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Use of GIS and Remote Sensing on Ornamental Fish Farm's Activites Monitoring in Layang-Layang, Kluang, Johor

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Abstract: Ornamental fish is the export-oriented sub-sector relishes as one of the fastest-growing in Malaysia's agriculture sector. along with the high demand locally, the industry successfully penetrated the international market. However, the Malaysia's ornamental fish industry started to face an embargo on exports made by the European Union (EU) in 2015. The study was conducted to solve the issue of import restrictions by establishing the compartment system, using GIS and remote sensing. A total sample population comprised of 19 ornamental fish farmers in Layang-Layang, Kluang. The data sources used in this study were based on non-spatial data (survey), spatial data (GIS) and SPOT-6 satellite images to capture farm location effect on the farm operational activities. The descriptive analysis was used to describe the respondent's socio-economic profile and relationship between farming participation and independent variables identified were cross-tabulated. SPOT-6 satellite images was used to determine the spatial characteristics to farming activities in distinctive regions. Majority of the farmers were male and married and at (36.8%) aged more than 40 years old. Results shows the highest number of the people who had participated in secondary education level were Malaysian Certificate of Education (SPM) holders with 41.6%, majority of 7 (36.8%) respondents had a scale more than 10ha of farm size and average total of 2 millions of production a year. Most of them breed goldfish (29%) and tiger barb (8%). Age, education level, total of production and income have a significant relationship with farm participation. Spatially, the results showed that 52.6% of the farmers live near the town which in Kluang, less than fifteen (10) kilometres away from their house and farm. Having spatial database of the compartmentalized farm will facilitate farm monitoring and it benefits the Department of Fisheries Malaysia, particularly Fisheries Biosecurity Division, in the management of aquatic animal health for the country's export trade value.

Keywords: Ornamental Fish, Spatial Analysis, GIS, Fisheries Bio-security, Remote Sensing

1. Introduction

Malaysia is known for its large farms for breeding freshwater fish. Due to restrictions and fish health regulations the farming of goldfish and koi carp has become limited and many specialized in farming Asian Arowana, which later the interest might change over the time. Next to the breeding of the popular fish like Livebearers, Barb, Gourami, Tetras and Cichlids. there is also large farming of Stingray, Blood parrots and Discus. Contribution to the fisheries sector in Malaysia continues to play an important in the development of the country's socio-economic status. Hence, the sector has also provided employment opportunities, contributing to the Gross Domestic Product (GDP) and foreign exchange. This sector has big potential in creating job opportunities besides develop extremely large profits to national treasury. Thinking that the fisheries sector also plays a big role in national development, comprehensive resource management has been made to ensure sustainability of fishery resources. The development of the fisheries sector in Malaysia has contributed positively to the economy of the country and the locals near the fishery resources. The progress made to advance the fisheries sector has had a positive impact on the socio-economic development of the population involved with this fishery source gradually. One of the best strategy in order to ensure the smooth implementation of the Fisheries Department's in managing the fishery resources of the department has formulated the Fisheries Act 1985 and all the Fisheries regulations implemented thereunder. Indeed, the DOF is known as the national Competent Authority (CA) responsible for all matters involving live fish.

Record shows in year 2016, that the total landings of marine fish were 1,486.1 thousand tonnes were recorded, up 1.9 percent from 1,458.1 thousand tonnes in year 2014 while freshwater aquaculture production increased to 112.1 thousand tonnes (5.1%) in 2015. And, the production of brackish water or saline aquaculture decreased by 4.7 per cent to 394.3 thousand metric tonnes compared to year 2015.

In year 2016, the fishery sub-sector produces increased of 3.7% compared to year 2015 with 2.06 million tonnes of fish and this production includes marine capture fisheries, land fisheries and aquaculture. In terms of value, it showed an increase of 9.24 per cent over the same period of RM10.1 billion compared to RM9.3 billion in 2015. Thus, in 2016 alone, catchment and aquaculture fields accounted for 1.57 million tonnes and 490,027 tonnes of fish production, with aquaculture 407,403 million tonnes with RM2,784,721. In 2017, the overall value of the fisheries industry is RM13 billion a year (Annual Fisheries Statistics, 2017). 11th Malaysia Plan (11MP) is the five-year strategic agenda of the Ministry of Agriculture and Agro-based Industry planned to improve the agro-food industry over modernization and improvement in

