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TECHNOLOGY DRIVEN DECISION MAKING AMONG PURSE-SEINE FISHERS IN THE CENTRAL REGION OF GHANA: AN APPLICATION OF THE EXTENDED TECHNOLOGY ACCEPTANCE MODEL (TAM3)

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Abstract

The introduction of the Sound Navigation and Ranging (SONAR) technology in recent years to help fishers detect changes in bathymetry, or help locate aggregations such as fish schools, underwater formations among others using sound waves transmitted from on-board the vessel has received little attention from the scientific community. With this equipment, crew on board vessels easily identify fish schools, aggregations and bathymetry anomalies for successful purse-seine operations. The study was conducted to determine how purse-seine fishers have adopted SONAR and the factors influencing their adoption decisions. Little empirical data exists on adoption of this technology in Ghana. Utilising the extended technology acceptance model (TAM3), and a validated structured questionnaire, 161 fishers were surveyed from three fishing communities in the Central region of Ghana. With the help of SmartPLS 4.0, partial least squares structural equation modelling (PLS-SEM) was used for data analysis. The results showed that, perceived ease of use, perceived usefulness, and subjective norms accounted for 38% of the variance in the behavioural intention of purse-seine fishers to adopt SONAR whiles behavioural intention predicted 8% of the variation in their use behaviour of the technology. The results indicate that, as the fishers perceive SONAR to be useful and easy to use, and important people like vessel owners, family and friends thinking that the fishers should use the technology, these significantly influence their behavioural intention to adopt SONAR and ultimately their adoption behaviour. We recommend that the Fisheries Commission of Ghana should leverage on the characteristics of SONAR as ease of use and usefulness as well as the influence of vessel owners, family and friends to drive its adoption in the study area.

Keywords: Central region, Extended technology acceptance mode (TAM3), Ghana, Sound Navigation and Ranging (SONAR), Partial least squared structural equation modelling (PLS-SEM), Purse seine

Introduction

For many people in developing countries, fishing is a significant source of employment, income, and livelihood, and also serves as a primary source of fish meal and raw materials for fish feed for the

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aquaculture and poultry industries (Fisheries Commission-Ghana, 2022). For example, in Africa, about 35 million people representing 5% of the population, rely entirely on the fishing industry for their livelihood (FAO, 2001). In Ghana, due to a long-standing fishing tradition dating from pre-colonial times, the country has a well-developed fishery industry and skilled fishers compared to other African countries. The development of the marine fishery sector in Ghana was primarily influenced by the arrival of European traders, who employed fishermen as canoe men to ferry passengers and cargo from their ships to the beaches and vice versa (Law, 1989; Quagrainie & Chu, 2019). Fish is important for meeting the demand for animal protein, micronutrients, and critical fatty acids and serves as the most preferred source of animal protein in Ghana (Asiedu et al., 2018), and is essential for nutritional food security (Fisheries Commission-Ghana, 2022). Ghanaians are reported to consume roughly 25 kilogram of fish annually per person which is higher than the global average of 20 kg (FAO, 2016).

It is worth noting that the marine fishery sector accounts for over 80% of all fish landed locally (FAO, 2001; Nunoo et al., 2014). Approximately 10% of Ghana's active labour force is employed by the sector as fishermen, processors, boat owners, boat builders and other ancillary workers (Fisheries Commission-Ghana, 2022). According to the Ghana statistical Services (GSS), percentage share of the sector to gross domestic product (GPD) increased from 0.94% in 2020 to 2.30% in nominal terms 2022 (GSS, 2023). Small pelagics, large pelagics, and demersal species are among the marine fisheries resources exploited by Ghanaian fishers along the 550 kilometers of coastline along the Gulf of Guinea (Fisheries Commission-Ghana, 2022). The artisanal or small scale, semi-industrial or inshore, industrial or deep sea and tuna fleets make up the subsectors of Ghana's marine sector which play an important role in poverty reduction and livelihood (Quagrainie & Chu, 2019), nutritional needs and social well-being in coastal communities (Ayilu et al., 2023).

An open access, multi-gear fishery sector with over 14,600 dugout canoes as the primary vessels contributes more than 71% of the total marine catches, which consist primarily of small and large pelagic species exploited by artisanal and inshore subsectors (Fisheries Commission-Ghana, 2022). This makes it imperative for the sustainability of the marine sector (Quagrainie & Chu, 2019). The artisanal fishing sector is quite complex due to the diversity and large quantity of fish captured, as well as the multiplicity and high number of fishing gears and crafts used there (Dovlo et al., 2016). Like any industry, the artisanal and inshore subsectors are faced with a myriad of challenges including illegal fishing, over exploitation, activities of industrial trawlers and climate change which negatively influence the activities of artisanal and inshore fishing activities leading to declining fish stocks (Afoakwah et al., 2018; Ankrah, 2018; Ayilu, 2023). In an effort to curb overfishing and effect of climate change, the government, international organisations, and multinational institutions have advocated for the mechanisation of the marine fishing sector for economic advancement and modernisation (Ayilu et al., 2023).

Mechanized fishing was introduced in 1946; and efforts intensified in the 1960's due to efforts of Ghana's first president, Kwame Nkrumah (Lawson, 1968). During this time, mechanized fishing vessels in the form of trawlers were introduced (Nunoo et al., 2014). These vessels employed technologies first deployed during the World Wars such as radar and Sound Navigation and Ranging (SONAR) technology to detect changes in bathymetry, or help locate aggregations such as fish schools, underwater formations, among others using sound waves transmitted from on-board the vessel with a device into the water (National Oceanic and Atmospheric Administration, 2023). With this equipment, vessels could easily identify fish schools or uneven bottoms (Lawson, 1968; The Bank of Ghana, 2008).

Even though industrial fleets (trawlers and shrimpers) employed SONAR technology in Ghana when the fishery sector was mechanized; artisanal and inshore fishers did not use such technologies (Nunoo et al., 2014). Fishers depended on their experiences and navigational skills to determine location as well as used physical characteristics of the sea to predict fishing grounds (Dovlo et al., 2016). Nonetheless, such 'conjectures' were often deceptive and many fishers frequently lost their navigation abilities, especially on cloudy nights when the moon could not be visible (Nunoo et al., 2014). These were gross limitations that affected the time fishers spent at sea; affecting the duration of fishing trips (Abissath, 2015). However, in recent years, the advent of portable SONAR devices, has led to Ghanaian fishers in the artisanal and inshore sector employing this technology. Fishers have reported the use SONAR technology to locate previous fishing grounds as well as identify new ones (Abissath, 2015). The portable SONAR devices also function as "SONARs" to enable vessel crew identify fish aggregations in the water thus making purse-seine activity more efficient (Lawson, 1968; The Bank of Ghana, 2008). Fishers who operate purse seine gears for exploitation, that is artisanal and inshore fishers generally adopt the technology.

The adoption decision of purse-seine fishers of SONAR device and the factors influencing their adoption decision in Ghana, especially in the Central region, has received little attention from the scientific community. The Central region is one of the coastal regions in Ghana where SONAR has been adopted by fishers (Dovlo et al., 2016). This study utilized the third generation of the technology acceptance model (TAM3) to examine the adoption decision of purse-seine fishers (Venkatesh & Bala, 2008). TAM 3 is a unique (Holden & Karsh, 2010), widely utilized approach (Ammenwerth, 2019) and well-known model for examining the adoption of novel technologies (Gansser & Reich, 2021). Many scholars have utilized TAM3 to predict the adoption behaviour of actors in different fields including agricultural education (Berhanu et al., 2017), cloud computing (Nikolopoulos & Likothanassis, 2018), assistive technologies for people with cognitive impairment (Dirks & Bühler, 2018). Others are health informatics (Ammenwerth, 2019), block chain technology (Ferri et al., 2020), mobile learning (Al-Rahmi et al., 2021), use of information communication technology among extension agents (Kabir et al., 2022). Furthermore, scholars have significantly advanced the area of small-scale fisheries by examining coastal livelihoods, food security, and poverty in relation to the use and governance of marine resources and the welfare of fishing players in Ghana (Afoakwah et al., 2018; Ankrah, 2018; Ayilu, 2023; Ayilu et al., 2023). None of these studies focused on the adoption decision of fishers to use SONAR for fishing exploitation and the factors influencing the decision. Our study sought to fill this knowledge gap on SONAR driven decision making among purse-seine fishers in the Central region of Ghana. The specific objectives were to examine the:

1. use behaviour of fishers towards SONAR technology,
2. behavioural intention of the fishers to accept SONAR technology,
3. perceived usefulness of SONAR technology,
4. perceived ease of use of SONAR technology and
5. effect of SONAR technology on the social image of the fishers.

