Jurnal Silva Tropika
Vol. 6 No.2, Desember 2002

e-ISSN 2621-4113
p-ISSN 2615-8353

ECOSYSTEM APPROACH AS A FRAMEWORK FOR BATANGHARI WATERSHED MANAGEMENT IN JAMBI-SUMATRA

Aswandi[1*)]

Asociate Professor, Depart of Agro-Ecotechnology, Agricultural Faculty, Jambi Universitas

*) corresponding author: **aswandi@unja.ac.id*

Abstract

There is recently an issue; Batanghari watershed degradation and sustaining Batanghari watershed quality in Jambi Province, Indonesia. Watershed degradation and sustaining watershed quality as well as putting ecological point of view upon watershed management, which in turn emerge in term : integrated watershed management, is also a global issue. We aware of the interdependency between land and soil along with all inherent aspects in them and watershed quality and all inherent aspects in it. It has been proved that unwise measures upon land and soil gives undesired impacts on watershed quality. The first damages shall mostly be upon water quality. For the existence of human being and livelihood of most communities depend strongly on soil and water, at least true to happen in developing and under developed countries, it is true then that both soil and water should be regarded as very important natural resources. By this thought managing and sustaining watersheds need an integrated measures for both components: river, landuse-soil through an ecological approach, conditio sine qua none all efforts will end in failure. The main goal of watershed management are to integrate the use of water, soil, forest and other natural resources within watershed into a NOT CONFLICTING dynamic-ecological based management. This goal can be achieved through an implementation of interdependency concept to regional space planning.

***Keywords**: watershed, river and interdependency*

Abstrak

Baru-baru ini ada masalah; Degradasi DAS Batanghari dan Menjaga Kualitas DAS Batanghari di Provinsi Jambi, Indonesia. Degradasi DAS dan mempertahankan kualitas DAS serta menempatkan sudut pandang ekologi pada pengelolaan DAS, yang pada gilirannya muncul dalam istilah: pengelolaan DAS terpadu, juga merupakan isu global. Kami menyadari adanya saling ketergantungan antara tanah dan tanah beserta segala aspek yang melekat di dalamnya dan kualitas DAS serta segala aspek yang melekat di dalamnya. Terbukti bahwa tindakan yang tidak bijaksana terhadap tanah dan tanah memberikan dampak yang tidak diinginkan pada kualitas DAS. Kerusakan pertama sebagian besar terjadi pada kualitas air. Karena keberadaan manusia dan mata pencaharian sebagian besar masyarakat sangat bergantung pada tanah dan air, setidaknya benar terjadi di negara berkembang dan terbelakang, maka benar bahwa tanah dan air harus dianggap sebagai sumber daya alam yang sangat penting. Dengan pemikiran tersebut pengelolaan dan pelestarian DAS memerlukan langkah-langkah yang terintegrasi dari kedua komponen: sungai, tata guna lahan-tanah melalui pendekatan ekologis, conditio sine qua none semua upaya akan berakhir dengan kegagalan. Tujuan utama pengelolaan DAS adalah mengintegrasikan pemanfaatan air,

e-ISSN 2621-4113
p-ISSN 2615-8353

tanah, hutan dan sumber daya alam lainnya di dalam DAS ke dalam suatu pengelolaan berbasis ekologis dinamis yang TIDAK BERKONFLIK. Tujuan ini dapat dicapai melalui implementasi konsep interdependensi dalam perencanaan ruang wilayah.