investment opportunities as well as enhancing marketing. It can be concluded that the ornamental fish culture sector contributed to the global economy with a enormous turnover of billions of dollar yearly. On the other hand, the market for ornamental fish in the world for public aquaria is less than one percent at present and over ninty nine percent of ornamental fish market is limited to hobbyist group. Entrepreneurship concept is developed through ornamental fish farming and it is gaining popularity continually. Though, we can see that people are progressively entering into the ornamental sector especially from African and Asian countries. The top exporting country is Singapore followed by Hong Kong, Malaysia, Thailand, Philippines, Sri Lanka, Taiwan, Indonesia and India (Shabir Ahmad Dar et.al.,2018).

The ornamental industry in Malaysia is doing well until the issuance of non-compliance with a requirement, standard, or procedure needed by the European Union (EU). CAR was received based on the DG (SANTE) / 2015-7562 audit on 09th March to 17th March 2015 specifically, in monitoring the assess of health control on aquaculture animals in aquaculture farms for export purposes. Then, lead to the import restrictions by the EU against the Malaysia's ornamental fish's export industry. Therefore, this restriction has negatively affected the breeders and the value of exports of the country. Fisheries Bio-security Division (FBD) was responsible as CA to control and manage fish health and food safety, particularly for fish and fishery products. In order to escape from EU sanctions, FBD carry out the role of fishery bio-security in responsding to an EU-issued audit using the Geographic Information System (GIS). Bio-security or "hazard reduction through environmental manipulation" (Plumb, 1992), is often defined as practices that reduce the number of pathogens that enter a facility. Bio-security is the concept of protecting culture animals from contamination by diseases and of preventing the spread of diseases across boundaries, has become increasingly important with the intensification of aquaculture production systems (Sachin O. Khairnar, et.al.,2018).

Hence, the objective of this study is to examine the spatial characteristic variables in terms of management of aquatic animal health of 19 ornamental aquaculture farms in Layang-Layang, Kluang. The structure of the study will be implemented by creating the compartmentalisation system using GIS and remote sensing. Eventually, at the end of this project, Malaysia will be free from the import restrictions on ornamental fish and this paper will focus farm activities.

Particularly, the objective of this study is to examine the spatial characteristic variables in terms of management of aquatic animal health of 19 ornamental aquaculture farms in Layang-Layang, Kluang by creating the demographic information of the farmers and later, the compartmentalisation system using GIS

spatial analysis, hoping that at the end of this project, Malaysia will be able to use the system as one of the tools and reference spatially for fish health monitoring program.

And spatial characteristics of the ornamental fish farmers in the Layang-Layang, Kluang district. Ruslan et al., (1998) claimed that in order to identify the farmers, farm and spatial variables of farming activities, it needs a lot of precision and well managed and updated data gathered from various sources. This can be done with a database that contain all the related data of the study. Furthermore, with the GIS and remote sensing combination, we will be able to insert, manage, manipulate, analyse and present data related to geography or spatial completely. Hence, Ruslan et al. (1998) found that both spatial and non-spatial data are important in the GIS and must be updated precisely to make it valuable to the user. Otherwise, remote sensing is the scanning of the earth by satellite or high-flying aircraft in order to obtain information about it. Remote sensing is the science of obtaining information without physically being there. For example, the 3 most common remote sensing methods is by airplane, satellite and drone. Remote sensing is the art and science of making measurements of the earth using sensors on airplanes or satellites. The role of the sensors are to collect data in the form of images and provide specialized capabilities for manipulating, analyzing, and visualizing those images. Remote sensed imagery is integrated within a GIS.

