

DEVELOPMENT OF MINI / MICRO HYDRO POWER PLANT FOR RURAL ELECTRICITY IN INDONESIA

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ABSTRACT

Indonesia has a lot of water energy resources, some of it could be developed for rural mini / micro hydro power plant. The resources have been estimated to be able to provide electricity of 74,976 MW capacities with annual energy output equal to 401 billion kWh. However, it is only 5% that has been exploited for electricity, 62% in Java and 38% outside Java. This shows that the opportunity to develop electricity from water resources is widely opened especially outside Java. The increase price of fossil fuel has shown an important drive to explore the alternative energy. Development of rural electricity could be initiated by developing mini / micro hydro power plant (PLTMH) in rural area either by PLN or by Private Sector of Middle Small Industry (rural UKM) or by Rural Co-Operative. Schemes to push development of PLTMH have been introduced by the Government and in some areas have been working successfully. Some constraints have been identified and with right and good governance, it is believed that participation of rural society in development of PLTMH to support rural electricity will work successfully.

Keyword: Potential of water energy, Development of PLTMH, Rural electricity

ABSTRAK

Indonesia banyak memiliki sumberdaya air, di antaranya baik untuk dikembangkan bagi pembangkit listrik mini /mikro hidro (PLTMH). Sumberdaya air ini diperkirakan dapat menghasilkan 74.976 MW listrik dengan keluaran tahunan sebesar 401 juta kWh. Namun baru 5% yang dimanfaatkan untuk kelistrikan: di Jawa 62% dan di luar Jawa 38%. Ini menunjukkan bahwa pembangunan kelistrikan dg tenaga air masih terbuka luas terutama di luar Jawa. Kenaikan harga bahan bakar fosil menjadi dorongan yang penting dalam mengembangkan energi alternatif. Pengembangan listrik pedesaan dapat dimulai dengan pengembangan pembangkit listrik mini / mikro hidro di pedesaan oleh PT. PLN, atau oleh industri skala menengah (UKM) di pedesaan atau Koperasi desa. Skema untuk mendorong pengembangan PLTMH telah diperkenalkan oleh pemerintah dan berfungsi dengan baik. Beberapa kendala telah diidentifikasi, dengan upaya pemerintahan yang baik dan tepat diyakini bahwa partisipasi masyarakat desa dalam pengembangan PLTMH untuk pengadaan listrik pedesaan akan berhasil dengan baik.

Kata kunci: Sumberdaya air, Pengembangan PLTMH, Kelistrikan desa

1. INTRODUCTION

Indonesia has huge water resources and some have been utilized for various needs. The locations of these resources are widespread in many islands and some are very remote. The increase price of fossil fuel (BBM and coal) and the existing possibility of government policy to delete subsidy of fossil fuel have given an important drive to find an alternative

energy for electricity. Energy from water is one of the best alternatives to superseded BBM and coal for electricity.

Data of fossil fuel burned by PLN for electricity in the year 2003 and 2005 and its cost per kWh are given in **Table 1** and **Table 2**. The price of fossil fuel increases to 21.3% per year for BBM and 7.7% per year for coal. The price is still moving up due to the lack of BBM supply in the world.

Based on PLN data in the year 2003 and 2005, the operating expenses of power plant using fossil and hydro power plant are compared and shown in **Table 3** and **Table 4**. The data show a significant increase in operating expenses of fuel in fossil power plant. The increase reaches up to 11.7% per year for PLTU (BBM + coal) and 15.9% per year for PLTD (BBM). On the other side, operating expenses of hydro power plant tend to decrease as the depreciation cost decrease.

