

Extent of implementation of vessel monitoring system: Perceived challenges and opportunities of commercial fishing vessel operators in Infanta, Quezon

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Abstract

There is a shortage of studies in the Philippines that address the challenges and opportunities associated with the Vessel Monitoring System (VMS). This study aimed to determine the extent of challenges and opportunities related to VMS and to investigate whether these factors significantly affect adoption and compliance. A descriptive, non-experimental quantitative survey was conducted, involving 76 CFV operators with installed VMS-100 transponders and 10 BFAR Regulatory Officers. Simple random sampling was employed to select respondents from Infanta, Quezon, and a 4-point Likert Scale was used to measure perceptions of challenges and opportunities. Data were analyzed using means, percentages, and Pearson's r , with a two-tailed test to examine significant correlations between variables at significance levels of $p \leq 0.05$ and $p \leq 0.01$. Results indicated that the overall level of challenge was moderately high ($\bar{x}=2.50$, $S.D.=0.40$) regarding VMS's impact on daily operations and moderately low ($\bar{x}=2.09$, $S.D.=0.40$) concerning support for VMS implementation. The perceived opportunities were high ($\bar{x}=3.32$, $S.D.=0.39$) for the benefits experienced from using VMS, moderately high ($\bar{x}=3.05$, $S.D.=0.33$) in terms of its contribution to fishing operations, and high ($\bar{x}=3.28$, $S.D.=0.32$) regarding its usefulness. The study also revealed high levels of adoption and compliance, as evidenced by the likelihood of using VMS in the future ($\bar{x}=3.41$, $S.D.=0.38$), awareness and understanding ($\bar{x}=3.58$, $S.D.=0.35$), and adherence to Section 1 of FAO 266, series of 2020 ($\bar{x}=3.79$, $S.D.=0.42$). Significant correlations were found between training and impact on daily operations ($p=0.00206$), likelihood of using VMS with benefits ($p=0.00001$), extent of contribution ($p=0.00088$), and usefulness ($p=0.00542$), as well as between awareness and understanding of VMS with benefits ($p=0.02277$) and usefulness ($p=0.03927$). In conclusion, the study revealed that respondents perceived the opportunities associated with VMS as significantly affecting adoption and compliance. To further substantiate these findings, a more in-depth study employing a mixed-methods approach is recommended.

Keywords: vessel monitoring system; commercial fishing vessel operators; challenges; opportunities; correlations

1. Introduction

Fishing is considered one of humankind's oldest occupations. This has been proven by archaeological evidence (Borgstrom & Sainsbury, 2024) and stories of fisher-characters portrayed in the Bible. The importance of fishing throughout history is also tracked by (Gough, 2015), who revealed that in Canada, "while related industries declined, by the First World War, only fishing remained a major employer." Worldwide, fishing initially was mainly an activity for subsistence. However, over time, a mounting population increased the demand for food. Thus, postharvest technologies such as salting, drying, smoking, fermentation, and now canning became widespread to preserve freshly caught fish (Borgstrom et al., 2024). Fishing has continuously developed from traditional techniques to more sophisticated technologies. Eventually, commercial fishing emerged, resulting in overfishing and depletion of fishery resources, which called for management strategies and development programs for its conservation.

In the Philippines, it was only in the 1990s that people realized the management of fisheries and

government development programs had been unsuccessful. Philippine fishery law evolved from centralized management to decentralized management, with responsibility granted to the LGUs following the passage of the Local Government Code of 1991. Then, in 1998, a more refined piece of legislation was enacted—the Republic Act (RA) 8550, also known as the Philippine Fisheries Code of 1998. In 2015, RA 8550 was amended by RA 10654, otherwise known as “An Act to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing.”

RA 10654 requires Vessel Monitoring Measures (VMM) for all commercial Philippine-flagged fishing vessels and mandates the installation of a Vessel Monitoring System (VMS) and Port and Coastal Monitoring Centers (PCMS) in all regions of the country. The VMS is part of the Integrated Marine Environment Monitoring System (IMEMS) Project of the Bureau of Fisheries and Aquatic Resources (BFAR), the lead agency responsible for overseeing the enforcement of fishery laws and VMS implementation.

This study explored the extent of VMS implementation among commercial fishing vessel operators in Infanta, Quezon. It investigated the level of challenges and opportunities and assessed whether such challenges and opportunities significantly affect the adoption and compliance of CFV operations. The study likewise examined whether a significant relationship exists between respondents’ profiles and challenges.

1.2. Background of the Study

The IMEMS project is an innovative, optimized, and integrated monitoring system. Through this system, DA-BFAR can track and communicate with Philippine-flagged fishing vessels in real-time on a national scale. To better understand the IMEMS System, DA-BFAR, through its website (at <https://www.bfar.da.gov.ph>), provides the following explanation. Figure 1 below depicts the process by which the system works.

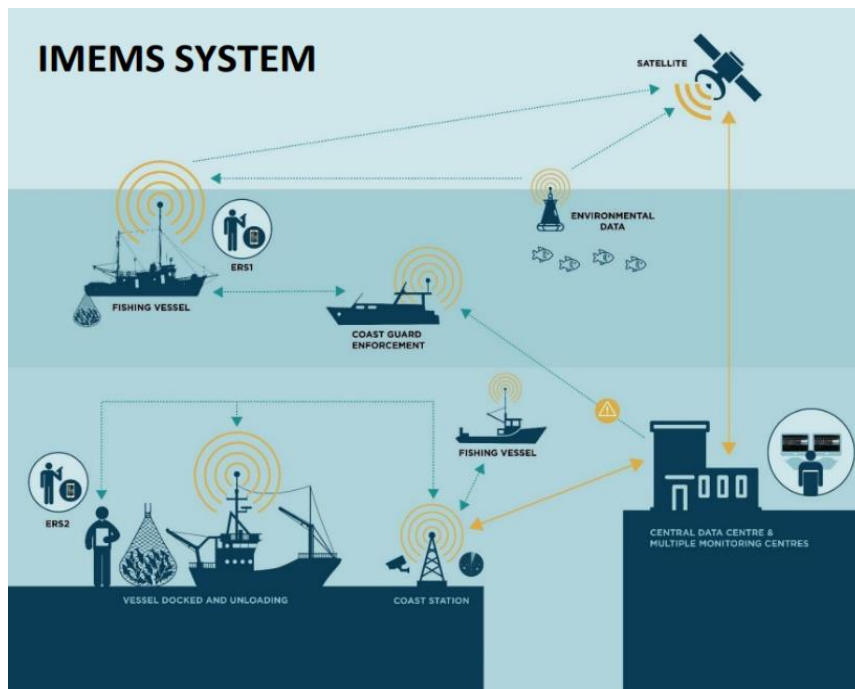


Figure 1. Integrated Marine Environment Monitoring System

Source: Bureau of Fisheries and Aquatic Resources

The Central Data Centre and Multiple Monitoring Centre oversee data processing and analytics, including integrated vessel tracking, license management, Enhancing Local Government Operations through e-Governance (E-LOG), and automated detection of illegal, unreported, and unregulated activities.

Using low-cost technology that combines terrestrial and satellite systems for vessel data collection, the IMEMS ensures that the data gathered from fishing vessels is secured using up-to-date encryption technology and made accessible to DA-BFAR partners to ensure data transparency.

While there has been successful implementation of VMS in the fisheries sector of some countries, there is still evidence of challenges associated with its implementation (Sule Abiodun, 2021). In the Philippines, there is a dearth of research in this area that would confirm or negate the findings of the studies done abroad. However, there are reports of challenges confronting the VMS implementation. For instance, in Infanta, Quezon, reports (verbal and written) from commercial fishing vessel operators seemingly point to the emerging hurdles, including technological barriers, financial constraints, and concerns over data privacy due to the implementation of VMS.

1.2. Theoretical Frameworks

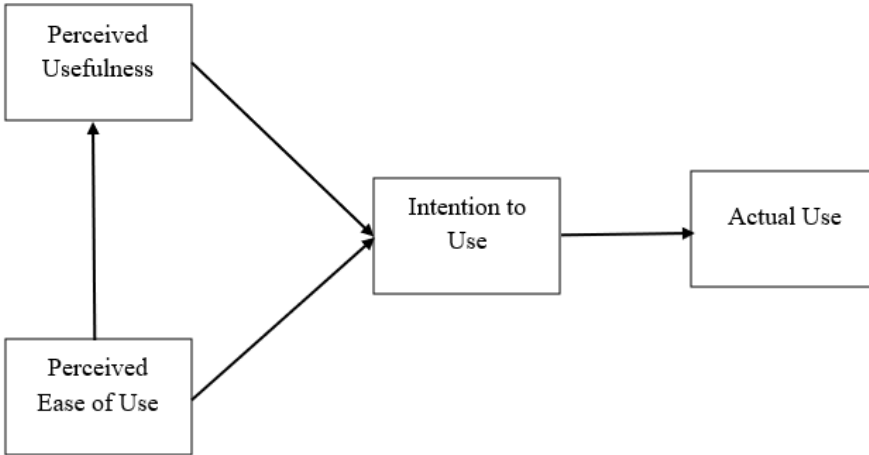
The Innovation Diffusion Theory (IDT), introduced by Everett Rogers in 1962, provides the foundation for understanding innovation adoption and the factors influencing an individual's choice. This theory is broad in scope, allowing for flexibility across various contexts. However, it can be challenging to utilize as a process model when planning for organizational change related to the adoption of an innovation. Additionally, this theory explains how innovations spread and what factors influence the decision to adopt or reject them.

The theory highlights four key components: innovation, the communication channels used to share information, the social system surrounding adopters and non-adopters, and the timescale of adoption. IDT outlines five stages in the decision-making process: learning about innovation, developing an opinion (persuasion), deciding whether to accept or reject it, implementing it, and confirming the decision to either retain or modify the innovation. It also identifies five factors that affect adoption: relative advantage (perceived benefits over alternatives), compatibility (fit with existing practices), complexity (ease of use), trialability (opportunity to test), and observability (visibility of the innovation's impact). The goal is to gather initial information on what should be considered before implementing strategies to foster adopter acceptance of the new technology (Straub, 2017).

The Technology Acceptance Model (TAM), initially introduced by Fred Davis in 1985, emphasizes that a potential adopter's attitude and expectations significantly influence the adoption of innovations. TAM focuses on two main components: perceived ease of use, which refers to how easily the innovation can be learned and implemented, and perceived usefulness, which denotes the extent to which it improves personal or job performance. This theory argues that ease of use influences perceived usefulness, as innovations that are quickly embraced have a higher chance of enhancing productivity.

However, a later study implies that *perceived usefulness* had a more substantial impact on adoption, suggesting that even if a technology is easy to use, it will not be adopted if it is not seen to be beneficial (Agag & El-Masry, 2016).