2. Literature Review

2.1 Ornamental fish and the industry

Aquaculture sector is currently the fastest growing food sector in the world, and the open oceans are seen as one of the most likely areas for large-scale expansion (Lovatelli, Aguilar-Manjarrez, & Soto, 2013; Rubino, 2008). Basically, the aquaculture sub-sector has three major components including the brackish-water aquaculture, freshwater aquaculture and mariculture. Despite the long tradition of aquaculture, aquaculture sector expanded rapidly and diversified its production only in the 1980s (Rabanal, 1995). For quite a long time, coastal brackish-water fish ponds dominated the country's main aquacultural activities. Ornamental fish keeping is becoming popular as an easy and stress relieving hobby. Thus, ornamental fishes commonly mean attractive colourful fishes of various characteristics, which are kept as pets in confined space of an aquarium or a garden pool for fun and recreational purposes. These living jewels need not always have bright colours; as sometimes their unique characteristics such as body colour, morphology and apparently, mode of taking food may also add to their attractiveness. Ornamental fish bring about more revenue for countries that deal on it. On the other hand, the ornamental fish market's contribution to world trade in terms of value is small overall, the sector plays a relevant role in terms of

poverty alleviation in developing countries and marine preservation. Coastal and riverine communities are able to utilize ornamental fish, which can be a sustainable and renewable resource, as a source of income.

Thus, the world's largest market for ornamental fish are The United State (US) and the European countries. This fishes exhibit wonderful array and have different methods of breeding. Their behaviors and life span are varies from one species to the other and can be found in brackish water, salt water and fresh water. The ornamental fish sector is a small but vital part of international fish trade. It contributes positively to rural development in many developing producing countries, and in the major markets for ornamental fish, the retail value is many times that of its trade value with a positive impact throughout the value-chain. Most of the ornamental fish is sourced from developing countries in the tropical and sub tropical regions. The value of ornamental fish and invertebrates imported into different countries worldwide is approximately around $278 million US dollars (FAO 1996-2005). However, the greatest volume or number of individuals in the trade, at average of 90-96%, are of freshwater origin and are produced in commercial aquaculture facilities (Chapman 1997; Cato and Brown 2003). Hence, the international trade in ornamental fish in fact, provides employment opportunities for thousands of rural people in most developing countries. As a result of advancements in breeding, transport and aquarium technology, more and more species are being added every year (V K Dey, 2016).

2.2 Socio-economic and Livelihood Profile of Ornamental Fish Producers

Livelihood does not only mean the activities that people carry out to earn a living but also the different elements that contribute to or affect their ability to ensure a living for themselves which includes the assets that enable them to gain access to human, natural, social, financial, physical capital and its use to satisfy basic needs (Messer and Townsley, 2003). Ornamental fish trade is a booming business across the globe, and the ancillary activities associated with the sector such as supplementary feed, medications and manufacturing of chemicals and providing aquarium support services provides opportunities of business for breeders, farmers, aquarists and other people (Itzkovich, 2011). Thus, it is important to understand the current livelihood patterns of the people involved in this sector. The ornamental fish trade is a multi-million dollar business with more than one hundred countries involved worldwide including Africa, South America and South East Asia, where the industry are an important source of overseas income. Though, some research groups have changed their aquaculture research activities from food to ornamental fish. The collection, breeding and marketing of ornamental fishes is a sizable industry that generates jobs and foreign exchange. But, there are concerns over the economic viability and ecological sustainability of

the industry. Otherwise, Ayyappan and Krishnan (2004) found in their study that the fisheries sector contributes to the livelihood of a large section of the economically underprivileged population. In some areas, such as South America, the selling of these fish represent the sole income of often impoverished families (Chao, 1995a). Thus, it has been estimated that over 1.5 million people are engaged in this sector, and over 3.5 million hobbyists constitute the trade in the world (Dey, 2010). There are about 259 ornamental fish exporters in Malaysia (Department of Fisheries, 2016).

The prospects of ornamental fisheries have been emerging substantially as a lucrative horizontally integrated commercial aquaculture venture. Though, the ornamental fish keeping which started as a hobby across the world, owing to its burgeoning demand in national and international markets, has turned out to be a commercially traded commodity in different parts of the world (Ukaonu et al. 2011). Indeed, Stallard (1994) found that The Department of Ichthyology and Fisheries Sciences at Rhodes University, Republic of South Africa, had concentrated its efforts in the past on the culture of food fish, but has switched its focus towards ornamental fish, as they believe that "it was better to create jobs in paying businesses so that people can buy food, than to try and develop 'cheap' protein sources and never elevating people's standard of living". The ornamental fish sector has been recognized for its ability to generate employment opportunities and contributing to the growth of national income by enhancing foreign exchange earnings. With the phenomenal increase in the demand of ornamental fishes worldwide, more countries have realized the economic potential of this sector and intervened directly to promote its development (Lee, 2005). And, production of animals for the aquarium hobbyist trade is a rapidly growing sector of the aquaculture industry, and it will continue to become more important as restrictions are placed on collecting animals from the wild (Tlusty, 2001). Gurumayum and Goswami (2002) studied that ornamental fish culture has made a paradigm shift among entrepreneurs ushering in economic development. It is quite clear that the global ornamental fish industry has been growing steadily over the years, and an increasing number of entrepreneurs are becoming interested in the trade.

