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BIODIVERSITY LOSS IN LAKE TOBA ECOSYSTEM

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Abstract

Lake Toba, like other lakes in the world, provided services to people live in surrounding area. It provided plants from which people utilised food, herbs, wood, as well as types of fish from the lake. In addition to this provision service, the lake also provided regulating service and cultural service. Some studies revealed that the ecosystem has been changed especially in past decades due to population growth and development purposes. Human activities caused change of ecosystem. Widespread deforestation, shifting of land use pattern, and intensive agricultural practices in catchment area of Lake Toba contributed both directly and indirectly to the plant diversity. Not many available references documented the variety of indigenous flora and fauna in the area, however through interview with local inhabitant in the area, it was found that many of known local species were become difficult to find. This paper spelt out some of rare if not endangered plant species such as pine, *mobe, antarasa, andalehat, and sijungkot*. As to fish, ihan Batak is already listed as endangered species. Some of them have direct or indirect supports to the food security and sustainable environment.

Keyword: Lake Toba, ecosystem, biodiversity

1. Introduction

Lake Toba is Indonesia's largest lake located 176 km from the capital city of North Sumatera Province, Medan. Situated at 904 meter above sea level with depth about 505 meter it is known as the largest caldera lake in theworld. Holding about 280 km^3 fresh water, Lake Toba is recognised as the largest permanent lake body in Southeast Asia.

The ecosystem of Lake Toba and its surrounding serves the people living in the area. The basin provides abundant fresh water, and catchment area supplies food to the community through agricultural and fisheries activities, whilst forest provides wood and various herbs. Lake Toba catchment area covers 3,658 km^2 embracing parts of area of seven districs.

Ecosystem of Lake Toba Catchment Area (LTCA) has been changed dramatically especially in last decades. The Lake Toba catchment area faces an environmental crisis characterized by widespread deforestation, drought, decline of the water level, water quality degradation, invasive species and loss of biological diversity [1]. Changes of ecosystem of Toba region may be a result of numerous variables. Agricultural practice has been changed a lot. Traditional agriculture was no longer sufficient to maintain productivity for food production. Economic forces led to increasing of specialization of productive plant species and utilised more land than before.

Habitat destruction was also occurred not only due to land use change for planting industrial commodities, in the same time housing and industrial development purpose should be one of the factor. Loss of plant biodiversity was also occurred, and it is believed hundreds of species of flora and fauna in LTCA region are currently extinct or in a state of endangered. Some of them have direct or indirect supports to the food security and sustainably of environment.

2. Agrobiodiversity Loss

Endangered Plant Species

Toba land, which is inhabited by the Batak ethnics group, is blessed with a variety of plants that are being used for multiple purposes. Plants provide fuel, food, medicine and wood for shelter, as parts of provision service of the Lake Toba ecosystem. Some of the domesticated plants species are listed on Table 1, however this data gained from statistic bureau is not enough to show complete plant species

grown in the area, as wild plant species for example are absent in the list.

Table 1. Flora grown at Lake Toba catchment Area (LTCA)

Agricultural	Plantations and Forestry
Arachis hypogaea L.	*Artocarpus heterophyllus* Lam.
Allium cepa L. forma ascalonicum	*Aleurites moluccana* (L.) Willd.
Allium sativum L.	*Arenga pinnata* (Wurmb.) Merr
Ananas comosus (L.) Merr	*Anacardium occidentale* L.
A. [illegible]	*Areca catechu* L. *A.* [illegible]
Brassica rugosa Prain.	[illegible]
Capsicum annuum L.	*Bambusoideae* spp.
Cucumis sativus L.	*Coffea arabica* L.
Carica papaya L. and	*Cocos nucifera* L.
Curcuma longa L.	*Citrus aurantium* L.
C. [illegible]	*Cinnamomum burmanni* (C.G. & Th.Nees) Bl.
Daucus carota L. *Glycine max* (L.) Merr. *Ipomoea batatas* (L.) L. *Ipomoea aquatica* Forsk	*C.* [illegible]
Lycopersicon esculentum Mill.	*Citrus* [illegible] Lamk
Manihot esculenta Crantz.	*Durio zibethinus* Murr
Musa paradisiaca L.	*Eugenia aromatica* O.K.
Oryza sativa L.	*E.* [illegible]
P. [illegible]	*E.* [illegible]
Psidium guajava L.	*G.* [illegible]
[illegible] R.Br.	*Gmelina arborea* Roxb.
Phaseolus vulgaris L.	*Mangifera indica* L.
Solanum aculeatissimum Jacq.	*Melia azedarach* L.
Solanum melongena L.	*Myristica fragrans* Houtt
S. [illegible]	*Macadamia hildebrandii* Steenis
Solanum torvum Sw.	*Persea americana* Mill.
Vigna unguiculata (L.) Walp	*Parkia speciosa* Hassk
Zea mays L.	*Pinus merkusii* Jungh. & De Vr.
Zingiber officinale Rosc.	*Sandoricum koetjape* (Burm.f.) Merr.
	Syzygium aqueum (Burm.f.) Alston.
	Theobroma cacao L.
	T. [illegible]

Source: Central Bureau Statistic (CBS) of Simalungun District (2015); CBS Samosir District (2015); CBS Karo District (2015)

Lake Toba catchment area currently faced not only the losses of the existing ancient Toba forest but also lose its biodiversity, as well as hectars of critical lands due a worst of enviromental destruction. Some plants species are found only in a very small number, and left without any action for conservation.