Kata kunci: DAS, sungai dan interdependensi

Diterima. 02 Mei 2023
Disetujui, 02 Mei 2023
Online, 29 Mei 2023

INTRODUCTION

Watershed

Watershed or *river* (*drainage*) *basin* or *catchment area* can be defined as a hydrology unit. A watershed usually consists of tens or hundreds of sub-watersheds. Theoretically, earth surface has wholly been divided or split up into millions of watersheds. Therefore the term watershed does not merely refer to protection area, instead, refers to the overall system occurring within watershed boundary including upstream and downstream area. Physically, a watershed is a basin shape area within natural topographic boundary appearing as hill slopes or mountainous barriers, within which area rainwater flows into creek(s), stream(s) and river(s) then to the sea, carrying sediment load across. Ecologically, watershed can also be thought of as an ecosystem within which all existing subsystems (soil, water, air, living creatures (including human being) elements] interact each other in term of dynamic interdependency.

By this integrated view, watershed management, in turn, obtained its definition as a kind of rational management of all natural resources within a watershed boundary (and also possibly within its vicinity), which means as processes: directing and organizing land use and natural resources utilization in order to optimizing goods and services production. These optima can only be achieved by considering much of land and other natural resources capabilities.

Concept of interdependency of watershed

There usually occurs an interdependency of elements found in a watershed, by which an implication resulted. Water is natural resource by whose properties flows without any administration restriction. In turn, there are consequences should take into account in term of decentralization of water resource management: (a) Water resource utilization within upstream (administrative) area diminishes its utility within downstream (administrative) area (opportunity value) (b) Pollution occurred within upstream (administrative) area imposes an impact (as social cost) to those who live within downstream (administrative) area (externality effect), and (c) Those who live within upstream (administrative) area can play a role in sustaining water resource and can provide some benefits to those who live within downstream (administrative) area.

Based on this concept emerged an issue: how to build a model on watershed and water resource management of Batanghari Watershed. Cost and benefit shall be rightly-proportionally shared among corresponding local government, local community and stakeholders.

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Watershed system

Watershed system passes three main steps; a) input system, b) working structure system, and c) output system. Watershed characteristics (working structure) determines how the input system to go on and how the output system to be. This included interception, depression storage, infiltration and evapotranspiration. The system will not properly function if watershed have already been disturbed, indicated by a high flow rate fluctuation.

Watershed management does refunctioning depraved variable(s) of disturbed watershed. It meant that the watershed was empowered up to control input water, infiltrated-percolated input water into ground water and slowly driven it out into stream(s)/river(s). By this buffering effect on discharge, input water is kept in storage for longer period after raining (which of most important in dry season).

Objectives

a. To develop an integrated landuse based Batanghari watershed management, which **(a)** can promote economics and livelihood of local communities **(b)** can restore and preserve sustainable ecology within Batanghari watershed **and (c)** can reduce hydrological and ecological inpacts caused by improper landuse scheme currently exists within Batanghari watershed
b. To promote a good understanding and good cooperation among all parties responsible to any change in landuse of Batanghari watershed (government, stakeholders, local communities, NGOs)
c. To formulate a Watershed Management based Strategic Guidelines in Jambi Province. The strategic guidelines is intended to help Provincial Spatial Planning Agency establish a sustainable spatial planning which incorporates watershed and ecosystem approach. The strategic plan is also purposed to help creating a watershed-ecosystem approach coordination of Provincial Spatial Planning Agency with other sectoral governmental bodies as provincial development implementors.

Expected Output

a. Hydrological and ecological sustainable *landuse scheme recommendation* for Batanghari watershed
b. Integrated, upstream-downstream interdependency approach, inter-sectoral, landuse scheme based Batanghari *watershed management recommendation*
c. Batanghari Watershed Forum for initialising *communications and cooperations* among local communities, stakeholders, government, universities and NGOs representatives

Results of above activities will be formulated and written down into a strategic guidelines consist of : 1) hydrological and ecological functionings of Batanghari watershed, 2) major (potential) threats and impacts on watershed, 3) logics and (potential) solutions to challenge

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problems, 4) guidelines recommended to Provincial Spatial Planning Agency (BAPPEDA) describing hydrologic-ecosystem-based zonation guidance in allocating landuse plan. In this guidelines three concepts of integrated watershed management will be incorparated: ***multistakeholder concept, cross-sectoral concept and ecological sustainability concept.***

Watershed based strategic guidelines, once completed and used as guidance by (Provincial) Spatial Planning Agency, will start a sustainable and ecologically oriented regional development scheme. As the guidelines will highly encourage cross-sectoral coordination and multistakeholder approach the ecological interrelationship and stakeholder interests and problem within watershed will be put emphasis.

