Integration of participatory and aerial mapping for sea turtle conservation zoning in Malang coastal area

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Abstract. One of the sea turtle nesting habitats in Indonesia is located on the southern coast of Java Island. Bajul Mati and Jolangkung coastal areas, Malang Regency are locations of sea turtle nesting that exist in Java Island and already had conservation efforts along with it. The data inventories are nesting area data gathering and the result of sea turtle nesting which is aimed to develop conservation efforts. The purpose of this research is to integrate participation maps with aerial photographs and to identify potentials and challenges of the eco-tourism activity in the coastal area of Malang Regency. The data used are participation maps nesting point, aerial photographs result, and plotting point of nesting. The method in this research includes digital participation maps making which is then integrated with aerial photographs result and plotting point of nesting. The result of this research is integration maps of participation with aerial photographs which show in coastal area zonation as the habitat of sea turtle nesting and conservation area zonation. The conservation area zoning is one form of education for the ecotourism approach. The challenge of eco-tourism activity is to grow the regional government's trust and commitment to join and participate in sustainable eco-tourism.

1. Introduction

Indonesia is an archipelago country which rich in biodiversity becoming one of the world's habitats of sea turtle nesting, including six types [1]. The coastal areas that potential to sea turtle habitat in Indonesia according to geomorphological characteristics such as Ujung Genteng coastal area in Sukabumi Regency and Batu Hiu coastal area in Pangandaran Regency [2]. Other areas that suitable also for turtles nesting are on the southern coast of Java Island such as Bantul Regency, Malang Regency, Jember Regency, and Banyuwangi [3]. The coastal area in Malang Regency already had conservation efforts along with it. This conservation effort has been operated since 2014 and involved in a group of community care or called “Pokmaswas”. Malang coastal area which becomes habitats of sea turtle nesting is located in Bajul Mati and Jolangkung beach. These two beaches located next to each other and have a similar type of sea turtles: Green sea turtle, Leatherback sea turtle, and Olive ridley sea turtle.

Bajul Mati and Jolangkung beach has fluvio-marine landform and surrounded by solutional hills/karst [4]. This condition can cause the difference of slope inclination, but in the coastal area has
a typical flat to the undulating slope. Coastal area's typology in this area is classified into wave erosion coast, subaerial deposition coast and land erosion coast. While the wave type in Bajul Mati and Jolangkung coastal areas is categorized as surging breaker type. The data inventory and collection is done by survey and interviewing the conservation management to gather the data number of sea turtle's nest and its nesting location. This data inventory is functioned as a tool which simplifies the conservation management in reminding and marking sea turtle nesting point location. According to this background, then data inventory is drawn into participation maps through interpretation results. Participation maps are one of spatial knowledge which is applied in the form of maps traditionally/manually with a purpose to empower individual or community participation [5].

Bajul Mati and Jolangkung coastal areas have conservation efforts in preserving sea turtle in Malang Regency. This conservation effort besides aimed to preserve sea turtle also has the potential to build eco-tourism on an educational basis. Eco-tourism is a tourism approach that includes nature preservation, the interaction between tourism and environment, conservation, and involve tourists with the local community to earn benefit which can be beneficial [6]. Generally, eco-tourism is a tourism concept that focused on ecology conservation, social life, and economic benefit [7]. Benefit in the eco-tourism approach can be increasing the economic value of tourism, improving local communities' welfare, gaining knowledge, and building an integration between management and tourists [8]. Besides enjoying the beauty of nature, tourists can also feel experience and knowledge through the eco-tourism approach [9]. Bajul Mati and Jolangkung coastal areas as the habitat of sea turtle nesting has an effort to develop tourism to become an eco-tourism concept. This condition is supported by the beauty of nature and sea turtle conservation efforts along with it. Through eco-tourism, the benefits earned are the increasing economies of the coastal community, gaining knowledge of tourists, and the potential to be more responsible in preserving sea turtle.

Conservation efforts that have been done in Bajul Mati and Jolangkung coastal areas including the build of sea turtle house as hatchery and sea turtle's egg quarantine, the existence of point map sea turtle's nest and activity of preserving sea turtle every month. Hatchery and sea turtle's egg quarantine can be seen in Figure 1. Point maps sea turtle's nesting is done by participatory by the local member of conservatory group management (Pokwamas). This activity is done through periodical observation along with Bajul Mati and Jolangkung coastal areas. Based on this field condition, the purpose of this research is to integrate the participatory map and the aerial photo to generate the sea turtle conservation zone and to identify potentials and challenges in developing eco-tourism in the coastal area of Malang Regency, specifically in Bajul Mati and Jolangkung.