2.3 Fisheries Biosecurity Division (FBD)

Bio-security is a set of the practices and procedures used to prevent the introduction, emergence, spread, and persistence of infectious agents and disease within and around fish production and holding facilities. Basically in general terms, it is a strategic and integrated approach to analyzing and managing relevant risks to fish health and associated risks to the environment. These practices help eliminate conditions that can enhance disease susceptibility among the fish and applicable to all levels of the ornamental fish

industry, producers, wholesalers, retailers and the hobbyists. In year 1995, DOF became a member of the World Trade Organization (WTO) and had also ratified the Sanitary and Phytosanitary (SPS) Agreement that was designed to protect human, animal and plant life or health in its member countries. Since the FBD was mandated directly, FBD need to ensure that the spread of fish diseases is contained and that fish and fishery products are free from contaminants for safe consumption for human. In achieving these objectives, FBD conducts activities including official control, official analysis and official guarantee at the primary production of the supply chain, such as in aquaculture farms, fishing vessels, feed mills and fish meal manufacturing plants (Hemalatha R. S., 2014).

2.4 Geographic Information System (GIS) and Remote Sensing

GIS may be determined as the integration of computer and software with spatially referred digital data so that storage, retrieval, manipulation, analysis stages and display all forms of geographically referenced information. GIS is a computer assisted system that can input, store, retrieve, analyse & display geographically referenced information useful for management's decision making. Thus, GIS is a toolbox to analyze spatial data. Burrough (1986) defined GIS as one of powerful data set designed to gather, store, make changes and transformation and show reality data in spatial base. Clarke (1995) defined that GIS is a computer system used for the purposes of gathering, storing, regaining, analyzing and presenting spatial data. Therefore, it can be concluded that GIS is a tool that created to solve special matters. The usage of GIS in social science still scanty but has a big potential especially in fisheries monitoring. Thus, studying demographic research using GIS is referring to two different phenomena in a same geographical spatial location, including individuals as a phenomenon and other type of phenomena such as house, farm, road, river or forest that stays evenly in geographic spatial. The individual people data will be integrated with other spatial object for an example the home address or small unit of survey data. It is different compared to physical objects such as a roads, as it's difficult to predict the real location of an individual person. Otherwise, the complete and reliable database is the most important component in GIS where GIS covers the data model attribute and spatial data. Clarke (1997) claimed that GIS could integrate the attribute data model and spatial data model which later on can be integrated with sharing ID. The ability of analysing and visualizing the agricultural environment and workflows in the GIS has proven to be very beneficial to the farming industry.

On the other hand, remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance from the targeted area. It is known

that special cameras collect remotely sensed images of the Earth, which help researchers monitor and sense things about the Earth. It is well known that the remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation. Remote sensing is used in numerous fields, including geography, land surveying and most Earth Science disciplines including hydrology, ecology, oceanography and geology); it also has military, intelligence, commercial, economic, planning, and humanitarian applications. It is generally refers to the use of satellite- or aircraft-based sensor technologies to detect and classify objects on Earth, including on the surface and in the atmosphere and oceans, based on propagated signals. The study uses a SPOT-6 satellite image as a referral source of ground monitoring. SPOT-6 satellite sensor built by AIRBUS Defence and Space was successfully launched on September 9, 2012 by a PSLV launcher from the Satish Dhawan Space Center in India. Watch video of SPOT-6 satellite launch. SPOT-6 is an optical imaging satellite capable of imaging the Earth. The SPOT-6's resolution is 1.5 meter panchromatic and 6 meter multispectral (blue, green, red, near-IR) and will offer imaging products to customers in defense, agriculture, deforestation, environmental monitoring, coastal surveillance, engineering, oil, gas and mining industries. With SPOT 6 and SPOT 7, Astrium secures the mission continuity of the SPOT series, which has collected an archive of more than 30 million scenes since 1986. This SPOT-6 is an optical satellites features technological improvements and advanced system performance that increases reactivity and acquisition capacity as well as simplifying data access.

