Since 1980's number production of marine capture fisheries in the world has steady progress. However, the number of fish in unsustainable level was increase greatly for three last decades. This indicate that the status of fisheries resources in the world has depleted and need serious concern. Due to some benefits from fisheries, which has big contribution to supply human's food, fisheries need to be managed properly. Moreover, fisheries also face some challenges, which are human population and climate change effect. With increasing number of human population, the demand of fish rise greatly to supply human's food. Thus, we need to increase the production of fish, but we also should keep the resources in sustainable level. Another challenge is climate change, which has significant impact for fisheries, specifically in marine ecosystem.

With the urgencies of fisheries for human life and some challenges in fisheries, we need a solution to keep fisheries in sustainable level. For a long time, many fisheries scientists have tried to find solutions to keep fisheries available in the future. However, many of them only focus on fish as the sole target in fisheries management, such as how to define the number of fish stock, the age-length relationship, biological reference points such as Maximum Sustainable Yield, and Maximum Economic Yield. This conventional approach has only few objectives, predictive, and ignore the human impact and environmental. Due to the complicated issue in fisheries, we need an integrated approach to solve the problem. The ecosystem approach to fisheries management (EAFM) is new approach, where fish is not only sole target in management. In this new approach, we are not only concern on fish, but also consider human and environment impact on fisheries. With the good governance, EAFM tries to balance between ecosystem well-being and human well-being.

Connectivity between fish, human, and ecosystem is required in EAFM. In this view, the ecosystem consider as a part of fisheries management. The important of ecosystem in fisheries management make spatial indicators also as part of considerations in fisheries management. In this case, as spatial tools, GIS and remote sensing play important role to support fisheries management especially in decision-making process (St. Martin 2015). Although spatial data are recognized by many fisheries scientists, but only a few fisheries scientist incorporate spatial data into management process. Through the new perspective, ecosystem become serious concern in fisheries management. One of applications of GIS and remote is on coastal. As a part of fisheries management, coastal has important role because it provides crucial area for early life stages fish as nursery ground and feeding ground. Habitat mapping are required to figure out this fish distribution. For instance, Odonne et al. used GIS and remote sensing to analyze essential habitat of humphead wrasse fish. Similarly, Poulus et al. also used GIS and remote sensing for habitat mapping of soft coral.

The applications GIS and remote sensing become broader in fisheries management. With remote sensing and marine GIS, Saitoh et al. predict the fishing ground of skipjack tuna using spatial indicator and vessel monitoring system (VMS). Related to application of GIS and remote sensing to support EAFM, Babcock et al. argue that uses of GIS and remote sensing can be varied through spatial zoning from single species approach to multi species approach. Predicting stock, catch, and CPUE (catch per unit effort), which are part of concern in single species approach, also can be conducted using spatial analysis. Another important aspect in EAFM is participation local community in management. In research that has been conducted by Leopold et al., local fisher’s knowledge are used as the sole information to create the framework for mapping small-scale coastal fisheries.

In conclusion, although only few managers and scientists have used spatial indicator in fisheries management, spatial indicators become important part to be considered in EAFM. With this new approach will encourage to all actors in fisheries management to make better use of GIS and remote sensing to save our fisheries resources and environment for human well-being. We believe that these spatial tools will help fisheries managers and scientists to solve some issues and challenges in fisheries management to ensure a sustainable fisheries.
Annotated Bibliography


This article analyzes the perspective of spatial analysis on ecosystem-based fisheries management (EBFM). The perspective that is given by the authors is very detailed and sharp. They review the spatial indicator that are used in spatial zoning, from the single-species approach to multi-species/ecosystem approach. Incorporating spatial indicator into fisheries management is as a part of ecosystem approach that will generate multiple objectives. Even though only few scientists and fisheries managers use spatial indicators in fisheries management, spatial zoning in EBFM has significant impact to examine the effectiveness of project, such as marine protected area. Some of examples of incorporating spatial indicator are related to the abundance of fish stock, catch rate, and fishing effort. Another indicator such as local fisher community still should be considered in management. This paper also change our think that the applications of spatial tools can be used in many ways. Through the spatial zoning and use of spatial indicator, which has influence in the models, can improve fishery management and prevent biased in trends.