![Figure 1. Hatchery and sea turtle’s egg quarantine in bajul mati coastal area.](image)

Actually, the participation maps can be integrated with aerial photographs for risk mapping, but also useful for other purposes [10]. In this research the integration method used for the local community's participation related to threats and dangers with aerial photographs for conservation map purpose. The result is expected to be able to improve the local community's endurance and capacity towards tourism development challenge and for climate change. This research is also focused on the conservation method for hatchery of the sea turtle. The result of the map integration is functioned to support area conservation zonation in Bajul Mati and Jolangkung coastal areas.
2. Methods
The location of this research is on the southern coast of East Java Province, specifically in the coastal area of Malang Regency. There are two coastal areas in Malang Regency, which are Bajul Mati beach and Jolangkung beach. Bajul Mati and Jolangkung located in Gedangan District, Malang Regency. The location of this research is shown in Figure 2. The participation map obtained from conservation community management (Pokmawas) then proceeded into a digital sketch. For useful information, aerial photographs need to process into mosaics orthophotos [11]. The digital participatory map was then integrated with aerial photographs and sea turtle's nest plotting to produce integrative map participative. After that sea turtle's hatchery habitat ready to delineate in Jolangkung and Bajul Mati for generating the zonation map. The zonation map is expected for conservation purposes in the study area.

Figure 2. Research Location Map in Jolangkung and Bajul Mati Coastal Areas, Malang Regency.

3. Result and Discussion

3.1 Sea Turtle Conservation in Malang
Awareness towards protection efforts for sea turtle is getting increased, one of them happened in Malang. The southern coast of Malang is one of the sea turtle nesting habitat, where one of the areas sea turtle found in Bajul Mati coastal area namely Green sea turtle, Leatherback sea turtle, and Olive ridley sea turtle. There is sea turtle conservation was built Malang, specifically in Bajul Mati coastal
area which was voluntarily built by the local community who involved in the group of community group care namely "Pilar Harapan." This community has built a conservation place since 2014 and funded voluntarily by the locals. Several reasons for building this conservation place is because many people hunt eggs and sea turtle itself for consumption or commodity. This condition triggers concern of the local community, they become aware that sea turtle is one of the ecosystem chains. If one of the ecosystem chain is extinct, it will affect the whole food chain in the ecosystem. Hence, to balance and reduce poaching, this local community started to build a conservation place.

6 people involved in the community group which involved in sea turtle conservation in community watchdog "Pilar Harapan". Several efforts stage which has been done is by starting night patrol during sea turtle nesting season. Some people get around in Bajul Mati coastal area and surrounding to collect sea turtle's egg and do data inventory by counting the number of eggs found. Sea turtle's eggs that have been found were then being collected in the hatchery. The hatchery is done through a semi-natural process by putting the eggs inside the sand beach. Sand beach is considered as good incubator media. The success of sea turtle's egg incubation is very determined by the suitability of sand beach conditions [12]. Sand can affect important aspects of the success of sea turtle's incubation in the form of humidity, porosity and sand density [13]. The incubation process needs time for about 60 days. If 60 days have passed, the egg will be hatched to be hatchling and will be coming out from the artificial nest. When the hatchling has been hatched, data inventory will be done to count the number of eggs to be hatchling and the number of rotten eggs. The newly-hatch hatchling is placed in the pond and taken after for 2-4 weeks before ready to release. The sea turtle release generally is done along with special events in Bajul Mati coastal area, but if there is no event the sea turtle will be released themselves to the sea. Scheme stage conservation of sea turtle can be seen in figure 3.

![Figure 3. Stages of Sea Turtle Conservation.](image-url)

Local conservation condition which built by the community has not earned full support yet from the local government due to conflicts about conservation ownership. Up to this day, the development of a bigger nesting place has been done compared to the previous nesting place located near the offshore. The old sea turtle nesting place is shown in figure 1.