Format of Activity

The cooperation consists is of two components interlinked each other; a) Study/Research and b) Batanghari Watershed Forum/Commission initialization.

A. Study/Research

The research action aims to find the solution(s) for persisting problems and disasters found in Batanghari watershed. For the problems and disasters coped with in the project are of hydrological and ecological and affect local communities' economic term and livelihood and that are also of global environmental issue, the research is set to be of hydrological-ecological based.

Hydrological and ecological impacts are currently being common problems and disasters within Batanghari watershed, such as flood, forest degradation, decreasing soil fertility, increasing erosion and sedimentation rate, decreasing river water quality, increasing lists of extinct and endangered species, and mangrove ecosystem degradation. These impacts are likely improper landuse scheme origin.

Within part of upstream area of Batanghari watershed (Kerinci and Southeastern part of West Sumatera) there is a tendency of increasing erosion rate. The erosion problem could be an effect of conventional farming system commonly found in those areas. Traditional dryland farming on steep hilly landscape has increased runoff and erosion rate without sufficient, if any, soil and water conservation effort. It was estimated that Kerinci area is one of major source of sediment load Batanghari river carries downstream, other than hilly area of the upstream within West Sumatera Province area. There is no sufficient data available on the extent of the West Sumatera and Kerinci parts of the watershed contribute to Batanghari river's sediment load. Aswandi (personal communication) predicted West Sumatera part contributes as much as twice as Kerinci part does. There is still few study and analysis already conducted, though the problem has become urgent to solve, as now Batanghari river acts as a source of water for most inhabitants of the middle and downstream areas meanwhile Muara Sabak Sea Port has been schematised as one among the most prospectous means of development of Jambi Province.

Flood is one among common disasters within middlestream and downstream areas. Extreme rainfall could be a major factor, but the severity of flood could be an exaggerated effect landuse scheme has on the extreme, thus need to study. Existing drainage scheme are not yet studied in a context of watershed neither of ecological.

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p-ISSN 2615-8353

There are as much as thousands of drainage canals/ditches within middlestream and downstream of Batanghari watershed. Approximately, one third of them were dig in peat soil. It is reasonable then that groundwater drawdown caused peat subsidence and fireburn to occur. Along the eastern coast huge areas of peatsoil have already gone by means of either subsidence or fireburn, exposing pyritic acid sterile subsoil. It is likely shallow peat soil underlaid by pyritic subsoil had been heavily drained. Along with this pyrite exposing comes salt water intrusion reaching far inland. Both phenomena poses bad impacts to peasants.

Outline

Landuse scheme is assumed to highly affect hydrological and ecological properties of Batanghari watershed and set to be major variable for simulating its hydrology and analyzing its ecology. Relevant hydrological and ecological nature and properties of Batanghari watershed need to be studied first, in order to gather sufficient data for hydrological modeling of the watershed as well as analyzing its ecology. The ultimate purpose of the simulation/analysis is getting an overview of (most) possible futures of Batanghari watershed, hydrological as well as ecological. All future schemes then are set into next steps: Practical Purpose Analysis, B/C analysis/Rating Analysis. Best landuse scheme found is then set into recommendation. If needed modeling and analysis tasks can be divided into several region based on their specific characteristics.

An ecosystem zonation map will be produced as a base for determining their hydrological functionings as part of a broader ecosystem, ie. Batanghari watershed. Available maps (topographic maps, land cover maps, geologic maps) will be used as well as databases on biodiversity and research findings of other projects ever held.

