

021-andang-
Mapping_of_energy_demand_a
nd_potential_of_biofuel.pdf
by

Submission date: 05-Aug-2021 06:45AM (UTC+0700)

Submission ID: 1627821897

File name: 021-andang-Mapping_of_energy_demand_and_potential_of_biofuel.pdf (960.34K)

Word count: 4980

Character count: 24308

PAPER · OPEN ACCESS

Mapping of energy demand and potential of biofuel development in Kelara watershed

4
To cite this article: Delwin Ipang Kartopa *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **807** 022035

View the [article online](#) for updates and enhancements.

Mapping of energy demand and potential of biofuel development in Kelara watershed

Delwin Ipang Kartopa¹, Roland Barkey¹, Andang Suryana Soma², Syamsu Rijal¹, Munajat Nursaputra¹ and Chairil A¹

¹Laboratory of Regional Planning and Forestry Information System, Faculty of Forestry, Hasanuddin University, Makassar, Indonesia

²Laboratory of Watershed Management, Faculty of Forestry, Hasanuddin University, Makassar, Indonesia

E-mail: delwinipang@gmail.com

Abstract. The increase in population on earth is increasing, stimulating the need for energy to grow. The Indonesian Government is looking for alternative renewable energies such as Biofuels. Various types of biofuel plants have been developed, such as Nyamplung and Kemiri Sunan. These biofuel crops can also be used for land rehabilitation and reduced carbon emissions in the Kelara watershed, which have been in critical condition. On this basis, a study on the mapping of energy needs and potential for the Development of biofuel plants in the Kelara watershed. This study makes extensive use of the analysis of geographic information systems. The analysis begins with the zoning of the watershed morphology (upstream, middle, and downstream). Watershed morphology zoning in a watershed for energy demand data collection using the energy list recording method. This method represents energy use data, including the type and volume of energy use, the affordability of energy sources, the availability of energy stocks, and people's purchasing power for energy. Also, spatial analysis of land suitability for Nyamplung and Kemiri Sunan plants as a function of biophysical conditions and critical lands for biofuel energy development. Biophysical conditions include elevation, slope, annual precipitation, dry months, soil pH, and soil texture. Most Kelara watershed people work as farmers, with the most significant number of dependents of 3-5 persons/heads of households around 73.68%. The average energy needs of the community are around 396.437 kcal/day for LPG and firewood. The potential for biofuel development for the Nyamplung type is 10,130 hectares, with an area of 5,477 hectares in critical lands. The potential for the Development of Kemiri Sunan biofuels 17,370 ha with an area of 3,479 ha. The future Development of biofuel energy is a concept of sustainable Development. Economically, biofuel crops serve as sources of income for the community and ecologically improve soil conditions, carbon storage sources, and function hydrology.

3

1. Introduction



Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI

Published under licence by IOP Publishing Ltd

Energy use continues to multiply, without the exception of Indonesia as a developing country. National energy production has increased with an average annual growth of 4.6%. Additionally, energy exports experienced much higher growth. This has led to a reduction in fossil energy sources and an increase in prices [1]. In line with population growth and rapid economic Development, the subsidies will negatively affect the state spending budget [2].

The energy crisis encourages all countries to divert their energy sources towards renewable energy. One form of alternative energy that has been studied and developed is biofuel. To promote the Development of biofuels, the Government has issued a National Energy Policy, including PP No. 5/2006, establishing a target for biofuel production in 2025 at 5% of the total national oil energy demand.

Several types of biofuel plants have been developed, such as Nyamplung (*Calophyllum inophyllum* L) and Kemiri Sunan (*Reutealis trisperma* (White) Airy Shaw). Nyamplung is a relatively new type of biodiesel globally, so research on the cultivation and production of nyamplung continues [3]. Nyamplung for biofuel has advantages such as high yield, does not compete with food products, and is easy to cultivate [4]. Nyamplung is found in many tropical areas, especially in coastal areas and lowland areas, but can sometimes be found in the highlands [5,6].