Theoretical framework

The study was supported by the extended technology acceptance model TAM3 by Viswanath Venkatesh and Hillol Bala in 2008 (Venkatesh & Bala, 2008). TAM3 which has its roots in adoption studies in information communication technology (Kabir et al., 2022; Lai, 2017; Maican et al., 2018) has been extensively tested in agriculture (Sharifzadeh et al., 2017; Tohidyan Far & Rezaei-Moghaddam, 2018; Verma & Sinha, 2018; Eweoya et al., 2021; Mccormack et al., 2021; Saravanos et al., 2022). TAM3 posits that three constructs, perceived usefulness (PU), perceived ease of use (PEOU), and subjective norm (SN) predict an individual's behavioural intention (BI) to use, which ultimately predict actual use behaviour (UB) of a technology (Venkatesh & Bala, 2008). Use behaviour is seen as the actual behaviour of the person toward the technology (Venkatesh et al., 2012) which is predicted by behavioural intention (BI) (Venkatesh & Bala, 2008; Lai, 2017).

Warshaw and Davis (1985) posited that BI is the 'extent to which a person has formulated conscious plans to perform or not perform a specific future behaviour'. Venkatesh and Bala (2008) noted that, perceived usefulness, perceived ease of use, and subjective norms are three variables which are important predictors of BI. However, the effect of PU on BI is stronger than the other PEOU and SN. Venkatesh and Davis (2000) defined perceived usefulness as the extent to which a person believes that using a technology will improve his or her job performance. Venkatesh (2000) also defined perceived ease of use as the extent to which an individual believes that using a technology would be free of effort. Furthermore, Venkatesh and Bala (2008) posited that subjective norm is the 'extent to which an individual perceives that persons who are important to him/her think that he/she should use the technology.

The anchor variables of perceived ease of use are anxiety (ANX), perceived enjoyment (ENJ), playfulness (PLAY), self-efficacy (SE), perceived behavioural control (PEC) and Objective usability (OU) (Venkatesh & Bala, 2008). Venkatesh (2000) defined ANX as "the degree of an individual's apprehension, or fear, when he/she is confronted with the possibility of using the technology (p. 349)." PLAY is "the degree of cognitive spontaneity in technology interactions"(Webster & Martocchio, 1992, p. 204). Venkatesh (2000) also defined ENJ as the extent to which "the activity of using a specific technology is perceived to be enjoyable in its own right, aside from any performance consequences resulting from technology use (p. 351)." SE is defined as the degree to which an individual believes that he/she has the ability to perform a specific task/job using the technology (Compeau & Higgins, 1995). PEC is the extent to which the individual believes that organizational and technical resources exist to support the use of the technology (Venkatesh et al., 2003). Whiles OU is "comparison of technology base on actual level (rather than perception) of effort required to complete specific task (Venkatesh, 2000, pp. 350-351)." OU was not utilised in this study due to our inability to compare abilities of the fishers with SONAR to ability of an expert to use the technology.

The literature points outs that PEOU, SN, image (IMG), job relevance (REL), output quality (OUT) and results demonstrability (RES) are the drivers of perceived usefulness (PU) (Venkatesh & Bala, 2008). Moore and Benbasat (1991) defined IMG, as the degree to which the individual perceives that use of a technology will enhance his/her social status or social system and RES, as the extent to which the individual believes that the results of using a technology are tangible, observable and communicable. Venkatesh and Davis (2000) also defined REL as the degree to which the individual believes that the target technology is applicable to his/her job and OUT as the extent to which the individual believes that he/she can use the technology to perform his/her task well. Previous studies have demonstrated the validity of TAM3 for predicting the adoption behaviour and factors influencing the adoption decisions effectively (Sharifzadeh et al., 2017; Tohidyan Far & Rezaei-Moghaddam, 2018; Verma & Sinha, 2018; Manis & Choi, 2019; Al-Rahmi et al., 2021; Al-Rahmi et al., 2021; Eweoya et al., 2021; Mccormack et al., 2021; Saravanos et al., 2022). The study utilised TAM3 to examine SONAR driven decision making among purse-seine fishers in the Central region of Ghana. Figure 1 presents the conceptual framework of the study.

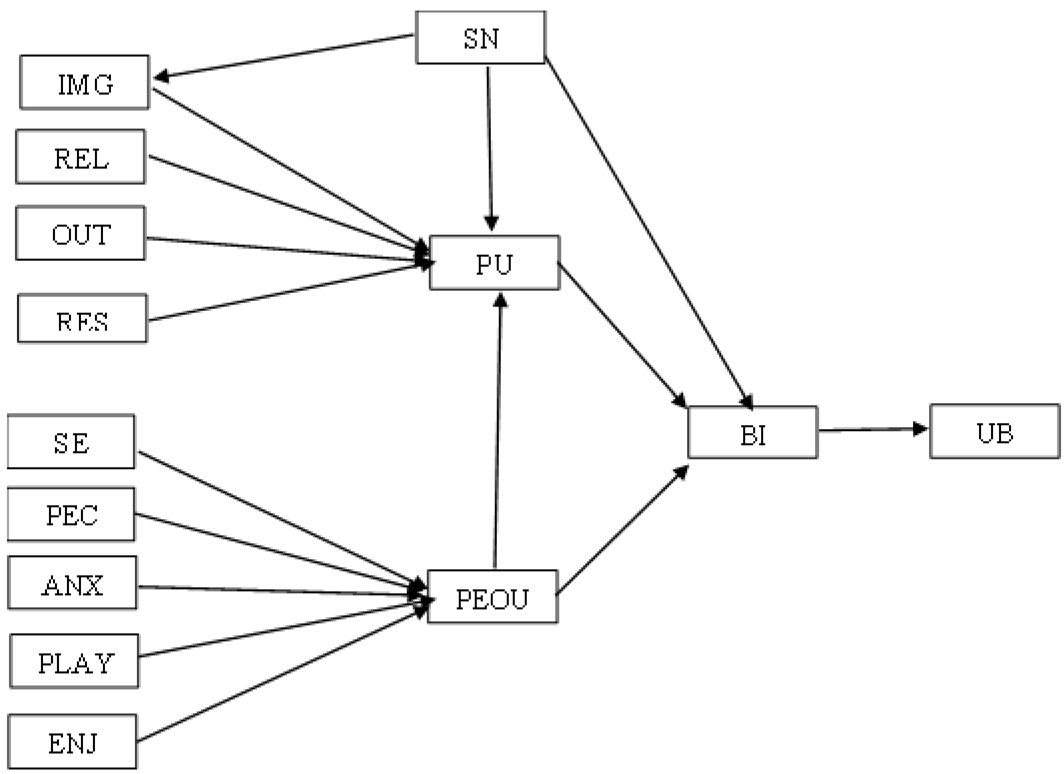

Figure 1: Conceptual framework of the study showing relationships in TAM3

Materials and Methods

Profile of the study area

The study area is the Central region of Ghana, situated in the south-western centre of Ghana (Ministry of Local Government and Rural Development [MLGRD], 2022). The region's population stands at 2.86 million people according to the 2021 national population and housing census (GSS, 2021). The Central region shares borders with the Western region to the west, Ashanti region to the north, Greater Accra region to the south-east, and Eastern region to the north-east (GSS, 2021). The region is boarded to the south by the Gulf of Guinea with a coastline of 150 km, the longest in Ghana (MoFA, 2023). The study was conducted in three (Effutu Municipal, Gomoa West District and Komenda, Edina, Eguafo, Abrem Municipal) of the nine coastal districts in the Central region of Ghana (Dovlo et al., 2016). In these three districts, the survey was carried-out in Winneba, Apam and Elmina respectively.

