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CAPACITY BUILDING FOR FOOD SAFETY PRACTICES IN FISH FARMERS IN INDIA

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ABSTRACT

This study examines how fish farmers in India can efficiently address issues with food safety requirements by implementing a problem-based learning (PBL) method. This paper further demonstrates the potential of PBL to foster the skills required to train various stakeholders, including employees of local, district, and national organizations, and to help local fish farmers implement the FAO Food Safety Code of Practice on their farms, using the example of a Food and Agriculture Organization (FAO) Food Safety Program. To evaluate and give a detailed account of the PBL program, the prospective capacities produced, and the impact(s) of the project, a qualitative intrinsic case study technique was used in conjunction with qualitative content analysis of written reports. Using a cascade model of training, the PBL approach used to train numerous stakeholders was founded on the social constructivism teaching and learning theory. Based on these ideas, the training has improved fish farmers' business quality and performance as well as food safety control, encouraged capacity building at the various cascade model levels, and given them the authority to modify their behavior and embrace the FAO Food Safety Code of Practice. Additionally, the training program's effectiveness allowed it to be expanded to an additional 100,000 fish farms, and other farm types, including crop and poultry farms, have also adopted the same strategy. By forming cooperative relationships with various actors in the fishing industry, this article clearly explains how a PBL approach can surpass capacity building and increase sustained effect while bringing about beneficial changes in the communities they assist.

Keywords: Problem Based Learning, Constructivism, Capacity Building, Food Safety Practices, Improving Stakeholder Benefits in Fishery Value Chains

1. INTRODUCTION

With 172.37 million inhabitants spread across 1328, 68 square kilometers, India is one of the most impoverished and densely populated nations in the world [1]. In light of this, roughly 63.37% of people reside in rural areas and make farming or similar occupations their primary source of income [2]. Fish, in particular, is one of the main agricultural products in the nation and is crucial to employment, livelihood, nutrition, and the economy [3].

Despite the fact that the nation is regarded as one of the top fisheries regions in the world [4], food adulteration and contamination are serious issues. These are brought on by antiquated food laws and regulations that do not take into account new advancements in international standards and agreements, as well as the lack of an adequate framework for regulating and controlling food. Lack of knowledge and awareness among food producers, handlers, and consumers, as well as business culture that favors quick fixes to increase profits [5].
Most significantly, the long-term consequences of such incidents are unlikely to be noticed or documented, and food exporters or foreign purchasers may be impacted by the absence of a

suitable food control system supervised by an appropriate body. Therefore, the implementation of grades and integrated food safety and quality control requirements, which call for further substantial improvements in hygienic/food safety measures in fish farming, is essential to the sustainability of fish farm production, consumer health, export performance, and commerce.

To address these difficulties, a robust and capable public health workforce is required, where communities are empowered to collaborate on food safety concerns and advance consumer health. As a result, by exchanging knowledge and offering evidence based on practice, chances are presented to build capacity and extensive networks for coordinated activities at the local, national, and worldwide levels. However, there isn't much consensus regarding the function of capacity building and its components in guaranteeing sufficient performance on projects and other development activities. As a prelude to networking and collaboration, capacity development can be used to alter perceptions about the shortcomings, inadequacies, and personal struggles of an individual, group, organization, or system [6].

Faced with this situation, the FAO supported the implementation of a Dutch funded project, ImprovingFood Safety, Quality and Food Control in India. The overall aim of the project was to improveconsumer health in India through a series of activities designed to improve food safety, qualityand 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 bytrained, resourced and supervised food and sanitary inspectors;
(4) Enhanced food analysis capability and capacity, using trained analysts with appropriate sampling and testing equipment

The second activity covered in this case study is the implementation of a Food Safety Program that includes Good Aquaculture Practices (GAQP) and Good Hygienic Practices (GHP) to further strengthen food security through improved public health, a better food safety control system, and increased stakeholder coordination and involvement, which in turn has led to increased trade in fish and fish products.

In light of this, this article will try to show how a PBL approach may be utilized to tackle issues with food safety regulations being implemented in communities and build the necessary skills for fish farmers in the context of an expanding India.

2. RELATED WORKS

2.1 Capacity Building:

The ability of people, organizations, or society to recognize and carry out development goals or challenges in a sustainable way, as well as to perform better by enhancing skills, knowledge,

and competencies, can be enhanced through the multifaceted and dynamic approach of capacity building [7]. As a result, it may present chances for increased production.