Besides the Nyamplung plant, there are also types of Kemiri Sunan plants as feedstock for producing biofuels. Pecan sunan is used as a feedstock for biodiesel, which is recommended to replace alternative renewable fossil fuels because it can reduce toxicity and exhaust gas emissions [7]. The kemiri sunan biofuel has many advantages, including low yield, high oil production, and does not compete with other types of plants [8]. Kemiri sunan was also identified as the type of non-food plant that produces the most biofuel handled by the Ministry of Agriculture.

Efforts are being made to produce Nyamplung and kemiri sunan plant types to provide multiple benefits to produce biofuel and rehabilitate land. These biofuel crops can be used as reclamation of degraded marginal lands [9]. One of the areas experiencing land degradation is the Kelara Watershed in the Gowa and Jeneponto Regencies. The Kelara watershed with homogeneous agricultural land use conditions causes degradation. The land cover index is also classified as lacking in the Kelara watershed due to the lack of permanent cover. Land degradation is indicated by an increase in surface runoff leading to flooding discharge [10].

On this basis, a study was carried out on the mapping of energy needs and potential for the Development of biofuel plants in the form of nyamplung and kemiri sunan in the Kelara watershed. The potential for biofuel development can reduce critical lands. In addition, biofuel crops increase energy sources and increase the opinion of the agricultural community.

2. Methods

This research is focused on mapping energy needs and developing biofuel plants in Critical lands. The hydrological limit used is in the Kelara watershed. These studies include:

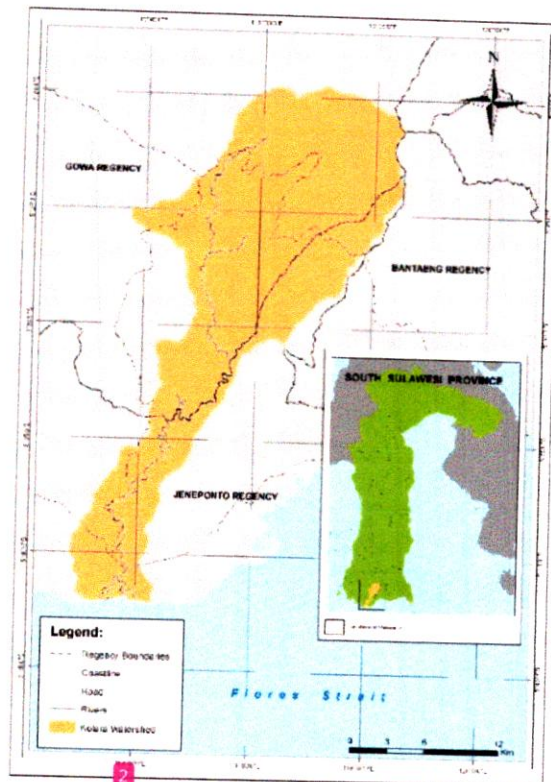


Figure 1. Location research map.

2.1. Research time and location

The Kelara watershed boundary is the outer limit of all types of data used to analyze the research location. Administratively, Kelara boundaries are located in two districts, namely Gowa Regency and Jenepono Regency, South Sulawesi Province, which can be seen in figure 1. In more detail, the watershed consists of seven districts and 39 villages.

12

2.2. Collecting research data

This study makes extensive use of the analysis of geographic information systems. Data collected in this study consisted of primary data and secondary data. Primary data collected is energy sources, prices, and energy consumption volume for each household. Secondary data includes data on watershed boundaries, watershed zoning, village-level administrative boundaries, 30 meter DEM aster, river, road, soil type, and critical land maps.

2.3. Analyzing research data

2.3.1. Characteristics and people's energy needs. Analysis of the characteristics and energy needs of the community through the energy list registration method. This method can represent data on the energy sources used by the community, the price, and the consumption of each household. Data collection begins with watershed zoning (upstream, middle, and downstream). Collecting data on

community energy needs with five respondents in each village. The calculation of the volume of energy used by the community for each energy source is as follows:

- a. Kerosene, calculating the volume of kerosene, uses liters.
- b. LPG, LPG volume calculation uses units.
- c. Firewood, the calculation of the volume of firewood uses units of kg.

Match the amount of energy by converting each energy source unit into units of kilocalories (kcal). This is done to determine the energy use level of households as a whole. The conversion units for each energy source are as follows [11].