In Winneba, artisanal fishers dominate at the landing beaches (Ankrah, 2018). Apam and Elmina on the other hand, are dominated by both artisanal and inshore fishers who operate the landing beaches (Dovlo et al., 2016). In all three locations, set nets, gill nets, drift gill nets, encircling nets and hook-and–line gears are deployed by artisanal fishers; while inshore vessels deploy purse seines and trawls to coincide with small pelagic and demersal fishing seasons (Dovlo et al., 2016). The dominant fish species landed in these three communities include small pelagics (Sardinellas, anchovy and chub mackerel); demersals such as sparids and burrito (Brahydeuterus auritus) and grouper; to large pelagics and tunas. Figure 2 depicts the map of the study area with the regional and national contexts.

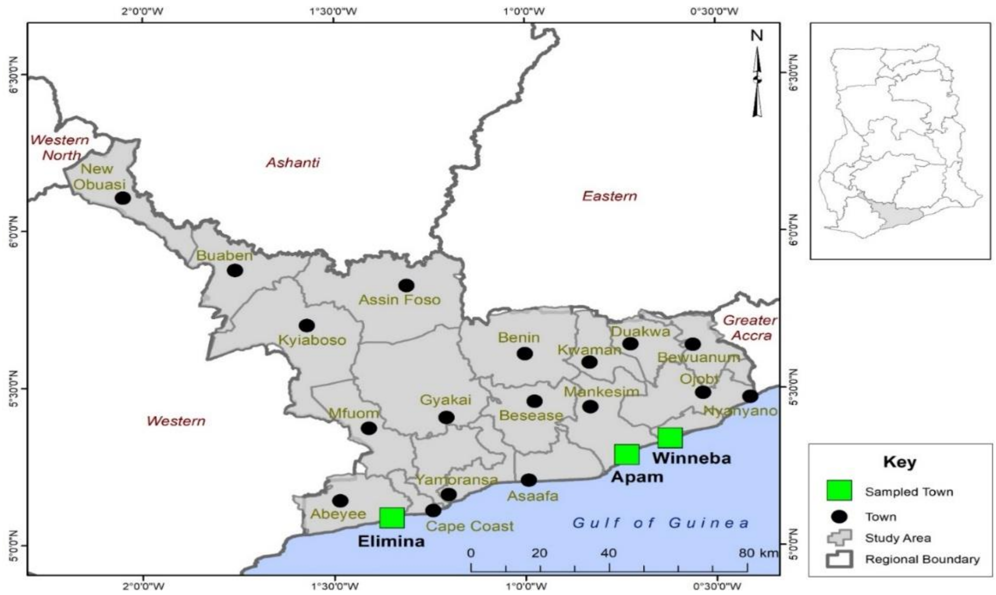

Figure 2: Map of study area within the regional and national contexts

Design, sampling, sample size, instrument and data collection procedure

Descriptive survey design was utilized to sample 161 purse-seine fishers through face-to-face interviews in three fishing communities in the Central region of Ghana (Zangirolami-Raimundo et al., 2018). The study population were artisanal and inshore fishers who used SONAR for fishing in the Central region (Kesmodel, 2018). Adopting the multi-stage sampling technique, respondents were selected for the study. The first stage involved the random selection of three districts (Effutu Municipal, Gomoa West District and Komenda, Edina, Eguafo, Abrem Municipal) out of the nine coastal districts in the Central region. In the second stage, the district capitals (Winneba, Apam and Elmina) which also had the highest number landing beaches were selected. In the third stage, fishers who operate with purse seine were conveniently selected as respondents of the study. The fishers were visited on a Tuesday that are fishing holidays in the respective communities (Adjei & Sika-Bright, 2019). To determine the adequacy of the sample size, Chin and Newsted (1999) advised that a sample size of 150 or more can be considered adequate for PLS-SEM. Again, Cohen's, (1992) sample size criteria was used. The rule state that sample size of 156, 59, 27, and 18 respondents are needed to obtain statistical power of 80% for detecting R2 scores of 0.10, 0.25, 0.50, and 0.75 respectively, when there are 10 exogenous constructs in the measurement and structural model. Therefore, Cohen's (1992) criterion, our sample size of 161 is considered appropriate because there are ten exogenous constructs in our measurement and structural model.

Structured questionnaire divided into two parts was used as the instrument for data collection (Kesmodel, 2018). Part one of the instrument elicited data on the demographic characteristics of the respondents. Variables such age, fishing experience, level of education, marital status, role on vessel and years of working experience with SONAR were measured. Part two gathered data on the TAM3 constructs which were adopted and modified in line with context of this study, and included, anxiety (4 items) behavioural intention (3 items), image (3 items), perceived ease of use (5 items), playfulness (4 items), and perceived enjoyment (3 items). The rests were, perception of external control (6 items), perceived usefulness (4 items), output quality (3 items) job relevance (3 items), results demonstrability (4 items), self-efficacy (4 items), and subjective norms (4 items), and use behaviour (1 item) (Venkatesh & Bala, 2008). A seven-point Likert type scale of strongly disagree to strongly agree were used to elicit data from the purse-seine fishers on their level of agreement with the statements listed on the structured questionnaire.

Two experts in agricultural extension and fishery science from the Department of Agricultural Science Education and Biology Education ensured the face and content validity of the instrument. The instrument was then pre-tested with 20 artisanal fishers who did not form part of the main survey. The internal consistency of the structured questionnaire was calculated using MacDonald's Omega reliability coefficients with International Business Machines Corporation's Statistical Package for Social Sciences (IBM SPSS) version 26.0 (Hayes & Coutts, 2020). With an Omega coefficient better than 0.70, all constructs demonstrated adequate reliability (Ravinder & Saraswathi, 2020). After pre-testing, eight trained enumerators administered the final structured questionnaire during a series of fishing holidays where participants were gathered at the beach mending their seines. The University of Education, Winneba's Ethical Review Board gave its approval before data collection. All respondents were also asked to certify that they agreed to take part in the study voluntarily. The respondents were given the option to withdraw if they did not want to participate in the study. Face-to-face interviews were used to gather data, and enumerators accurately documented respondents' responses after accurately translating the questions on the structured questionnaire to respondents. Data collection was done from March 14, 2023 to April 4, 2023. In all 161 participants (64 from Apam, 50 from Elmina, and 47 from Winneba) responded to the survey over a three-week period of data collecting during fishing holidays.

Data processing and analysis

Data were coded, cleaned and processed for analysis with IBM SPSSS version 26.0 and SmartPLS 4.0 (Ringle et al., 2022). Frequencies, percentages, mean scores, and standard deviations were used to analyse the demographic characteristics whiles partial least square-structural equation modelling (PLS-SEM) was used to compute the relative effect of the TAM3 factors on the decision of the purse seining fishers to the acceptance of SONAR for fishing. The overall mean scores for all statements included in each TAM3 construct were utilized to get the final score for each construct. The likelihood of linear relationships between the exogenous and endogenous constructs in the TAM3 constructs was examined using PLS-SEM. At p-values of 0.05 or p 0.01, significant relationships were confirmed.

Results

Demographic characteristics

Table 1 presents the demographic characteristics of fishers. Seven out ten (71.4%) of the fishers are between age 20 and 49 years with a mean age of 41.86±12.36 years. More than are a quarter (26.7%) are 50 years and above. The fishers are experienced at fishing. The mean years of fishing, experience is 23.59±13.29 years. Close to half (48.4%) have between one to 20 years of fishing experience, on the other hand, two fifth (42.2%) have accrued between 21 and 40 years of experience. Additionally, more than half (59.0%) have acquired formal education from primary to senior high school level. Majority (78.3%) are married while some are singles who have never married (15.5%) or have come out of marriage through divorce (4.3%). Whereas more than seven out of ten (72.7%) are crew members on the vessel, the rest are vessel owners (27.3%). On the average, the number of years of experience of the fishers with the portable SONAR device is 4.77±3.05 years.