2.5 Spatial Distribution and Distance Characteristics

The study was designed to create a simple database that could help in identifying the distribution of ornamental fish farm by doing spatial analysis using GIS and statistics analysis using SPSS software. Thus, GIS is a technological field that incorporates geographical features with tabular data in order to map, analyze and assess real-world problems. The real power in GIS is through using spatial and statistical methods to analyse the attribute and geographic information. The end result of the analysis can be derivative information, interpolated information or prioritized information (Amod Ashok Salgaonkar, et.al., 2018). Coupled with this data is usually tabular data is also known as attribute data. Attribute data generally defined as additional information about each of the spatial features in the database an example of this would be location of farm location. Additional data such as the farmer's name and level of education would make up the attribute data. Leeuwen et al. (2008) found the importance of off-farm activities in distinctive regions in the Netherlands and possible effects on the efficiency of agricultural policies. The

result shows that the location of farm households along the spatial gradient affects resource availability and farmers' livelihoods. On the other hand, Starr and Estes (1990) studied that location-specific information of an ornamental fish farm for an entire region is best handled by a computerized information system such as GIS, where the software provides tools for the display and analysis of spatial information. It stores geographic data, retrieves and combines the data to create a new representation of geographic space, provides tools for spatial analysis, and performs simulations to help experts organize their work in many areas including transportation and agricultural development (Rigaux et al., 2002). The GIS displays and analyses socioeconomic data that could aid many social researchers in understanding socioeconomic reality influenced by geographical positions. Research done by Bhatta (2010); Bhatta and Doppler (2010) showed that the variations in resource availability and socio-economic attributes of farm households in the small transects of Nepal's mid-hill regions are due mainly to topographical differences, population density, market demand, and availability of infrastructure. GIS is important in the study as it is used to monitor the farm. The health implications of animal movements across borders has always been a matter of concern of the CA and the importing countries involved. International transfers of any kind of animal represent a genuine risk for disease dissemination. Due to the rapid expansion of aquaculture in many countries, the trade in aquatic animals and their products has increased substantially (Blancou 1996). Large-scale international transfers of aquatic animals have been suggested as the source of introduction of exotic pathogens, which have causes enormous ecological and economical impact in the receptor country (Laurence, McDonald and Speare, 1996; Lightner, 1996).

Furthermore, the trade in many species of live aquatic animals, freshwater and marine fish and shellfish for ornamental purposes can be as productive or more so than the trade in food fish. Millions of ornamental fish cross borders and continents every day, and as a consequence, concern has been raised, mainly in developed countries, that this trade risks spreading diseases worldwide. However, this concern is not reflected in the scientific literature. There is a large amount of information and quality research dedicated to food fish as disease vectors, whereas ornamental fish have been poorly studied. committed hobbyists have undertaken research (Ford, 1995). Thusly, a study shows that poverty decreased considerably more in localities where salmon farms were installed than in localities without salmon farms. They identify the distances between localities and salmon farms where this impact was significant and the findings contribute to the debate on the socioeconomic effects of aquaculture for capital-intensive, international market-oriented industries (Adam., et.al, 2018). Such studies exposed the crucial behaviour on farm work activities suggested by farmer's mobility related with regional condition, such as to work to

the nearest town or urban area. The more rural a location is, the less likely a farmer will engage in off-farm activities, mainly due to travel costs. Following this line of reasoning, we can also include distance to the nearest concentration of jobs and distance to the nearest city as related variables that probably have an impact on the share of farm activity. Studies showed that farm employment location may affect the participation of farmers and their households due to the availability of a better transport system and related infrastructures. The location of nearest town, job availability, transportation system and public amenities also play a big role in the involvement of ornamental fish farmers in the study area. Their study shows that returns to education are comparatively high and location in relation to urban areas is an important determinant of both employment and earnings in rural off-farm agricultural activities. However, a study done by Goodwin and Mishra (2004) about US farm families that the number of miles to the nearest town, a factor representing the cost of commuting, does not appear to significantly influence the supply of labour off the farm.