- a. LPG equivalent to 11,900 kcal / kg
- b. Kerosene equivalent to 9,000 kcal / liter
- c. Firewood equivalent to 4,000 kcal / kg

2.3.2. *Development of biofuel plant (nyamplung, and kemiri sunan)*. Development of biofuel plants (Nyamplung and Candlenut) with analysis of soil suitability and a Geographic Information System approach. The soil suitability is a precise analysis and according to the requirements of the places where nyamplung and kemiri sunan plants grow (table 1 and table 2). Each indicator of the place to be cultivated was made by superimposing the biophysical conditions of the land. The suitability of biofuel plants for improving soil conditions in the Kelara watershed is classified as critical.

Table 1. Suitability of the land for Nyamplung plants [12].

No.	Criteria	Nyamplung (<i>Callophyllum inophyllum</i> L.)
1	Altitude (m asl)	0-500
2	Slope (%)	3- 55
3	CH (mm / year)	1.000-3.000
4	Months dry	5
5	Ph Soil	4.0-7.4
6	Erosion hazard level	Under-weight
7	Soil Texture	A little smooth-rough

Table 2. Suitability of the land for Kemiri Sunan plants [13].

No.	Criteria	Kemiri Sunan (<i>Reutealis trisperma</i> (Blanco) Airy Shaw)
1	Altitude (m asl)	0-1.000
2	Slope (%)	3- 55
3	CH (mm / year)	1.500-2.500
4	Months dry	3-4
5	Ph Soil	5.4-7.1
6	Erosion hazard level	Under-weight
7	Soil Texture	Clay to sandy loam

11

3. Result and discussion

3.1. Characteristics of the community

The characteristics of the community can be seen in the dominant population and livelihoods. Watershed zoning is likely to show different community characteristics (figure 2). The community's livelihoods are representative of its social and economic conditions. In addition, community life can be seen from their families, the number of their dependents. The livelihoods and the number of dependents of each family in the Kelara watershed can be seen in table 3 and table 4.

Table 3. Number of families and community livelihoods in the Kelara watershed.

Livelihoods	Total population in each regional area						Kelara Watershed	
	Upstream		Middle		Downstream		KK	%
	KK	%	KK	%	KK	%		
Farmer	75	42.61	4	25.00	48	42.86	127	41.78
Entrepreneur	72	40.91	4	25.00	38	49.61	97	39.80
fisherman	0	0.00	0	0.00	1	0.89	1	0.33
Civil servants	9	5.11	3	18.75	17	15.18	29	9.54
House Wife	20	11.36	1	6.25	5	4.46	26	8.55
Total	176	100.00	16	100.00	112	100.00	304	100.00

Table 4. Number of dependents for each family in the Kelara watershed.

Number of Dependents (Lives)	Total population in each area of the watershed						Kelara Watershed	
	Upstream		Middle		Downstream		KK	%
	KK	%	KK	%	KK	%		
≤ 2	25	14.20	3	18.75	13	11.61	41	13.49
3-5	131	74.43	9	56.25	84	75.00	224	73.68
≥ 6	20	11.36	4	25.00	15	13.39	39	12.83
Total	176	100.0	16	100.0	112	100.0	304	100.00

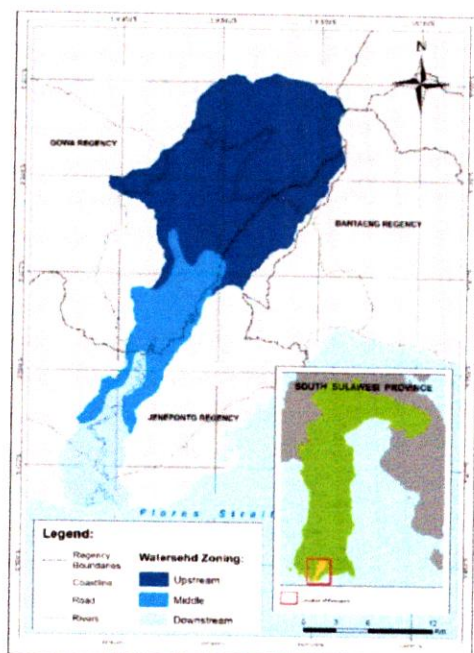


Figure 2. Watershed zoning.

