Analysis of e-readiness on fish disease diagnosis applications and e-commerce applications to improve the competitiveness of the aquaculture sector in Indonesia

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***Abstract*— As a maritime country, Indonesia's fisheries and marine sector is the focus of the government to be developed. This sector has enormous potential. This can be seen from the GDP growth in the fisheries sector which is always above the national GDP and agriculture sector GDP, with a growth value of 6.79% until the third quarter of 2017. Ironically, this has no direct impact on the welfare of fishermen in Indonesia. Fish farmers and fishermen still face various obstacles in running their businesses. Based on the level of production, aquaculture has a very high production level, reaching more than 70% of the total national fisheries production. In order to improve the competitiveness of aquaculture products, optimal utilization of digital technology is needed from upstream to downstream. When fish farmers are able to guarantee that their products are of good quality free from disease pathogens and free antibiotics, this will be a good added value for farmers. Moreover, when they have the ability to reach market access through e-commerce applications, the welfare of fish farmers can become a reality. Although the existence of Information and Communication Technology (ICT) is known to be able to encourage the strategic role and competitiveness of businesses, its utilization among small businesses, especially fish farmers, is still relatively low. So this study aims to (1) Measure the readiness of fish farmers using upstream and downstream digital applications by measuring e-readiness index; (2) Analyzing the behavior of fish farmers on the acceptance and use of technology, and their impact on increasing the scale of business; and (3) Formulating an effective strategy for fish farmers based on mapping the existing conditions. As an initial portrait, the research was carried out in the West Java region. The analytical tool used in this study is descriptive analysis, Cluster analysis K-means, Structural Equation Modeling (SEM) and Analytical Hierarchy Process (AHP). The research hypothesis in general is that farmers who have a high level of e-readiness index category will be better at utilizing and using related digital applications. So in the end the optimal use of digital applications can increase business scale and competitiveness in the market.**

Keywords*— *technology acceptance model, aquaculture, e-readiness, fish disease diagnosis, internet marketing

I. INTRODUCTION

As a maritime country, Indonesia has a huge amount of marine wealth. According to UNDP data in 2017 the country's sea wealth reached USD 2.5 trillion per year, but due to technological limitations, the utilization of resources is still not optimal, which is only 7% [1]. Until now, fisheries production in Indonesia has been dominated by aquaculture. BPS data for 2017 shows that until the fourth quarter of 2017, the total national fishery production reached 23.26 million tons which consisted of 6.04 million tons of capture fisheries and 17.22 tons of aquaculture [2]. This illustrates that Indonesian aquaculture has the potential to be developed both to meet domestic and foreign consumption.

Unfortunately, some classic problems such as the susceptibility of fish diseases and environmental health control become obstacles that can interfere with the productivity of fish farming. Aeromonas motile virus is one of the diseases that often arise in shrimp farming. While the potential risks of cross-border disease types that also threaten the aquaculture business include Acute Hepatopancreatic Necrosis Disease, White Feces Syndrome, Enterozyton Hepatopenaei, and Tilapia Lake Virus [3]. Apart from disease attacks, another factor causing mass fish mortality is a decrease in environmental quality such as extreme weather conditions with high rainfall intensity which can bring back disease pathogens. In 2016, the Ministry of Maritime Affairs and Fisheries noted that there were around 4,725 tons of dead fish or around 0.95% of the total national freshwater floating net cage production. If we assume that the price of fish is IDR 10,000 per kilogram, the economic loss due to this case will reach IDR 47.25 billion. The development of a disease control system is an urgent for fish farmers. How to help fish farmers to diagnose, treat and prevent fish diseases on time and effectively is a serious challenge in Indonesia. The diagnosis of fish disease is a rather complicated process in aquaculture production activities [4]. The fact is that fish that have been infected will usually die very quickly before proper handling is carried out which ultimately risks causing death of the whole pond [5]. Therefore, the existence of digital applications for diagnosis of fish diseases needs to be optimized by fish farmers to maintain the quality and productivity of fish.