The eco-tourism project in Bajul Mati and Jolangkung coastal areas will be conducted after the completion of the new nesting place building. One of the eco-tourism activities is done is by educating the importance of preserve the life of sea turtle to the visitors and the release of hatchlings which are
ready to be delivered in the sea according to a certain procedure. The existence of eco-tourism will be able to grow the local community's economic and wished to be able to improve the welfare of the local community. However, this eco-tourism up to this day has not earned support yet from the local government, even some people in the local community have fully not supported this activity. So that, the eco-tourism is practically done imperfectly.

3.2 Participatory Map by Local Conservator

Pokmaswas in doing conservation activity has several stages of data inventory. One form of data inventory is by making participation map location of sea turtle nesting point in Jolangkung and Bajul Mati coastal areas. The participation map can be functioned as simplify land use planning, natural resources management and a tool to organize community [14]. This data inventory used to count locations of sea turtle nesting. Therefore, the data can be used for an area where the potential need to be conserved. Sea turtle nesting point is obtained during the night patrol picking up of sea turtle's egg. The community involved in Pokmaswas will do data inventory by walking along the sea and make plotting the location of nesting with a benchmark of a differentiable area such as cliffs, reservoir, and cave. There are several benchmarks along with Jolangkung and Bajul Mati coastal areas namely Batu Bolong (cliffs), Kondang Anyar (reservoir), Gowa Wil (cave), dan Gunung Tengger (hillock). There are 18 points of sea turtle nesting in the research period 2017-2018 which has inventoried by some type of sea turtles such as Green sea turtle, Leatherback sea turtle, and Olive ridley sea turtle. The participatory map of sea turtle nesting that is made by the head of Bajul Mati sea turtle conservation management is still in the form of sketch from the interpretation. The result of the participatory map was then completed to be a digital sketch. The manual and digital participatory map are shown in figure 4.
3.3 Integration of Participatory And Aerial Maps

The result of the participatory map made by conservation management, then being integrated with aerial photographs (UAV) which have been proceeded to be orthophoto mosaics. The integration result of a participatory map with aerial photographs is by walking along the beach and plotting each location of sea turtle nesting. The determination is done based on the missing nesting trace, then the location point of nesting is being proceeded through sketch interpretation from the conservation management. Participation map interpretation results by conservation management then applied in the form of aerial photographs. Therefore, it is delineated based on the sea turtle nesting place. The purpose of map integration is to simplify data inventory easily and clearly. Delineation zona result of sea turtle nesting can be used as the basis of determination guide in building eco-tourism in Bajul Mati and Jolangkung coastal areas. This zone has length 1163 meter and wide average 79.4 meter and 0.08 km2 large and slope slant average which are categorized as declivous. On several coastal areas that has sea turtle nesting zone, for example in Cape San Blas, Northwest Florida has a long sea turtle nesting zone around 5.7 km with the highest Loggerhead sea turtle nesting in North Bay Mexico [15]. The Integration Map result based on nesting location zone can be seen in figure 5.
Figure 5. Map of Sea Turtle Nesting Zonation in Bajul Mati and Jolangkung Coastal Areas Resulted from Participatory and Aerial Data Integration.

Bajul Mati and Jolangkung coastal areas as tourism locations and sea turtle conservation spots have both potentials and challenges in developing eco-tourism. Sustainable eco-tourism activity could not maximally accomplish without supports from the local government and community. Hence, the challenges in developing eco-tourism in Bajul Mati and Jolangkung coastal areas is to grow the local government's trust and commitment to join and participate in sustainable eco-tourism. Through eco-tourism, the benefits earned are the increasing economies of the coastal community, gaining knowledge of tourists, and the potential to be more responsible in preserving sea turtle in Indonesia.

4. Conclusions
The findings of this research can be concluded as follows: (1) participation map integration with aerial photograph functions as a tool which simplifies the night patrol activity to count sea turtle nesting location, however, the spatial reference is not included become the weakness of this tool. Besides, that map can help the inspector in proceeding data inventory sea turtle nesting and be the basis in determining the conservation area and eco-tourism. This activity including interpretation of conservation management and aerial photographs result using UAV; (2) the result of participation map integration with aerial photographs resulting in coastal area zonation as the habitat of sea turtle nesting and conservation area zonation. This conservation area zonation is one of the educational forms to approach eco-tourism in Bajul Mati and Jolangkung coastal areas. Through the eco-tourism approach, local communities' economic stability will be increased and could grow the feeling of responsibility towards sea turtle preservation.
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