3. Methodology

Research on distribution of ornamental fish farmers at Layang-Layang, Kluang was done through the survey and field verification. Layang-Layang, Kluang is presently recorded as the highest number of ornamental fish exporter in Malaysia. Ornamental fish farmers at Layang-Layang, Kluang were assumed to have different preferences of which farm activities they would do. Therefore, this study was conducted to determine the decision making of ornamental fish farmers in Layang-Layang, Kluang towards a wide range of farm activities they do most to get income that affect the country's export trade value for ornamental fish. However, their decision making whether to participate are affected by non-spatial structural characteristics including personal characteristics, fish farm characteristics and spatial characteristics. The relationship between farm work and a fish farm's economic performance indicates that a farm household's dependence on farm income affects the distributional consequences of agricultural policies in a country. In the terms of spatial analysis, Ruslan (1996) found that spatial referencing data allows the data gathering on different geographical stages such as election area, infrastructure services area, posting area or area that has postcode. Timing in a research is very important, as the GIS project timing may take some period with a high cost, about 80% from the project sources. Therefore, GIS analysis need to be done earlier to make the data reliable and useable. In this study, the spatial data obtained were analysed. Later, the distribution of data were displayed by creating a simple database, as the database model for spatial data needs a specific data model where it can only be found in GIS, vector

model and raster model. Remote sensing data will be used to identify the farm location. Later, remote sensing allows researchers to follow up and monitor risk areas in the long term, to determine desertification factors, to support decision-makers in defining relevant measures of environmental management, and to assess their impacts (Begni G.et. al 2005).

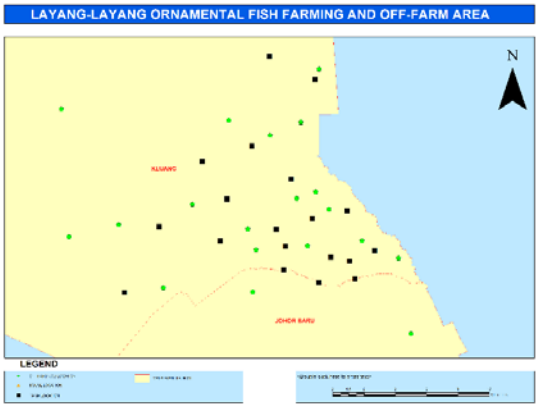

Figure 1. Layang-Layang, Kluang Ornamental Fish Farming Area

3.1. Data Collection and Sampling Design

The study was targeted on ornamental fish farmers of Layang-Layang, Kluang, the respondents are confined to Department of Fisheries and census sampling method was used for selecting the representatives of farmers in Layang-Layang, Kluang. For the primary method, structured questionnaire was used to interview the respondents;19 respondents were selected. A structured questionnaire was designed to know the recent status of off-farm employment among the farmers; the questionnaire consists of structured questions and was divided into two forms, dichotomous choice and multiple categories questions. The dichotomous choice questions offer just two answer choices, yes or no. And the multiple categories questions have more than two answers choices. For the secondary method, different analogue maps were provided by the Malaysian Department of Survey (JUPEM) and Department of Agriculture (DOA), which were used to prepare the baseline GIS data for the study area including maps which cover roads, rivers and streams, land use, settlements and the administrative boundaries.

3.2. Descriptive Analysis

The descriptive analysis is used to describe the characteristics of the variables in terms of the frequencies and the percentage of distribution of the surveyed data. It also aids to make comparison

among the data variables. It will include a summary derived from samples that will be used to illustrate the data graphically, which gives clear descriptions concerning the unvaried questions and the hypothesis of the variables. The descriptive analysis was used to describe the respondents' perception and related data.