People's livelihoods are dominated as farmers in the Kelara Watershed. This can be seen in the conditions of agricultural land use, such as rainfed agriculture, rice fields, and plantations [10,14]. Besides farmers, many people also work as entrepreneurs. Differences in livelihoods are related to the energy sources used by the community.

Another characteristic of the community is that the head of the family with moderate dependents is around 3-5 people. All watershed zoning areas in the upstream, middle and downstream areas show the number of dependents. The number of dependents dramatically affects people's energy consumption, the more dependent, the greater the energy consumption.

3.2. Community energy needs

Community energy needs begin with identifying the type of energy use for each family. The identification of energy types is also based on the zoning of each watershed. The type of energy is used as information to determine the amount of energy required in each zoning. The percentage of energy use can be seen in table 5.

Table 5. Percentage of energy consumption of each home.

Type of Energy	The total population in each regional zone						Kelara Watershed	
	Upstream		Middle		Downstream		KK	%
	KK	%	KK	%	KK	%		
LPG	55	33.33	5	33.33	60	48.39	120	39.47

Firewood	22	13.33	3	20.00	14	11.29	39	12.83
LPG and Firewood	88	53.33	7	46.67	50	40.32	145	47.70
Total	165	100.00	15	100.00	124	100.00	304	100.00

Two types of energy are used in the Kelara watershed, namely firewood, and LPG. The type of energy from firewood is most used by people who work as farmers. Farmers also use fuelwood more because it is easier to access. In addition, the lack of vendors of this type of LPG energy close to where farmers live makes them prefer to use firewood.

The LPG type of energy is predominantly used by people in the downstream part of the watershed. This type of LPG energy is easy to use, efficient, and easily accessible close to residential areas. Added to this is the lack of land for the Development of firewood. The high-energy needs of the community make people look for other alternatives to help meet their energy needs.

The community's energy needs are identified from the amount of energy that the community uses during a day (Table 6). Energy consumption is very different in each area of the watershed area. The upstream area of the community's energy needs for LPG energy consumption is 100,893 kcal/day, while the energy consumption for firewood is 686.78 kcal/day. The total energy needs of the population of the upstream area are 787.67 kcal/day. The energy consumption in the middle of the watershed for the use of LPG energy is 65,435 kcal/day, while the use energy from firewood is 322 kcal/day. The number of needs in the central zone is 131.51 kcal/day. The downstream area of the community's energy needs for LPG energy consumption is 124.47 kcal/day, while the energy consumption for firewood is 675.74 kcal/day. The total energy needs of the population in the upstream area are 800.11 kcal/day.

The greatest energy needs of the community are found downstream. Although it has a small area downstream, it has a considerable population. The energy needs of the people in the upstream area are almost like the downstream areas. The demand for energy upstream is high because it has a reasonably large size. Meanwhile, the downstream region is tiny because it is tiny and a transition area. Consumption.

The community around the Kelara watershed combines fuelwood and LPG energy sources to meet their needs. The combination of these types of energy helps to reduce the cost of people's energy needs. Furthermore, the energy consumption of firewood remains high due to its cultural conditions. Furthermore, under different conditions, the highest and lowest levels of need are strongly influenced by the affordability of energy sources and the socio-economic conditions of the community in the Kelara watershed area.

Table 6. Average community energy consumption (kcal/kk) in the Kelara watershed.