Two type of hydrologic models will be produced : a model for entire basin and a model for each subbasin showing high hydrological complexity (eq. subbasin at hilly and mountinous areas). These models will describe surface water and ground water system of Batanghari watershed that will be very important as reference in flood, drought, erosion-pollution-sedimentation mitigation-prevention planning; and the most important one: **as a system-based**

Spatial frame for landuse allocation plan.

Future studies or research shall put emphasis on Batanghari area as a whole system, including its dynamic properties as well as ecosystem concerns. It is possible to develop a distinct model for this catchment area, by which a certain wise management practice originates. It is imperative also that future studies not to be trapped in pitfalls leading to misinterpretations. Lack of available data has been common problem for existing studies. Comparisons to other similar studies could prove useful, but still local specific features of every study needs “art of handling”.

B. Batanghari Watershed Forum/Commission

Batanghari Watershed Forum/Commission is intended to initialise communications and cooperations among local communities, stakeholders, government, universities and NGOs representatives. This is hoped to develop into a *real* **Batanghari Watershed Authority** in the

e-ISSN 2621-4113
p-ISSN 2615-8353

future, which capable of continously monitoring and evaluating Batanghari watershed quality, having sufficient power to conduct legal pressure upon any party causing detrimental effect(s) on Batanghari watershed quality (Figure 2).

Output of the above activities are introduced to all representves in establishing this . It is also intended to introduce the basic of watershed management concept to the representatives by means of workshops, short trainings, and other ways of communications; and to extract all local wisdoms and alternative thoughts and ideas for further improvement of landuse based Batanghari watershed management scheme.