Applying TAM in this study provides insights into evaluating commercial fishing vessel operators' perceptions of the VMS. Data on challenges, opportunities, and adoption and compliance were obtained from respondents who possess certain characteristics (the independent variable) that may influence their perceptions of the VMS's impact on daily operations, its contribution to sustainable fishing practices, its usefulness, the benefits experienced from using the VMS, BFAR's level of support for VMS implementation, and the likelihood of continued adoption and compliance in CFV operations (the dependent variables). The suggestions and recommendations derived from the study may offer valuable input to the implementers' decisions regarding improvements or changes to the vessel monitoring system's project implementation.



1.3. Conceptual Framework

Figure 3 depicts the study's framework. As shown below, the Independent Variables include the profiles of both the CFV operators and the BFAR regulatory officers. The CFV operators will be profiled according to their age, educational attainment, years of experience in commercial fishing operations, type of fishing vessel being operated, and participation in training.

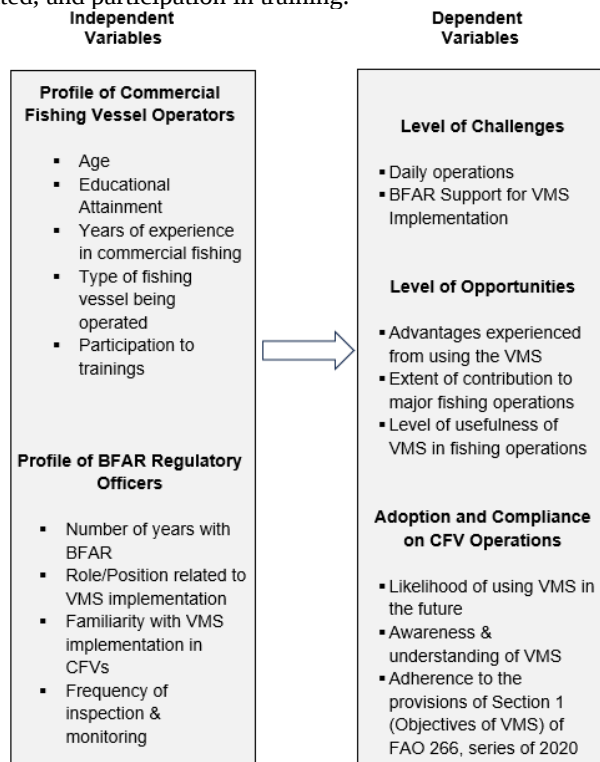


Figure 3. The Study Framework

On the other hand, the BFAR regulatory officers' profile will include: number of years with BFAR, role or position related to VMS implementation, familiarity with VMS implementation in commercial fishing vessels, and frequency of inspection and monitoring.

The Dependent Variables consist of CFV operators' perception as to: Level of Challenges, Level of Opportunities and Adoption and Compliance on CFV Operations. The Level of Challenge will include measurement of impact to daily operations and the level of support by BFAR for VMS implementation. The Level of Opportunities includes assessing the advantages experienced from using the VMS, the extent of contribution of VMS to major fishing operations, and perceived level of usefulness of VMS in fishing operations. Adoption and Compliance of CFV Operation will include determining the likelihood of using VMS in the future, awareness and understanding of VMS, and adherence to the provisions of Section 1 of FAO 266, series of 2020.

The study argues that the profiles of CFV operators and BFAR regulatory officers are likely to influence the Level of Challenge and Opportunity and their adoption and compliance with VMS in their CFV operations.

1.4. Statement of the Problem

This study determined the extent of VMS implementation among commercial fishing vessel operators in Infanta, Quezon, and investigated the perceived challenges and opportunities. Specifically, the study sought answers to the following questions:

1. What is the profile of commercial fishing vessel operators in Infanta, Quezon in terms of:
 - 1.1 Age
 - 1.2 Educational attainment
 - 1.3 Years of experience in commercial fishing
 - 1.4 Type of fishing vessel being operated, and
 - 1.5 Participation in trainings?
2. What is the profile of BFAR Regulatory Officers in terms of:
 - 2.1 Number of years with BFAR
 - 2.2 Role/position related to VMS implementation
 - 2.3 Familiarity with VMS implementation in CFVs
 - 2.4 Frequency of inspection and monitoring?
3. What is the level of challenges in terms of:
 - 3.1 Daily operations
 - 3.2 Level of support by BFAR for VMS implementation?
4. What is the level of opportunities in terms of:
 - 4.1 Advantages experienced from using the VMS
 - 4.2 Extent of contribution to major fishing operations, and
 - 4.3 Level of usefulness in fishing operations?
5. What is the status of the adoption and compliance on CFV operations as to:
 - 5.1 Likelihood of using VMS in the future
 - 5.2 Awareness and understanding of VMS and
 - 5.3 Adherence to the provisions of Section 1 (Objectives of VMS) of FAO 266, series of 2020?
6. Is there a significant relationship between respondents' profiles and challenges?
7. Is there a significant effect on the challenges and opportunities in utilizing VMS and the adoption and compliance on CFV operations?

1.5. Hypotheses of the Study

Concerning specific problems 6 and 7, the following hypotheses were examined:

There is no significant relationship between CFV operators' profiles and the level of challenges.

There is a significant relationship between CFV operators' profiles and the level of challenges.

There is no significant relationship between the BFAR Regulatory Officers' profile and the level of challenges.

There is a significant relationship between the BFAR Regulatory Officers' profile and the level of challenges.

There is no significant effect on the challenges and opportunities in utilizing VMS and the adoption and compliance of CFV operations.

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1.6. Scope and Limitations of the Study

The Vessel Monitoring System project is being implemented nationwide. However, in this research, the study area was confined to Infanta, Quezon, and therefore, results represented only a scenario for Infanta, Quezon, and do not reflect a general scenario for the VMS implementation. However, insights from this study either confirmed or negated scenarios in other areas, and thus provide ideas that can improve the strategies being employed in implementing the VMS, and in achieving the objectives contained in Section 1 of FAO 266, series of 2020.

But, given the operational nature of commercial fishing and the geography in Infanta, Quezon, these factors served as limiting factors that hampered data gathering. Another limiting factor was the tendency of respondents to cancel at the last minute or agree on a date for the surveys, which resulted in rescheduling the survey.

Infanta is also the investigator's work area. Hence, to avoid biases and expedite data gathering, the researcher asked the assistance from co-workers who are adept at conducting interviews and underwent briefing/orientation. Prior to the interview proper, respondents were informed that the study was being managed in accordance with the Data Privacy and Confidentiality Act.

This investigation contributes to and supplements the existing information on the extent of implementation of the vessel monitoring system that may be useful to the implementing agency the Bureau of Fisheries and Aquatic Resources.

1.7. Significance of the Study

This study, entitled "Extent of Implementation of Vessel Monitoring System (VMS): Challenges and Opportunities in Commercial Fishing Vessel Operations in Infanta, Quezon," imparts useful information that may lead to designing an appropriate strategy for improving the implementation of the VMS. The study is significant for several stakeholders, including commercial fishing vessel operators, government agencies, and the fishing industry as a whole. Insights from this study will contribute to improved policymaking, sustainable fisheries management, and enhanced compliance within the fishing sector.

Specifically, the study significantly contributes to the following:

Department of Agriculture – Bureau of Fisheries and Aquatic Resources- provide informative and research-based data to improve its policies and programs related to the implementation of the vessel monitoring system by identifying specific challenges encountered by commercial fishing vessel operators, such as technical difficulties, lack of awareness, lack of government support, and resistance to change. DA-BFAR can design targeted interventions like subsidies, training programs, or technical support to enhance compliance. It will also provide a framework for monitoring and evaluating the success of VMS implementation, helping the agency track progress and identify areas for improvement.

Commercial Fishing Vessel Operators - provide valuable insights to commercial fishing vessel operators in Infanta, Quezon. By identifying the challenges, VMS operators can make informed decisions on how to adopt and utilize the system effectively. More importantly, by identifying and understanding the opportunities that VMS could offer (i.e., enhanced operational safety, better monitoring of fishing activities, and increased market competitiveness through compliance with national and international standards, etc.), operators would be enlightened that adopting the VMS can strengthen their position in the industry, gain access to more regulated markets, and reduce the risks associated with illegal, unreported, and unregulated (IUU) fishing. Thus, the study will empower fishing operators by providing them with data-based solutions to improve compliance while maximizing the potential benefits of VMS, thereby fostering more efficient and sustainable fishing practices.

Community - since Infanta, Quezon is a coastal community, most of the residents depend on fishing for their livelihood. An improved strategy for compliance with VMS will boost the long-term productivity of the fishing sector which provides stable income and employment opportunities to the community. The adoption of VMS may also enhance vessel safety through real-time monitoring, allowing authorities to respond quickly in case of emergencies, which helps protect the lives of the fishers.

For the Fishing Industry - the results of this study may predict the likelihood of adoption and compliance with the vessel monitoring system. Adopting the technology can improve

transparency and traceability in the supply chain, helping operators meet national and international standards. Insights from this research can foster collaboration among operators, government, and industry organizations, leading to more efficient fishing operations and improved market access.

Future Researchers - results of this study will serve as a valuable reference for future researchers who may be interested in exploring the fields of fisheries management, maritime technology adoption, and regulatory compliance. It will contribute to the body of knowledge on the implementation and impact of Vessel Monitoring Systems (VMS), especially in developing coastal communities like Infanta, Quezon. Future researchers can build upon the findings of this study to further investigate related topics, such as the long-term effects of VMS on fishing operations, the role of government incentives in compliance behavior, or the effectiveness of training programs in enhancing technology adoption.

1.8. Definition of Terms

The following terms are defined for a clearer understanding of this study:

Bureau of Fisheries and Aquatic Resources - the Philippine government agency responsible for managing, regulating, and developing the country's fishery and aquatic resources, including implementing and overseeing VMS regulations.

BFAR Regulatory Officers - it refers to the regulatory officers from the BFAR Region IV-A who are directly involved in the implementation of VMS

Challenges in VMS implementation – it refers to the perceived obstacles and difficulties in adopting and using VMS as identified/mentioned in the survey questionnaire by respondent-CFV operators in Infanta, Quezon

Commercial Fishing – it refers to the practice of CFV operators capturing fish and other high-value seafood species to sell and profit from these activities rather than for personal or subsistence use.

Commercial Fishing Vessel or CFV – it refers to boats or ships weighing 3.1 gross tonnage and above that are being used in Infanta, Quezon to catch fish and other high-value seafood for commercial purposes.

Commercial Fishing Vessel Operator or CFV operator – it represents the individual respondent from Infanta, Quezon, who is responsible for managing and operating the CFV

Compliance – it refers to the extent to which CFV operators meet the requirements set forth by the Bureau of Fisheries and Aquatic Resources (BFAR) for using VMS.

Extent of Implementation - this term refers to how widely and effectively the VMS has been adopted by commercial fishing vessel operators in a given area, including levels of compliance, coverage, and functional usage of the system.

Illegal, Unreported, and Unregulated (IUU) Fishing – it describes activities that violate fisheries management rules, such as fishing without a permit, failing to report

catches accurately, or engaging in unauthorized or unregulated fishing in certain areas.