Zone	District	Village	Energy Consumption				Total (kcal)
			LPG		Firewood		
			kcal/day	%	kcal/day	%	
Upstream			100.893	12.81	686.780	87.19	787.673
	Rumbia		58.841	17.76	272.462	82.24	331.303
		Bontocini	48.696	23.07	162.402	76.93	211.098
		Bontomanai	54.783	22.37	190.121	77.63	244.904
		Bontotiro	60.870	14.73	352.392	85.27	413.262
		Jenetallasa	60.870	20.47	236.514	79.53	297.384
		Lebangmanai	66.957	31.95	142.620	68.05	209.577
		Loka	42.609	9.45	408.190	90.55	450.799
		Palantikang	70.000	28.67	174.155	71.33	244.155
		Tompobulu	54.783	11.68	414.169	88.32	468.952
		Ujung Bulu	70.000	15.85	371.593	84.15	441.593
	Tompobulu		39.057	8.89	400.399	91.11	439.456
		Cikoro	30.435	6.30	453.039	93.70	483.474
		Garing	42.609	14.42	252.833	85.58	295.442
		Malakaji	60.870	13.56	388.108	86.44	448.978
		Rappoala	3.034	0.89	339.557	99.11	342.591
		Rappolemba	54.783	8.79	568.191	91.21	622.974
		Tanete	42.609	9.61	400.668	90.39	443.277
	Bottolempangan		62.899	17.71	292.293	82.29	355.192
		Bottolempangan	82.174	50.60	80.239	49.40	162.413
		Bontoloe	60.870	11.79	455.605	88.21	516.475
		Bontotanga	54.783	15.81	291.620	84.19	346.403
		Julumattene	73.043	20.69	280.064	79.31	353.107
		Palandingang	66.957	20.73	256.091	79.27	323.048
		Ulujungan	39.565	9.21	390.138	90.79	429.703
Middle			65.435	49.76	322	0.24	131.513
	Biring Bulu		65.435	99.51	322	0.49	65.757
		Tonrorita	63.913	99.46	348	0.54	64.261
		Taring	66.957	99.56	295	0.44	67.252
Downstream			124.474	15.56	675.631	84.44	800.105
	Binamu		66.775	17.81	308.183	82.19	374.958
		Balang	88.261	43.66	113.901	56.34	202.162
		Balang Beru	70.000	20.10	278.235	79.90	348.235
		Balang Toa	66.957	24.77	203.376	75.23	270.333
		Bontoa	34.522	5.86	554.130	94.14	588.652
		Empoang	51.739	8.84	533.796	91.16	585.535
		Empoang Utara	60.870	18.23	272.982	81.77	333.852
		Monro-Monro	85.217	33.71	167.573	66.29	252.790
		Pabiringa	82.174	32.60	169.859	67.40	252.033
		Panaikang	88.261	42.09	121.459	57.91	209.720
		Sapanang	45.652	8.00	525.262	92.00	570.914
		Sidenre	60.870	11.93	449.437	88.07	510.307

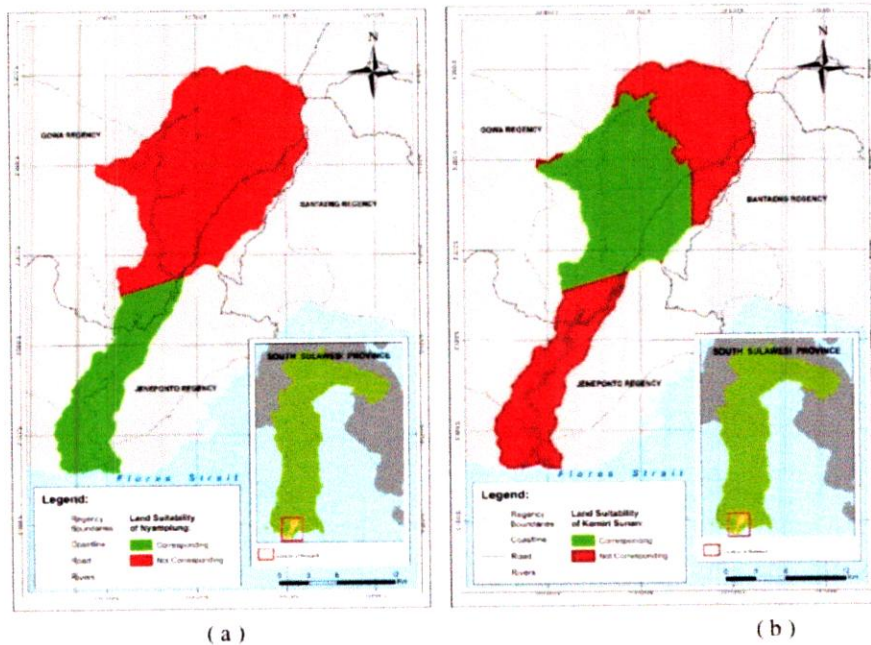


Figure 3. Suitability of the land for biofuel crops (a) Nyamplung (b) Kemiri sunan.

