impact of the five key parts of food control in low areas. These controlsl covered 5 things (i.e., key control measures) farmers needed to remember for germ control (e.g., to not contaminate ponds with human and animal waste) and chemical control (e.g., to protect fish from incorrect veterinary drug use). This audit both at baseline and follow-up level focused on assessing quality performance (e.g., reject rate), safety (e.g., monitoring performance key indicators), business outputs (e.g., sales), and farmers' views (e.g., commitment to adopt safe practices). Figure 3 depicts the food safety control performance measurement system performed for monitoring and evaluating the programme.

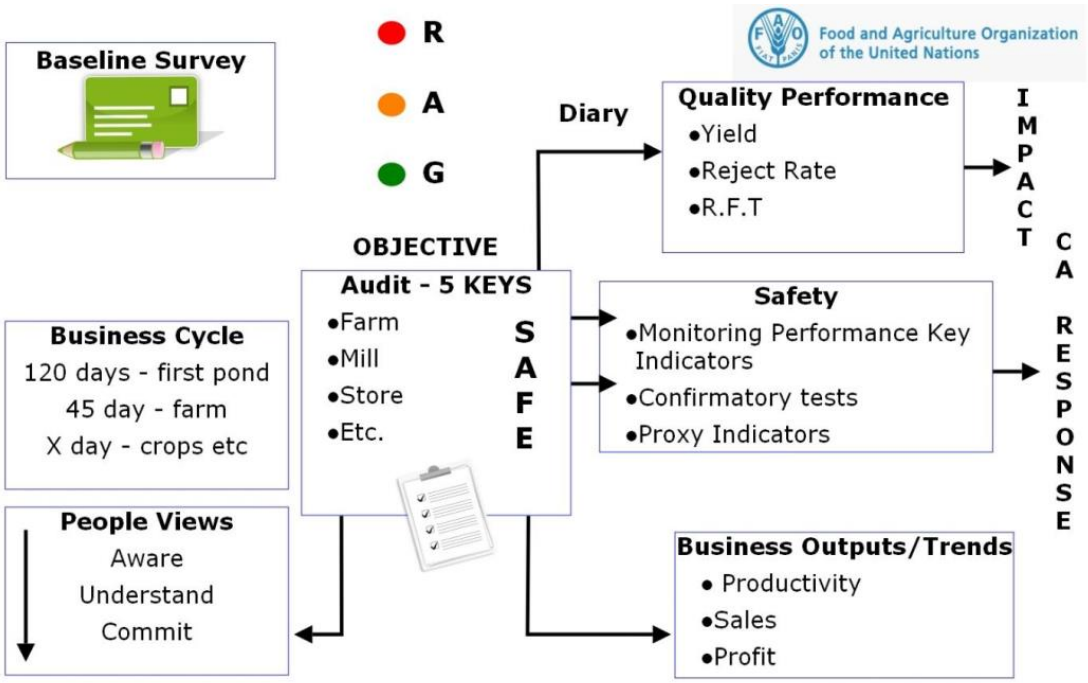

Fig. 3. Food Safety Control - Performance Measurement System [23]

This monitoring and evaluation of the programme, underlines another PBL principle, where students' learning and progress are measured toward the goals of the PBL. Here, the baseline and follow-up audits of fish farmers can be seen as valid measures of learning assessment developed by the programme, where their abilities, knowledge, and attitudes were assessed. Therefore, ensuring that they were benefiting as intended from the programme approach.

Presentation of findings:

After implementing the possible solution and analyzing it, the solution (i.e., programme) was made public and presented to a number of audiences. Here, a number of written reports and oral presentations were created to communicate the findings, and explain the reasons behind the solution to support its selection. Accordingly, the Solidaridad team working on food safety with FAO were trained in codes of practice and presented their findings, and changing minds approach at the World

Seafood Congress using the performance measurement system from the FAO project. Ahmad, Ryder and Dillon, 2015 [23] wrote a separate abstract for the World Seafood Congress where they have explained the education programme approach, and the work was presented by the Fishery Department through their Senior Fishery Officer, Golam Rabanni. Here, the Secretary of State for Agriculture and Fisheries (MINFAL), Shelim Afroza, attended the event with the Bangladesh UK High Commissioner to confirm the impact of the programme.