Large-scale CFV – these are vessels with a capacity of more than 150 GT

Level of Adoption and Compliance – it was measured using a 4-point Likert Scale in terms of likelihood of using VMS in the future, awareness and understanding, and adherence to Section 1 of FAO 266, series of 2020.

Level of Challenge – it was measured in a 4-point Likert Scale in terms of impact on daily operations and level of support by BFAR for VMS implementation.

Level of Opportunities – it was measured in a 4-point Likert Scale in terms of benefits experienced from using the VMS, extent of contribution to major fishing operations, and level of usefulness of VMS in fishing operations.

Medium-scale CFV – these are vessels with capacity of 20.1 to 150 GT.

Opportunities in VMS implementation – this refers to the potential benefits that VMS adoption may provide, such as improved safety at sea, market traceability, enhanced resource management, compliance with international standards, and a reduction in IUU fishing activities.

Small-scale CFV – these are vessels with a capacity between 3.1 and 20.0 gross tonnage.

Sustainable Fisheries Management - these refer to practices and policies that aim to maintain fish populations at healthy levels while ensuring long-term ecological and economic viability of fishing activities. This often involves monitoring, regulating catch limits, and using systems like VMS.

Vessel Monitoring System (VMS) – this is a satellite-based system that monitors and tracks the movements of fishing vessels. It is used to promote compliance with fisheries regulations, enhance maritime safety, and reduce illegal, unreported, and unregulated (IUU) fishing by providing real-time location data and operational status.

1.9. Review of Related Literature and Studies

This chapter presents the reviewed literature and studies that were found relevant to the present investigation. The reviewed literature, studies, and articles provide significant information on the implementation of vessel monitoring systems in the commercial fishing sector, which focuses on the variables of the study. Through this review, the study was to contextualize the VMS experience against broader findings, identifying both existing gaps and best practices. This literature review provides foundational knowledge and highlights the relevance and necessity of addressing the unique needs of local commercial fishing vessel operators.

1.9.1. Related Literatures

For clarificatory purposes, the Philippine Fisheries Code of 1998 (RA 8550) defines

commercial fishing vessels (CFVs) as those fishing vessels with a capacity of more than three (3) gross tonnage (GT). The Code further classifies CFVs into three (3) different sizes: Small-scale, defined as those with a capacity ranging from 3.1 to 20.0 GT; Medium-scale, comprising vessels with capacity ranging from 20.1 to 150 GT; and Large-scale vessels, which are those having a capacity of more than 150 GT (Section 4 No. 10).

The latest available data from BFAR shows that there are 4,560 licensed commercial fishing vessels throughout the country. Of this number, 355 were large-scale, 2,224 were medium-scale, and 1,981 were small-scale. The data further showed that, of the 4,560 licensed CFVs, 160 were from Region IV-A. The 160 registered CFVs in Region IV-A consists of 38 medium-scale and 122 small-scale (Fisheries Profile, 2023, p. 18).

In an article entitled “Empowering high seas governance with satellite vessel tracking data” published in the *Fish and Fisheries Journal*, Dunn et al. (2018) chronicled initial efforts on monitoring, control, and surveillance (MCS) to curb the spike in illegal, unreported, and unregulated (IUU) fishing. Citing several studies, they noted that, nearing the end of the 20th century, the international fishing community started crafting frameworks that would control and monitor fishing vessels and their activities. This was in the form of catch documentation schemes and coming up with an international list of vessels engaged in IUU fishing activities.

The integration of artificial intelligence (AI) and big data analytics has altered the methods for collecting, analyzing, and using fisheries data. Large volumes of data from many sources, including catch reports, environmental sensors, and vessel monitoring, can be processed by machine learning algorithms. By identifying trends and correlations, AI can provide accurate stock assessments, predict fish population dynamics, and optimize fishing strategies for long-term return. This data-driven approach enables adaptive management, leading to reduced environmental consequences and more efficient resource allocation (Pinsky et. al., 2018).

Electronic monitoring equipment have altered the way that fishing activities are watched and documented. To assure adherence to regulations and reduce reliance on human observers, EM systems use cameras, sensors, and GPS technology to record fishing activity onboard vessels. Fishermen that use EM systems to electronically report their catches streamline data collection, cut down on paperwork, and enable near-real-time reporting. These developments improve data transparency, accuracy, and the capacity to make informed decisions regarding managing fisheries (Gutierrez et. al., 2012).

Alongside these initial attempts, in 2001, the International Monitoring, Control and Surveillance (IMCS) network was established, and later the High Seas Task Force was created. Through the IMCS, member States (50 by 2012) shared information on IUU fishing activities and vessels (p. 730). Observer programs were then put in place. However, it was realized that the costly observer programs may be better replaced by using both vessel monitoring system (VMS) and automatic identification system or AIS which have global coverage (Dunn et al., 2018).

The ability to monitor fishing activity in real-time on a worldwide scale is made possible by satellite-based technologies. To efficiently detect illegal fishing, prevent overfishing, and enforce rules, vessel monitoring systems (VMS) and satellite imaging are used to track the movement and behavior of fishing vessels. Additionally, the application of remote sensing technology offers relevant information on oceanographic conditions, assisting stakeholders in making decisions regarding the best times and places to fish (Balaji et. al., 2023).

The use of Vessel Monitoring System (VMS) is an important step in monitoring fishing vessel activity and tackling illegal fishing. VMS uses GPS technology to track the position and movement of vessels in real time, which supports more effective fisheries policy making and conservation of marine resources (Doherty et. Al., 2021). VMS allows fisheries authorities to identify violations of restricted zones and detect illegal fishing practices quickly. VMS was implemented for fishery vessels by establishing a VMS monitoring and operational system, as well as installing transmitters on fishery vessels of a certain size, making it possible to know the presence and movement of fishery vessels and to identify their activities (Bachtiar et. al., 2024).

At present, there is no exact and official figure that reveals the number of countries adopting the VMS. However, as early as CY 2000, 30 countries were listed by FAO. This was reported by Smith (n.d., available online at www.fao.org). The said report showed a total global estimate of 9,200 vessels fitted with VMS.

In the Philippines, Espinilla (2021) recounted that, as early as 2016, BFAR started drafting rules for implementing the VMS. Such rules were based on feedback from consultations and workshops with various public and private stakeholders. Then, in 2018, the Department of Agriculture issued Fisheries Administrative Order (FAO) No. 260. The said FAO, however, was highly criticized since it stated that immediate implementation of the VMS rules was limited only to commercial fishing vessels that target straddling and highly migratory fish stocks. According to critics, the said limitation weakens the enforcement and conservation potential of an effective VMS.

To address the issue, FAO 260 was amended by the Department of Agriculture on 12 October 2020, with the proclamation of FAO No. 266. The new FAO now requires all commercial fishing vessel operators to install VMS in their vessels as part of BFAR's Integrated Marine Environment Monitoring System or IMEMS. Thus, without a VMS, all commercial fishing vessels operating in Philippine waters and all fishing vessels in distant waters shall not engage in fishing activity. The administrative rules contained in FAO 266 toughened BFAR's MCS capabilities. It also "details the specifics of implementation for VMS (including restrictions on data access), operational guidelines, as well as penalties in case of violations" (p. 126).

Essentially, FAO 266 (available online at www.bfar.da.gov.ph) is the legal document that serves as a "Bible" or reference for BFAR regulatory officers to monitor the compliance of commercial fishing vessel operators effectively. It is a document reference

upon which a CFV and its operator are assessed. As such, BFAR enforcers must ensure that the following are implemented/observed as FAO 266:

(1) All commercial fishing vessels must have an accredited Automatic Location Communicator (ALC) that contains the vessel name, its registered fishing gear and fishing ground, and other parameters in the vessel registration.

(2) The ALC must be kept ON at all times and must transmit a status report to the Fisheries Monitoring Center (FMC) at least 24 times a day.

(3) The installed ALC should also have a distress alert button that, when activated, will trigger an emergency transmission to the Philippine Coast Guard (PCG) and any other nearby vessels.

FAO 266 further requires all fishing vessels to send catch information to the BFAR via an Electronic Reporting System (ERS). This measure is intended to provide the following minimum information to BFAR: (1) species and volume of fish caught, (2) position of the vessel where the fish was caught, (3) date and time, (4) vessel activity, (5) port of origin and arrival, (6) tracking and reporting devices used, (7) margin of tolerance and weight for catch reporting, and (8) manual data reporting in case of operational failure.

Vessels equipped with an ERS are required to transmit a minimum of one catch report per day. With this information, it is thought that the BFAR will be better able to address the country's persistent illegal, unregulated, and unreported fishing problem (Espinilla, 2021).

Electronic monitoring (EM) has emerged as a cost-efficient supplement to existing fishery catch monitoring programs. An EM system consists of various activity sensors and cameras positioned on vessels to record fishing activity remotely and catches. EM proved to be a successful tool to test alternative management regimes, for example, catch quota management (CQM) trials and "unrestricted gear" trials. In several studies, changes in fishers' behavior were observed because of a change in management regimes in combination with EM. In some cases, there was a shift in behavior towards greater avoidance of undersized fish, reduced high grading, and generally greater compliance with rules and regulations in recording discards. Thus, EM triggered compliance and provided a rich source of information that can be used to inform on the outcome of management measures (Helmond, 2019).

In Nigeria, Abiodun (2021) conducted an exploratory survey on the installation and implementation of VMS. Using a purposive sampling method in selecting 50 members of Nigerian Maritime Administration and Safety Agency (NIMASA), the study revealed that, (1) installing VMS will allow fisheries management authorities to monitor near real-time movements; (2) provide directions for vessel inspections upon detected infringements which limits the costs of routine patrols; and, (3) it will also improve compliance with fisheries regulations; (4) enhances the effectiveness of search and rescue missions. The study also found that the primary challenges affecting the installation of VMS were financing, technical know-how, availability, as well as poor maintenance culture. The

investigation also disclosed that the installation and implementation of VMS will minimize criminality on Nigerian seas (p. 1153).

On a global scale, two dominant technologies are currently used in vessel tracking for industrial fisheries: vessel monitoring systems (VMS) and the automatic identification system (AIS). A third type of technology, GPS vessel tracking, is used in some small-scale fisheries. VMS is the most common technology used by management agencies to monitor, control, and surveillance in fisheries. This technology has been used since the 1990s to monitor vessel activity from national fleets and foreign vessels within national waters and track national distant water fleets.

Enforcement activities can reduce or prevent non-compliance among fishers, but there are limits to the resources available to strike a balance between enforcement costs and fishing profits. Fishers are often creative in finding ways to bypass regulations. An alternative approach could be to promote regulation supported by fishers, but managers lack knowledge of the conditions and factors influencing rule compliance and legitimacy of fisheries management systems. Understanding compliance behavior in fisheries is more complex than the instrumental approach. An alternative strategy could be to establish a larger degree of convergence between management objectives and what fishers perceive as legitimate by adjusting or changing the design of the complex management regime. Adding a normative approach can improve the knowledge of incentives among fishers for non-compliance behavior (Nielsen, 2003).