Nyamplung-type plants have more potential to be grown downstream of the Kelara watershed. The most limiting biophysical condition where nyamplung plants grow in the Kelara watershed is the height factor. Nyamplung is mainly found in coastal areas and lowland areas but can occasionally be found in the highlands [5,6]. Other factors, such as slope, annual rainfall, dry months, soil pH, and soil texture, are quite adequate.

Unlike the nyamplung plant species, the kemiri sunan plant can develop upstream of the Kelara watershed. The height factor is a factor that affects the suitability of the site for cultivating candlenut in the Kelara watershed. Kemiri Sunan plants grow well at an altitude of 0-1000 meters[13]. Furthermore, soil factors also limit the place to grow kemiri sunan plants in the Kelara watershed. The soft to sandy loam soil is found primarily in the upstream area of the Kelara Watershed.

3.3.2. *Development of biofuel crops on critical lands.* Increased degradation of land resources by looking at the critical condition of the land. Critical land conditions in the Kelara watershed are pretty extensive (table 9 and figure 4). Critical land is a land condition that is not suitable for its land use and capacity, has undergone or is in the process of physical-chemical-biological damage. Furthermore, degraded land not only deteriorates soil properties but also results in a decrease in conservation function and production function that will affect the community's agricultural production.

Table 9. The critical area of the Kelara Watershed.

Class	Regional Zone	Kelara Watershed
-------	---------------	------------------

	Upstream		Middle		Downstream			
	ha	%c	ha	%c	ha	%c	ha	%c
Uncritical	4,562	17.55	4	0.06	1,285	22.80	5,851	14.96
Moderate	3,468	13.34	3,089	41.30	2,679	47.54	9,236	23.61
Critical	17,414	66.98	4,312	57.65	1,666	29.57	23,392	59.81
Potential Critical	554	2.13	74	0.99	5	0.09	633	1.62
Total	25,998	100.00	7,479	100.00	5,635	100.00	39,112	100.00

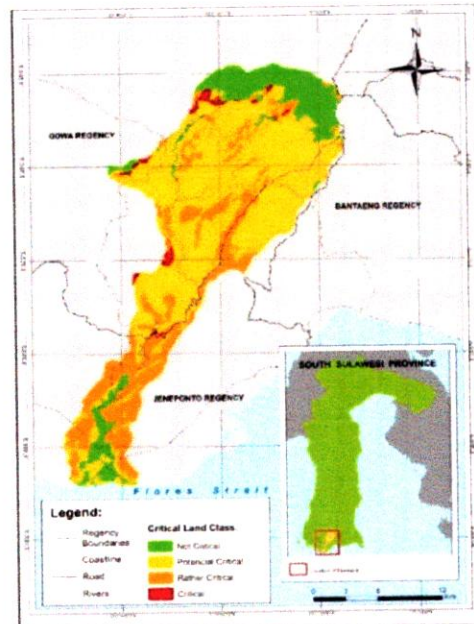


Figure 4. Critical land in the Kelara Watershed.

9 The critical land comes from the General Director of Control of Watersheds and Protected Forests of the Ministry of Environment and Forestry. The critical potential is a description of the land that is slightly more critical. The critical and critical potential classification reaches 24 thousand hectares or 60 percent of the total area of the Kelara watershed. This is a significant concern for land rehabilitation to take place immediately.

The classification of critical lands rehabilitated by biofuel crops has critical potential and is critical. Critical land data overlaps with suitability data for where nyamplung and kemiri sunan plants grow. The development potential of biofuel plant species for land rehabilitation in the Kelara watershed can be seen in tables 10, table 11 and figures 5.

Table 10. Nyamplung plant development potential in critical areas of the Kelara Watershed.