Despite being seen as a key component of farmers' and farming communities' development, training-based capacity building has received little attention and/or little effort to evaluate its immediate and long-term effects. The majority of the literature that is currently accessible focuses on capacity building components that affect training results. A prior agribusiness training program in Ugunja sub-county, for instance, revealed that farmers valued the training's strategy, content, delivery, availability, and quality of capacity-building resources in order to improve their learning and knowledge transfer [8]. Thus, it is suggested that training and capacity building may be able to alter perceptions and provide farmers with the resources they need to increase output.

This strategy can be especially helpful for individual farmers in India, who are often extremely impoverished, have little access to resources and income, and depend heavily on extension services to support their livelihoods by getting advice on safer and more productive farming methods. More significantly, it may be used in fish farming, one of the most important agricultural subsectors that is vital to employment, nutrition, foreign exchange earnings, and socioeconomic stability in India's rural areas [9].

By offering fish farmers training programs and courses in collaboration with partner universities, the FAO builds capacity for aquaculture, inland fisheries, and marine fisheries [10]. Since its founding in 1945, FAO has consistently positioned capacity building at the center of their mission to combat hunger globally. The long-term effects of their project work on creating sustainable change were given more weight in the 2010 assessment of the FAO's capacity building strategy [10]. An earlier study conducted by the FAO in Uganda in 2012 [11] focused on creating a business strategy for the aquaculture industry in order to boost profits. Poor planning and record keeping by fish farmers led to inadequate strategic planning to expand the industry, according to issues the government highlighted.

FAO offered a targeted capacity training program that aimed to improve business planning and boost profit. The software tool that made it possible for the stakeholders to evaluate model fish farms brought to light the necessity of precise record keeping in order to track the benefits of particular actions [11]. Accordingly, the process by which "individuals, organizations, and society as a whole unleash, strengthen, create, adapt, and maintain capacity over time" [10] is referred to as capacity building in the framework of FAO Corporate Strategy. The conceptual and theoretical foundations supporting the training program that FAO provided as a case study for this research are introduced in the next section.

2.2 Conceptual and Theoretical Frameworks:

2.2.1 Problem-based Learning and Constructivism:

In the context of the development of fish farming, capacity building may entail contacts between farmers, buyers, traders, providers of inputs, government extension agencies, and creative stakeholders. To foster the transmission of knowledge and skills, this will necessitate ongoing organizational efforts and an interactive learning environment that allows these actors

to comprehend one another. PBL is linked to capacity building, which is a holistic approach to learning by doing.

PBL is a method of teaching where students actively learn while solving real-world problems that need further investigation for their solutions [12]. Through practice and reflection, students are able to create mental models for learning, solve problems in a group setting, and form self-directed learning habits [13]. As a result, learning in a PBL setting can be viewed as a contextual, cooperative, constructive, and self-directed activity.

Theories of how knowledge is created, communicated, and/or retained are linked to educational pedagogy. These theoretical stances can be applied to other domains where learning is integrated. Constructivism, behaviorism, and cognitivism are the three primary ideas that have been used in the context of learning. Behaviorism is more focused on how people behave than on mental processes. As a result, the learning process emphasizes student response to stimuli and repetition [14]. Focused on human cognition, cognitivism views learning as an internal process that takes place in the student's head, including thought [15].

As a result, prior knowledge is used to create new knowledge, and learning requires active student participation. Both behaviorism and cognitivism are teacher-centered methods in education, in which the instructor provides the pupils with knowledge [16]. As opposed to passively absorbing information, constructivism is a student-centered approach where students generate their own knowledge based on their own experiences [17]. Accordingly, constructivism's components include an active, collaborative approach to learning that incorporates reflection pertinent to the students, who are urged to behave independently and self-directedly.

PBL is a constructivist teaching methodology that emphasizes the importance of social interaction in a student's cognitive development. This theory's main tenet is that information is "constructed" by the student's cognitive activity, or prior knowledge, which includes continual engagement and involvement in the community in which the student lives. As a result, learning happens through active social contact during a purposeful PBL activity, and as a result, it may encourage lifelong learning, which is crucial for capacity building. However, the literature has not recognized the impact of constructivism theory or how it might be applied through PBL to maximize capacity growth in the fishing industry.

3. OBJECTIVES

In this article, we describe and analyze a capacity-building program that was created as part of an FAO Food Safety Program that included constructivist theory and other PBL components. The Jessore region of India was the focus of this course, which trained employees of local, district, and national organizations as well as local fish farmers on how to implement the FAO Food Safety Code of Practice on their farms.