1.9.2. Related Studies

In the 2008 study of Napata, Espectato, and Serofia (2014), which was conducted among 1,171 fishermen in selected municipalities of Panay Island, 55% of the respondents had either an elementary level or an elementary graduate as their highest educational attainment.

The above finding was affirmed by the study of Siason, Monteclaro and Ferrer (2014) who described the socio-economic conditions of fishers (municipal and commercial) from three study areas in the Visayan Sea: Concepcion, Iloilo; Escalante, Negros Occidental, and Daanbantayan in Cebu. The authors described the commercial fishers as: approximately 34 to 37 years old, male, married and with educational attainment of elementary level (in Concepcion and Escalante) and high school level (in Daanbantayan).

Citing Nielsen (2003) and Keane et al. (2008), Napata, Espectato and Serofia (2014) stated that, “fishers’ compliance is usually determined by the economic gains of breaking the rules compared to the risk of being detected and the economic sanctions for violating the rules” (p. 74). Losses and gains are assessed differently by people, and fishers’ way is taking full advantage of the profits or benefits they could obtain in a situation and evaluating if they could gain more from non-compliance. In their study that described the effectiveness of the system of registration and licensing of municipal fishers, fishing

vessels, and fishing gears in three coastal municipalities of Panay Island, the authors found that, higher compliance rate in one of the sites was due to its active fishery law enforcement and frequent seaborne operation. This heightened the exposure of fishers who are operating without the necessary permits or license. Hence, rather than paying the penalty and other administrative sanctions when caught without permits or licenses, fishers opted to comply with the regulation rather than paying the penalty and other administrative sanctions.

The fisheries sector is demanding to produce the catch quantities of small-scale fisheries because of a lack of proper monitoring. Vessel Monitoring System (VMS) is an important tool that allows the government to monitor small-scale fishing vessel activities. The implementation of VMS in small-scale fisheries is a powerful solution for unauthorized data. VMS provides economic benefits as most fishermen are nowadays equipped with smartphones. With the recent technological advancements, the VMS has improved, allowing integrated fisheries management (Raghu, 2022).

VMS transmits information on the vessel's location and identification at intervals ranging from every 10 min to once daily, depending on local regulations. Although VMS data are collected intermittently at low temporal frequencies, these records can be interpolated to obtain continuous vessel tracks. Fishing activity is commonly inferred from vessel speed information, which may be reported directly by VMS or estimated using the time and distance between VMS records (Orofino et al., 2023).

Phuong and Hang (2023) studied the effectiveness of vessel monitoring systems in managing and monitoring fishing vessels in Ca Mau province in Vietnam. The data was obtained from 94 surveyed fishermen who were captains and owners of Ca Mau fishing vessels equipped with VMS. Using stratified random interviews from December 2021 to April 2022, results showed that 96.8% of the respondents believed that VMS was effective, and this was particularly true for emergency rescue functions, as affirmed by 73.4% of the respondents.

Furthermore, the automatic transmission of the vessel's location via GPS every two or three hours was highly rated as effective by 78.7% of the respondents. Additionally, most of the respondents (68.5%) believed that the core requirements of VMS were just appropriate. However, the function on voice communication, texting with any phone number was rated lowest, with 60.6% of the respondents evaluating it as "very inefficient". The main problem encountered with VMS, as cited by the study, was disconnect failure for more than 10 days. However, the study concluded that VMS effectively supports the efforts to combat IUU fishing.

VMS's effectiveness was not only confirmed in the area of governance and curbing IUU fishing. A study by Watson et al. (2018) found that implementation of VMS can have a positive impact on harvest. In their study, Watson et al. (2018) integrated three data sources (observer, VMS and logbook data) and quantified an increase in fishing efficiency. The study analyzed more than 1 million VMS records to identify 4371 longline trips made by 150 vessels in the Gulf of Mexico from 2007 to 2013. It was observed that after the

regulatory transition, there were fewer vessels. However, these vessels loaded more fish and generated higher revenues in less time and with fewer hooks than before the transition. In the aforementioned studies, the subject countries mandated the installation of VMS. Hence, target users have to abide by the regulations. However, It is unknown how these perceptions are formed and what factors influenced their responses. No study has been found that shows a relationship between the profile of respondents and the perceived opportunities and challenges of using the VMS. Thus, studies about other technologies (factors affecting perceptions and the decision to adopt) were reviewed.

For instance, Cardenas et al. (2019) investigated the predictors (demographic characteristics, attitudes, and cultural values) of using four technology-based products and services in Ecuador and Russia. Adopting a regression model, the study found that the two countries' demographic variables have the highest predictive capacity. Attitudes toward technology demonstrated some predictive ability, while cultural values have a negligible direct impact on technology use.

Hooks et al. (2022) explored the country factors influencing technology adoption through a random effects panel model for a sample of 15 countries from 2010-2019 using secondary datasets. The study found a statistically significant effect of competitiveness, cybersecurity, ease of doing business, political stability/non-violence, and terrorism. The study concluded that a “country that is highly competitive, has enhanced cybersecurity, is easy to do business in, and has a low level of political violence and terrorism adopts new technologies more readily than others” (n.d.).

2. Methodology

This chapter addresses the methods and procedures utilized in the study. It covers the research design, population and sampling technique, procedure, instruments, and treatment of statistical data.

2.1. Research Design

A descriptive non-experimental quantitative research design was adopted. This research design was used in the study to ensure rapid data collection, since the researcher had a very limited time to conduct the study and gather the needed data. Furthermore, considering the geographical characteristics of Infanta, Quezon, where most target respondents are remotely located, this design was chosen as this is one of its advantages - quantitative research can be performed remotely.

This is survey research combined with a correlational design.

2.2. Population and Sampling Technique

This study has two groups of respondents: the commercial fishing vessel (CFV) operators equipped with VMS-100 transponders from Infanta, Quezon, and the BFAR regulatory officers involved in implementing VMS in Infanta.

To get a representative sample for the CFV operators, the researcher coordinated with the regional focal person for IMEMS stationed at the BFAR 4A Regional Office in Los Baños, Laguna. A list of licensed commercial fishing vessels with installed VMS-100 transponders was obtained from the focal person, and a total of 94 were found in Infanta, Quezon. From this total population, the sample size was computed using Slovin's formula with a 95% confidence level and a 5% margin of error. The computed sample size was 76.

As for the BFAR regulatory officers, all 10 officers involved in the implementation of VMS were surveyed.

Simple purposive random sampling was used to choose the respondent-CFV operators for the study.

The researcher chose to conduct the study in Infanta, Quezon, a coastal community where commercial fishing is a significant industry. This provides a unique setting to study the practical implications of VMS. The perspective of the community's stakeholders is crucial in understanding the broader impact of this technology.

Research Instruments

The researcher prepared two questionnaires to collect the needed data: one for the CFV operators and another for the BFAR regulatory officers.

Both sets of questionnaires had two parts: Part I for data on demographic profile and Part II for the measurement of Level of Challenge, Level of Opportunities, and Adoption and Compliance on CFV operations.

Part I of the questionnaire for CFV operators was intended to answer research question #1. On the other hand, Part I of the questionnaire for BFAR Regulatory Officers addressed research question #2.

Part II of both questionnaires was constructed using statements evaluated on a 4-point Likert Scale. This part of the questionnaire addressed research questions 3 to 5. The remaining research questions were addressed using the same data obtained in Part II of the questionnaire but subjected to statistical tests/treatments.

2.3. Research Procedure

The research procedure of this study began with reviewing several related studies and literature regarding the researcher's stated problem.

As depicted in Figure 4, the researcher first conducted observations in the workplace to identify potential problems suitable for study. Subsequently, the title was formulated based on the area of interest regarding the extent of implementation of the Vessel Monitoring System among commercial fishing vessel operators in Infanta, Quezon. The title focused on gathering data about the challenges faced by CFV operators and the

opportunities presented by this technological advancement.

Following the approval of the chosen topic and title, the researcher started reading various related international and local literatures and studies about the implementation of vessel monitoring system. Also, relevant and recent data on the internet was searched. With the assistance of his adviser and other thesis panelists, the researcher managed to gather sufficient data, literature and related research that was a great source for constructing his conceptual and theoretical frameworks.

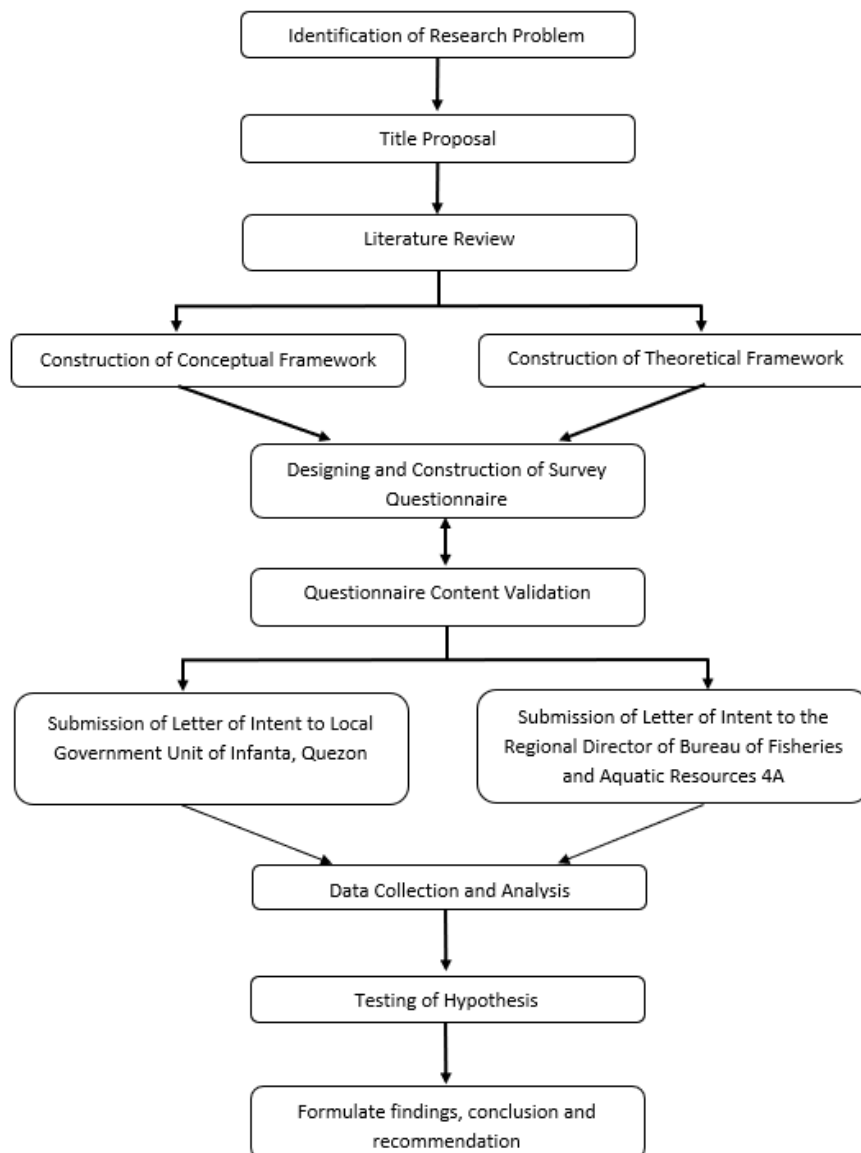


Figure 4. The Research Procedure of the Study

The researcher designed two sets of self-made questionnaires: 1 for the CFV operators and 1 for the BFAR regulatory officers to gather data. The questionnaire was reviewed by the researcher's adviser, statistician and subject specialist for comments and corrections.

