Eel (Anguilla marmorata) commodity in Rana Lake, Buru Island: lake ecology and eel development prospects

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Abstract. Rana Lake is located in the middle of Buru Island, Maluku Province Indonesia. One of the organisms which inhabit Rana Lake is eel (Anguilla marmorata) or locally known as mloko. Eels are exploited by indigenous community or Bupolo people for long time by using traditional gear during their annual migration through Wainibe River to reproduce somewhere in Pacific on December. This paper examines ecology of Rana Lake related to the population of eels (A. marmorata). Socio-economic of local indigenous community or Bupolo people is also discussed including their culture and possibility to improve their livelihood through innovation of eels processing and seeking for their market.

1. Introduction

Buru Island with total area of 12,656 km² located in Maluku Province has two regencies namely Buru Regency and South Buru Regency. Based on BPS (2014) [1], Buru Island is inhabited by 180,583 residents and 120,798 of them live in Buru Regency which has larger administrative area i.e. 7,576 km². As many as 12% of residents are native (autochton) of Buru Island and locally this indigenous people are called Bupolo people.

Bupolo people live in the mountain and they tend to be introvert because they do not like to interact with outsiders (allochton) who occupy the coastal area in the south and north of the island. Those people who inhabit the coastal area are trans-migrant, mostly came from Java and Bali and other parts of Indonesia including Maluku. Most of Bupolo people in the mountain live in the surrounding area of a lake called Danau Rana (Rana Lake) but there are small numbers of them live in the coastal area due to government program in order to try to educate as well as to make them to communicate and interact with outsiders. Rana Lake for Bupolo people is a sacred place because they believe that their ancestors are sleeping in the lake. Because of their believing, exploitation of the living resources such as fish and eel in the lake is not utilized optimally yet to improve their livelihood.

Information about Bupolo people, Rana Lake and its living resource is very limited, therefore this research was conducted. The objectives of this research were to study socio-culture of Bupolo people and ecology of Rana Lake as well as prospect of eel (Anguilla marmorata) commodity to Bupole people.
2. Material and Method

2.1. Territorial organization
Information on territorial organization which consists of social, space and time organizations was done through interviewed with key persons i.e. elder of Bupolo people to get the picture of their socio-culture. To get the valid data, information from one key person was cross-checked with other key persons.

2.2. Ecological mapping of Rana Lake
Ecological mapping of Rana Lake was done to get information on soil, water, plants and animals which occur in there. The information was collected through direct observation, interview and study of literature.

2.3. Data analysis
All data collected was interpreted by researchers in which interpretation on interview was done carefully by cross examination to get the valid data because there is no written information. In addition, information on Bupolo people is limited because it was inherited orally from one generation to the next generation.

3. Results and Discussion

3.1. Bupolo people and their world
World of Bupolo people is full of myth and sacred. Something forbidden and taboo from their ancestor is common and practiced in their daily life. World of Bupolo people is also full of ritual such as wedding ritual, baby born ritual, mort ritual, ablution (cleanse ritual) and so on.

Social organization in Bupolo people start from the small unit i.e. home and then place in the village and the last is paternal name as a greatest unit. Bupolo people who have the same surname are a unity in their custom even though they live in separate place in Buru Island. So, land owned by Bupolo people depend on their identity i.e. their paternal name. Land of Bupolo people is owned communally and it is bordered by mountain and river so their land is very large.

Agriculture practice of Bupolo people is traditional, subsistence and discursively. They will move to another place to plant if they fell that the land is less fertile and let the old land to recover. In general, they plant banana, peanut, cassava, corn and sago to fulfill their daily need. They also plant perennial crops such as coconut, nutmeg, clove, chocolate and coffee and distilled eucalyptus (Melaleuca leucadendron) oil to earn some money. To fulfill animal protein needed, they hunt pig, deer and cuscus or catch tilapia and eel in Rana Lake.

3.2. Ecology of Rana Lake
Rana Lake is located in the valley and it is surrounded by mountain about 700 m above sea level therefore rainfall in this area is high. Water in this lake comes from 7 rivers namely Bialahinangan, Waereman, Saposia, Lipati, Ersali, Tinggeba and Waehude and the water from the lake flows to the sea through Waenibe river.

Types of soil in the surrounding area of Rana Lake are alluvial, lithosol and podzolic soils. Since its structure is covered by volcanic soil which was formed thousand years ago, this area is fertile and suitable for planting corn, cassava, peanut, banana and some perennial crops.

Rana lake is surrounded by heavy rainforest. Upper land of the lake is dominated by high trees such as Shorea sp, Litsea spp, Elmerillia montana, Machilus rinoa and Paraserianthes falcata. In the lower land there are Bambusa spp, Pandanus spp, Thysano sp, Eleocharis sp, Hanguana malayana, Lepironia articulata while in the lake there are Hydrylla verticella and Nelumbium speciosum.
Variety of animals inhabit this area including birds which are endemic to Buru Island can be found abundantly in the surrounding area of Rana Lake i.e. *Kring Buru* (*Prioniturus mada*), *Opior Buru* (*Madanga ruficolis*) dan *Betet Buru* (*Tanygratus gramineus*) [4]. According to Pattinama (2005) [4], birds from Australia (*Sula leucogaster*) can be found also in Rana Lake on July and August when they do their annual winter migration and spent their time in there.