4. METHODOLOGY

4.1 Data collection and data analysis:

The nature of a single PBL project (the case), its impact, and the importance of forming cooperative relationships in this setting were all thoroughly examined and described in this work using a qualitative intrinsic case study technique. A methodical approach to analyzing

and characterizing textual content is known as a qualitative analysis [18]. Consequently, a variety of information sources were gathered in order to create a comprehensive picture of the situation. Specifically, to support and strengthen the study's conclusions, historical materials pertaining to the project, such as desk audits, reports, and PowerPoint presentations, were gathered.

The following methods were used to analyze the data. First, patterns in the data were found, examined, and reported by a hybrid technique that combined deductive and inductive methods in a qualitative content analysis of the written reports [19]. First, a coding frame containing labels and/or definitions pertaining to PBL ideas was developed using a deductive approach based on social constructivism, an existing theory in PBL. This method made it possible to evaluate the key ideas to be examined in the data, their connections, and, consequently, what data ought to be gathered and examined [20]. Two researchers developed the coding frame. Then, using keywords that were inductively derived from the data, the identified theory-based PBL concepts were examined and expanded. 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:

This program's objectives were to increase food safety and lower the prevalence of food-borne illness in the populace, encourage cooperation and participation from stakeholders, and boost commerce in the fishing industry in order to establish an effective and functional food safety control system in India.

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

- Develop food safety guidelines for aquaculture GAQP in India.
- 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 pointswhere 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 theentire length of the respective value chains (from production/capture until the final sale of fishproducts to the consumer).
- Support the development of business partnerships between Dutch and/or Indiai food processors to strengthen key linkages of the respective fisheries value chains.
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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.

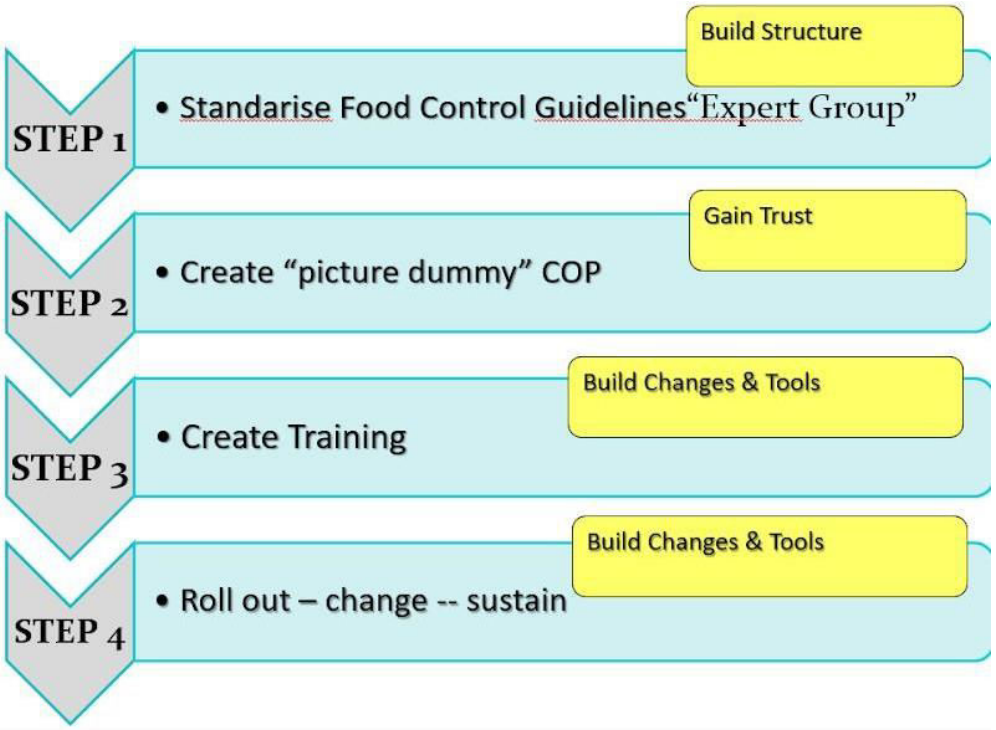

Fig. 1. Strategy for safe food supply

- ***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, India Food Safety network, NGO's and farmersto 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):

First, the issue was recognized. Due to fish farmers' noncompliance with food safety and quality requirements, India's export potential was not being completely utilized. Furthermore, there was no food control system in place that was being supervised by a qualified authority. As a result, these problems affected food importers, exporters, and consumers, making them hesitant to accept imports and fostering mistrust about the safety of the goods they were consuming. Therefore, the FAO recognized the fish farmers' failure to implement food safety standards as an issue, and the PBL approach was utilized to develop the program.