Prior to the conduct of the survey, the researcher submitted a letter of intent to the Local Government Unit of Infanta and to the office of the Regional Director of Bureau of Fisheries and Aquatic Resources IV-A for approval to conduct the survey. Upon the approval of the LGU and BFAR IV-A, the researcher asked the assistance of co-workers who are adept at conducting interviews. A briefing/orientation was conducted before the administration of the questionnaire.

The gathered data were carefully tallied/encoded in Microsoft Excel to produce the raw data that was submitted to the statistician for statistical analysis. Tables were constructed to present the data more clearly. The statistical data were appropriately interpreted for reliable findings and valid conclusions.

2.4 Statistical Treatment of Data

Mean was used to determine the ratio of the respondents' responses to the different factors and the total number of responses.

Standard Deviation was used to show the degree to which the individual responses to a questionnaire "deviate" from the mean.

Pearson's correlation coefficient (r) was used to determine the type of relationship (positive, negative, or none) and the strength of the relationship (weak, moderate, or strong) between two variables.

A two-tailed test was used to test the significance of the Pearson's correlation coefficient (r)

For the interpretation of the level of challenge, the level of opportunities, and adoption and compliance on CFV operations, the weighted mean of the data obtained in the 4-point Likert Scale was interpreted as follows, according to Pimentel (2019):

Likert Scale	Interval	Verbal Descriptors	Interpretation
1	1 -1.74	Strongly Disagree	Low
2	1.75 – 2.49	Disagree	Moderately Low
3	2.5 – 3.24	Agree	Moderately High
4	3.25 - 4	Strongly Agree	High

3. Results and Discussion

This chapter presents the results obtained by the researcher from administering the constructed survey questionnaire among CFV operators and BFAR regulatory officers in Infanta, Quezon. It presents the data gathered by the researcher from the commercial fishing vessel operators and BFAR Regulatory Officers in Infanta, Quezon. The results were interpreted using the appropriate statistical analysis stated in Chapter 3.

3.1. Demographic Profile of Commercial Fishing Vessel Operators

Out of the 94 commercial fishing vessels with installed VMS in Infanta, Quezon, 76 were surveyed. This represented a response rate of 81%. The profile of the respondents is presented and discussed below:

Age

Table 1. Frequency and Percentage Distribution of CFV Operators According to Age

Age (Years)	Frequency (n)	Percent (%)
15 - 24	-	-
25 - 54	68	89.5
55 - 64	8	10.5
65 and above	-	-
Total	76	100.0
N=76		

As shown in Table 1, of the 76 respondents, 68 (89.5%) were aged between 25 and 54 years, while only 8 (10.5%) were between 55 and 64 years old. The youngest CFV operator was 28 years old, while the oldest was 63 years. The Philippine age structure presented in the CIA World Factbook issued on September 18, 2021, categorizes the age bracket of 25 to 54 years as prime working age, while those aged 55 to 64 years are considered to be in mature working age. Hence, the majority (89.5%) of the surveyed CFV operators were of prime working age. The average age of the respondent CFV operators was 44 years. This is 6 years younger than the average age of 50 for those engaged in commercial fishing, as reported in the 2023 Fisheries Profile (p. 14).

Educational Attainment

Table 2. Frequency and Percentage Distribution of CFV Operators by Educational Attainment

Educational Level	Frequency (n)	Percent (%)
Elementary level	11	14.5
Elementary graduate	12	15.8
High School level	21	27.6
High School graduate	22	29.0
Vocational Course	6	7.9
College undergraduate	2	2.6
College graduate	2	2.6
Total:	76	100.0
N=76		

The majority of the CFV operators were either high school graduates (29%) or reached the high school level (27.6%). This group consisted of 43 respondents (56.6%) out of the 76 surveyed operators. Following this group were those who either graduated from elementary (12 or 15.8%) or reached the elementary level (11 or 14.5%), which made up a total of 23 (30.3%) respondents.

Six respondents (7.9%) took vocational courses, while 2 (2.6%) were college-level. Similarly, two (2.6%) CFV operators graduated from college (Table 2). Comparatively, the finding shows a relatively higher level of education among commercial fishers than those found by Siason, Monteclaro, and Ferrer (2014) and by Napata, Espectato, and Serofia (2014).

Siason, Monteclaro and Ferrer (2014) who synthesized three case studies in the Visayan Sea revealed *elementary level* as being the highest education of commercial fishers from Concepcion, Iloilo and Escalante, Negros Occidental. However, high school graduates or high school level were found in Daanbantayan, Cebu, which is similar to the data obtained by this study. Napata, Espectato, and Serofia (2014) also found that the majority of the 1,171 fisher-respondents that they interviewed were elementary graduates.

Years of Experience in Commercial Fishing
 Table 3. Frequency and Percentage Distribution of CFV Operators
 by Years of Experience in Commercial Fishing

Years of experience in commercial fishing	Frequency (n)	Percent (%)
Less than 1 year	0	0
1-5 yrs	8	10.5
6-10 years	22	29.0
> 10 years	46	60.5
Total:	76	100.0
N=76		

The data in Table 3 reveals that more than half (46 or 60.5%) of the 76 respondent CFV operators had over 10 years of experience in commercial fishing. This result confirmed the findings of Siason, Monteclaro, and Ferrer (2014) who reported that the average number of years in fishing for respondent commercial fishers was 18.82 years in Concepcion, Iloilo, 17.57 years in Escalante, Negros Occidental, and 16.07 years in Daanbantayan, Cebu.

Twenty-two or 29% of the 76 respondents in the current study had 6 to 10 years of experience in commercial fishing, while only 8 (10.5%) were relatively beginners, with 1 to 5 years of experience (Table 3).

Type of Fishing Vessel Being Operated

As to the type of commercial fishing vessel (CFV) being operated by the respondents, Table 4 below shows that the majority (52 or 68.4%) operate a small fishing vessel. In comparison, 24 (31.6%) operate a medium-sized fishing vessel. As defined in Chapter 1, small-scale CFVs are vessels with a capacity of between 3.1 and 20.0 gross tonnage (GT), while medium-scale CFVs have a larger capacity of 20.1 to 150 GT.

Table 4. Frequency and Percentage Distribution of CFV Operators
 by Type of Fishing Vessel Being Operated

Type of fishing vessel being operated	Frequency (n)	Percent (%)
Small-scale	52	68.4
Medium-scale	24	31.6
Large-scale	0	0
Total	76	100.0
N=76		

According to the 2023 Philippine Fisheries Profile, out of the 160 licensed CFVs in CY 2023 in the entire Calabarzon region, 122 were small-scale, while 38 were medium-scale. Thus, the results of this study align with this data trend.

Participation in Training

Table 5. Frequency and Percentage Distribution of CFV Operators' Perceived Effectiveness on Attended VMS Training/ Orientation

Perceived Effectiveness on attended VMS training	Frequency (n)	Percent (%)
Slightly effective	25	32.9
Very effective	42	55.3
Extremely effective	9	11.8
Total	76	100.0

N=76

When asked whether they received any formal training or orientation on the use of VMS, all (100%) respondents answered affirmatively. Table 5 above discloses the CFV operators' perception on the effectiveness of the training/orientation they have received.

As shown in Table 5, more than half of the 76 respondents evaluated the trainings/orientations they attended as very effective (42 or 55.3%), while 25 (32.9%) rated them as slightly effective. Additionally, 9 (11.8%) reported that the training/orientation was extremely effective.

Based on the data gathered by the study among 76 CFV operators in Infanta, Quezon, the summarized demographic profile revealed that they were in the prime working age of 25 to 54 years with an average age of 44 years old, reached high school level or are graduates of high school, with more than 10 years of experience in commercial fishing, mostly operating a small-scale fishing vessel and have attended trainings which they perceived as "very effective".

3.2. Demographic Profile of BFAR Regulatory Officers

This study profiled and surveyed all 10 BFAR regulatory officers involved in implementing VMS in Infanta, Quezon. The following describe their profiles in terms of

their number of years with BFAR, role/position related to VMS implementation, familiarity with VMS in commercial fishing vessels, and frequency of inspection and monitoring related to VMS compliance.

Number of Years with BFAR

Six (6 or 60%) of the 10 regulatory officers were with BFAR for 1 to 5 years. Two (2 or 20%) said they have worked at BFAR for less than 1 year and over 10 years (Table 6).

Table 6. Frequency and Percentage Distribution of BFAR Regulatory Officers in terms of Number of Years with BFAR

Number of years with BFAR	Frequency (n)	Percent (%)
<1 year	2	20.0
1 – 5 years	6	60.0
6 – 10 years	-	-
>10 years	2	20.0
Total	10	100.0
N=10		

Role/Position Related to VMS Implementation

Based on the data shown in Table 7, the BFAR regulatory officers included 1 (10%) VMS Director, 6 (60%) VMS operators, and 3 (30%) VMS support staff.

Table 7. Frequency and Percentage Distribution of BFAR Regulatory Officers in terms of their Role/Position related to VMS Implementation

Role/Position related to VMS implementation	Frequency (n)	Percent (%)
VMS Director	1	10.0
VMS Operator	6	60.0
VMS Support Staff	3	30.0
Total	10	100.0
N=10		

Familiarity with VMS Implementation in Commercial Fishing Vessels

Based on the data shown in Table 8, all 10 (100%) respondent regulatory officers claimed that they were *very familiar* with the VMS implementation in commercial fishing vessels.

Table 8. Frequency and Percentage Distribution of BFAR Regulatory Officers in terms of their Familiarity with VMS Implementation in Commercial Fishing Vessels

Familiarity with VMS Implementation	Frequency (n)	Percent (%)
Very familiar	10	100.0
Somewhat familiar	0	0
Not familiar	0	0
Total	10	100.0

N=10

Frequency of Inspection and Monitoring Related to VMS Compliance

When asked how often they conduct inspections or monitoring activities related to VMS compliance, the following results were obtained:

Table 9. Frequency and Percentage Distribution of BFAR Regulatory Officers in terms of their Frequency of Conducting Inspections/Monitoring Activities Related to VMS Compliance

Frequency	Frequency (n)	Percent (%)
Daily	6	60.0
Weekly	3	30.0
Monthly	1	10.0
Total	10	100.0

N=10

From the above results, it can be summarized that the BFAR regulatory officers in Infanta, Quezon, who have been with BFAR for 1 to 5 years and are mostly VMS operators, are very familiar with the VMS implementation in commercial fishing vessels and conduct daily inspection and monitoring activities related to VMS compliance.