3.3. Bupolo people, Rana Lake and eel

Most of Bupolo people live in the surrounding area of Rana Lake. Rana Lake for Bupolo people is a sacred place because they believe that their ancestor is sleeping in the lake and grant water in the lake with animals which live in there for them. For that reason, they do annual ritual called *meta* ceremony to cleanse the lake and its surrounding area on December. During this ritual, they harvest eel *Anguilla marmorata* which is one of anguillids live in the Rana Lake.

There are 19 species of freshwater eel anguillids in the world in which 6 species occur in temperate waters while the rest inhabit tropical area [5]. According Sugeha to et al (2008) [6], Indonesia has the greatest variety of eel in which as many as 9 species/sub species can be found in the Indonesian rivers/lakes i.e. *Anguilla bicolor bicolor*, *A. nebulosa nebulosa*, *A. bicolor pacifica*, *A. interioris*, *A. borneensis*, *A. celebesensis*, *A. marmorata*, *A. obscura* and *A. megastoma*.

*Anguilla marmorata* is the largest and the most widespread distribution of fresh water eels. This species can reach up to 2 m in length with a maximum weight of 21 kg [7, 8]. The maximum size of *A. marmorata* in Indonesian lake/river reported so far is from Southeast Sulawesi i.e. 160 cm TL and weight 12.8 kg [9]. This species distributed from the western Indian Ocean, through the Indonesia region, north to southern Japan, and across the western South Pacific [5, 10].

*Anguilla marmorata* is catadromous species which is born in saltwater, then migrate into freshwater (river, lake) as juvenile where it grow into adult before migrating back into the deep ocean waters to spawn. The exact location of spawning ground of *A. marmorata* is not known but it is predicted somewhere in Pacific Ocean. Based on catches of leptocephali (larvae) it is predicted that *A. marmorata* spawn in the North Equatorial Current region of the western North Pacific [11, 12]. After spawning, larvae of eels were carried by ocean current, metamorphose during the journey and recruit to estuary habitats as glass eels [13] which take about 150 days [14] then migrate to the river/lake as their adult habitat.

As mention above, *upacara meta* of Bupolo people is done on December every year, and during this month is the peak season to harvest eel (*A. marmorata*) or locally called *mloko* when they leave the lake to reproduce in Pacific Ocean. This activity has been done for years by using traditional gears such as spear gun, hook and line and trap. However harvesting of eels before reproducing is critically endangered and can be threatening their sustainability. Therefore, alternatives ways are required to prevent decreasing of the population of this valuable resource in Rana Lake and the best alternative is through aquaculture.

3.4. Prospect of eel aquaculture for Bupolo people

Aquaculture is one way used to reduce fishing pressure especially for population which is over fished and to fulfil increase of market demand of valuable marine resources. Some species of temperate eels particularly glass eels have overfished and have been declared as being endangered species [15]. Meanwhile, international market demand on eels is increasing up to 300,000 ton/year with the price depend on the size up to IDR 175,000/kg [16].

Aquaculture of eel is so important because 97% of world total production come from this sector [17]. There are some advantages factors to culture eel such as high rate of survival in captivity, better tolerance to environment condition, good growth rate and high productivity [17]. However, cultivation of eel is also problematic because up to now there is no technique to spawn this resource commercially. The main reason for this is late onset of sexual maturity i.e. 3 – 9 years for male and 5 – 18 years for female and all
breeders die after breeding season [17]. Thus, currently this sector depends entirely on seeds i.e. glass eels/elvers from nature.

Eels are robust species that can tolerate changing in environment condition, so intensive farming in earth pond is suitable for Bupolo people because there is no technical equipment or artificial oxygen needed. Bupolo people also have large land and plenty of water from Rana Lake. The fact that they catch eels not only in December when meta ceremony but also all year round to fulfill their daily animal protein needed indicate that there are plenty of glass eels/elvers they can get to grow out in the pond from the wild in the estuary easily.

As mention above, Bupolo people who live in the surrounding area of Rana Lake are introvert, simple people and old fashion. They still keep their culture, planting crops and hunting animals to fulfil their daily live. Effort to change their way of life or to adopt something new surely need more time, slowly, quite challenging and should be done comprehensively, thus many related parties should be involved. In addition, Bupolo people must be involved in every stage from the beginning (planning) and not only at implementation because they are the subject and not the object.

For growing out eels in earthen pond for example, several institutions should be involved such as regional government (marine and fisheries), university (social-cultural anthropology, aquaculture, fish processing technology and agribusiness) and non-government organisation. During the process, Bupolo people should be accompanied and they must be convinced that the program is going to be done for their advantage in order to increase their livelihood. If they are convinced and involved, they will do it eagerly. Related institution should help this indigenous community not only for technical assistance for growing out eels but also for post-harvesting and marketing. Because eels have good prospect due to high demand and good price in national and international market, this product can reduce poverty of Bupolo people.

4. Conclusion

Eel (A.marmorata) is one of fishery resource in Rana Lake, Buru Island which is exploited traditionally by indigenous community called Bupolo people using simple gear to fulfil their daily need of animal protein. This resource has good prospect due to high demand and good price in national and international market. If Bupolo people can be persuaded for growing out this valuable resource in the surrounding area of Rana Lake, they not only fulfill animal protein needed but also earn some money and thus reduce their poverty.

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