Table 1. Fossil fuel burned by PLN for electricity in the year 2003 [1]

Type of Fuel	Price	Usage	Electricity Production	Efficiency	Cost per kWh
BBM	HSD: Rp 1.741/L IDO: Rp 1.705/L MFO: Rp 1.595/L Avg. Rp 1.680/L	7,613,481 kilo litre	27,941 GWh	0.73 L/kWh	Rp 458 / kWh
Coal	Rp 230.8 / kg	15,260,305 ton	31,736.6 GWh	0,481 kg/kWh	Rp 111 / kWh

Table 2. Fossil fuel burned by PLN for electricity in the year 2005 [2]

Type of Fuel	Price	Usage	Electricity Production	Efficiency	Cost per kWh
BBM	HSD: Rp 2.819/L MDO: Rp 2.486/L MFO: Rp 2.418/L Avg. Rp 2.574/L	9,912,558 kilo litre	39,048 GWh	0.254 L/kWh	Rp 653 / kWh
Coal	Rp 252 / kg	16,900,972 ton	33,253 GWh	0.508 kg/kWh	Rp 128 / kWh

Table 3. Operating expenses of power plant in the year 2003 [1]

(in Rp/kWh)

Source of Energy	Power Generation	Fuel ++	Maintenance	Depreciation	Other Cost	Labor Cost	Total
Water	PLTA/PLTMH	6.57	13	92.12	3.23	13.89	128.81
Fossil	PLTU (BBM + Coal)	187.5	16.51	61.57	2.15	3.73	256.47
	PLTD (BBM)	467.85	123.97	71.70	6.45	31.91	701.89

Table 4. Operating expenses of power plant in the year 2005 [2]

(in Rp/kWh)

Source of Energy	Power Generation	Fuel ++	Maintenance	Depreciation	Other Cost	Labor Cost	Total
Water	PLTA/PLTMH	7.53	13.9	74.97	3.84	14.47	114.71
Fossil	PLTU (BBM + Coal)	240.88	14.92	53.9	2.58	4.43	316.71
	PLTD (BBM)	713.38	110.11	60.99	8.47	32.23	925.18

From environmental aspect, energy from water is known as environment friendly. Its clean and renewable characters give a high opportunity to be developed in the future as one solution to face global warming issue. This opportunity with a right management process will bring a good development of water power plant in Indonesia to support sustainability to fulfill energy need for the society.

2. POTENCY OF HYDRO FOR POWER PLANT

In 1982 PLN executed energy study throughout Indonesia. The purpose of this study is to identify potency of hydro for electricity. The study has identified 1210 locations having hydro potential with capacity estimated equal to 74,976 MW electricity and output energy equal to 401 billion kWh annually. The spreading of these hydro potential throughout Indonesia is given in **Table 5** and **Table 6**. To date, only 5% of these potential have been developed to generate electricity by the Government, PLN and private sector. The exploitation of hydro outside Java is very limited. It is only 3% has been used for electric generation. The total conversion of hydro power to electricity in GWh is given in **Table 7**.

Table 5. The spreading of this water energy potency throughout Indonesia [3]

No	Island	Numbers of Location			Capacity (MW)	Energy (GWh/year)	%
		Type ROR	Type Reservoir	Total			
1	Sumatra	188	259	447	15,587	84,110	20.9 %
2	Jawa	37	83	120	4,200	18,042	4.5%
3	Kalimantan	9	151	160	21,581	107,202	26.7%
4	Sulawesi	26	79	105	10,183	52,592	13.2%
5	Maluku	14	39	53	430	2,292	0.6%
6	Papua	130	75	205	22,371	122,759	33.3%
7	Bali + Nusa Tenggara	66	54	120	624	3,287	0.8%
Total		470	740	1,210	74,976	401,284	100 %

Table 6. The developed potency

No	Island	Capacity Potency (MW)	Developed (PLN / Private) (MW)	Percentage %
1	Sumatra	15,587	833.5	5.3 %
2	Jawa	4,200	2,597	62 %
3	Kalimantan	21,581	30.5	0.2 %
4	Sulawesi	10,183	190	2 %
5	Maluku	430	-	0 %
6	Papua	22,371	3.4	0.1 %
7	Bali + Nusa Tenggara	624	1.3	0.2 %
Total		74,976	3,455	5 %