In addition to the upstream aspects related to disease and aquaculture product quality, downstream side is also important. The presence of digital technology is expected to create efficiency in the supply chain of the fishing industry. The complexity of the supply chain in this industry has resulted in an increasingly weak bargaining position of fish farmers. It is not surprising that there are still many fish farmers and fishermen who live below the poverty line. Through the adoption of digital technology, it is hoped that farmers will be able to sell their products directly to consumers without having to go through a long supply chain. So that fish farmers will enjoy a better selling price, while consumers also get prices far cheaper than before.

In order to producing highly competitive products, Indonesian aquaculture products need to be supported by the efficient use of technology from upstream to downstream. However, one of the main challenges in introducing new technology is its uptake. In small and medium scale businesses, the basic foundation of business success depends on the entrepreneurial self-efficacy from business actors [6]. Entrepreneurial spirit or entrepreneurial self-efficacy includes the belief of individuals to accept and make changes, capture market opportunities and develop their resources [7]. The higher entrepreneurial self-efficacy will further improve sales performance and business sustainability. In the use of new technology, the biggest obstacle comes from the internal users. They are often resistant to change so that technology adoption cannot be done quickly.

So it becomes necessary to conduct a technology readiness analysis that measures the readiness of fish farmers to accept new technologies. The main research objective of this research is to study the ability of farmers to change their behavior towards more sustainable ways of production so as to be able to improve their bargaining position in the market which has an impact on improving welfare. Following are specific aims of this study to (1) Measure the readiness of fish farmers using upstream and downstream digital applications by measuring e-readiness index; (2) Analyzing the behavior of fish farmers on the acceptance and use of technology, and their impact on increasing the scale of business; and (3) Formulating an effective strategy for fish farmers based on mapping the existing conditions. The scope of the study includes digital applications in the upstream sector regarding fish disease diagnosis to maintain the quality and productivity of fish, as well as in the downstream sector such as e-commerce applications.

II. MATERIALS AND METHODS

A. Technology Readiness

The readiness of users when accepting technology is very important to understand. By adopting the technology system they can feel the extent of the ease and difficulties encountered. Furthermore, user perceptions will be identified based on 4 criteria that measure the level of optimism, innovativeness, discomfort, and insecurity. The optimistic factor is defined as the belief that easy to understand and master the technology, innovative factors measure the tendency to be a pioneer in the use of technology, the discomfort factor is reflected by the perception of anxiety about technology and the insecurity factor is explained by the perception of users who are worried or feel insecure when using technology [8]. The four criteria will then be calculated as contributors and inhibitors that form the Technology Readiness Index as follows.

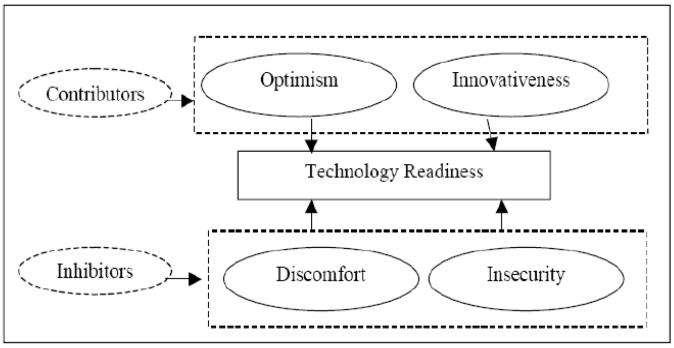

Fig 1. Technology Readiness Index Model

B. Technology Acceptance

Technology Acceptance Model (TAM) explains how individuals accept the concept of new technology and the factors that influence acceptance [9]. This model is a development of Theory of Reasoned Action and Theory of Planned Behavior which formulates what factors support individuals to increase their interest in using new technology. After several previous studies trying to make the formulation of the TAM model for every aspect of business there. Finally, a new model of technology acceptance, namely the Unified Theory of Acceptance and Use of Technology (UTAUT), was developed which formulated four core determinants of intention and use including performance expectations, business expectations, social influence and facility conditions which were assessed based on four moderating variables such as gender, experience, age and voluntarism of use [10].