Identify potential solution(s):

Learning began with the presenting of a real-world problem. Here, the national food control rules were standardized by a committee of food safety experts who had prior understanding of the issue. They were able to get to a consensus over the content of the guidelines by specifically discussing the issues with food safety and control. In order to support the ensuing action plan, these talks included generating ideas, analyzing the issue at hand, weighing the significance of various pieces of information, and selecting which information should be applied to solve the problem. One important aspect of this PBL approach was the application of cross-disciplinary knowledge, where knowledge from multiple important actors was taken into account while creating the problem solution. This dynamic group exercise established a learning atmosphere where learning was supported and there was room for reflection and discussion of the opportunities and challenges farmers faced when implementing food safety regulations (i.e., analyzing the problem's cause-and-effect relationship). The main issues with food safety and control that fish producers confront were determined after this interactive approach. Specifically, farmers were unable to comprehend the current codes of practice due to their complexity. Therefore, developing food safety guidelines that fish farmers could easily understand was one possible way to solve this issue.

Develop the learning programme:

Based on the primary issues found, the program was created. Here, capacity building was established through the use of a cascade model of training, which included a network of change agents made up of 1500 lead farmers who earned a certified award, 300 lead trainers, and 98 master trainers. Up until it reached the last target group, fish farmers, the model was used to train various stakeholders at various levels. As a result, information and new skills spread throughout the system. The various tiers of the cascade model of training for this program are shown in Figure 2.

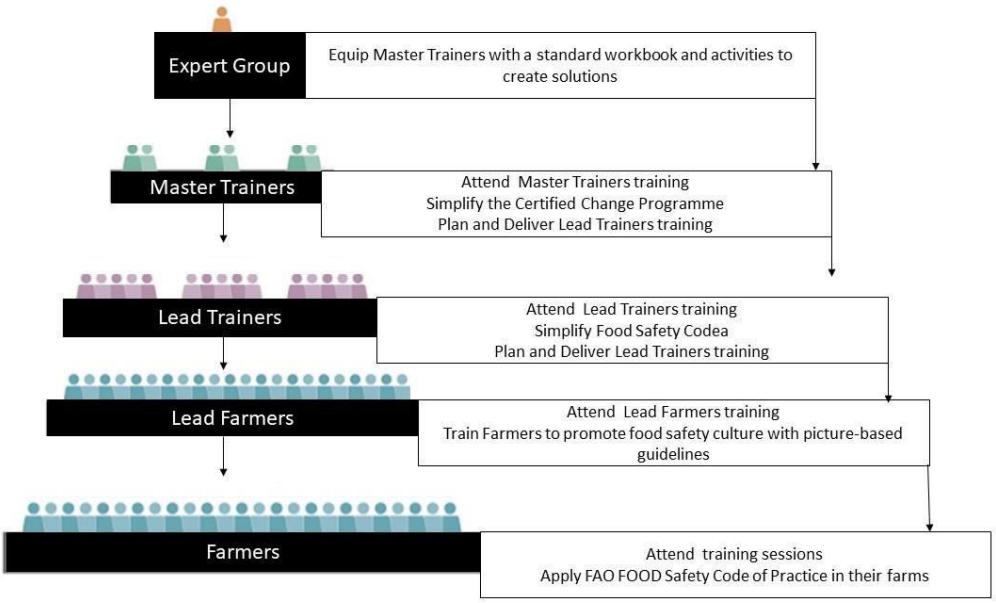

Fig. 2. Cascade model of training

First, based on a variety of tasks that the Master Trainers needed to perform, the Expert Group developed a standard workbook at level 4 (first year degree level). These activities included the Master Trainers developing case-study-based solutions for farm safety issues, creating basic food safety codes of practice, identifying any pro-poor codes, developing knowledge-transfer quizzes and enjoyable tasks, designing basic training exercises, presenting their work to other trainers, and getting feedback.

Second, Lead Trainers were trained by the Master Trainers. For the following stage of program delivery, this team condensed and streamlined the certified change program. In addition to industry professionals collaborating with suppliers, FAO national experts and international consultants, and non-governmental organizations (NGOs) with a background in food safety from the India Food Safety Network and Solidaridad NGO (Dutch FAO Partner), Master Trainers were mainly policy level government officers who would assist in developing the national guidelines. The level 3 Food Safety Hazard Analysis Critical Control Point (HACCP) program, which was based on change, was taught in the curriculum. The UK adult learning qualification (PTTLS), which was created to help trainers upskill adult learners, was also addressed in the curriculum.