3.3. Level of Challenges

The level of challenges of BFAR operation was measured in terms of impact on daily operations and level of support by BFAR for VMS implementation. Each item had five (5) statements/items for the respondents to rate on a 4-point Likert scale. The mean ($\bar{x}$) for each item was calculated and interpreted.

Impact on Daily Operations.

Table 10. Mean Scores for Level of Challenges in terms of Impact to Daily Operations

Statements	Mean ($\bar{x}$)	Standard Deviation	Remarks
1. The technical attributes of the VMS unit often create problems or technical issues, such as device malfunctions, that affect our operation.	2.50	0.89	Agree
2. Maintenance of VMS is costly and causes excessive consumption of battery.	3.59	0.64	Strongly Agree
3. There is some resistance from crew members.	1.62	0.49	Strongly Disagree
4. Regulations and guidelines on VMS are still unclear.	2.41	0.79	Disagree
5. VMS is a threat to our data privacy.	2.38	0.88	Disagree
Sample Mean	2.50	0.40	Agree
Interpretation		Moderately High	

Legend: 3.25 – 4.00 = Strongly Agree; 2.50 – 3.24 = Agree; 1.75 – 2.49 = Disagree; 1.00 – 1.74 = Strongly Disagree

Table 10 above indicates the level of challenges of commercial fishing vessel operators in terms of impact on their daily operations. The respondents strongly agree

that maintenance of the VMS is costly and causes excessive consumption of battery, which obtained the highest ($\bar{x}=3.59$, $SD=0.64$). They also agree that the technical attributes of the VMS unit oftentimes create problems or technical issues, such as device malfunction, that affect their operation ($\bar{x}=2.50$, $SD=0.89$). These two statements are both above the benchmark mean ($\bar{x} \geq 2.5$) which implies that only these items were accepted as the challenges that impact in their daily operations.

On the other hand, in relation to statement number 3, the study respondents strongly disagree that there is some kind of resistance from the crew members in using the VMS, which obtained the lowest ($\bar{x}=1.62$, $SD=0.49$). They also disagree that regulations and guidelines on VMS are still unclear ($\bar{x}=2.41$, $SD=0.79$), nor is VMS a threat to their data privacy ($\bar{x}=2.38$, $SD=0.88$).

Altogether, the five statements obtained a sample mean of 2.50 ($\bar{x}=2.50$, $SD=0.40$), which is interpreted as a moderately high level of impact on daily operations.

In Phuong and Hang's study (2023), the problem of technical attributes was found to be the major challenge mentioned by respondents. Phuong and Hang cited that the main problem encountered with VMS was disconnect failure for more than 10 days, which may be attributed to battery consumption.

This research, therefore, confirmed the study of Phuong and Hang.

Support by BFAR for VMS Implementation

Out of the five statements on Support by BFAR for VMS implementation, only statement number 2 was above the benchmark mean ($\bar{x} \geq 2.5$), which implies that this is the only statement that is accepted as a challenge in terms of support by BFAR for VMS Implementation. As shown in Table 11, the means for statements 1, 3, 4, and 5 were all below 2.5.

These results indicated that respondents disagree that there is a limited budget for VMS implementation ($\bar{x}=2.18$, $SD=0.69$), they lack training and technical support regarding VMS ($\bar{x}=1.79$, $SD=0.64$), compliance monitoring is not strictly observed ($\bar{x}=1.84$, $SD=0.61$), and BFAR information and education materials about VMS are deficient or lacking ($\bar{x}=1.88$, $SD=0.75$).

Support by BFAR for VMS Implementation

Table 11. Mean Scores for Level of Challenges in terms of Support by BFAR for VMS Implementation

Statements	Mean ($\bar{x}$)	Standard Deviation	Remarks
1. There is a limited budget for VMS implementation	2.18	0.69	Disagree
2. BFAR is lacking in manpower/regulatory officers to implement adherence to VMS implementation	2.76	0.69	Agree
3. We still lack training and technical support when it comes to VMS.	1.79	0.64	Disagree
4. Monitoring on compliance to VMS is not strictly observed	1.84	0.61	Disagree
5. BFAR information and education materials about VMS are deficient	1.88	0.75	Disagree
Sample Mean	2.09	0.40	Disagree
Interpretation	Moderately low		

Legend: 3.25 – 4.00 = Strongly Agree; 2.50 – 3.24 = Agree; 1.75 – 2.49 = Disagree; 1.00 – 1.74 = Strongly Disagree

However, respondents agreed that BFAR lacks manpower or regulatory officers to ensure compliance with VMS ($\bar{x}$ =2.76, SD=0.69). The derived sample mean ($\bar{x}$) for all statements under *Support by BFAR to VMS Implementation* was only 2.09, below the benchmark mean of 2.5. Therefore, the level of challenge in this area is moderately low (Table 11).

This is supported by the findings of the study conducted by Bachtiar et al. (2024), which found that a sufficient number of personnel is important for the implementation of VMS because this system allows fisheries authorities to identify violations of restricted zones and detect illegal fishing practices quickly.

3.4. Level of Opportunities

The level of opportunities was measured in terms of advantages experienced from using the VMS, the extent of contribution to major fishing operations, and the level of

usefulness of VMS in fishing operations. Each item had five (5) statements/items for the respondents to rate on a 4-point Likert scale. The mean ($\bar{x}$) for each item was calculated and interpreted.

Advantages Experienced from Using the VMS

Table 12 below shows that all the statements for advantages experienced from using the VMS obtained a mean ($\bar{x}$) greater than 2.5; thus, all five statements were accepted as opportunities from using the VMS. The respondents strongly agree that VMS has improved the monitoring and tracking of fishing activities ($\bar{x} = 3.53$, $SD=0.53$), there is better compliance with fishery regulations ($\bar{x} = 3.42$, $SD=0.55$), and VMS enhances safety at sea ($\bar{x} = 3.38$, $SD=0.56$). Additionally, the respondents agree that VMS increased efficiency in fishing operations, like easier reporting and catch recording ($\bar{x} = 3.07$, $SD=0.74$), and VMS can enhance the effectiveness of search and rescue operations ($\bar{x} = 3.18$, $SD=0.67$).

Table 12. Mean Scores for Statements on Level of Opportunities in terms of Advantages Experienced from Using the VMS

Statements	Mean ($\bar{x}$)	Standard Deviation	Remarks
1. The VMS has improved the monitoring and tracking of fishing activities.	3.53	0.53	Strongly Agree
2. With VMS, there is better compliance with fishery regulations.	3.42	0.55	Strongly Agree
3. I believe that VMS enhances safety at sea	3.38	0.56	Strongly Agree
4. Installation of VMS increased the efficiency in fishing operations, like easier reporting and catch recording.	3.07	0.74	Agree
5. VMS can enhance the effectiveness of search and rescue operations.	3.18	0.67	Agree
Sample Mean	3.32	0.39	Strongly Agree
Interpretation	High		

Legend: 3.25 – 4.00 = Strongly Agree; 2.50 – 3.24 = Agree; 1.75 – 2.49 = Disagree; 1.00 – 1.74 = Strongly Disagree

The obtained mean ($\bar{x} = 3.32$, $SD = 0.39$) was above 2.5 and interpreted as having a high level of opportunity.

Thus, VMS is viewed as beneficial. It shows relevance to the study conducted by Raghu (2022), which implies that the Vessel Monitoring System is an important tool that allows the government to monitor small-scale fishing vessel activities.

Extent of Contribution to Major Fishing Operations

The rating on statements for the extent of contribution of VMS to major fishing operations revealed a sample mean ($\bar{x}$) of 3.05, which is a moderately high contribution level. As such, the CFV Operators agreed that the installation of VMS minimize the level of crime at sea ($\bar{x} = 3.25$, $SD=0.57$), contribute towards improved obedience with fisheries regulations by providing regular location and vessel activity information ($\bar{x}=3.07$, $SD=0.47$), significantly minimize manipulated or false data ($\bar{x}=2.64$, $SD=0.63$), prevent over exploitation of fisheries resources ($\bar{x} = 3.04$, $SD=0.53$), and help improve sustainable fishing practices ($\bar{x} = 3.25$, $SD=0.49$).

Table 13. Mean Scores for Statements on Level of Opportunities in terms of Extent of Contribution to Major Fishing Operations

Statements	Mean ($\bar{x}$)	Standard Deviation	Remarks
1. minimize level of crime at sea	3.25	0.57	Strongly Agree
2. contribute towards improved obedience with fisheries regulations by providing regular location and vessel activity information	3.07	0.47	Agree
3. significantly minimize manipulated or false data	2.64	0.63	Agree
4. prevent over exploitation of fisheries resources	3.04	0.53	Agree
5. help improve sustainable fishing practices	3.25	0.49	Strongly Agree
Sample Mean	3.05	0.33	Agree
Interpretation	Moderately High		

Legend: 3.25 – 4.00 = Strongly Agree; 2.50 – 3.24 = Agree; 1.75 – 2.49 = Disagree; 1.00 – 1.74 = Strongly Disagree

Level of Usefulness of VMS

Based on the sample mean ($\bar{x}$ = 3.28, SD=0.32) for level of usefulness of VMS as depicted in table 14 below, which is interpreted as equivalent to a high level of usefulness, it can be inferred that VMS is seen as a useful technology for fishing operations.

Table 14. Mean Scores for Statements on Level of Opportunities in terms of Level of Usefulness of VMS

Statements	Mean ($\bar{x}$)	Standard Deviation	Remarks
1. With VMS, clearer and more responsible fishing is achieved since it sheds light on fishing activities and facilitates transparency and accountability.	3.12	0.49	Agree
2. VMS is an impressive ally in the fight against IUU fishing.	3.67	0.47	Strongly Agree
3. VMS helps safeguard our marine ecosystems, thereby protecting marine life.	3.53	0.55	Strongly Agree
4. VMS data provides useful insights that contribute to making informed decisions.	3.17	0.60	Agree
5. With VMS, reporting delays are eliminated.	2.89	0.64	Agree
Sample Mean	3.28	0.32	Strongly Agree
Interpretation	High		

Legend: 3.25 – 4.00 = Strongly Agree; 2.50 – 3.24 = Agree; 1.75 – 2.49 = Disagree; 1.00 – 1.74 = Strongly Disagree

Accordingly, from the lens of the respondents, clearer and more responsible fishing is achieved with VMS since it sheds light on fishing activities and facilitates transparency and accountability ($\bar{x}$ = 3.12, SD=0.49). Furthermore, VMS is seen as an impressive ally in the fight against illegal, unreported and unregulated fishing ($\bar{x}$ = 3.67, SD=0.47). It also helps safeguard our marine ecosystems, thereby protecting marine life ($\bar{x}$ = 3.53, SD=0.55). It is also agreed that VMS data provide useful insights that contribute to making informed decisions ($\bar{x}$ = 3.17, SD=0.60), and that reporting delays are eliminated with VMS ($\bar{x}$ = 2.89, SD=0.64).