C. Conceptual Framework Model

Conceptual modeling in this study refers to the UTAUT model. This model consists of 6 latent variables and 4 moderation variables. The latent variables of the study are performance expectancy, effort expectancy, and social influence and facilitating conditions. Where the model is moderated by several criteria such as: gender, experience, age and voluntary use. In order to obtain a more in-depth study, each latent variable will be explained by each indicator. The hypotheses in this study are as follows:

- H1: There is a significant influence between performance expectancy on behavioral intention
- H2: There is a significant influence between effort expectancy on behavioral intention
- H3: There is a significant influence between social influence on behavioral intention
- H4: There is a significant influence between facilitating conditions on use behavior

H5: There is a significant influence between behavioral intention on use behavior

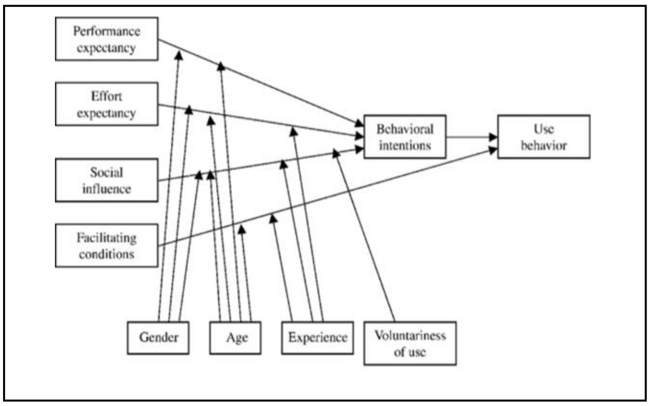

Fig. 2 Conceptual Framework Model

D. Research Object

Location of the study will be conducted in several centers of aquaculture industry in West Java. West Java Province was chosen because it has the highest level of production compared to other regions on the Java island. The object of research is aquaculture farmers who have never used digital fisheries technology. The number of respondents taken using quota sampling in accordance with the number of fish farmers in West Java.

E. Data Analysis

There are two main analyzes in this study namely cluster analysis and structural equation modeling. K-Means is a non-hierarchical data classification method that groups data into one or more classifications or is called cluster analysis [11]. In this method, data that has the same characteristics are grouped into one and the same classification and data that has different characteristics are grouped into other groups. In this study based on the perception of the respondents will be classified based on the level of technology segments as follows [8].

The next analysis is Structural Equation Modeling (SEM), analysis technique that can test the relationship between variables and indicators so that a comprehensive picture of the model is obtained. SEM is a multivariate statistical analysis technique that allows researchers to examine the direct and indirect effects of complex variables, both recursive and non-recursive simultaneously to get a comprehensive picture of the model [12]. In this study the method used is SEM analysis with a covariance based approach.

III. RESULTS AND DISCUSSION

In the first stage, fish farmers will be clustered based on the e-readiness approach. After mapping the technology segmentation and also the TRI index, an analysis of the behavior of fish farmers will be carried out on the acceptance of new technologies, especially the application of digital fish disease diagnosis and e-commerce. Testing this behavior using the TAM approach that will be analyzed by Structural Equation Modeling (SEM). The results of this test will indicate which factors influence the attitude and use of digital technology.

TABLE 1 CHARACTERISTICS OF TECHNOLOGY SEGMENTATION

Technology Segment	Optimism Level	Innovativeness Level	Discomfort Level	Insecurity Level
Explorers	High	High	Low	Low
Pioneers	High	High	High	High
Skeptics	Low	Low	Low	Low
Paranoids	High	Low	High	High
Laggards	Low	Low	High	High

After knowing the inhibitor and contributor factors in the adoption of digital technology, the next research is to formulate an effective policy strategy on the role of digital technology starting from upstream (fish quality) to downstream (market access). The sustainability of the fish farming business also needs to be studied in more depth. So that in the future a progress measurement of the usefulness of this digital technology will be carried out through a comparison analysis of business conditions before and after using digital applications.

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