Thirdly, Lead Trainers taught the Lead Farmers how to apply food safety regulations, which were then made simpler and applied to real farmers through participatory extension strategies like "farmer field schools." Specifically, the Lead Farmers assisted in choosing methods and activities to improve farmers' learning. As the training content become more straightforward and business-oriented, learning improved.

Then, by showcasing safe food production and consumption methods based on sound business principles, Lead Farmers educated farmers on how to advance a culture of food safety. The picture-based pamphlet was sent free of charge to all participating farmers.

Lastly, the training sessions were attended by fish farmers, who implemented the food standard guide on their farms. Here, farmers were able to progressively expand their knowledge, gain experience, and incorporate new information in manageable portions so they had time to process, think about, and incorporate the material into their fields.

Therefore, the following principles of PBL were applied in the training process within each layer ofthe 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 experienceof the group
- Learning was relevant and goal orientated, where people were more likely to apply newknowledge in their current context

These ideas are consistent with the social constructivism theory, which holds that social interactions in relevant contexts shape and impact learning [21]. As a result, the program offered a great chance for group inquiry and education throughout the problem identification and subsequent answers. In this case, the combined efforts of national and international players fostered collaboration and ownership, increasing the possibility of making an effect and bolstering national capabilities. Additionally, it made it easier for actors to commit to establishing a community of practice over the long term [22].

Specifically, by posing a real-world issue, these actors engaged in extensive candid conversations, compromises, and introspection, during which the PBL exercises consistently questioned their unique viewpoints and presumptions. These conversations brought to light the power dynamics between the many parties involved as well as the abilities needed to reach a consensus and a common understanding. As a result, they became more adept students, influential change agents, and more likely to become important "resources" for their nation. Additionally, this encouraged the development of leadership, problem-solving, and communication abilities.

Since their job was to direct others' learning without giving lectures, all of the trainers in this program were viewed as facilitators. This enhanced their ability to deliver instructional materials and activities that were appropriate for the participants' social and cultural backgrounds while guaranteeing their own comprehension of the knowledge and abilities required to address the issue. In this instance, the actors' mutual respect was modeled, their expertise and experience for each duty were valued, and Every actor, regardless of title, had the same value in this secure, nonjudgmental learning atmosphere, which increased the likelihood that they would communicate with one another during the show.
Vygotsky's social constructivism theory of the "zone of proximal development," which holds that learners' mental processes need to be improved through group activities facilitated by more seasoned people, was further validated by this method [17]. As a result, the student internalizes the lessons learned, including the strategies used in these exchanges to illustrate a concept, and

gains the capacity to carry out comparable tasks on their own. Consequently, a key strategy for learning and interacting with one another was cascade modeling of training.

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 withhuman 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.