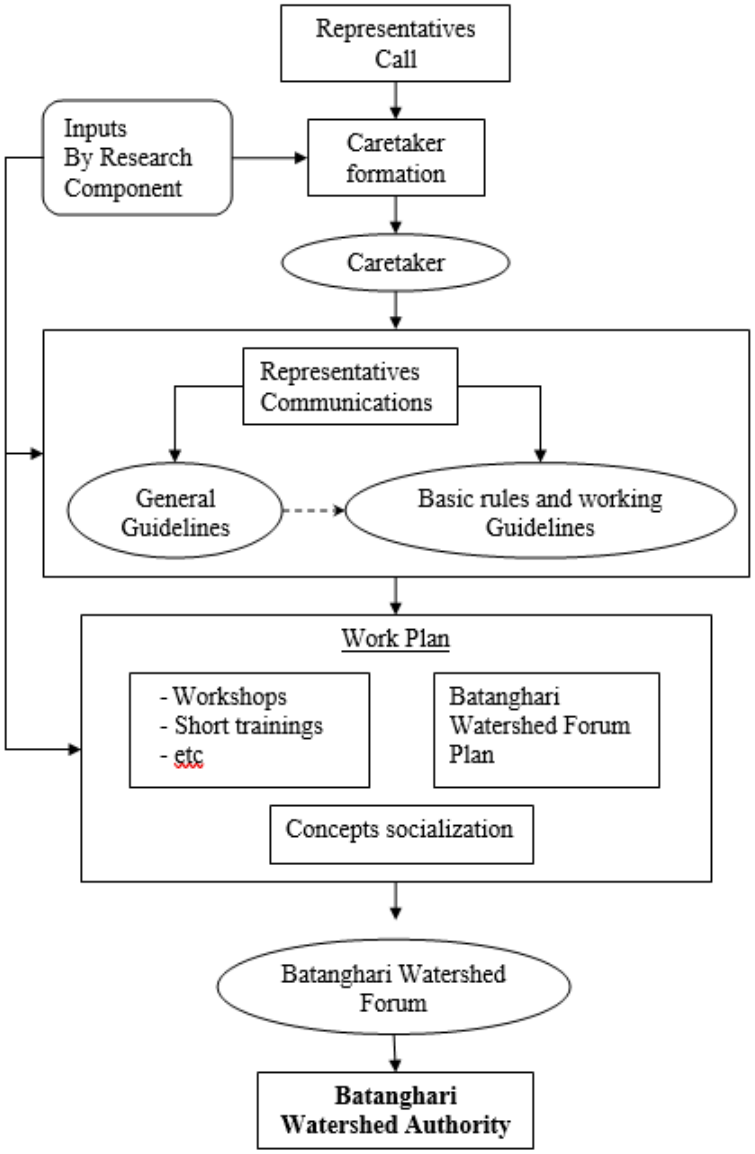

Figure 2. Establishment of multi-stakeholders (Forum) outline

RESULTS AND DISCUSSION

General Overview

Geographically, Batanghari watershed lays down an approximate position 0°43' – 2°40' South and 101°05' – 104°25' East, covering almost whole area of Jambi Province (Figure 1).

e-ISSN 2621-4113
p-ISSN 2615-8353

Approximately eighteen or twenty per cent of the watershed covers a part of West Sumatera Province area. Within Jambi Province area, Batanghari watershed is composed of six smaller watersheds, ie. Batanghari Hulu, Batang Tebo, Batang Sumai, Batang Tabir, Batang Merangin, Batang Tembesi and Batanghari Hilir watersheds. Batanghari watershed stretches west to east, as large as almost 5 million hectares.

Batanghari watershed is characterized by the relatively larger sized, mountainous–hilly, steep (slope > 25%) upstream catchment area streches along Bukit Barisam mountain, with a tropical rainforest ecosystem; and the relatively smaller sized, flatter (slope 0–25%) middle and downstream catchment areas. Upstream catchment area has mostly volcanic origin soils (classified into Andosols order according to USDA classification system) which among its properties are porous solum and high fertility. Middle and downstream catchment areas have mostly low porosity, heavily weathered soils (classified into Ultisols) and fragile, prone to degradation peat soil (classified into Orgnasols).