3.3. Spatial Analysis

The spatial analysis is a process of looking at geographical patterns in the data and the relationships between the features and the spatial analysis is also the process by which we could turn raw data into useful information. The method can be very simple or difficult, which might involve models that mimic the real world by combining data layers as the analysis allows us to study the real–world processes including the present situation of specific areas and features, it includes all of the transformations, manipulations, and the methods that can be applied to geographic data, to support decisions, and to reveal patterns. Spatial analysis functions ranged from simple database query to arithmetic and logical operation to complicated model analysis. The spatial analysis is a set of techniques for analysing spatial data. The results of spatial analysis are depending on the locations of the objects being analysed. On the other hand, Haining, (1990) found that spatial analysis is the technique applied to structure the human scale, most notably in the analysis of geographic data. The demographic data are collected in spatial context and methods of analyses of spatial data include data description, map interpolation, exploratory data analyses, explanatory analyses, and confirmatory data analyses. The study will be using ArcGIS software to do all the GIS work. ArcGIS is one of the GIS software that could implement spatial analysis techniques requires access to both the locations of objects and their attributes. The spatial analysis in the study was done based on a data set in which each observation is referenced to Layang-Layang, Kluang on respondents' house location, farm and off-farm activity's location.

4. Results and Discussion

The descriptive analysis was used to discuss the involvement of respondents in farm activities, distance to the nearest town and the relationship between them. Thus, spatial analyses were done to get the geographic location between farmer's house, farm location including distance to the nearest town.

4.1 Descriptive Analysis Results

Table 1 below presents the age of the respondents. In Layang-Layang, Kluang 36.8% of the respondents participated in farm activities aged more than 40 years old, 31.65% aged 31-40 years old, 21.1% aged 21 to 30 years old and 10.5% aged below 20 years old. From the result below, we can see that farmers in

Layang-Layang, Kluang who participated in farm activities are elderly farmers who do not intend to abandon farming activities.

Table 1. Participation in Off-farm Employment

Age of Farmers	*n(19)*	*Percentage*
Less than 20 years old	2	10.5%
21 to 30 years old	4	21.1%
31 to 40 years old	6	31.6%
More than 40 years old	7	36.8%

Table 2 below presents the type of fish being reared in which respondents participated. In Layang-Layang, Kluang 57.9% of the respondents reared goldfish, 31.6% reared Tiger Barb and 10.5% reared other type of fishes. From the analysis, we can see that total of 11 out of 19 respondents farmers in Layang-Layang, Kluang reared Goldfish because of the market demand over the fish type.

Table 2. Type of Fish Reared

Type of Fish Reared	*n(19)*	*Percentage*
Goldfish	**11**	**57.9%**
Tiger Barb	**6**	**31.6%**
Other type of Fish	**2**	**10.5%**

4.2 Spatial Analysis Result

4.2.1 Distance of Home and The Farm Location

Table 3 and Figure 2 below show the respondents' distance of home and their farm. In Layang-Layang, Kluang, it can be seen that 52.6% of the ornamental fish farmers live about less than 10 kilometres away from their home. It can be observed from this study that most respondents tend to do agricultural job near to where they live. Thus, location has a positive effect to the participation in farm employment farmers who live near the farm location were seen involved in farm employment, because the farmer has more time to diversifying his source of income through agriculture activities.

Table 3. Distance of Home and The Farm Location

Distance beween home to Farm Location	*n(19)*	*Percentage*
Less than 10 km	**10**	**52.6%**
11 to 20km	**6**	**31.6%**
21 to 30 km	**3**	**15.8%**
More than 31 km	**0**	**0**

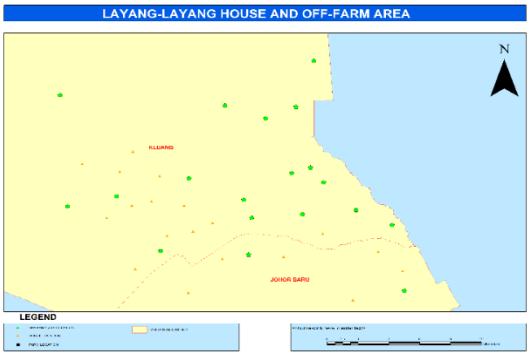

Figure 2. Layang- layang Distance of Home and The Farm Location

4.2.2. Distance from Home to Ornamental Fish Type

Table 4 and Figure 3 below show the relationship between distance from home to ornamental fish type. 73.7% of ornamental fish farmers who participated in goldfish farming were located less than 10 kilometres distance to their house. 15.8% of ornamental fish farmers who participated in goldfish and tiger barb rearing lives 11 to 20 kilometres distance to their house and 10.5% of the respondents who reared in goldfish and tiger barb lived 21 to 30 km away from their house. From this result, it can be concluded that house location has a positive effect to the participation in aquaculture activities of in goldfish and tiger barb rearing. Farmers who live near the ornamental fish farm will probably choose to do farming activities because of their interests and the distance between locations do affect both travelling time and save money.