Considering the above results, it can be inferred that, for most of the CFV Operators, technology offers vast opportunities since it is perceived as: advantageous and beneficial, greatly contribute to major fishing operations, and is perceived as useful.

These findings align with earlier studies that investigated the opportunities in vessel monitoring system such as the study in Taiwan by Chang (2011), in Vietnam by Phuong and Hang (2023), in Indonesia by Soemarmi et al. (2020), Raghu and Ancy (2022), and affirmed the contentions of Oceana (2017) on the benefits of adopting the technology.

3.5. Adoption and Compliance with CFV Operations

Table 15 below shows the results for the statements on adoption and compliance in CFV operations in terms of the likelihood of using VMS in the future. As reflected, all the derived means ($\bar{x}$) for each statement were above the benchmark mean of 2.5. Thus, the respondents agreed with all of the statements.

Likelihood of Using VMS in the Future

Based on the mean ($\bar{x}$ =3.54, SD=0.53), the respondent CFV operators will ensure that the VMS is installed correctly in their fishing vessel. They also agreed that installation of VMS in fishing vessels should be mandated ($\bar{x}$ =3.32, SD=0.59). CFV operators in this study strongly agreed that the VMS brings more benefits, so they will continue adopting the technology ($\bar{x}$ =3.49, SD=0.53). Furthermore, safety is ensured with a VMS in their fishing vessel, hence, they will not go to distant waters without it ($\bar{x}$ =3.13, SD=0.57), and they will never be against using the VMS ($\bar{x}$ =3.59, SD=0.55).

Table 15. Mean Scores and Standard Deviation for Statements on Adoption and Compliance on CFV Operations in terms of Likelihood of Using VMS in the Future

Statements	Mean ($\bar{x}$)	Standard Deviation	Remarks
1. I ensure that the VMS is properly installed in my fishing vessel.	3.54	0.53	Strongly Agree
2. Installation of VMS in fishing vessels should really be mandated.	3.32	0.59	Strongly Agree
3. I believe that the VMS brings more benefits so I will continue adopting it.	3.49	0.53	Strongly Agree
4. My safety is ensured with a VMS in my fishing vessel, hence I will not go to distant waters without it.	3.13	0.57	Agree
5. I will never be against using the VMS.	3.59	0.55	Strongly Agree
Sample Mean	3.41	0.38	Strongly Agree
Interpretation	High		

Legend: 3.25 – 4.00 = Strongly Agree; 2.50 – 3.24 = Agree; 1.75 – 2.49 = Disagree; 1.00 – 1.74 = Strongly Disagree

With the derived sample mean ($\bar{x}$ =3.41, SD=0.38), a high level of likelihood of using VMS in the future was obtained.

Awareness and understanding of VMS

As earlier presented, all respondents attended trainings that were, according to them, very effective. In this part of the study, the respondents' awareness and understanding of VMS were measured.

Table 16. Mean Scores and Standard Deviation for Statements on Adoption and Compliance with CFV operations in terms of Awareness and Understanding of VMS

Statements	Mean ($\bar{x}$)	Standard Deviation	Remarks
1. I am fully aware of what a VMS is all about	3.28	0.62	Strongly Agree
2. The VMS is required to be installed in all commercial fishing vessels	3.68	0.47	Strongly Agree
3. A commercial fishing vessel license will not be issued without a VMS	3.83	0.38	Strongly Agree
4. With VMS, BFAR can track and communicate with a vessel	3.86	0.39	Strongly Agree
5. An administrative case may be filed against me if I engage in fishing without an installed VMS	3.28	0.72	Strongly Agree
Sample Mean	3.58	0.35	Strongly Agree

Interpretation

Legend: 3.25 – 4.00 = Strongly Agree; 2.50 – 3.24 = Agree; 1.75 – 2.49 = Disagree; 1.00 – 1.74 = Strongly Disagree

Table 16 above shows that the respondents have a high level of awareness and understanding as disclosed by the sample mean ($\bar{x}$ =3.58, SD=0.35), which further means that these respondents strongly agreed with all the statements. Thus, based on the mean, respondents fully knew what a VMS is about ($\bar{x}$ =3.28, SD=0.62). They are fully aware that VMS is required to be installed in all commercial fishing vessels ($\bar{x}$ =3.68, SD=0.47), and that a commercial fishing vessel license will not be issued without a VMS ($\bar{x}$ =3.83, SD=0.38). Additionally, respondents were aware that with VMS, BFAR can track and communicate with a vessel ($\bar{x}$ =3.86, SD=0.39), and an

administrative case may be filed against them if they engage in fishing without an installed VMS ($\bar{x}=3.28$, $SD=0.72$). Seemingly, the results confirm that the training attended by the respondents were indeed effective.

Adherence to the Provisions of Section 1 of FAO 266, series of 2020

The adherence to the provisions of Section 1 of FAO 266, series of 2020 which pertains to the objectives of the said Order, is a function of BFAR regulatory officers. It details the functions of BFAR officers relative to the implementation of the vessel monitoring system. In this study, ten (10) regulatory officers were assigned in Infanta, Quezon, and all of them were covered by the investigation.

Table 17 presents the mean results for adherence to the provisions of Section 1 of FAO 266, series of 2020. All eight statements regarding adherence disclosed a mean ($\bar{x}$) above 2.5. Hence, the respondents strongly agreed with all the statements. The sample mean ($\bar{x}=3.79$, $SD=0.42$) revealed a high level of adherence to the provisions of Section 1 of FAO 266, series of 2020.

Table 17. Mean Scores and Standard Deviation for Statements on Adoption and Compliance on CFV Operations (Adherence to the Provisions of Section 1 of FAO 266, series of 2020)

Statements	Mean ($\bar{x}$)	Standard Deviation	Remarks
1. Enhanced monitoring of fishing operations	3.80	0.42	Strongly Agree
2. Enhanced law enforcement to regulate capture fisheries for long-term resource sustainability	3.80	0.42	Strongly Agree
3. Implementation of vessel monitoring measures to track fishing behavior for scientific research and data	3.80	0.42	Strongly Agree
4. Establishment of a system that will facilitate law enforcement and aid in case building and prosecution of fisheries law violations.	3.70	0.48	Strongly Agree

5. Gathering of data on fishing effort and catch data by means of an electronic reporting system that will serve as basis for fisheries management measures.	3.80	0.42	Strongly Agree
6. Aid in the seafood traceability and catch documentary requirements of the government	3.80	0.42	Strongly Agree
7. Ensuring safety for fishers thru a tracking device that would monitor the vessels' location during accidents and disasters	3.80	0.42	Strongly Agree
8. Implementation of policies embodied in RA 8550, as amended by RA 10654 and its implementing rules and regulations relating to vessel monitoring requirements of fishing vessels	3.80	0.42	Strongly Agree
Sample Mean	3.79	0.42	Strongly Agree
Interpretation	High		

Legend: 3.25 – 4.00 = Strongly Agree; 2.50 – 3.24 = Agree; 1.75 – 2.49 = Disagree; 1.00 – 1.74 = Strongly Disagree

All statements except statement number 4 (Table 17) obtained a mean of 3.80 and a standard deviation of 0.42. Thus, the regulatory officers, have high adherence to: enhanced monitoring of fishing operations; enhanced law enforcement to regulate capture fisheries for long-term resource sustainability; implementation of vessel monitoring measures to track fishing behavior for scientific research and data; gathering of data on fishing effort and catch data employing an electronic reporting system that will serve as basis for fisheries management measures; aid in the seafood traceability and catch documentary requirements of the government; ensuring safety for fishers, thru a tracking device that would monitor the vessels' location during accidents and disasters; and, implementation of policies embodied in RA 8550, as amended by RA 10654 and its implementing rules and regulations relating to vessel monitoring requirements of fishing vessels. Likewise, the regulatory officers observe establishing a system that will facilitate law enforcement and aid in case building and

prosecution of fisheries law violations ($\bar{x}=3.70$, $SD=0.48$).

As such, in terms of extent of implementation of Section 1 of FAO 266, series of 2020, BFAR regulatory officers have a high level of adherence, which may also account for the high level of understanding and awareness of the VMS with a sample mean ($\bar{x}$) of 3.79 and standard deviation of 0.42.

3.6. Relationship between Respondents' Profile and Challenges

The study investigated whether a significant relationship exists between respondents' profiles and the level of challenges.

To come up with a valid conclusion, Pearson's correlation coefficients (r) of the data on profile (age, education, years of commercial fishing experience, type of fishing vessel being operated and effectiveness of training) and level of challenges (impact to daily operations and support by BFAR for VMS implementation) were derived. To test for significance of the coefficients (r), a two-tailed test for significance was conducted, with a level of significance set at $p \leq 0.01$

Table 18. *Result of Test on Significant Relationship between CFV Operators' Profile and Level of Challenges in terms of daily Operations and Support by BFAR for VMS Implementation*

Demographic Characteristic	daily operations		support by BFAR	
	r	p-value	r	p-value
age	0.197	0.08806	0.050	0.66797
education	-0.033	0.07771	0.115	0.32255
experience	-0.128	0.27049	-0.199	0.08482
type of vessel	-0.029	0.80360	0.070	0.54792
effectiveness of training	-.348	0.00206**	-0.193	0.09484

** . Correlation is significant at the 0.01 level (2-tailed).

The derived Pearson's correlation coefficients (r) of the different variables under investigation for significant relationships are presented in Table 18. These correlation coefficients were subjected to a two-tailed test with a significance level set at $p \leq 0.01$.

For easy calculation of the p-value, the Pearson's r for the variables was entered into a p-value calculator for correlation coefficients to decide whether to reject or accept the null hypothesis. The calculated p-values are likewise presented in the above Table.

Results from the p-value calculator for correlation coefficients found that, of the five (5) demographic characteristics—age, educational attainment, years of experience in commercial fishing, type of fishing vessel being operated, and perceived effectiveness of trainings attended—only the Pearson's $r = -.348$ for daily operations and effectiveness of trainings was found to have a p-value less than 0.01.

The obtained p-value for the effectiveness of training and its impact on daily operations) was 0.00206, which is <0.01 . This caused the rejection of the null hypothesis (H_0) and acceptance of the alternative hypothesis (H_a) for these variables. Hence, a significant relationship exists between perceived training effectiveness and challenge level and their impact on daily operations.

It is therefore concluded that, except for the perceived effectiveness of training, there is no significant relationship between commercial fishing vessel operators' profiles and the level of challenge.

3.7. Effect on Challenges and Opportunities in Utilizing VMS and Adoption and Compliance

The study explored if there is a significant effect on the challenges and opportunities in utilizing VMS and the adoption and compliance on CFV operations.

To answer the above problem, the Pearson's correlation coefficients of the variables were obtained and subjected to a 2-tailed test to decide the rejection or acceptance of the null and alternative hypotheses.