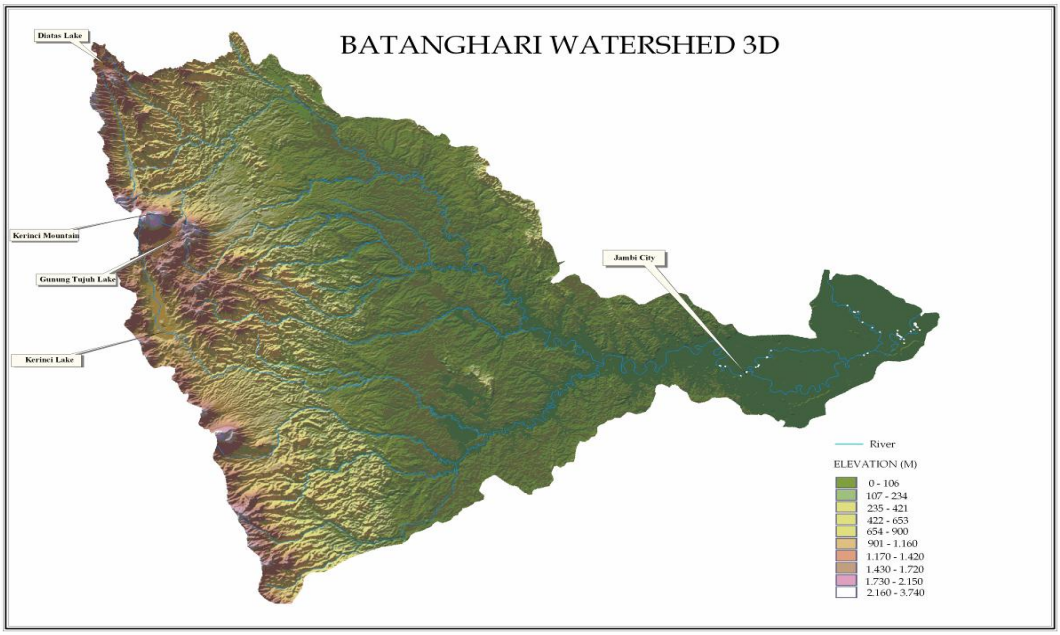

Figure 1. Map of Batanghari Watershed

Part of upstream catchment area (1.3 million hectares) is now protected in a form Kerinci Seblat National Park (KS-NP) for the sake of conserving corresponding area as a tropical rainforest conservation area. Within middlestream of the catchment area there is a conservation area purposed to preserve remaining exotic Jambi's Malay natives, Suku Kubu in form of Bukit Dua Belas National Park (BDB-NP). Within downstream area of the Batanghari watershed, which of a large floodplain, there is also a part of the area that of in the fringe of another conservation area, Berbak National Park (B-NP). Geologically and hydrologically, B-NP plays a role in pertaining the existence of lowland peat mass within a considerable area which, in turn, has its own role in lowland peat forest ecosystem as a whole.

e-ISSN 2621-4113
p-ISSN 2615-8353

There is currently an infrastructure project having highly strategic value conducted at the end of downstream of Batanghari river, ie. Muara Sabak Sea Port. Service ability and useful life of the port depend highly on Batanghari river water yield. As the port positioned at the downstream area landuse scheme affecting sedimentation rate of the river determines its ability and useful life. It points out therefore that, based on upstream–downstream interdependency concept, Batanghari watershed needs a new integrated management.

Problems

Disasters have continually happened in Jambi Province since last thirty years, includes: tropical forest fireburn in 1983 – 2004, periodical flood disasters of Batanghari river 1991 – 1992, longlasting periodical dry spell 1982 – 1983 and 1986 – 1987, worse flood disasters 2002 – 2003 and the worst flood disaster, so far, in December 10 – 20 2003, during which period Batanghari river water level had reached 15 metres above mean level, equivalent to 12,200 m^3/sec discharge, the highest record 1955 – 2003 period ever reach. That means Batanghari river discharge increased up to 35% increment based on previous mean discharge 9,000 m^3/sec. The flood disastered 9 regency area of Jambi Province, as shown by Table 1

Table 1. Count of flooded area and victime people by December 10–20 2003
Batanghari river flood disaster in Jambi Province

Regency	District	Village	Victime family	Victime people
Merangin	1	9	1,932	7,728
Sarolangun	3	10	2,446	9,845
Bungo	5	8	819	3,705
Tebo	4	10	2,230	8,920
Batanghari	5	65	16,757	145,325
Muaro Jambi	5	77	2,565	129,343
Kota Jambi	6	33	12,496	51,512
Tanjabbar	1	10	251	1,004
Tanjabtim	2	5	105	420
Total	32	227	39,601	352,802

Source : BP DAS Batanghari, Dept. Kehutanan Propinsi Jambi, 2003

The Batanghari river flood disaster in December 2003 has become a national disaster. Many people had been killed and 254.7 billion Rupiahs property of many sectors had lost during the disaster (Balai Pengelolaan DAS Batanghari, Departemen Kehutanan Republik Indonesia, 2003). It is not yet precisely known what impact(s) the disaster had on either long term or short term ecology of Batanghari watershed.

e-ISSN 2621-4113
p-ISSN 2615-8353

Converting tropical rain forest to traditional rice field had taken place within hilly landscaped upstream area of Batanghari watershed long time ago and is sporadically kept continue in small scale untill recent years. Traditional rice farming shows no significant contribution to erosion rate, unlike dryland agriculture type. This type of agriculture is estimated to be the main source of sediment load Batanghari river carries downstream.