(Note : in the Directory of PLTMH and PLTS operated by Small and Medium Industry (UKM) and Rural Co-Operative published by the Office of Directorate Co-Operative, Small and Medium Industry, Year 2002, the water energy that has been exploited is 4,200 MW)

Table 7. The percentage of total energy converted to electricity

Location	Energy Potency (GWh/year)	Energy converted to electricity (GWh/year)	Percentage %
Total Indonesia	401,284	13,297	2,6%

The PLN study is very useful as a data based to implement road map target of hydro power plant in Indonesia. However, it does not give clear picture on division of potential of small scale hydro power plant (< 5 MW) known as PLTMH and medium/big scale hydro power plant (> 5 MW) known as PLTA.

On the other hand, definition of PLTMH itself in Indonesia is still unclear. Some Indonesian experts stated that hydro power plant smaller than 250 kW referred as micro hydro and those smaller than 5 MW referred as mini hydro. As to comparison, the definitions of mini/micro hydro in several countries are given in **Table 8**.

The Master Plan of Development of New Energy (RIPEBAT) published by The Directorate General of Electricity and New Energy, described that the estimation of the potency of micro hydro (PLTMH) reach 459 MW (1% from potency of water energy). This data is compared to the study of PLN and is shown in **Table 9**.

Table 8. The definition of mini/micro hydro by countries

Country	Micro Hydro (kW)	Mini Hydro (kW)	Small PLTA (MW)
USA	< 100	100 – 1000	1 – 30
China	-	< 500	0,5 – 25
Rusia	< 100	-	0,1 – 30
France	5 - 5000	-	-
India	< 100	101 - 1000	1 – 15
Brazil	< 100	100 - 1000	1 – 30
Norwegia	< 100	100 - 1000	1 – 10
Other country	< 100	< 1000	<10

Table 9. The comparison between exploited capacity and potency

Energy	Capacity Potency (MW)	Capacity has been exploited (MW)	Note
Hydro	74,517	3,637	PLTA
Mini Hydro	-	64	PLTM owned by PLN
Micro Hydro (PLTMH)	459	54	
Total Indonesia	74,976	3,655	

3. MINI / MICRO HYDRO POWER PLANT.

Based on history in the past, the electricity from mini / micro hydro power plant was used in plantation industries such as: tea plantation, paddy hulling, coffee processing, or wood

sawmill. During the Dutch colonization period, this electricity was distributed to the society near the power plant. Although the Dutch has built several mini/micro hydro power plants, it is unclear when the first hydro power plant was conducted in Indonesia. Several references mentioned that micro hydro power plant of Pelton type 50 kW has been installed in 1892 and used for plantation of tea in Patuah Watee, West Java. According to PLN data, the oldest mini hydro power plant developed by the Dutch was PLTM Cijedil (550 kW) which was operated in 1923 and PLTM Bengkok Dago (700 kW) both located in West Java. These PLTM to date is still operated by PLN.

There are two categories of electricity distribution:

1. distributed directly through PLN distribution line (called “on grid”) and
2. distributed separately from PLN distribution line (called “off grid”).

PLTMH on grid mostly are PLTMH operated by PLN, whereas the PLTMH off grid are mostly developed by private UKM sector and village cooperative, see **Table 10**.

The electricity from PLTMH on grid is entirely sold by PLN to society either in urban or rural area, while the electricity generated from PLTMH off grid, known as “isolated power plant” usually is managed and operated by small / medium Industry (UKM) or Village Co-Operative (KUD). The electricity mostly distributed for rural society. With some support in technology & management, empirically, the rural society has the capability to manage and operate PLTMH.

Table 10. Comparison on grid and off grid PLTMH

Distribution	unit	Total Capacity (kW)	Average capacity per Unit (kW/unit)	Owner
On grid	86	64,566	750	Mostly PLN
Off grid	178	5,000	28	Private UKM, Village Cooperative

4. DEVELOPMENT OF PLN MINI / MICRO HYDRO (PLTMH)

The total installed capacity of PLTMH by PT PLN reaches up to 64,566 kW, see **Table 11**. Several PLTMH was built during the Dutch colonization. In dry season, the total electricity generated reduced to 79% of its installed capacity or become 50,979 kW. The low capacity of water flow in the dry season, made some of the PLTMH only able to operate for several hours, 4 up to 5 hours.

