Hydro Energy and Its Significant Role In the Future of Indonesian Energy Case Stud

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Hydro Energy and Its Significant Role In the Future of Indonesian Energy Case Study: Telang II - Banyuasin

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Abstract

Historical review of waterwheel has conducted to evaluate the significant role of waterwheel in the future related to the needs of clean energy and the availability of water energy in South Sumatra. Tidal Hydro Energy is a feasible alternative energy to apply in Indonesia in order to support energy diversification, to minimize CO_2 emission to the atmosphere up to 26% in the year 2020 and to meet with the law mandatory to consume renewable energy up to 5% in the year 2025. Hydro Energy became important to promote in Indonesia regarding the potential beach of 81.000 kilometers long, the 33 millions hectras of swamp area, 20 millions hectares of tidal swamp area, where the hydro energy is theoritically applicable to create. This paper is completed with the analysis of tidal energy estimation available in irrigation channels in Telang II – Banyuasin as a case of study.

I. Introduction

The tidal hydro energy is a promising alternative energy for Indonesia regarding the potential and abundant source of water energy that is convertible into mechanical energy.

The tidal energy becoming interesting alternative energy regarding the Indonesian pain experience in three last decade in managing the economic crisis as the impact of the increase of the world oil price.

The past pain experience of Indonesian economic has push the government to seeks ways to exempt from the oil energy dependence. Following the attempts, The National Energy Board arrive to a convince that the solution supported on three pillars, i.e. Energy Diversification, Energy Saving and Energy Conservation. The three pillars should act simultaneously to bring Indonesia to keep away from world oil price dependence. These actions are detailed formulated in formal legislation in Perpres No:5 Year 2006.

Table 1: Indonesian Energy Consumption Rate at Present and Consumption Projections in The Year 2025

No:	Energy Specifications	Present Consumption Rate *)	Consumption Rate Projection in the Year 2025 **)
1	Oil	47.5%	20%
2	Gas	26.5%	30%
3	Coal	24.3%	33%
4	Biofuel	-	> 5%
5	Geothermal	2.45%	> 5%
6	New and Renewable Energy	1.7%	> 5%
7	Others	-	> 2%

*) British Petroleum, Year 2008.
**) Perpres No5, Year.2006.

Table 1 shows the Indonesian energy consumption projections from Oil heavy consumption at the present day to Energy Mix (Gas, Oil and Coal) consumption in the year 2025. Table 1 also shows, The New and Renewable Energy Rate Consumption is pushed to increase from 1.7% at present to more than 5% in the year 2025.(Perpres No:5 Tahun 2006)

To step up the use of Renewable Energy in the country, the government take some major policies i.e. Increasing the investation in renewable energy, Significantly step down deforestation and Reviews the planned of land-use have made. Meanwhile, in the five years program, the president of Indonesia announce the Program of Energy Self-fulfill Villages (Program Desa Mandiri Energi). This program is firstly announced in State Speech the year 2007. whereupon, the hydro power is feasible to apply.

I.1. The Hydro Power and Global Warming

Global warming is faced by all country and threatening all nations in the world. Global warming is an impact of ozone layer thinning, which chemically dissociation, mainly caused by CO2 emission from the atmosphere. Many scientific attempts has made, many world leaders meeting has done in order to control CO2 emission to the atmosphere. The agreements focused on the attempts to reduce the use of fossil fuel and minimized deforestation.

Indonesia has commitment to reduce the CO2 emissions up to 26% until the year 2020. This commitment is stated by Indonesian president at September 25,2009 in Bangkok and restated by the president at December 15, 2009 in Copenhagen, German. This commitment take a serious plan and effort to achieve, mainly because its strong relation to development activities in the country and economic growth and reliability. Its hard to reduce from present emission to be 26% in ten years. Indonesia has to modify their industries fuel from fossil energy to other kind energy which is free from CO2 emissions and try to convert the moving matters such as the wave, water stream and the wind energy to be mechanical energy.

Hydro power such as Wave Energy, Ocean Thermal Power, Tidal Energy and Water Energy are the feasible energies to apply. It has no CO2 emission and harmless to the environment.

Tabel 2: Indonesian swamp area distribution.

*)

Lokasi	Total Lahan Rawa (ha) dan % dari total		
	Pasang surut	non-pasang surut	Total
Sumatera	6.604.000	2.766.000	9.370.000
Kalimantan	8.126.900	3.580.500	11.707.400
Irian Jaya	4.216.950	6.305.770	10.522.720
Sulawesi	1.148.950	644.500	1.793.450
Total	**20.096.800**	**13.296.770**	**33.393.570**

Departemen Pekerjaan Umum RI, 1996.