5.2 The impact of PBL:

5.2.1 Positive Behavioral Change - Adoption of safer practices in fish farms:

Socially meaningful activities are important for human consciousness, and the use of tools in this programme such as picture-based guidelines influenced cognition [24]. The picture-based approach using a printed book to communicate the codes of practice for food safety and control in the fish value chain in a simpler and practical way has promoted positive behavioral changes and practices among the participating fish farmers. This form of communication demonstrated to be more effective for fish farmers as this was a population with low literacy, who could not understand the complex language presented in text format in the original document of food control guidelines. Demonstrating the safe actions that farmers should take through images or pictures provided them a clear idea of what they needed to consider, and aroused their interest to experiment these practices more effectively than the extended details provided in a formal document. Moreover, when they were able to observe the economic benefits of such practices, they were more enthusiastic and motivated to change their behaviours. Consequently, this has improved their learning process, promoted their engagement, facilitated communication and collaborations, and improved further the expression of tacit knowledge to potentially bring changes at individual or community level.

5.2.2 Business Performance:

The learning of and adoption of safe food practices have consequently impacted fish farm business performance. Firstly, the fish farm productivity was improved, where the feed conversion ratio was improved from 2.5 to 1.5, indicating that a feed was efficiently converted into fish weight gain. This and the further reduction of medication used improved daily farmers' costs, which in turn was easily recognized by them. Then, a decrease in wastage was observed. In particular, fish mortality was reduced from 20% to 5% by protecting juvenile in nets. This meant that farmers had more fish per production cycle to sell. Moreover, fish quality was improved by ensuring regular feeding. Consequently, a better uniformity in fish size (fall 20mg size) was observed along with better fish quality and shape. This meant that this promoted the acceptance of fish by retailers, and that fish farmers obtained no rejects. Then, and so it was accepted by retailers. Due to the improved productivity and knowledge about efficient food safety practices gained by the FAO Food Safety Code, fish farmers were able to improve sales, revenue and profits. In particular, they were able to reduce the costs of fish per kg, achieve higher sales and demand, and obtain a wide diversification of new retail buyers and wholesalers. A similar approach adopted by Dillon et al, 2022 [25] obtained similar results where training based on social constructivism contributed to business improvement, lifelong learning capabilities and promoted professional capabilities in different manufacturing industries.

5.2.3 Programme Extension:

The expert from the fishery NGO, SHISHUK, which was part of the Bangladesh Food Safety Network (BFSN) extended the number of trained fish farmers to a further 100,000 farms using their own Certified team. This team, which included Master Trainers, and a further group of Lead Trainers, and Lead Farmers who were contracted under an FAO service level agreement were trained on food safety and the FAO Codes of Practice. The main objective of these programmes was to enhance food safety culture mainly among farmers, their families and community members to demonstrate safe food production and consumption practices as models in the intervention in 10 upazilas of 8 districts in Bangladesh.

Other researchers extended this work by adopting the FAO Codes of Practice for the development of good practice in other farms. In particular, [26] reported on the critical reduction in microbial load

occurring in poultry farms, and Hortex (Horticulture team) reported the impact on mango farmers to supply to Walmarts using the FAO Codes of Practice [27].

6. RECOMMENDATIONS :

The aim of this paper was to assess how a PBL approach was used to effectively resolve problems in food safety standards being adopted by fish farmers in Bangladesh and how this has been applied to optimize capacity building. Based on the findings of this study, the following recommendations for policy makers, development actors and researchers who have a strong interest in optimizing capacity building and promoting the value chain are provided.

- Although the programme provided a number of benefits and impacts to different actors, including improved outcomes, further insights could be obtained if their soft skills were monitored and evaluated to substantiate the effectiveness of the PBL approach. In particular, it would be important to see additional research into the effects of PBL on the different actors' capacity to problem solve, manage change, collaboration, decision-making, critical thinking, motivation, and self-regulated learning.
- This PBL approach should be considered in value chain analysis in line with constraint analysis.
- The HACCP codes of practice created by critical control points analysis at each step of the fishery chain should be considered to cover food safety and food control to optimise and improve productivity. This may be considered on future value chain work as a suitable approach for technical review.
- The Water, Sanitation, and Hygiene (WASH) in Fisheries and Aquaculture [28-30] tool developed by the World Bank Group, PROBLUE and GWSP could be used in similar interventions and/or programmes to ensure that control points, and good practice measures for food products are being adopted by the fisheries and aquaculture workers and communities.

7. CONCLUSION :

This programme highlighted the importance of designing and applying a PBL approach based on a theory of adult learning and teaching, namely social constructivism. Accordingly, in each layer of the cascade model of training, the different actors in the fishery sector learned by doing, brought experience and knowledge into learning situations, and were able to apply new knowledge in their everyday practice. By developing a community of practice that is open to understanding how other individuals perceive a problem makes them better learners, and develops flexibility in dealing with new situations in the future. Therefore, experiential, transformative, and socially constructed learning are significant for behavioural change strategies and optimising capacity building, and PBL provides a platform for these learning processes to occur.

8. ACKNOWLEDGMENT :

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