Considering the total numbers of villages in Indonesia and electrification ratio, it can be said that the potency of growth for rural electrification is widely open, see **Tables 12** for the numbers of villages, the number of customers and ratio of electrification [4]. The amount of customer increases, while the percentage of electrified village decreases. This is caused by the development of additional new villages as an impact of government

autonomy policy (OTODA). **Table 13 – 15** show almost all villages in Java have been electrified, while outside Java reaches up to 70%.

Table 11. Installed capacity of PLN PLTMH

No	Island	Installed Capacity (kW)	Operated Capacity (kW)
1	Sumatra	12,984	9,105
2	Jawa	33,262	31,120
3	Kalimantan	400	395
4	Sulawesi	12,750	10,070
5	Maluku	-	-
6	Papua	2,100	2,100
7	Bali + Nusa Tenggara	2,420	536
Total Indonesia		64,566	50,979

Table 12. Number of village, electrified villages, customer

Year	Number of village	Number of electrified village	Number of customer
1998	58,987	47,676 (80.8%)	17,682,122
1999	58,987	48,562 (82.3%)	18,569,810
2000	58,545	49,155 (83.9%)	19,264,138
2001	60,049	49,476 (82.4%)	19,905,537
2002	66,215	52,007 (78.5%)	20,031,297
2003	-	-	-
2004	68,593	55,346 (80.6%)	21,439,614

Table 13. Number of electrified village between Java and outside Java

Location	Number of village	Number of electrified village	Number of customer
Outside Java	41,099	28,805 (70.0%)	7,251,67
Java	25,116	23,412 (93.2%)	12,779,628
Indonesia	66,215	52,127 (78.5%)	20,031,297

Table 14. Number of electrification ratio between Java and outside Java, 2003

Location	Number of village	Number of customers	Home customer	Electrification Ratio	Sale kWh /capita
Outside Java	89,277,000	21,881,000	10,146,753	46.37 %	223
Java	125,875,000	34,682,000	19,850,801	57.24 %	560
Indonesia	215,152,000	56,562,000	29,997,500	53.03 %	420

Table 15. Number of electrification ratio between Java and outside Java, 2005

Location	Number of village	Number of customers	Home customer	Electrification Ratio	Sale kWh /capita
Outside Java	91,200,500	22,748,100	10,979,508	48.27 %	260.27
Java	130,126,400	36,766,500	21,195,414	57.56 %	640.11
Indonesia	221,326,900	59,514,600	32,174,922	54.06 %	483.59

The electrified village has reach 78.5%, but the national electrification ratio is still about 54%. In the year 2003 until 2005, it increased 1.03%. Considering, all un-electrified villages, the potency to develop rural electrification is widely open. PLN blueprint shows that PLN will develop up to 13.25 MW PLTMH in 2010. The locations of these projects are spread outside Java [5]. Some PLTMH has been designed by PLN, see **Table 17** and are planned to be offered to private sector in Independent Power Producer (IPP) scheme.

Table 16. The locations of the projects at outside Java [5]

No	PLTMH	Location / Province	Capacity	Operation	Rural Development Program
1	Lobong	Kotamobagu, Sulawesi Utara	1.6 MW	April 2009	Power Welfare Scheme
2	Mongango	Gorontalo	1.2 MW	April 2009	Power Welfare Scheme
3	Merasap	Pomtianak, Kalimantan Barat	1.5 MW	April 2009	Power Welfare Scheme
4	Ndungga	Sumbawa, NTT	1.9 MW	Sep 2009	Power Welfare Scheme
5	Poigar 2	Sulawesi Utara	2.3 MW	Mid 2010	-
6	Amai	Papua	1.1 MW	End of 2010	-
7	Tatui	Papua	1.2 MW	End of 2010	-
8	Prafi	Papua	1.6 MW	Sep 2009	-
9	Santong	Lombok	0.85 MW	Sep 2009	-