The hardness effort to reduce the CO2 emissions become 26% in the year 2020 is in align to Indonesian effort to step up the consumption rate of renewable energy from 1,7% at present day to more than 5% in the year 2025. It is very hard, but not impossible. For this case the hydro power is the most promising alternative.

. Indonesia is a tropical country which has a huge area of waters, long beaches, wave moves everytime, tide comes everyday and wind blows everywhere. The swamp area in Indonesia is about 33,393,570 hectras in the year 2006. It consist of 20,096,800 hectras (60,2 %) tidal swamp area, and 13,296,770 hectras (39,8 %) non-tidal swamp area. As much as 835,200 hectras from Indonesian tidal swamp area, already developed by government, which 615,250 hectras out of it (75%) is located on east shore of South Sumatra.

I.2.Telang II – Banyuasin

Muara Telang is a Kecamatan in Kabupaten Banyuasin, Sumatera Selatan,

Indonesia. This area is now being developed as an Kawasan Terpadu Mandiri (Integrated Self Sufficient Area) or abbreviated by KTM-Telang. This area includes Delta Telang I and Delta Telang II which is separated by Telang River. Delta Telang I and Delta Telang II is surrounded by four main rivers, Musi River on East, Banyuasin River on the West, Sebalik River and Gasing River on the the south, while on the north bordered by Terusan PU and Banka Strait.

Delta Telang I has an area of 26.680 hectras involving three Kecamatans,i.e. Kecamatan Muara Telang, Kecamatan Banyuasin II and Kecamatan Makarti Jaya. Delta Telang II has an area of 13,800 hectras including Kecamatan Tanjung Lago, Kecamatan Talang Kelapa and Kecamatan Muara Telang. Delta Telang II has 12 villages, i.e. Desa Telang Sari, Desa Purwosari, Desa Mulya Sari, Desa Banyu Urip, Desa Bangun Sari, Desa Sumber Mekar Mukti, Desa Suka Damai, Desa Suka Tani, Desa Tanjung Lago, Desa Sri Menanti and Desa Kuala Puntian.

This hydro power study is situated in Desa Bangun Sari Telang II.

I.2.a.Climate and Hydrology

The climate of KTM Telang is categorized as tropical rain where warm and moist is existed all the year. Average monthly temperature is 27 C dan relative humidity is 87%. The area of KTM Telang categorized as agroklimat C1 zone. In wet season (rain season) with period of 5-6 months the average rainfall is >200 mm per-month and in dry season (summer), of equal period the average rainfall is <100 mm per-month. Dry season does on October-April, and rain season does on May-September.

Irrigation channels are fully developed in KTM Telang to support the watering tidal rice fields. Primary channels are stretching connecting between rivers and Secondary channels are stretching connecting between primary channels. Mainly, the drainage system in KTM Telang is double-grid system. Mostly the distance between primary channels are 8.000 m. Secondary channels are perpendicular and directly connected to primary channels. The distance between secondary channels are 1,150 meters and 3,850 meters long.

I.2.b.Geology and Topography

Most of KTM Telang area topographically are tidal swamp area with the elevation of 0,5 m - 2,25 m above the sea level.. The water come in and out of channels everyday, creating the influence of tide does bigger than the rainfall.

I.3. Bangun Sari Village

Bangun Sari is a village where the study of micro hydro power is focused on. Bangun Sari village is situated in Telang II and located at about one kilometers at the side of Jalan Raya Tanjung Api-api. Bangun Sari is an area of 1650 hectras square. This area is inhabitted by 3,390 people, consist of 1,786 man and 1,604 women or about 681 Family Heads. Most of the people or about 60 % of the population are farmers and some others coarse jobs. Small village with public facility is at the center of the village where the people do trading and their daily activities.

II. Hydro power : The needs and The potentials.

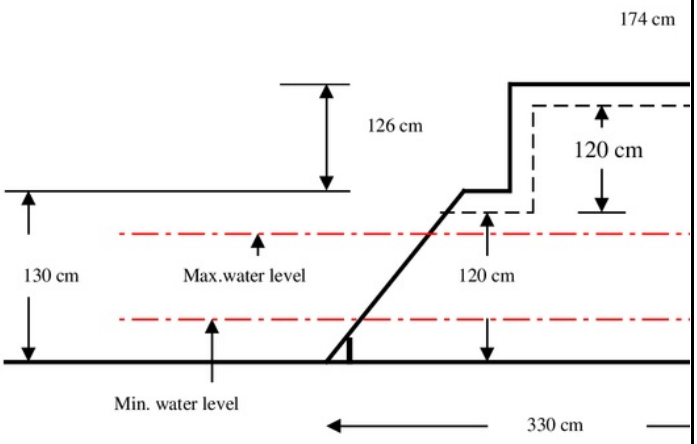
From the local point of view, the needs of hydro power generating in Bangun Sari village is quite high, regarding some reasons: firstly, the electricity is expensive to install, meanwhile the hydro power is free of charge; secondly, the hydro power is strongly possible to generate the small farming engine such as paddy separators, corn shedder etc. and thirdly, supporting the effort of Indonesian government to ascend the people prosperous and the walfare. The utilization of irrigation channel for energy purpose could fastly change the social culture of the local people. Irrigation channel could viewed as not only for farmings but also for the

daily life. Shortly, the people will change from water culture to techno-water culture.