Table 4. Distance from Home to Ornamental Fish Type

Distance	*n(19)*	*Percentage*	*Fish Type*
Less than 10 km	**14**	**73.7%**	Goldfish
11 to 20km	**3**	**15.8%**	Goldfish & Tiger Barb
21 to 30 km	**2**	**10.5%**	Goldfish & Tiger Barb
More than 31 km	**0**	**0**	

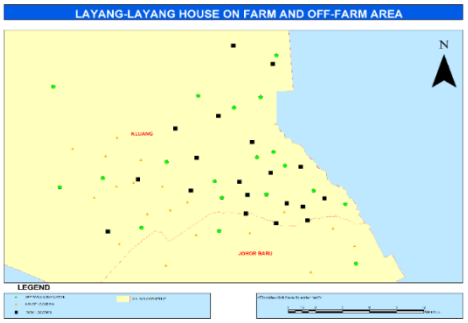

Figure 3. Distance from Home to Ornamental Fish Type

4.2.3. Distance from Home to the Nearest Town and Off-farm Type

Table 5 and Figure 4 below show the relationship between distance from home to the nearest town and their type of fish reared. In Layang-Layang, Kluang, it can be seen that 26.3% of ornamental fish farmers who participated in goldfish rearing live less than 5 km distance to the nearest town and off –farm job. 21.1% who reared goldfish and tiger barb live 6 to 10 km from home and off –farm job and 15.8% who involved lived more than 11 km distance to the nearest town and reared tiger barb fish type. From this result, it can be concluded that house location and nearest town have a positive effect to the participation in aquaculture and the type of fish reared, where they have more access to transportation linkage, suppliers and most probably close to public amenities.

Table 5. Distance from Home to the Nearest Town and Fish Type

Distance	*n(19)*	*Percentage*	*Fish Type*
Less than 5 km	**5**	**26.3%**	Goldfish
	4	**21.1%**	Goldfish & Tiger Barb
	3	**15.8%**	Tiger Barb
6 to 10 km	**2**	**10.5%**	Goldfish & Tiger Barb
	1	**5.3%**	Tiger Barb
	2	**10.5%**	Goldfish & Tiger Barb
	1	**5.3%**	Goldfish & Tiger Barb
More than 11 km	**1**	**5.3%**	Goldfish & Tiger Barb

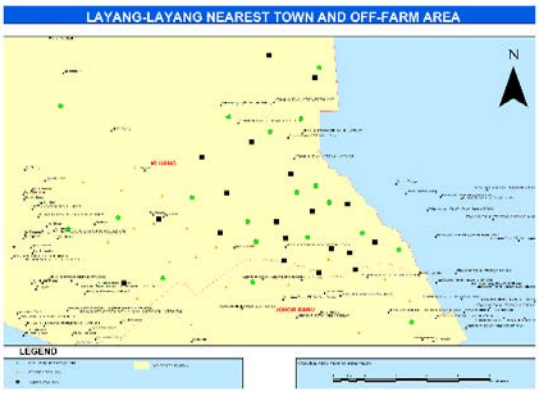

Figure 4. Distance from Home to the Nearest Town and Off-farm Type

5. Conclusions

Ornamental fish farming is an alternative strategy and has a potential to improve the income and wellbeing of the ornamental fish farmers in Malaysia. Having embargo on exports made by the European Union (EU) in 2015 do affect the overall industry. It is noted that the farmers do involve in other farm activities in order to sustain a living. The diversification of employment however helps to smooth income

by spreading risk across several activities. In order to monitor the farm by being geographically monitored from a system, a database of farm location were created and spatial analysis were done. Spatial analysis through GIS helps to determine the geographic patterns in the data and the relationships between the features. So the process of identification of farm location and other spatial characteristics becomes easier. Having spatial database of the compartmentalized farm will facilitate farm monitoring and it benefits the Department of Fisheries Malaysia, particularly Fisheries Biosecurity Division, in the management of aquatic animal health for the country's export trade value.

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