Table 17. PLTMH developed by private sector by IPP scheme [6]

No	PLTMH	Location / Province	Capacity	Operation	Rural Development Program
1	Menarung	Kaltim	220 kW	-	-
2	Pa Betung	Kaltim	240 kW	-	-
3	Puruk Cahu	Kalteng	240 kW	-	-
4	Muara Kendihin	Kalsel	600 kW	-	-
5	Gendang T	Kalsel	560 kW	-	-
6	Parigi	Sulteng	600 kW	-	-
7	Tindaki	Sulteng	800 kW	-	-
8	Sawidago II	Sulteng	800 kW	-	-
9	Sansarino	Sulteng	900 kW	-	-
10	Hanga-hanga 2	Sulteng	3400 kW	-	PSK tersebar
11	Kalumpang	Sulteng	1700 kW	-	PSK tersebar
12	Palangka	Sulsel	1900 kW	-	-
13	Rante Balla	Sulsel	2200 kW	-	-
14	Kadundung	Sulsel	1600 kW	-	-
15	Batu Sitanduk	Sulsel	2700 kW	-	-
16	Usu Malili	Sulsel	5000 kW	-	-
17	Mikuasi	Sulteng	2400 kW	-	-
18	Rongi	Sulteng	1500 kW	-	-
19	Sambilambo	Sulteng	5000 kW	-	-
20	Rate Lemb II	Sulteng	1895 kW	-	-
21	Ira	Maluku	2990 kW	-	-
22	Kombenur	Irian	6600 kW	-	-
23	Marioratu	Irian	775 kW	-	-
24	Pekatan	NTB	700 kW	-	-
25	Wolodeso	NTT	540 kW	-	-

5. DEVELOPMENT OF RURAL SOCIETY

Program PLN for development of rural society will attached side by side with construction of PLTMH. For PLTMH funded by ADB, those are PLTMH Lobong, Mongango, Merasap and Ndungga, PLN and ADB has a program called Power Welfare Scheme or PWS [7]. The PWS is one of the community development programs run by PLN.

The basic principle of PWS is that the development of PLTMH should give an impact on surrounding society and increase the welfare of low income people around the location of PLTMH.

The objectives of PWS are:

- Assisting rural society to use electricity from renewable energy (RE) system installed in the rural area.
- Provide sustainable fund to increase economic standard of living of low income people.
- Enhancing the use of electricity for productive purposes.
- Assisting the establishment of rural society organization, such as rural co-operative (KUD) in order to improve rural group capability.

At the moment, the fund for PWS comes from ADB grant and is managed by Government institute named DJLPE, PLN and Non Government Organization. Local fund for this program is provided by PT PLN's community development fund program. The macro scheme of PLN PWS is shown in **Fig. 1** below.

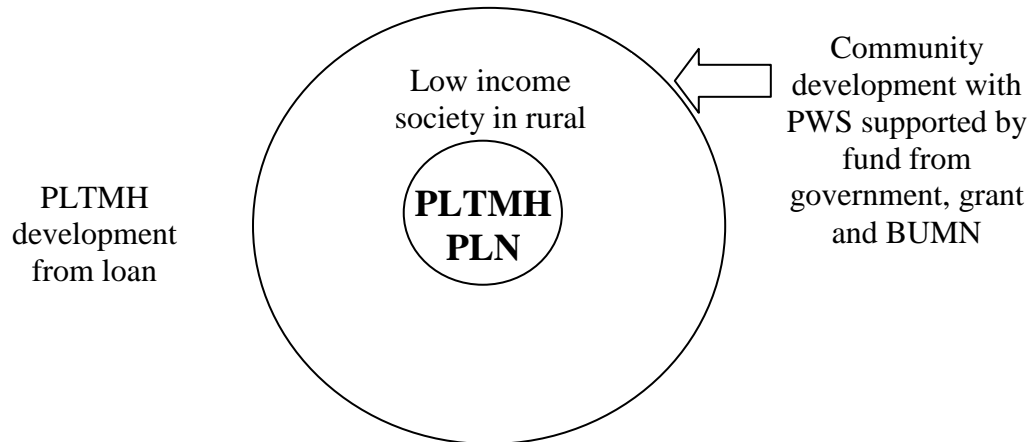


Fig. 1. The PLN Power Welfare Scheme (PWS)