Table 1: Demographic characteristics (n = 161)

Variables	Frequency	Percent
Age (years) [$\bar{X}$ = 41.86±12.36]		
Less than 20	3	1.9
20 – 29	25	15.5
30 – 39	41	25.5
40 – 49	49	30.4
50 – 59	24	14.9
60 – 69	19	11.8
Experience (years) [$\bar{X}$ = 23.59±13.29]		
1 – 20	78	48.4
21 – 40	68	42.2
41 – 60	15	9.3
Education		
No formal education	66	41.0
Primary	53	32.9
JSS/JHS	32	19.9
SSS/SHS	10	6.2
Marital status		
Married	126	78.3
Single	25	15.5
Divorced	7	4.3
Cohabitation	2	1.2
Widowed	1	0.6
Role on vessel		
Crew member	117	72.7
Owner	44	27.3
Years of experience with SONAR (years) [$\bar{X}$ = 4.77±3.05]		
1 – 10	154	95.7

11 – 20	7	4.3

Factors influencing purse-seine fishers' decision to adopt SONAR

The underlying factors influencing the acceptance of SONAR technology among fishers was measured with the TAM3 constructs. Generally, the fishers moderately agreed to the factors underlying their decision to adopt SONAR technology for fishing activities in the Central region, except anxiety which they somewhat disagreed that it influences their activities (Table 2). The results show that behavioural intention (BI) recorded the highest mean score among the constructs (overall mean = 6.26±1.16). The results indicate that fishers moderately agree that given the opportunity to have access to a SONAR technology, they intend, plan and predict to use the device. Perceived usefulness (PU) recorded the second highest overall mean score of 6.13±1.04. Fishers moderately agreed that using SONAR improves performance, increases productivity and enhances performance of their fishing activities. Output quality was third in the line with respect to the factors influencing acceptance of SONAR technology with overall mean of 6.12±0.95. The fishers moderately agreed that they rate the results of SONAR technology as excellent because the output is high with no associated challenges.

Additionally, the fisher moderately agreed that using SONAR is pleasant, enjoyable and fun when using it for fishing activities (ENJ: overall mean = 5.99±1.04). On the ease of use of the device, fishers also moderately agreed that (PEOU: overall mean 5.91±1.06) the device is easy to use, understandable, clear and easy to have access to it. Perceived environmental control (PEC) followed PEOU with an overall mean (5.86±1.01), indicating that fishers moderately agreed that given the opportunity, resources and knowledge, it would easy for them to use the device without external control. Whiles fishers moderately acknowledged that the results of the device are demonstrable (RES: overall mean = 5.83±), hence, can communicate to others the significance of using the technology, they also moderately agreed that (overall mean = 5.82±1.25) the use of SONAR is spontaneous, creative, playful and original. Again, the fishers moderately agreed that the usage of SONAR is relevant, important and pertinent to various fishing-related tasks (overall mean = 5.80±1.03).

Furthermore, fishers moderately agreed that significant associates such as canoe owners, family and friends who influence their behaviour think that using the portable SONAR device is helpful (overall mean = 5.70±1.19). Fishers also moderately agreed with the ability to use the device (SE: overall mean = 5.69±1.14) for fishing activities. They agreed that they could complete fishing with the device provided they are trained on its use, or have previous experience with a similar package. As a final point, fishers moderately agreed that the use of the device enhances the social image of the users because, other users have high profile, prestige and have become status symbols in the community (IMG: overall mean = 5.52±1.32). On the contrary, fishers somewhat disagreed that they have anxiety towards the use of SONAR technology (ANX: overall mean = 3.06±1.41). In other words, they do not feel uneasy, uncomfortable, nervous and scared about the use of the machine. Use behaviour was measured as the number of hour the device is used for fishing activities over a period of 24 hours. The results showed that on the average, the fishers use the portable SONAR device for approximately 8 hours out 24 hours for fishing activities (Table 2). These factors influence acceptance of SONAR technology among fisher in the Central region of Ghana.

Table 2: Means and standard deviations of acceptance of SONAR technology

Statement	Mean	S.D
Behavioural intention (BI)	**6.26**	**1.16**
I plan to use SONAR in the next few months	6.39	1.19
Assuming I had access to SONAR, I intend to use it	6.31	1.21
Given that I had access to SONAR, I predict that I would use it	6.09	1.42
Perceived usefulness (PU)	**6.13**	**1.04**
Using SONAR improves my performance of fishing job	6.17	1.19
Using SONAR increases my productivity in my fishing job	6.16	1.06
I find SONAR to be useful in my fishing job	6.11	1.12
Using SONAR enhances my effectiveness in fishing job	6.07	1.18
Output quality (OUT)	**6.12**	**0.95**
I rate the results from SONAR to be excellent	6.17	1.00
The quality of the output I get from SONAR is high	6.12	1.03
I have no problem with the output quality of SONAR	6.06	1.05
Job relevance (REL)	**5.80**	**1.03**
In my fishing job, usage of SONAR is relevant	6.12	1.09
In my fishing job, usage of SONAR is important	6.06	1.18
The use of SONAR is pertinent to my various fishing-related tasks	5.82	1.26
Perceived enjoyment (ENJ)	**5.99**	**1.04**
The actual process of using SONAR is pleasant	6.02	1.09
I find using SONAR to be enjoyable	6.01	1.10
I have fun using SONAR	5.94	1.169
Perceived ease of use (PEOU)	**5.91**	**1.06**
I find it easy to get SONAR to do what I want it to do	6.01	1.13
I find SONAR to be easy to use	5.98	1.16
My interaction with SONAR is understandable.	5.94	1.23
My interaction with SONAR is clear	5.86	1.23
Perceived environmental control (PEC)	**5.86**	**1.01**
Given the opportunities it takes to use SONAR, it would be easy for me to use SONAR	5.97	1.10
Given the resources it takes to use SONAR, it would be easy for me to use SONAR	5.95	1.20
Given the knowledge it takes to use SONAR, it would be easy for me to use SONAR	5.91	1.10
I have the resources necessary to use SONAR	5.88	1.26
I have control over using SONAR	5.75	1.41
SONAR is compatible with manual methods I use to find fish	5.68	1.41
Results demonstrability (RES)	**5.83**	**1.09**
I believe I could communicate to others the significances of using SONAR	5.97	1.19
I have no difficulty telling others about the results of using SONAR	5.87	1.19
I would not have difficulty explaining why using SONAR may or may not be beneficial	5.85	1.18
The results of using SONAR are obvious to me	5.63	1.37
Playfulness (PLAY)	**5.82**	**1.25**

Would you describe the use of SONAR as spontaneous	5.86	1.39
Would you describe the use of SONAR as creative	5.86	1.38
Would you describe the use of SONAR as playful	5.80	1.39
Would you describe the use of SONAR as original	5.76	1.46
Subjective norm (SN)	**5.70**	**1.19**
The canoe owners have been helpful in the use of SONAR	5.76	1.28
Family members who influence my behaviour think that I should use SONAR	5.70	1.32
Friends who are important to me think that I should use SONAR	5.67	1.40
In general, the fishery commission support the use of SONAR	5.66	1.50
Self-efficacy (SE)	**5.69**	**1.14**
I can complete the fishing job using SONAR, if someone showed me how to do it first	5.81	1.19
I can complete the fishing job using SONAR, if I had used similar packages before this one to do the same job	5.70	1.23
I can complete the fishing job using SONAR, if I had just the built-in help facility for assistance	5.68	1.41
I can complete the fishing job using SONAR, if there was no one around to tell me what to do	5.57	1.54
Image (IMG)	**5.52**	**1.32**
Other fishers who use SONAR have a high profile	5.55	1.38
Other fishers who use SONAR have more prestige than those who do not	5.54	1.48
Having SONAR is a status symbol in fishing in this community	5.48	1.45
Anxiety (ANX)	**3.06**	**1.41**
SONAR makes me feel uneasy	3.09	1.57
SONAR makes me feel uncomfortable	3.07	1.45
Working with SONAR makes me nervous	3.06	1.52
Working with SONAR makes me scared	3.01	1.55
Use behaviour (UB)	**7.91**	**3.84**

Means were calculated from a scale of 1 = strongly disagree; 2 = moderately disagree; 3 = somewhat disagree; 4 = neutral (neither disagree nor agree); 5 = somewhat agree; 6 = moderately agree; 7 = strongly agree.