In testing the hypotheses, the Pearson's correlation coefficients of the different variables were calculated. To determine whether the correlations are significant, a 2-tailed test was applied. Table 19 below presents the correlation coefficients (r) of the different variables and the corresponding p-values.

Table 19. *Result of Test on Significant Effect on the Challenges and Opportunities in Utilizing VMS and the Adoption and Compliance of CFV Operations*

Challenges and Opportunities	Adoption and Compliance			
	Likelihood of using VMS in the future		Awareness and understanding of VMS	
<i>Challenges</i>	r	p-value	r	p-value
Impact to daily operations	-0.144	0.21459	-0.004	0.97264
BFAR's support for VMS implementation	-0.082	0.48131	-0.101	0.38532
<i>Opportunities</i>				
Advantages experienced from using the VMS	.488**	0.00001	.261*	0.02277
Extent of contribution to major fishing operations	.353**	0.00088	-0.021	0.85710
Level of usefulness	.316**	0.00542	.237*	0.03927
*. Correlation is significant at the 0.05 level (2-tailed).				
**. Correlation is significant at the 0.01 level (2-tailed).				

Based on the results depicted in Table 19, the correlation coefficients (r) for challenges, adoption, and compliance obtained high p-values that were > 0.05 and 0.01 . As such, the null hypothesis was accepted. That is, there is no significant effect on the challenges and opportunities in utilizing VMS and the adoption and compliance of CFV operations.

In terms of effect on opportunities in utilizing VMS and adoption and compliance, the positive correlation ($r=.488$) of benefits experienced from using the VMS and likelihood of using VMS in the future, obtained a p-value of 0.00001 that was found significant at $p \leq 0.01$. Similarly, there was a positive correlation ($r=.261$) between benefits experienced from using the VMS and awareness and understanding of VMS, and this was found significant ($p=0.02277$) at $p \leq 0.05$. As such, the null hypothesis for these variables was rejected, while the alternative hypothesis was accepted.

Extent of contribution to major fishing operations and level of usefulness were both found to have significant effect on the likelihood of using VMS in the future, with p-values of 0.00088 and 0.00542, respectively. Similarly, the positive correlation between level of

usefulness and awareness and understanding was found significant ($p=0.03927$) at $p \leq 0.05$. Hence, the null hypothesis was rejected for these variables, while the alternative hypothesis was accepted.

The above results strengthened the Technology Acceptance Model which is the framework used in this research. The study of Agag and El-Masry (2016) was also affirmed by this investigation where a significant positive correlation was found between likelihood of using VMS in the future with that of benefits experienced from using the VMS ($r=.488$, $p=0.00001$), extent of contribution to major fishing operations ($r=.353$, $p=0.00088$) and usefulness ($r=.316$, $p=0.00542$).

Agag and El-Masry contend that even if the technology is seen as useful, it will not be adopted if it is not seen as beneficial. In this study, all of these opportunities were positively rated, thus adoption of the technology in the future was assured.

4. Summary, Conclusions, and Recommendations

This chapter summarizes the study's findings related to the problems the research intends to address. Conclusions are drawn from these findings, which form the basis for the recommendations.

4.1. Summary of Findings

The study was conducted to determine the extent of implementation of the vessel monitoring system in Infanta, Quezon. Based on the technology adoption model, perceived challenges and opportunities, including adoption and compliance, were examined.

A descriptive non-experimental quantitative research design was adopted to facilitate data collection from the target respondents, who are often remotely located. A self-made survey questionnaire that underwent validation was used to collect data. The respondents rated perception statements using a 4-point Likert Scale. Respondents consisted of 76 commercial fishing vessel operators and 10 regulatory officers of the Bureau of Fisheries and Aquatic Resources involved in implementing the VMS in Infanta, Quezon.

The research was conducted from February 10 to February 24, 2025. The following are the key findings of the study:

1. Demographic Profile of Commercial Fishing Vessel Operators in terms of Age, Educational Attainment, Years of Experience in Commercial Fishing, Type of Fishing Vessel Operated and Participation in Trainings

- 1.1 With respect to age, 89.5% were between 25 and 54 years old, with an average age of 44, which was verbally interpreted as the prime working age.

- 1.2 As to educational attainment, the majority were either high school students (27.6%) or high school graduates (29%).
- 1.3 Of those with years of experience in commercial fishing, 60.5% had more than 10 years.
- 1.4 As to the type of commercial fishing vessel being operated, 68.4% operated a small-scale fishing vessel.
- 1.5 With respect to participation in trainings, 100% of the trainings were attended and were evaluated as very effective.
2. Demographic Profile of BFAR Regulatory Officers in terms of Number of Years with BFAR, Role/Position Related to VMS Implementation, Familiarity with VMS Implementation in CFVs, and Frequency of Inspection and Monitoring
 - 2.1 Sixty (60%) of the 10 regulatory officers were with BFAR for 1 to 5 years.
 - 2.2 More than half (60%) of the regulatory officers were VMS operators.
 - 2.3 All (100%) were familiar with the VMS implementation in commercial fishing vessels.
 - 2.4 With respect to frequency of inspection and monitoring, majority (60%) conduct daily inspections.
3. Level of Challenges of BFAR Operation in terms of Impact to Daily Operations and Support for VMS Implementation
 - 3.1 There was a moderately high level of challenge for impact to daily operations (sample mean = 2.50, S.D. = 0.40). Technical attributes of the VMS ($\bar{x}$ =2.50, SD=0.89) and its costly maintenance that cause excessive consumption of battery ($\bar{x}$ =3.59, SD=0.64) were agreed as the major challenges.
 - 3.2 With respect to support for VMS implementation, the sample mean of 2.09 (S.D.=0.40) revealed a moderately low level of challenge. The statement that BFAR is lacking in manpower or regulatory officers to implement adherence to VMS implementation was agreed as challenge in terms of support by BFAR ($\bar{x}$ =2.76, SD=0.69).
4. Level of Opportunities in terms of Advantages Experienced from Using the VMS, Extent of Contribution to Major Fishing Operations, and Usefulness of VMS in Fishing Operations
 - 4.1 As for the advantages experienced from using the VMS, the sample mean of 3.32 (S.D.=0.39) disclosed a high level of opportunities. All the statements were accepted.

- 4.2 Relating to the extent of contribution to major fishing operations, a moderately high level of opportunities ($\bar{x}=3.05$, $s.d.=0.33$). All the statements were accepted.
 - 4.3 The level of usefulness of VMS was obtained with a sample mean of 3.28 ($S.D.= 0.32$), which indicated a high level of opportunities.
5. Status of the Adoption and Compliance on CFV Operations as to Likelihood of Using VMS in the Future, Awareness and Understanding of VMS, and Adherence to the Provisions of Section 1 of FAO 266, series of 2020
- 5.1 As for the likelihood of using VMS in the future, a high level of adoption ($\bar{x}=3.41$, $S.D.=0.38$) was disclosed, with all the statements being accepted.
 - 5.2 There was a high level of awareness and understanding of VMS, as revealed by the sample mean ($\bar{x}=3.58$, $S.D.=0.35$).
 - 5.3 Regarding adherence to the provisions of Section 1 of FAO 266, series of 2020, the calculated sample mean ($\bar{x}=3.79$, $s.d.=0.42$) revealed a high level of adherence.
6. Test for Significance on the Relationship Between Respondents' Profile and Challenges
- The null hypothesis that there is no significant relationship between the CFV operator's profile and the level of challenges was rejected for the correlation between the effectiveness of training and daily operations ($r = -.348$, $p = 0.00206$) at a significance level of 0.01 (2-tailed).
7. Test for Significant Effect on the Challenges and Opportunities in Utilizing VMS and the Adoption and Compliance of CFV Operations

The null hypothesis that there is no significant effect on the challenges and opportunities of utilizing VMS and the adoption and compliance of CFV operations was rejected due to the correlations between the likelihood of using VMS in the future and the following: benefits experienced from using the VMS ($r=.488$, $p=0.00001$), extent of contribution to major fishing operations ($r=.353$, $p=0.00088$), and level of usefulness ($r=.316$, $p=0.00542$).

Additionally, the null hypothesis was rejected for the correlations between awareness and understanding of VMS and the benefits experienced from using the VMS ($r=.261$, $p=0.02277$), as well as with the level of usefulness ($r=.237$, $p=0.03927$).

4.2. Conclusions

With the above findings, the following conclusions are drawn:

1. CFV operators in Infanta, Quezon, were of prime working age, high school level, are seasoned small-scale commercial fishers, and well-trained on the vessel monitoring system.
2. BFAR regulatory officers in Infanta, Quezon are relatively new employees of BFAR, are VMS operators who are familiar with VMS implementation in commercial fishing vessels, and are serious about conducting inspection and monitoring
3. CFV operators consider the VMS's technical attributes and costly maintenance major challenges in their daily operations. Furthermore, they are concerned with the lack of regulatory officers in their area.
4. The CFV operators' implementation of the VMS offers vast opportunities, as disclosed by the high level of opportunities derived from the data. They consider the VMS technology and its implementation beneficial and useful, which contributes greatly to major fishing operations.
5. There is a high level of adoption and compliance on CFV operations among CFV operators in Infanta, Quezon and a high level of adherence to Section 1 of FAO 266, series of 2020 among BFAR regulatory officers.
6. A significant correlation exists between effectiveness of training and impact to daily operations. This makes training an important component of VMS implementation that may address the challenges posed by the technology.
7. Benefits experienced from using the VMS, its extent of contribution to major fishing operations and usefulness is significantly correlated with CFV operators' likelihood of using VMS in the future. Also, perceived benefits and usefulness of the VMS technology had significant effects on awareness and understanding of the technology.

4.3. Recommendations

From the conclusions of this study, it is therefore recommended that:

1. BFAR considers the leveling up of training activities among CFV operators in Infanta, Quezon, given that they are relatively seasoned operators in commercial fishing. Being of prime working age and relatively educated, these CFV operators are seen as open to fresh and updated information. Training on climate change and resiliency, along with updates on VMS technology, will provide them with insights on how to cope with current situations at sea.
2. Commercial fishing is a major source of income for fishers in Infanta, Quezon. Given its geographical location, BFAR may consider adding more

manpower/regulatory officers in the area to mitigate illegal fishing and strengthen the implementation of fishery policies, including VMS implementation.

3. It may be important to inspect and evaluate the current technology and see whether there is room for improving its technical attributes as this is considered the major challenge for its adoption.
4. It is suggested that important and relevant information on VMS be disseminated continuously. To sustain the stakeholders' positive perception of the technology, its benefits and usefulness in commercial fishing may be emphasized in IEC materials.
5. As revealed by the study, the majority of our CFV operators in Infanta are small-scale operators, and for them, the full implementation of the VMS is necessary. The government may consider this finding in its decision-making. The full implementation of the technology in the country may uplift the living conditions and address the long-time problem of significant poverty among our fisherfolk and illegal fishing.
6. Finally, this study is quantitative in nature due to the time constraint. An in-depth study adopting a mixed model design is recommended. Future studies in this area with a different research design will greatly substantiate this study's findings.

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