Several schemes, similar to the PWS scheme, to help people to connect to PLN electricity has also been developed by PLN. These schemes are: Community Development, PUKK, Village electricity credit from BRI. Basically the objective of community development by PLN has two principle objectives, those are:

- rural society reinforcement through forming of society organization and
- training and establishment of cheap fund.

Several constraints have encounter during implementation of the scheme.

6. DEVELOPMENT OF PLTMH BY PRIVATE SECTOR AND VILLAGE COOPERATIVE

The government realizes that development of PLTMH in rural areas could not be done by PLN alone. To push society and private sector participation, Government have published Ministerial Decree (KEPMEN) No. 1122.K/30/MEM/2002 regarding small scale hydro power plant. In this KEPMEN, small / medium private business (UKM) or rural Co-Operative could develop small scale PLTMH and sell its electricity to PLN as on-grid [8]. The selling price is equal to 80% from Cost of Goods Sold (HPP) of medium voltage line or TM-PLN, if electricity channeled to TM PLN. The selling price is equal to 60% from HPP low voltage or TR-PLN if the electricity channeled to TR PLN. Although this KEPMEN has been socialized, several constraints during implementation have encountered, especially on selling tariff from developer to PLN.

For the off-grid isolated area, some donor through its financial institution like USAID, JICA Japan, GTZ Germany have conducted cooperation with private sector in the development of PLTMH in which the electricity output is directly used by the society, see **Table 18**. Development PLTMH represents one of best choice for rural electricity program as it is considered easy in technological point of view and easy in maintenance and operation. From the financial aspect, PLTMH need relatively small budget. From environmental point of view, PLTMH would decrease the use of fossil fuel. From the economic aspect, the development of PLTMH in rural areas will enhance development of rural society, create jobs and reduce un-employment. The development PLTMH by private sector or rural Co-Operative where its management is combined with PSK scheme, and in operation, is shown in **Table 19**.

Table 18. PLTMH funded by the Governmental or overseas grants, and operated by private sector or rural Co-Operative

Location	PLTMH	Capacity	Operated by	Customers
Aceh Tenggara	Rerebe	250 kW	-	-
Payung Selaki, Solok Sumatra Barat	Batu Bejangang, 1997	35 kW	KUD Sirukam, Solok	207
Payung Selaki, Solok Sumatra Barat	Simanau, 1996	30 kW	KUD Sirukam, Solok	-
Sukarami, Bengkulu	Sukarami, 2001	35 kW	KUD Harapan	265
Sukabumi, Jawa Barat	Cicemet, 1997	60 kW	KUD Hikmat Tani	-
Bogor, Jawa Barat	Citalahab, 1997	5,12 kW	KUD Tani Berkah	-
Cisarua, Jawa Barat	Leuwijamang, 2002	34 kW	KSM Pada Asih	-
Sirnarasa, Jawa Barat	Ciganas, 1997	80 kW	Koperasi Kommet	-
Aikmel, Mamben Daya, Lombok	Kukusan, 2001	20 kW	KUD Sinar Rinjani	200
Sumba Barat, NTT	Waikilosawa, 2000	15 kW		50
Sa'dan Basalu, Toraja SulSel	Sa'dan UluSalu, 1996	15 kW	PLDSa'dan UluSalu	65
Rinding Alio, Toraja, SulSel	Ta'Ba, 2000	46 kW	PLD Pasamboan	305
Bunto Rante bua, Toraja, SulSel	Bokin, 2000	13 kW	PLD Bokin	80
Saluputi, Toraja, Sulsel	Tendan Dua, 2000	64	PLD Tendan Dua	276