In the point of view of nationality, the hydro power is a way to bring the country out of oil dependence and protect the state economy from the influence of world oil price raise.

The study of hydro power is focused on the water gate of irrigation channel in Bangun Sari Village which located at the position of 2.381 southern across line and 104.42 east longitude.

Picture 1: Map of KTM Telang. Telang II at the left side. (Pusdatarawa,2006)



Picture 2: The irrigation watergate at Bangun Sari and the maximum water level at the wet season and minimum water level at dry season.

The observation conducted in march the year 2011 showing the water level at rain season is maximum at 95 cm from the baseline of watergate and the observation conducted in August the year 2011, the minimum water level at the dry season (summer) is at 30 cm, means that the cross section of flowing water at the irrigation watergate is 75 cm x 97 cm at the wet season and 10 cm x 97 cm at the dry season. The speed of flowing water in wet season measured by current meter is varying from zero at the beginning of tide and 1.12 m/sec at the end of tide at wet season and 0.76 m/sec at dry season. The maximum water level at dry season is 40 cm..

The maximum power contained in the flowing water at wet season is:

$$P = T \times \omega$$

Where: P is the power contained in water (Watt)
T is the torque produce by flowing water at the shaft of wheel (Nm).
ω is the circumferential speed of the wheel (rad/sec).

Torque T = F x r , where F = Force acting on the wheel blade (Newton) and r is the distance between the shaft and the blade center point.
The amount of the force acting on the blade is the total mass of water acting on the blade times the velocity of flowing water. ω is the angular speed of the wheel.

In case, we assume that all of the water power could accomodated by the device we use to converts the flowing water into mechanical energy , the power will be maximum at the wet season where the quantity of flowing water is maximum and the minimum power will be at at the dry season where quantity of flowing water through the gate is minimum. If the radius of waterwheel is assumed 0,75 meter, the circumfrential speed of the wheel does the same with the velocity of water hence the angular speed of the wheel is 1.49 rad/sec and the rotation of the wheel is about 14.4 rpm. The force of water acting on the blade of (0.75 x 0.97) m^2 will equal to: ρ.m.V which is equal to: ρ.A.V.V. where ρ is density of water 998,2 kg/m^3. A is the area of blade and V is the velocity of flowing water. The force acting on the blade will be 998.2kg/m^3 x (0.75x0.97)m^2 x 1.12 m/sec x 1.12 m/sec = 90.938 Newton. The torque at the center of the wheel shaft will be 90.938 N x 0.75 m = 68.203 Nm. Hence the total power harnessed from the water flowing through the gate will equal to 68.203 Nm x 1.49 rad/sec = 102,304 Watt.

By the same way, the power contained in water in the dry season could estimated as follows. From the preliminary measurements, the average velocity of water flowing out through the gate is 0.76 m/sec and the quantity of water acting on the blade is 998.2 kg/m^3 x (0.1x0.97)m^2 x 0.76 m/sec x 0.76 m/sec = 5.5926 Newton. Torque produced is 5.6 x 0.75 = 4.2 Nm. If the circumferential speed of the wheel is the same as the velocity of water, U = 0.76 m/sec and the angular velocity will be 1.01 rad/sec. The power produced is P = 4.2 x 1.01 = 4.24 Watt.

III. Indonesian Energy Future

Realizing that the irrigation channel in South Sumatra is at the moment as much as 2136 channels, Indonesia also have a huge waters territory which have tide and wave energy all the day, hydro energy has become the most promising energy in the future to apply. As stated in the early of this article, the independence of Indonesia from the oil energy is absolutely required. Indonesia should soonly diversivy the national energy consumption, and the law has come into force that the consumption of renewable energy should ascending from 1.7% at present to 5% in the year 2025. In this case the hydro power is a possible and seems feasible.

IV. Conclusions

From the above analyzing, we could take some conclusions as follows:

1. From the priliminary measurements and primary observations to the flow of tidal in Bangun Sari irrigation channel Telang II - Banyuasin, we arrive to conclude that micro hydro power is theoritically feasible to apply.

2. The local people in Bangun Sari and Banyuasin people in general, needs a cheap or free hydro electricity to support their life, in order to improve the quality of living and to ascend the prosperity and welfare.
3. From the point of view of nationality, Indonesia has soonly escape from the oil dependence in order to protect the state economy from the oil price raise and to divert the national energy consumption.

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