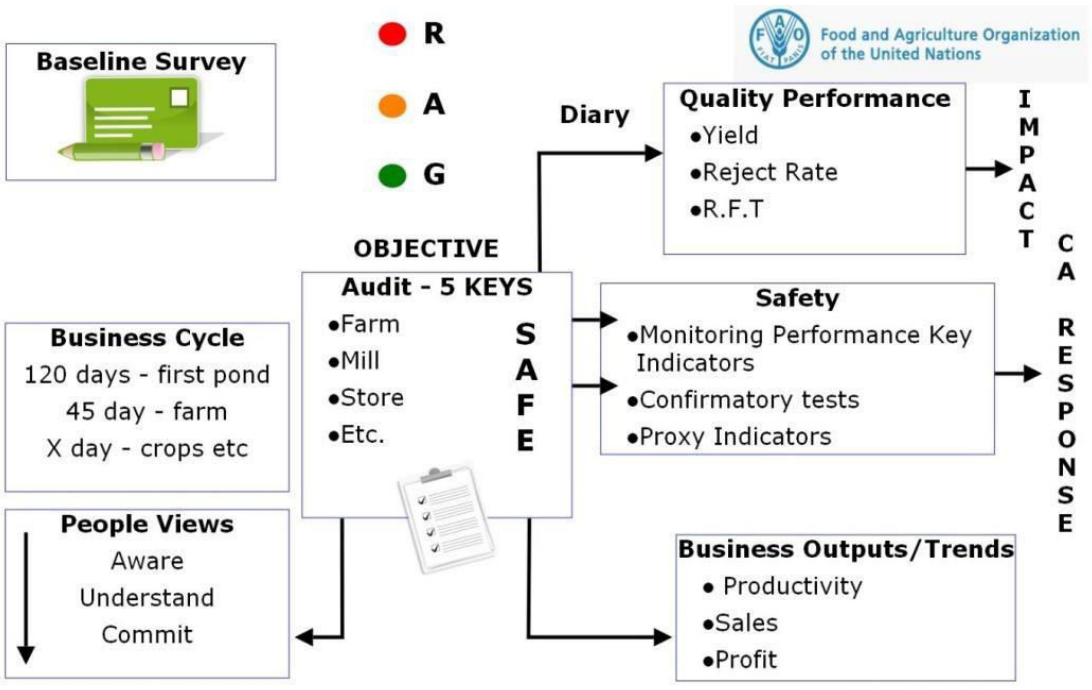

Fig. 3. Food Safety Control - Performance Measurement System [23]

This program monitoring and assessment highlights another PBL characteristic, which is that students' learning and development are gauged in relation to the PBL's objectives. In this case, the program's baseline and follow-up audits of fish farmers, which evaluated their skills, knowledge, and attitudes, can be viewed as reliable indicators of learning evaluation. Thus, making sure they were reaping the benefits of the program strategy as planned.

Presentation of findings:

Following the implementation and analysis of the potential solution, the program—the solution—was released to the public and given to several audiences. In order to convey the

results and provide justification for the solution's adoption, several written reports and oral presentations were produced. As a result, the Solidaridad team collaborating with the FAO on food safety received training in codes of practice and used the FAO project's performance evaluation system to present their findings and changing-minds strategy at the World Seafood Congress. Ahmad, Ryderand 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 Departmentthrough their Senior Fishery Officer, Golam Rabanni. Here, the Secretary of State for Agriculture andFisheries (MINFAL), Shelim Afroza, attended the event with the India UK High Commissionerto 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:

Human awareness benefits from socially relevant activities, and this program's usage of tools like picture-based guidance affected cognition [24]. Positive behavioral adjustments and practices among the participating fish farmers have been encouraged by the picture-based method of using a printed book to convey the codes of practice for food safety and control in the fish value chain in a more straightforward and useful manner. Because fish farmers were a low-literate group that was unable to comprehend the complicated terminology offered in text format in the original document of food control recommendations, this method of communication proved to be more effective.

More effectively than the lengthy facts in a formal paper, the use of visuals or photos to illustrate the safe steps farmers should take gave them a clear concept of what they needed to think about and sparked their enthusiasm in trying these practices. Furthermore, individuals were more eager and driven to alter their behavior when they could see the financial advantages of such actions. As a result, this has enhanced their educational experience, encouraged their involvement, made communication and teamwork easier, and enhanced the way in which tacit knowledge is expressed to perhaps effect change on an individual or communal level.

5.2.2 Business Performance:

The performance of fish farms has been altered as a result of the implementation and education of safe food practices. First, the productivity of fish farms increased, as evidenced by the feed conversion ratio, which increased from 2.5 to 1.5, showing that feed was effectively transformed into fish weight increases. Farmers were able to readily detect the improvement in their daily expenses as a result of this and the additional decrease in the amount of medication utilized. After then, waste was seen to have decreased. Specifically, the protection of juvenile fish in nets decreased fish mortality from 20% to 5%. As a result, growers were able to sell more fish per production cycle. Additionally, consistent feeding increased the quality of the fish.

As a result, improved fish quality and shape were noted, as well as improved fish size consistency (fall 20 mg size). As a result, stores were more likely to accept fish, while fish producers received no rejections. Retailers then began to accept it. Fish farmers were able to increase sales, revenue, and profits as a result of the FAO Food Safety Code's improved production and education about effective food safety procedures. Specifically, they were able

to lower the price of fish per kilogram, increase demand and sales, and acquire a diverse range of new wholesalers and retail clients. 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.

6. CONCLUSION

This curriculum emphasized the need of developing and implementing a PBL strategy grounded in social constructivism, a theory of adult learning and teaching. As a result, the various players in the fishing industry learnt by doing in each step of the cascade model of training, used new knowledge in their daily work, and brought experience and expertise to learning settings. They become better learners and gain flexibility in handling different situations in the future by creating a community of practice that is receptive to knowing how other people view a problem. Consequently, PBL offers a platform for experiential, transformative, and socially constructed learning, all of which are important for behavioral change tactics and maximizing capacity building.

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