Assessment of the convergent validity and internal consistency reliability of the TAM3 constructs

Table 3 presents the factor loadings, Cronbach's Alpha, rho_A, rho_C and average variance extracted (AVE) indices used to assess the internal consistency and convergent validity of the TAM3 as part of the measurement model (Hair et al., 2017). Utilizing factor loadings, Cronbach's alpha, Joreskog's rho_A (computed from the unstandardized loadings), and rho_C (computed from the standard loadings), the reliability of TAM3 was evaluated. The results showed that all latent constructs in the model had factor loadings greater than 0.70, signifying indicator reliability (Hulland, 1999). Additionally, it was discovered that TAM3's Cronbach's alpha, rho_A and rho_C are all above 0.70, demonstrating internal consistency (Nunnally, 1978) and indicator reliability (Gefen et al., 2000) respectively. To assess the convergent validity of the model, average variance extracted (AVE) was used. The results showed that the AVE values of all TAM3 constructs exceeded the suggested threshold value of 0.50 (Bagozzi et al., 1991), hence the model achieving enhanced validity (Hair et al., 2019).

Table 3: Assessment of convergent validity and internal consistency reliability

Item	Loading	Cronbach's Alpha	ρA	ρC	AVE
Use behaviour (UB)					

UB	-	-	-	-	-
Anxiety (ANX)					
ANX1	0.95	0.94	0.96	0.96	0.86
ANX2	0.95				
ANX3	0.89				
ANX4	0.91				
Behavioural intention (BI)					
BI1	0.93	0.90	0.91	0.94	0.83
BI2	0.88				
BI3	0.93				
Perceived enjoyment (ENJ)					
ENJ1	0.91	0.92	0.92	0.95	0.87
ENJ2	0.95				
ENJ3	0.93				
Image (IMG)					
IMG1	0.94	0.91	0.92	0.94	0.84
IMG2	0.95				
IMG3	0.86				
Output quality (OUT)					
OUT1	0.92	0.91	0.91	0.94	0.85
OUT2	0.91				
OUT3	0.93				
Perceived external control (PEC)					
PEC1	0.83	0.90	0.90	0.92	0.66
PCE2	0.77				
PCE3	0.86				
PCE4	0.87				
PCE5	0.82				
PCE6	0.71				
Perceived ease of use (PEOU)					
PEOU1	0.91	0.93	0.93	0.95	0.77
PEOU2	0.89				
PEOU3	0.83				
PEOU4	0.90				
PEOU5	0.87				
Playfulness (PLAY)					
PLAY1	0.90	0.91	0.93	0.94	0.80
PLAY2	0.95				
PLAY3	0.93				
PLAY4	0.79				
Perceived usefulness (PU)					
PU1	0.89	0.94	0.94	0.95	0.84
PU2	0.94				
PU3	0.93				
PU4	0.91				
Job relevance (REL)					
REL1	0.89	0.85	0.86	0.91	0.77
REL2	0.92				
REL3	0.83				
Result demonstrability (RES)					
RES1	0.92	0.91	0.95	0.94	0.79
RES2	0.95				
RES3	0.78				
RES4	0.90				

Self-efficacy (SE)					
SE1	0.81	0.88	0.88	0.92	0.73
SE2	0.85				
SE3	0.85				
SE4	0.90				
Subjective norm (SN)					
SN1	0.90	0.90	0.90	0.94	0.83
SN2	0.94				
SN3	0.90				

Note: ANX: Anxiety; BI: Behavioural intention; ENJ: Perceived enjoyment; IMG: Image; OUT: Output quality; PEC: Perceived behavioural control; PEOU: Perceived ease of use; PLAY: Playfulness; PU: Perceived usefulness: REL: Job relevance; RES: Results demonstrability; SE: Self-efficacy; SN: Subjective norms.

Adopting the Fornell-Lacker criteria and the Heterotrait-Monotrait (HTMT) ratio, discriminant validity of the TAM3 model was assessed. The Fornell-Larcker criteria for assessing discriminant validity indicate that the squared root of the average variance extracted values of the latent constructs should be higher than the inter-construct correlations in the model (Fornell & Larcker, 1981). Table 4 shows that the Fornell-Larcker values of the TAM3 constructs are greater than all inter-construct correlations in the columns in the table. The results indicate that the TAM3 model achieved discriminant validity based on the Fornell-Larcker criteria (Joseph F. Hair et al., 2019)

Table 4: Fornell-Larcker criteria for assessing discriminant validity

CONST	ANX	BI	ENJ	IMG	OUT	PEOU	PLAY	PU	REL	RES	SN
ANX	**0.93**										
BI	-0.10	**0.91**									
ENJ	-0.30	0.50	**0.93**								
IMG	-0.12	0.34	0.27	**0.92**							
OUT	-0.27	0.60	0.66	0.40	**0.92**						
PEOU	-0.21	0.56	0.61	0.20	0.55	**0.88**					
PLAY	-0.32	0.42	0.48	0.14	0.43	0.66	**0.89**				
PU	-0.35	0.54	0.71	0.23	0.65	0.67	0.51	**0.92**			
REL	-0.10	0.55	0.51	0.31	0.73	0.49	0.32	0.53	**0.88**		
RES	-0.16	0.52	0.42	0.44	0.51	0.38	0.37	0.40	0.42	**0.89**	
SN	-0.19	0.44	0.51	0.51	0.45	0.42	0.38	0.53	0.40	0.41	**0.91**

Note: ANX: Anxiety; BI: Behavioural intention; ENJ: Perceived enjoyment; IMG: Image; OUT: Output quality; PEOU: Perceived ease of use; PLAY: Playfulness; PU: Perceived usefulness: REL: Job relevance; RES: Results demonstrability; SN: Subjective norms.

Henseler et al.'s (2015) criteria for validating discriminant validity, the HTMT ratio which is defined as the mean value of the indicator correlations across constructs relative to the (geometric) mean of the average correlations for the indicators measuring the same construct was used to validate the discriminant validity of the TAM3 model.

Table 5: Heterotrait-Monotrait (HTMT) ratio for assessing discriminant validity

CONST	ANX	BI	ENJ	IMG	OUT	PEOU	PLAY	PU	REL	RES	SN
ANX											
BI	0.13										
ENJ	0.32	0.54									
IMG	0.16	0.37	0.30								
OUT	0.29	0.66	0.72	0.44							
PEOU	0.22	0.60	0.65	0.22	0.59						
PLAY	0.33	0.46	0.52	0.16	0.47	0.71					
PU	0.37	0.58	0.77	0.24	0.70	0.71	0.55				
REL	0.12	0.64	0.58	0.35	0.82	0.55	0.37	0.59			
RES	0.16	0.57	0.44	0.48	0.56	0.40	0.40	0.41	0.48		
SN	0.21	0.49	0.56	0.56	0.50	0.45	0.43	0.57	0.46	0.45	

Note: ANX: Anxiety; BI: Behavioural intention; ENJ: Perceived enjoyment; IMG: Image; OUT: Output quality; PEOU: Perceived ease of use; PLAY: Playfulness; PU: Perceived usefulness: REL: Job relevance; RES: Results demonstrability; SN: Subjective norms.

Henseler et al. (2015) recommends that, to achieve discriminant validity, HTMT ratio values of constructs in the model should not exceed 0.85. However, PEC (HTMT ratio = 0.92) and SE (HTMT ratio = 0.90) were move from the TAM3 model due to higher HTMT ratio values with PEOU respectively. On the other hand, Table 5 shows that the results of the HTMT ratios of the constructs in TAM3 were greater than the accepted threshold value of 0.85 (Hair et al., 2017). Therefore, the constructs in TAM3 achieved discriminant validity based on the HTMT ratio criteria (Hair et al., 2019).