Not many available references documented the variety of indigenous flora and fauna in Toba region. Through a direct observation and interview with local people, following are some example of rare if not endangered plant species in Lake Toba catchment area. Some of endangered plant species have a high economomic value, socio-cultural meaning, as well as functional/health benefit and medicinal properties.

Artocarpus hypargyreus

Artocarpus hypargyreus or kwai mụk is a tropical fruit tree belongs to family Sapotaceae. It is native to southern China, widespread and common in tropical and southern subtropical evergreen forest in South China [2,3]. This species is globally vulnerable. It is not very widely known around the world, but very popular in Toba area which is called *mobe* by its vernacular name. However, the tree is becoming rarely seen in the area of Toba.

The tree has a dense and rounded canopy, grows up to 20-25 m tall. The fruit is ovoid to globous with yellow skin/surface. It has a soft orange-red pulp with a melting texture and a pleasent and excellent acid flavor. In Toba region, this fruit is very popular and has been used traditionally but together with lemon pepper are limited as ingridients for local and traditional cuisine "*arsik*". However, the ripe fruit could be eaten ripe or preserve with salt or sugar syrup or dried. The leaves could also mix with mango leaves which are treated as tea and used as mouth washing. According to [3], not many information has been published on its nutritive and medicinal values.

Styrax benzoin

Styrax benzoin is a tree species belongs to family Styraceae, and native to the nothern hemisphere, including eastern and southeastern Asia. The most populer ones come from Sumatera and Laos. Styrax tree in Indonesia, known as kemenyan by its vernacular name, is commonly referred as to Sumatera Benzoin [4].

Its produce benzoin resin, which is tapped and dried by farmer and used for incense, perfume and pharmaceutical industries [5] as dried resin produced fragrant aromas when burn which made it become valuable source of incense.

In North Sumatera, Batak farmers manage benzoin trees in agroforest system. However, community forest where styrax benzoin grown has partially shifted to industrial plantation forest.

Chrysophyllum roxburghii

Known as apple star, and locally popular as *andalehat* (Batak). *Chrysophyllum roxburghii* is a member of Sapotaceae family. This tree species reaches a heigh of 30 metres, with a trunk diameter of up to 40 cm. The fruits are

eaten fresh, and contain considerably higher minerals B, Ca, Fe, Mn and P compared to other fruits. It is also high in aspartic acid and essential non essential amino acids [6]. It is currently found very rare in the area of Toba.

Lactuca canadaensis

Lactuca canadaensis is a plant species in the Asteraceae family. It is a type of wild lettuce and leafy vegetables, and locally known as *sijungkot* (Batak) by vernacular name. Wild lettuce commonly refers to the more bitter cousins of common. The three main species of this group are *Lactuca virosa*, *Lactuca canadensis*, and *Lactuca serriola*. Constitute a mild sedative and cough suppressant, calmative, anticancer activity of *Lactuca steriolla*. The leaves of this vegetable plant are eaten fresh, posses a very faint bitterness, and has a good crunch.

***Litsea cubeba* (Lour.) Pers**

Litsea cubeba is locally known as *antarasa* (Batak) belongs to Lauraceae family, and is an evergreen aromatic tree with dioecious flowers and small pepper-like fruit. The species could grows up to 30 metres, in the wild of secondary tropical forest in southeast Asian countries including Indonesia, India, China, Korea and Taiwan [7].

L. cubeba has been collected from forest, and the fruits of this vegetable plants are normally eaten fresh during meal for local Toba people. It is a very aromatic, and has a good crunch as eaten and promote digestion. However it is not much known in Toba region that essential oil could be extracted from *Litsea cubeba*. Generally known as May Chang in China, aromatic essential oil of *L. cubeba* is produced in China with an annual production of about 2000 tonnes and more than 50% of their production is exported to worldwide.

Mangifera foetida

Mangifera foetida belongs to family Anacardiaceae. Known as horse mango or bacang (Indonesia), the plant is endemic plant to Sumatera, Borneo, Peninsular Malaysia and Peninsular Thailand. Mostly are found wild in lowland natural wet evergreen forest [8]. *M. foetida* is grouped as least concern in IUCN Red List of Threatened Species.

M. foetida is perennial tree up to 30 – 40 m high. The fruit is vibrous, has a strong turpentin aroma and is normally eaten fresh, but in Malaysia is used to make chutney and pickle. It has a yellow pulp which contained flavonoid, carotenoid, and ascorbic acid. In the case of carotenoid, it was found higher in its fiber than in fresh and powder form. Overall, it was also found that high content of these component in *M. foetida* has a positive coorelation with its antioxidant activity [9].