In this paper, Leopold et al. discuss how the local fishers’ knowledge are used as the sole source information for mapping small-scale fisheries. The goal of this research is to create framework for small-scale fisheries on catch size and fishing effort. Information from local fishers are obtained by using stratified random sampling. They are interviewed about fishing activity, where they catch fish, how many fish are caught, and others important information, using map from the high resolution aerial photo. This high resolution aerial photo is better to describe location than nautical chart map, so the fishers can easily point out location of their fishing ground. The information from the local fishers is integrated into geodatabase and is calculated using statistical method. As the result, spatial indicators of fishing effort, catch, and CPUE (Catch Per Unit Effort) are generated. This research is very interesting, where the author only use the local fishers’ data. However, the results show that the accuracy and precision data is good. The framework from this research, as the author said, can be applied for developing country where the data acquisition is poor. Overall, this paper give good reference on application of spatial analysis using the local’s knowledge fishers.


This research paper examine the use of remote sensing and GIS analysis for mapping shallow reef area and habitat of certain fish, humphead wrasse (*Cheilinus undulates*). This research conducted at 6 location in Indonesia, Malaysia, and Papua New Guinea with the goal to estimate number of population humphead wrasse as a basic input for calculating sustainable export quota. With combining remote sensing analysis and GIS, make the results of this project more suitable and conservative than previous results. The research are started with underwater visual survey to figure out the adult habitat of humphead wrasse in reef edge. This information as a basis to define location that will analyze by remote sensing interpretation from Landsat-7 imagery. Spatial coverage and spectrum band are considerations to use Landsat imagery, although other satellite such as SPOT and Quickbird, which have finer resolution, are used in this research. Next, with GIS ability, suitability habitat of humphead wrasse are calculated. Despite this research need more enhancement by considering other factors such as feeding behavior of fish, physical factor, and biological factor, this research reveal essential use of GIS and remote sensing in fisheries science. This research also can be developed for other fisheries research to calculate the total biomass of fish in this area, to calculate the length of coastline, and to calculate area of reef. Those information can be a basic consideration to define the marine protected areas.
This paper discusses how the spatial tool are applied in habitat mapping of soft coral, *Dendronephthya australis*, in the Port of Stephens-Great Lakes Marine Park. The research has goals to explored and predict occurrence of *D. australis* by using four environmental parameters, which are bathymetry, slope of seabed, velocity of tidal currents, and distance from estuary mouth. Those environment parameters are used to figure out the resistance of this soft coral due to environment change. Combination of environment parameters and underwater observation point are resulting a species distribution model by using the maximum entropy method (Maxent). However, the result showed that the distribution of *D. australis* more covered at the outside of marine parks. This result reveal that the habitat of *D. australis* has limitation environment. Remain that the coral as a part of fisheries ecosystem, it should be considered in future management especially to decide protected area.

This paper discusses how the satellite remote sensing and marine GIS are used to support sustainable fisheries and aquaculture. The authors focus on two examples, which are defining fishing vessel activity in skipjack tuna fishery and the impact of climate change on site suitability for scallop aquaculture. In the first example the authors figure out the use of SRS to determine fishing ground by using sea surface temperature (SST), chlorophyll A indicator, and Vessel Monitoring System (VMS). This research could be improved if data from the logbook is considered. Yet, this research clearly enough to illustrate how the GIS and SRS application in fisheries. Combination between VMS data and SRS also can be used for various application in fisheries such as transferring fishing skill and knowledge from expert to new captain. In the second example, the suitability of scallop site is determined by combining remote sensing and GIS method. In this case, to define the suitability of scallop sites, the authors use multi criteria evaluation. After the site suitability is defined, the scenario are given in those area to examine the climate change impact by increasing temperature. The result, impact of climate change to fisheries and aquaculture varied. Research on climate change effect to fisheries and aquaculture varied. Research on climate change effect to scallop is needed to be developed to certain the resources in sustainable level.

In this paper, Kevin St. Martin discusses on utilization of GIS in marine fisheries decision-making. The author review the paradigm shift in the United States’ fisheries management from current regime, where only focus on fish as the sole target of management, to the new approach using communities and ecosystem as a basic consideration. Incorporation of GIS to the current paradigm make fisheries management use spatial approach as basic of decision. This paper also explain clearly with some example use of GIS as decision-making in many cases. For instance, defining essential fish habitat (EFH) and designing marine protected area (MPA) are the examples how GIS incorporated into current regime by using data acquisition and spatial analysis. Other examples such as fishing pattern, density fishing ground, and diversity particular resources by gear, boat size, and port participant delineate use of GIS not only as database query to derive map, but also combine social/economic data with biological and physical data with layering analytical and algebra technique as modelling tool to reveal complex interaction between human, social, and biological aspects over space. The key of success in this shift process will succeed if the scientist or fisheries manager do not ignore local communities’ knowledge as a part of analysis. This research is applicable to be implemented in EAFM especially in coastal planning. Combining conventional approach into ecosystem approach using spatial modelling can be an effective method in fisheries management.