Assessment of structural model

To assess the structural model of the TAM3 model, variance inflation factor (VIF), path coefficients (β), coefficient of determination R2, f2 effect size, and Stone-Geisser's (Q2) were used (Table 6). To ensure that the effect of multi-collinearity was not present among the exogenous constructs in the structural model, collinearity diagnostic test was performed (Hair et al., 2017). The results show that the exogenous constructs of the TAM3 model had VIF values less than three, indicating the non-appearance of multi-collinearity in the predictive model (Hair et al., 2019). The significance and relevance of the path coefficients were assessed. The results of the bootstrapping technique with 5000 samples showed that majority of the structural model relationships are significant (Table 6). Specifically, we found that BI has a significant and easy-to-read effect on UB ($\beta = 0.28$, $p < 0.01$). We also found that the POEU ($\beta = 0.34$, $p < 0.01$) and SN ($\beta = 0.19$, $p < 0.01$) has a significant and meaningful impact on BI whereas the impact of PU ($\beta = 0.22$, $p < 0.05$) on BI is less evident. When the impact of the exogenous constructs of PEOU was examined separately, we found out that both ENJ ($\beta = 0.40$, $p < 0.01$) and PLAY ($\beta = 0.49$, $p < 0.01$) have significant effect on PEOU whereas ANX ($\beta = 0.06$, $p > 0.05$) has no effect. Again, considering the impact of PU and its antecedent constructs, the results reveal that REL ($\beta = 0.00$, $p > 0.05$) and RES ($\beta = 0.02$, $p > 0.05$) have no influence on PU. On the other hand, PEOU ($\beta = 0.38$, $p < 0.01$), OUT ($\beta = 0.37$, $p < 0.01$) and SN ($\beta = 0.27$, $p < 0.01$) have significant and noticeable effect on PU whereas effect of IMG ($\beta = -0.14$, $p < 0.05$) though significant is negative. Additionally, the effect of SN with regard to IMG is significant ($\beta = 0.51$, $p < 0.01$).

The next index used to assess the structural model was the coefficient of determination R2 which explains the predictive power of the TAM3 model (Shmueli & Koppius, 2011). As a rule of thumb, R2 values, 0.25, 0.50 and 0.75 are regarded as weak, moderate and substantial respectively (Hair et al., 2011). Additionally, Cohen's (1988) criteria for determining the effect size f2, was used to examine the effect of the exogenous constructs on the endogenous constructs in the model. f2 values greater than 0.02, 0.15, and 0.35 are classified as small, medium, and large effects respectively (Hair et al., 2014).

The R2 values of the TAM3 model is between 0.08 and 0.61 showing that the model had between weak and substantial predictive power (Table 6), hence, the model can be deemed as relevant for predicting the variance in inshore fishers' adoption of SONAR for fishing in the study area. The results showed that, R2 of use behaviour is 0.08, signifying that BI predicted 8% (R2: UB = 0.08) of the variance in the use behaviour of the fishers towards SONAR. Based on the Cohen's (1988) criteria, the effect size of behavioural intention on use behaviour of fishers towards the adoption of SONAR was small (f2: BI = 0.08). Additionally, three exogenous constructs, namely: perceived ease of use, usefulness and subjective norms compositely accounted for 38% (R2: BI = 0.38) of the variance in behavioural intention of the fishers to adopt SONAR for fishing activities. The results of the f2 showed that all three variables; POEU (f2 = 0.10), PU (f2 = 0.04), and SN (f2 = 0.04) had small effect on the BI of the fishers to adopt the technology.

On the other hand, 55% of the variance in PEOU of SONAR was predicted by ANX, ENJ and PLAY (R2: PEOU = 0.55). One out of the three independent constructs, ANX (f2 = 0.01) had no effect on PEOU whiles ENJ (f2 = 0.26) and PLAY (f2 = 0.39) had medium and large effects respectively on PEOU of SONAR. The next endogenous construct considered in the TAM3 model was PU. The results showed that 61% of the variance in PU was predicted by IMG, PEOU, OUT, REL, RES, and SN (R2: PEOU = 0.61). When the six variables assessed independently, it was revealed that, REL (f2 = 0.00) and RES (f2 = 0.00) had no effect on PU, whiles IMG (f2 = 0.03), SN (f2 = 0.11) and PEOU (f2 = 0.13) had small effect on the usefulness of SONAR among the fishers. It is worth noting that OUT (f2 = 0.23) had medium effect on PU of SONAR. Lastly, SN (f2 = 0.35) had a large effect on IMG and predicted 26% of the variance in the endogenous construct (R2: IMG = 0.26).

Table 5: Beta coefficients, coefficient of determination, predictive sample technique and variance inflation factor

Relationships	Std. Beta	P-values	95% BCa confidence interval LB	UB	VIF	R^2	f^2	Q^2
BI -> UB	0.28	0.00**	0.17	0.37	1.00	0.08	0.08	0.07
PEOU -> BI	0.34	0.00**	0.18	0.46	1.83	0.38	0.10	0.29
PU -> BI	0.22	0.03*	0.03	0.42	2.09		0.04	
SN -> BI	0.19	0.00**	0.07	0.33	1.40		0.04	
ANX -> PEOU	0.06	0.33	-0.07	0.20	1.15	0.55	0.01	0.40
ENJ -> PEOU	0.40	0.00**	0.20	0.61	1.33		0.26	
PLAY -> PEOU	0.49	0.00**	0.27	0.69	1.35		0.39	
IMG -> PU	-0.14	0.04*	-0.28	-0.01	1.55	0.61	0.03	0.47
PEOU -> PU	0.38	0.00**	0.22	0.56	1.59		0.13	
OUT -> PU	0.37	0.00**	0.22	0.54	2.65		0.23	
REL -> PU	0.00	0.99	-0.16	0.20	2.19		0.00	
RES -> PU	0.02	0.74	-0.09	0.13	1.54		0.00	
SN -> PU	0.27	0.00**	0.12	0.43	1.63		0.11	
SN -> IMG	0.51	0.00**	0.32	0.65	1.00	0.26	0.35	0.21

Note: ANX: Anxiety; BI: Behavioural intention; ENJ: Perceived enjoyment; IMG: Image; OUT: Output quality; PEOU: Perceived ease of use; PLAY: Playfulness; PU: Perceived usefulness: REL: Job relevance; RES: Results demonstrability; SN: Subjective norms; UB: Use behaviour.

Also, Stone-Geisser's Q2 value was calculated to examine the strength of the predictive accuracy of the endogenous constructs in the model (Stone, 1974); Geisser, 1974). The blindfolding technique with specified omission distance of D was utilised to compute the Q2 values (Hair et al., 2019). As a rule of thumb, Q2 values greater than zero, 0.25 and 0.50 are indicative of small, medium and large predictive relevance of the TAM3 model (Hair et al., 2019). Table 6 shows that the different independent constructs had moderate predictive relevance on the respective endogenous constructs, i.e., UB (Q2 = 0.07), BI (Q2 = 0.29), PEOU (Q2 = 0.40), PU (Q2 = 0.47), and IMG (Q2 = 0.21). Furthermore, the results indicated that the TAM3 model demonstrated good analytical importance and accuracy of the data used in estimating the model (Hair et al., 2019).

PLS predict assessment of manifest variables

The PLS predict approach developed by Shmueli et al. (2016) was used to investigate the out-of-sample predictive power of the model. This procedure comprises constructing the model as an analysis sample (i.e., training sample) and assessing its predictive performance on data other than the analysis sample, or holdout sample. As shown in Table 7, all indicators obtained Q2predict scores greater than zero, outperforming the most naive benchmark (i.e., indicator averages of the training sample) (Shmueli et al., 2019). The distribution was not found to be extremely non-symmetrical through analysis of the predictive errors, thus the model's out-of-sample predictive performance was evaluated using the root mean squared error (RMSE) (Shmueli et al., 2016).