***Pinus merkusii* Junghuhn & de Vriese**

Pinus merkusii known as pine is a large tree up to 50 – 70 metres tall, with a straight and cylindrical bole with average diameter of 55 cm. Needles come in pairs, slender but rigid, cylindrical 16-25 cm long. Its distribution is in Asia, and mainly in Philippines and Sumatera. The resin of this pine is used in turpentine, medicine, paint, printing and in the parfume industry.

This species is native to Sumatera – Indonesia and Philippine, fragmentation and exploitation are puting the species as a vulnarable as listed in The IUCN Red List of Threatened Species. Around Lake Toba, logging and over exploitation has progressed the population to near extiet if the region. Industrial need for rayon is the factor responsible for most of the population of Sumatera pine that have been destroyed. Since 1988 a pulp factory was established in Porsea, near the lake, and consumed existing indigenous *Pinus merkuusi* from Toba surrounding area as raw material.

Several actions should be accomplished to conserve Sumatera pine. Natural forest management permit given to industrial company should be restricted to forest where no pines are grown. It should then follow by conserving and managing unprotected populations in cooperation with landowners; restoring populations impacted by off road vehicle use and other impacts, as well as studying Toba pine seed set, and threats to the species such as climate change.

Sandoricum koetjape

Sandoricum koetjape or santol (English) is belonging to genus of Meliaceae. In Indonesia is locally known as kecapi, with other vernacular names sentul and ketuat. In Toba region it is known as *sotul*, which fruit were normally collected by local people for domestic purpose. Santol is deciduous, small to large tree and native to Indochina, and from there has been introduce to South East Asia, and was spread to Australia. It s found in primary or sometimes secondary tropical forest below 1000 m. However, it has become increasingly rare in Toba land.

The fruit is about a clenched fist size, with 1-5 locular drupe. The seed is large, without aril and surrounded by a translucent or pale, acid, edible pulp of good flavor. Food nutrient composition of fruit of santol per 100 g edible portion is reported as: energy 57 kcal, moisture 84.5%, protein 0.4 g, fat 0.7 g, carbohydrates 13.9 g, dietary fibre 1.0 g, ash 0.5 g, Ca 9 mg, P 17 mg, Fe 1.2 mg, Na 3 mg, K 328 mg, B-carotene equivalent 5 mg, thiamin 0.05 mg, riboflavin 0.03 mg, niacin 0.09 mg, ascorbic acid 14 mg [3]. The fruits are eaten raw plain or with spice added. It could also be added as ingridient for local traditional recepy. In Philippine, however, santol marmalade is popular and had become export commodity. They also produced alcohol drink by processing the pulp of very ripe santol fruit with rice. In Malaysia, young fruits of santol are processed to produced candies [3].

Extract of the stem bark has anticancer activity and become good candidate for cancer treatment (Aisa *et al.*, 2009), and *S. koetjape is* a terpenoids-rich traditional medicinal plant belonging antiangiogenic [10].

Zanthoxylum acanthopodium DC.

Zanthoxylum acanthopodium DC. or lemon pepper tree (English), is a unique aromatic cushion-forming perennial plant of Rutaceae family. It is known as *andaliman* by its vernacular name by Batak people lived in Toba catchment area. Lemon pepper is local endemic plant to Toba land in North Sumatera province. In the wild forest of Toba, it grows as a shrub and small tree up to 2.5 m tall.

Concerning culinary used, the fruit of lemon pepper has been traditionally used freshly as spicy on several Bataknese food, such as *arsik, naniura, natinombur* or sauces. Yanti et al. [11] revealed that the fruits are used as folk medicine for remediation of diarrhea and stomach ache. Their work also revealed that the extract of lemon pepper could be potentially used as herbal medicine to heal inflammatory particularly gastrointestinal inflamantation.

Conservation

Healthy ecosystems with plants diversity is vital for livelihoods and well being of human kinds. Until now, continuous degradation of natural habit and fragmentation is still occurred in Toba region. It is a big concern regarding ecosystem. Deforestation and land degradation caused a continuous decline of biodiversity, which could reduce life sustaining ecosystem services. Often it will lead to loss of species diversity or even potentially to a loss of genetic diversity.

In the face of current situation for sustaining future human well-being, there is a need for conservation of the plants for sustainability of the nature and protection of ecological regions. Conservation could be define as the management of human use of the biodiversity so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. By protecting the indigenous variety of species and preserving genetic diversity we maintain the essential ecological processes and life support systems on which human survival and economic activities are depend. Conservation action could be start by a proper of documentation, monitoring, and proper training of the locals and reducing anthropogenic pressure.

3. Closing Remarks

Although North Sumatera government authorities have made some efforts to nature conservation, much work will remain to be done to strengthening biodiversity conservation in Lake Toba catchment area. Absence and lack of environment and biodiversity commitment both at goverment and grass root level, has lead to extiction

and irrepairable damaged to the biodiversity in Toba Land.

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