Table 19. PLTMH by private sector or rural Co-Operative which its management is combined with PSK scheme

No	PLTM	Capacity	Location	Manage by
1	PLTMH Cinta Mekar	120 kW	Subang	KUD Cinta Mekar
2	PLTMH Seloliman	30 kW	Mojokerto	Paguyuban Masyarakat Kalimantan
3	PLTMH Curug Agung	12 kW	Subang	KUD
4	PLTMH Waikelosawah	14 kW	Sumba Barat	KUD
5	PLTMH Dompokong	25 kW	Lombok Barat	KUD
6	PLTMH Anggrek Mekar Sari	900 kW	Sumbar	Swasta UKM
7	PLTMH Kalumpang	1000 kW	Luwuk	Swasta
8	PLTMH Hanga-Hanga	2 × 1000 kW	Luwuk	Swasta
9	PLTMH Salido	900 kW	Sumbar	Swasta UKM
10	PLTMH Perluasan	2 × 21 MW	Sumut	Swasta
11	PLTMH Teluk Berasap	2 × 3 MW	Jambi	Swasta
12	PLTMH Ranteballa	2 × 1.2 MW	Sulsel	Swasta

Two PLTMH, that is PLTMH Cinta Mekar and PLTMH Seloliman, have shown success. PLTMH Cinta Mekar capacity is 100 kW. It was funded by the grant from UNESCAP (50%) and 50% by a private local company named PT. Hidropiranti Inti Bakti Swadaya Microhydro System. Electricity generated from this PLTMH is used by the society and the rest is sold to PLN. The net revenue each month from selling electricity reaches Rp. 8 millions. Cinta Mekar Cooperative has been established and 50% of income is owned by the society around the PLTMH.

PLTMH Seloliman started operation in October 2003. This PLTMH have capacity of 25 kW and developed by non government organization named YBUL with grant funded from GTZ Germany. The source of water comes from irrigation ditch near the PLTMH. Electricity generated is used to electrify the school and the small industries in the village near by. The rest of electricity output is sold to PT PLN at the price of Rp. 425,- / kWh. From this sale, the organizer of PLTMH Seloliman that is Village Cooperative earns more than Rp. 5 millions per month.

The impacts of these two PLTMH that were developed by private and were well managed by the society raise economic capabilities of rural peoples.

The government continuously pushing development of PLTMH, however some constraints are still need to be encountered, those are:

- In ability of village people to develop PLTMH by themselves
- Lack of knowledge of village people to detect potency of PLTMH.
- Lack of management skill to manage PLTMH business.
- Lack of knowledge to measure electricity usage that some times cause social conflict.
- Lack of knowledge to operate and maintain PLTMH.

7. GOVERNMENT AND PLN SUPPORT

The government realizes that the development of PLTMH as a part of renewable energy development should be expedited. To push this, the Ministry for Energy and Mineral Resources (ESDM) as the technical regulatory body has issued a regulation on how private sector and rural cooperative may sell their excess power to PLN [8]. The Department of Public Work also has issued its intention to use excess of water from irrigation to be used as hydro resources for PLTMH [9]. PLN as BUMN in electricity has bought the electricity output of several PLTMH. PT PLN will issue policy that could attract investor to develop PLTMH.

8. CONCLUSION

- 1) Indonesia has great hydro potential; however, only small part has been exploited for electricity generation. The increasing price of fossil fuel will surely raise the urgency in developing RE such as PLTMH for future electricity provision.
- 2) The empirical experiences show that with good and right management skill, the development of PLTMH, maintenance and operation by rural society has shown a success.
- 3) Development of PLTMH is one of the alternatives for rural electrification. However, there are several constraints in its development and operation. Schemes to help rural society in develop PLTMH, regulation for better sales electricity output of PLTMH, incentive and support for rural society participation should continuously been developed and implemented, so that PLTMH dissemination could be developed faster in rural areas.

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