The PLS-SEM approach delivered lower predicted errors for all the indicators when the RMSE results from the PLS-SEM were compared with the naive linear regression model (LM) standard. The variations in PLS-SEM RMSE and LM RMSE are more pronounced for all endogenous construct indicators. Thus, TAM3 as used for the study demonstrated high predictive power because our results prove that none of the indicators of the PLS-SEM technique created larger prediction error compared to the nave LM benchmark (Shmueli et al., 2019).

Table 6: PLS predict assessment of manifest variables (original model)

	PLS-SEM		LM	PLS-SEM –
Items	RMSE	Q^2predict	RMSE	LM RMSE
BI1	1.01	0.30	1.08	-0.07
BI2	1.28	0.20	1.30	-0.02
BI3	1.01	0.30	1.17	-0.16
IMG1	1.32	0.21	1.47	-0.15
IMG2	1.21	0.24	1.34	-0.13
IMG3	1.35	0.15	1.42	-0.07
PEOU1	0.87	0.51	0.94	-0.07
PEOU2	0.98	0.37	1.05	-0.07
PEOU3	1.07	0.30	1.23	-0.16
PEOU4	0.95	0.34	1.03	-0.08
PEOU5	0.90	0.37	1.02	-0.12
PU1	0.94	0.38	0.95	-0.01
PU2	0.78	0.46	0.82	-0.04
PU3	0.83	0.51	0.90	-0.07
PU4	0.86	0.42	0.96	-0.10
UB	3.80	0.03	4.01	-0.21

Note: BI: Behavioural intention; IMG: Image; PEOU: Perceived ease of use; PU: Perceived usefulness: UB: Use behaviour.

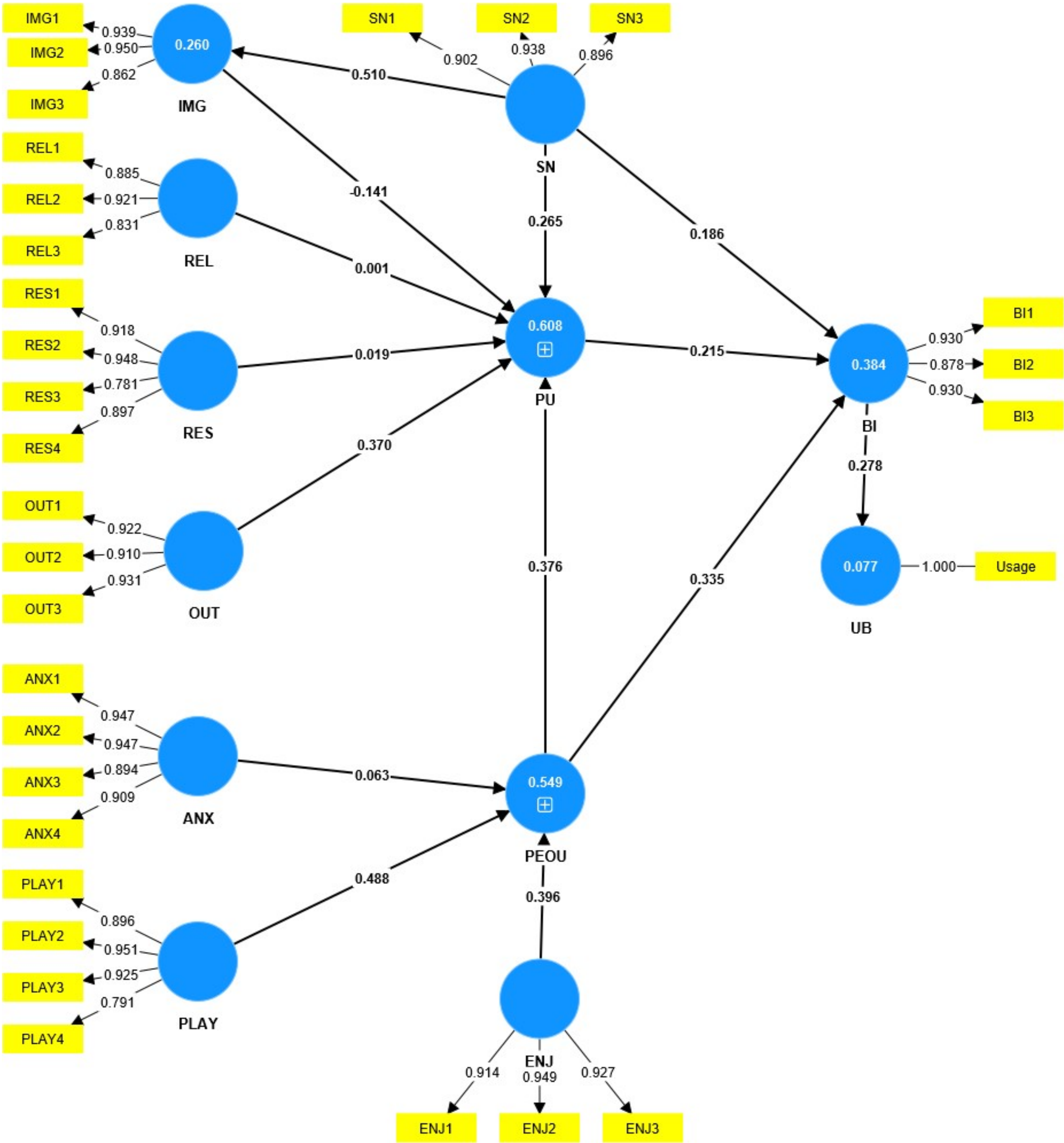

Figure 3: Extended TAM3 model of purse-seine fishers' adoption behaviour of SONAR

Discussion

In this study, we sought to examine the decision of purse-seine fishers to adopt SONAR for fishing activities in the Central region of Ghana. The extended technology acceptance model TAM3 underpins the study (Venkatesh & Bala, 2008). Many scholars have used the TAM3 to examine technology adoption decisions among many actors in agriculture (Sharifzadeh et al., 2017; Tohidyan Far & Rezaei-Moghaddam, 2018; Verma & Sinha, 2018; Eweoya et al., 2021; Mccormack et al., 2021; Saravanos et al., 2022). Our findings provide empirical evidence about the usefulness of TAM3 for predicting the adoption decision of fishers about SONAR in the Central region. TAM3 is one of the widely used theories for predicting technology adoption and has been used adequately to in many studies (Manis & Choi, 2019; Al-Rahmi et al., 2021; Al-Rahmi et al., 2021; Eweoya et al., 2021; Mccormack et al., 2021; Saravanos et al., 2022). However, since the introduction of SONAR in the Ghanaian fishing sector, little is known about the adoption decision of fishers (especially among artisanal and inshore fishers) of the technology and factors influencing their decisions. This study sought to provide new empirical evidence about the adoption of SONAR among purse-seine fishers in the Central region and the factors influencing the adoption decision. Our study also provided important insight into the technology adoption decision of fishers that would be applicable for technology dissemination in the region.

Our results show that behavioural intention is a significant predictor of the use behaviour of fishers towards SONAR. This indicated that as fishers' behavioural intention to adopt SONAR significantly influenced their use behaviour of the technology accounting for 8% of the variance in use behaviour. Therefore, good behavioural intention would lead to greater adoption behaviour of SONAR for purse-seine fishing expedition in the Central region. Our results is consistent with the findings of previous studies that found behavioural intention as an important predictor of use behaviour (Manis & Choi, 2019; Al-Rahmi et al., 2021; Al-Rahmi et al., 2021; Eweoya et al., 2021; Asante et al., 2023). Our results also show that the fishers are utilising SONAR, albeit, for an average time of 8 hours a day which is, one-third of the number of hours they can use the technology a day. The application of more advanced and effective technologies in agriculture and related industries enhances both the quality and quantity of yield (Ferri et al., 2020). A technology like SONAR helps fishers to identify geolocation of fishing activities and fish species-related information as well as capture rates (Dineshbabu et al., 2016). Additionally, SONAR helps fishers to accurately navigate, track, map, and access timely information on fishing expedition through a receiver (Narayanamurthy & Samsuri, 2016; Natsir et al., 2019).