Middlestream and downstream area of Batanghari watershed has been intensely deforested. Following JICA Report (2002) it is already known that within last 15 years forest exploitation appeared ingcreasingly. It is also suggested the exploitation came up in charge of logging activities and land clearings purposed to Oil Palm Plantation (OPP) establishments as well as to traditional farming provisions, working simultaneously. A rough indication of the severe of forest conversion ocuring within Batanghari watershed can be of that the existence of Timber Processing Industry (TPI) that reach 187 (either illegal or legally registered) with 4 million m^3 installed capacity which now keep running.

Increasing land erosion rate has given undisired impacts on Batanghari river system. Batanghari river, middle – downstream, is likely suffered from increasing rate of shallowing/sedimentation process. According to JICA Report (2002) Batanghari river's sediment transport rate could reach 2.9 million m^3/year, higher than that of either Riau's Siak river or South Sumatera's Musi river. Batanghari river is characterised by a lot of meander. From Suak Kandis downstream the river is more meandering while its slope is flatter which properties, in turn, can slow down the river flow rate. The nearer to the coast the more powerful tidal influence resulting back push water to be. As a result, sediment load has been given higher chance to deposit, posing worse shallowing problem whenever sediment load increase. At Simpang, where the discharge departs into two flow branches sedimentation rate has also been given higher chance to deposit. The high sedimentation rate can cause Muara Sabak Port maintenance cost to be high, even extremely high, thus need a new watershed management system; otherwise the port cannot meet its desired function for a long lasting period. In-stream solution seemed not promising because Batanghari watershed is as large as almost 5 million hectares.

It should be understood that the forest / vegetation will not be able to alter the limitations of the hydrological characteristics of soil that is not advantageous, eg if the forest is located on a thin soil over impermeable rock. In these circumstances how good forest cover, surface flow remains high, given the capacity of soil to store water is limited.

Extreme rainfall conditions in the wet tropical region (such as catchment areas Batanghari) relatively higher frequency than the other hemisphere. As happened in early 1992 in Kerinci with a thickness of 250 mm per day, then back again in 2002, this thickness is almost equal to the average monthly rainfall in the region. Imagine rain which in normal conditions for one month distributed, in extreme conditions were shed in a few hours. With this volume of rain as any closure of its land will not be able to stem the overflow of surface water, because water flow actually has exceeded the maximum capacity of soil to hold water.

Trends in land use change into oil palm plantation from 1986 until now (in 2009) has occurred very rapidly to reach more than 900 thousand hectares, unfortunately this is not followed by

e-ISSN 2621-4113
p-ISSN 2615-8353

changes in land and water conservation measures and do not apply the concept of the garden layout, so that in large scale has changed the hydrological response Batanghari River (particularly the parameters time to peak, time consentration, and time to base).