We also found that perceived ease of use, perceived usefulness, and subjective norms significantly influence behavioural intention of the fishers to adopt SONAR for fishing expedition. The three variables collectively predicted 38% of the variation in behavioural intention. The results indicate that, as fishers perceive SONAR as useful and easy to use and while significant influencers like vessel owners, family, and friends think that they should use the technology, these significantly influence their behavioural intention to adopt SONAR. Our results is consistent with the findings of previous studies (Sharifzadeh et al., 2017; Mccormack et al., 2021; Saravanos et al., 2022). The results suggest that fishers motivation to adopt SONAR was influenced by the ability of the technology help them to execute the fishing expedition and with ease (relative advantage) (Mndzebele, 2013; Mairura, 2016), coupled with a positive social pressure from vessel owners, family and friends to motivate them to adopt the technology (Ibrahim et al., 2022).

When the exogenous constructs of perceived ease of use were examined, we found that ANX, ENJ and PLAY predicted 55% of the variance in fishers' perception of ease of use of SONAR. Of the three constructs, PLAY had the strongest effect on POEU; whiles effect of ANX is not significant. The results indicate that when fishers find the use of SONAR for fishing activities as enjoyable, aside from any performance consequences resulting from using the technology (Venkatesh, 2000), and have good cognitive spontaneity with the interaction with SONAR (Webster & Martocchio, 1992), it significantly impacts on their perception of the ease of use of SONAR (Venkatesh, 2000). Some studies also reported significant effect of PLAY and ENJ on PEOU (Ferri et al., 2020; Al-Rahmi et al., 2021; Al-Rahmi et al., 2021; Saravanos et al., 2022). The non-significant effect of ANX on PEOU shows that the fishers did not demonstrate any apprehension or fear when using SONAR (Venkatesh, 2000), therefore their perception of the ease of use of the technology is not influenced by ANX (Venkatesh & Bala, 2008).

We found out that 61% of the variance in perceived usefulness was predicted by PEOU, OUT, REL, RES, SN and IMG. Examining the exogenous constructs, we observed that PEOU, OUT, SN, and IMG significantly influence PU whiles REL and RES do not. The results indicate that when fishers perceived that using SONAR would be free from effort (Venkatesh, 2000), and perform the fishing task well (Venkatesh & Davis, 2000), and vessel owners, family, and friends believe that they should use SONAR (Venkatesh & Bala, 2008), their perception about SONAR improving the fishing performance improves (Venkatesh & Davis, 2000; Lai, 2017). The findings is consistent with that of previous studies that reported positive significant effect of PEOU, OUT and SN on PU (Nikolopoulos & Likothanassis, 2018; Ferri et al., 2020; Mlekus et al., 2020; Al-Rahmi et al., 2021; Al-Rahmi et al., 2021). On the other hand, the effect of IMG on PU though significant was negative. The results show that fishers believe that using SONAR improves their social status (Moore & Benbasat, 1991), but their perception of the usefulness of the technology is not positively influenced by their social status (Venkatesh & Davis, 2000). Our results contradict earlier studies, which found positive effect of IMG on perceived usefulness (Raeisi & Meng, 2016; Dirks & Bühler, 2018; Saravanos et al., 2022). In psychometric research, social image or status as different types of emotions and feelings are important predictors in decision making (Peters & Slovic, 2000).

Since decision making and social status are related (Slovic et al., 1991), emotions for specific subject matter can be measured by giving the image a positive or negative value Lee & Lee, 2005). Recent studies on technology acceptance have revealed that social status have a positive impact on perceived usefulness of a technology (Lee & Jang, 2003; Kang et al., 2007; Al-Rahmi et al., 2021; Al-Rahmi et al., 2021; Saravanos et al., 2022). However, the negative effect of social status on perceived usefulness suggest that fishers prioritise rational judgement about the usefulness of SONAR for fishing activities over emotional judgement (Park et al., 2022). The no significant effect of REL and RES on PU suggest that the fishers' perception of SONAR improving their fishing performance is not influenced by the applicability of the technology to the fishing task (Venkatesh & Davis, 2000) and the tangibility of the results of using the technology (Moore & Benbasat, 1991; Templeton & Byrd, 2003). The effect is rather due to the fact that using the technology is free from effort (Venkatesh, 2000), and that they can use the technology to perform the fishing task well (Venkatesh & Davis, 2000), and the positive social pressure to adopt SONAR. Last but not the least, SN influence 51% of the variation in the social image of the fishers when they employ SONAR, indicating that if key associates believe that the fishers should use SONAR, their social image will significantly improve (Venkatesh & Bala, 2008). The findings are consistent with those of previous studies which predicted that SN significantly influences social image (Al-Rahmi et al., 2021; Al-Rahmi et al., 2021; Eweoya et al., 2021; Mccormack et al., 2021; Saravanos et al., 2022).

Our study offers significant empirical evidence on the SOANR adoption behaviour of artisanal and inshore fishers in the Central region of Ghana and the factors driving adoption that can be helpful to policy makers. The findings also shed light on fishers' behavioural intention and use behaviour that can be useful when policy makers try to introduce new technologies to fishers in the Central region of Ghana. The validity and robustness of our findings are further enhanced by the use of PLS-SEM technique. The convenience sampling technique employed to select study participants is one of the weaknesses of this paper. To make the results more generalizable, future studies should consider probability sampling. To shed more insight on how purse-seine fishers use SONAR, additional studies should look at the variables responsible for the low SONAR use behaviour. Further studies should also focus on the moderating effect of SONAR use experience on the relationship between perceived usefulness and ease of use and their exogenous constructs. The study can also be extended to the other coastal regions in Ghana. Additionally, mixed methods approaches can be explored to provide more explanation on areas not covered in this study due to the design used.

Conclusion

This study investigated the adoption decision of purse-seine fishers in the Central region of Ghana, and the factors underlying their adoption decisions. The study is unique with respect to using the extended technology acceptance model TAM3 to examine the adoption decision of purse-seine fishers about SONAR for fishing activities. The results validated the ability of TAM3 to predict purse-seine fishers' behavioural intention and adoption behaviour as they adopt SONAR for fishing operations. The most significant predictors of behavioural intention of fishers to adopt SONAR, which ultimately impacts on their adoption decision, were found to be their perception of the usefulness of SONAR, including improved productivity, performance, and effectiveness, the ease of use of SONAR, and subjective norms, that is social influence from vessel owners, family and friends. In light of this, the Fisheries Commission should leverage on the characteristics of SONAR such as ability to deliver improved productivity, performance and effectiveness and its ease of use as well as the influence of vessel owners, family and friends to drive the adoption of SONAR in the Central region. Perceived enjoyment and playfulness working with SONAR significantly influence the perception of the fishers about completing fishing operations with the technology that is free from effort. Therefore, when creating awareness about the ease of the SONAR, the Fisheries Commission and allied agencies should focus on the pleasure, fun and gratification as well as spontaneity, creativity and playfulness of SONAR technology. Perceived ease of use, output quality, subjective norms and social status significantly influence the perception of fishers on the usefulness of SONAR. The effect of social status on the usefulness of SONAR is however negative. Fishery extension agents when promoting the usefulness of SONAR for fishing operations among purse-seine fishers should focus their efforts on rational judgement of the fishers about ease of use of SONAR, and output quality features of SONAR such as high output and well as the influence of important people like vessel owners, family, and friends of the fishers. The emotional judgement arising from their social status should not be explicitly considered even though social influence from vessel owners, family and friend influence their social status.

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Institutional Review Board statement: This study was carried out based on the Declaration of Helsinki and approved by the Ethical Review Board of the University of Education, Winneba (reference code PVC/B.11/VOL.1/13 approved on March 13, 2023).

Informed consent: All participants provided their informed consent before participating in the study.

Data availability statement: The data that support the findings of the study are available on request by email to the corresponding author.

Conflict of interest:

The authors declare no conflicting interest.

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