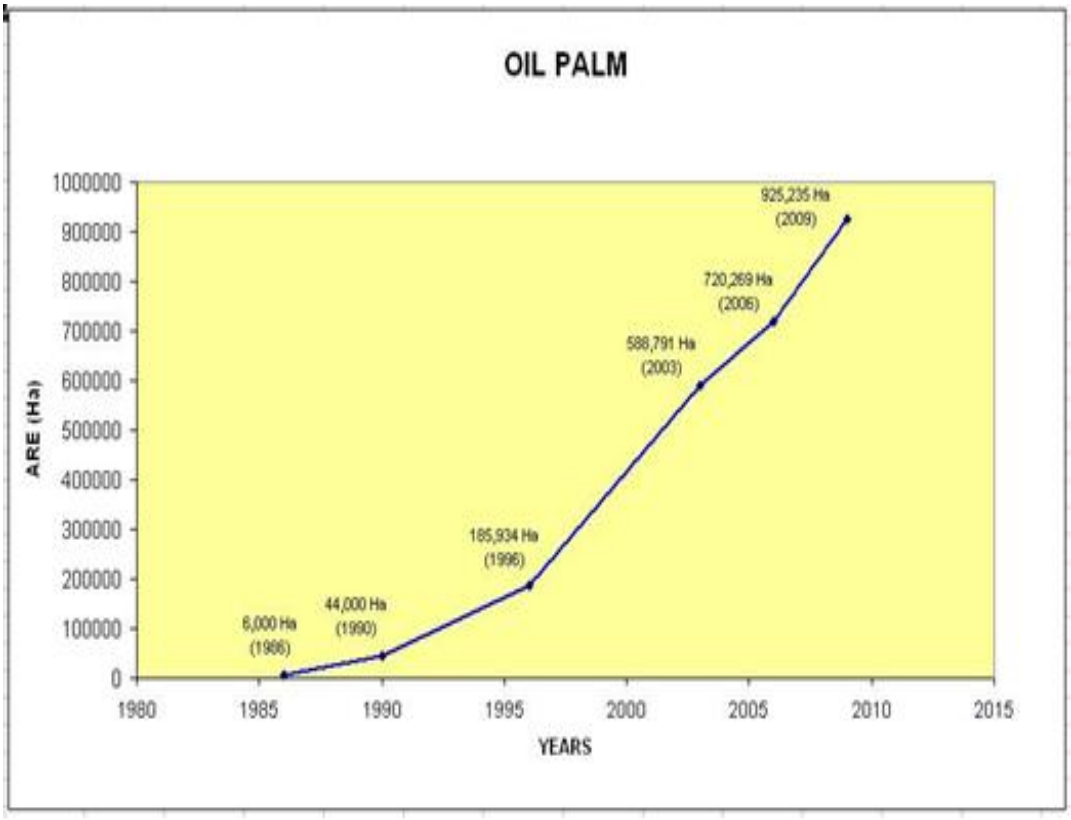

Figure 1. The change of land into oil palm plantations in the Batanghari watershed

Anatomy of Batanghari River, starting from the middle region (Tebo) to downstream (Jambi City, Muaro Jamb and Tanjabtim) is included designated as flood plains, with a slope surface of the river water ranged from 1m/10 km to 1m/15 km and found a lot of twists and meanders. This variable region strengthened border river Batanghari fact that there are very easily influenced overflow of river water (discharge area).

Flooding also comes from the inability of the soil to absorb rainwater that occurs, especially during the rainy season, due to large-scale changes in land use (from upstream to downstream of the watershed) into a monoculture system (oil palm and acacia). As a result, the hydrological balance is disrupted; and the ratio of Qmax to Qmin becomes very high, the time to peak increases drastically, and the time to base becomes shorter. It has been proven that the Batanghari River is currently more responsive to rainfall, the river floods easily and vice versa, if the rain stops for just 1-2 days, the river water immediately rises, meaning that its hydrological function has been damaged. Sediments that quickly accumulate in the river are increasingly difficult to overcome, and river navigation is also not functioning, so the Batanghari River is dying (a dead river), in a shorter time

e-ISSN 2621-4113
p-ISSN 2615-8353

CONCLUSIONS

The Batanghari River is a regional asset that must be used as an alternative energy for the future, which is abundant and cheap for Jambi Province for life and development (water for life and development).

In sustainable natural resource management, it requires an integrated approach in the watershed unit, so this approach must balance the opposite sides in the use of the resource itself, namely; (a) economic value versus conservation value, (b) need versus maintenance, (c) common interest versus party interest, (d) idealism versus reality, and (e) yield maximization versus efficiency maximization**.**

There is a development of a dynamic spatial planning concept, namely the need for planning for the provision and management of watershed space not only relying on space for forests/plants (room for forest/tree) but also integrating space for water (room for water or room for the river), because in reality These two natural resources will be the main actors in protecting environmental health, such as mitigating the impact of global warming, the green house effect, water pollution, drinking water scarcity, flooding, and so on.

The combination of the concepts of space for water and space for plants (green space) is interesting to formulate for Jambi Province, because the presence of the Batanghari River has local competence for that. It is this provision of space for water that gave birth to the concept of a water city, like most cities in Europe, not only green but cool and beautiful

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