Land	regional zone	Kelara watershed
------	---------------	------------------

suitability class	Upstream		Middle		Downstream			
	ha	%	ha	%	ha	%	ha	%
Consistent	7	0.03	4,488	60.01	5,635	100.00	10,130	25.90
Inconsistent	25,991	99.97	2,991	39.99	-	0.00	28,982	74.10
Total	25,998	100.00	7,479	100.00	5,635	100.00	39,112	100.00

Table 11. Potential Development of Kemiri Sunan plants in critical areas of the Kelara Watershed.

Land suitability class	Regional zone						Kelara watershed	
	Upstream		Middle		Downstream			
	ha	%	ha	%	ha	%	ha	%
Consistent	7	0.00	2,786	37.00	2,684	48.00	5,477	14.00
Inconsistent	25,991	100.00	4,692	63.00	2,951	52.00	33,635	86.00
Total	25,998	100.00	7,479	100.00	5,635	100.00	39,112	100.00

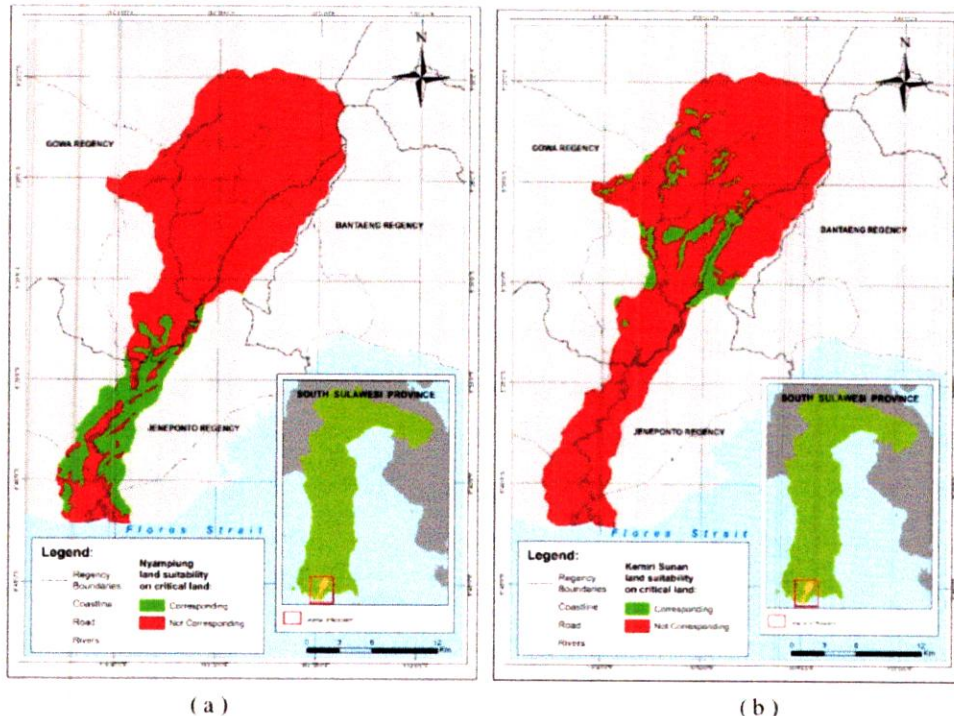


Figure 5. Plant development potential (a) Nyamplung and (b) Kemiri sunan as rehabilitation of critical lands in the Kelara watershed.

The Nyamplung plant for the rehabilitation of the Kelara watershed has about 10 thousand hectares or 25 percent of the total area of the watershed. The critical land planted with the Nyamplung type is found in the lower part of the watershed. Nyamplung plant development can be developed using agroforestry systems with other types of plants [9]. Apart from woody plants, nyamplung plants can be combined with seasonal plant types. This will maintain sustainable community economic resources with the agroforestry system.

The Kemiri sunan plants for the rehabilitation of the Kelara watershed cover about 5,400 hectares. The areas rehabilitated with the Kemiri Sunan plant were blown up in the upstream area of the watershed. Pecan plants are a type of conservation plant to rehabilitate degraded ones. The Development of kemiri sunan plants in critical lands can also be used as a plant of high economic value for the community. It can meet the energy needs of the community [9]. The Development of kemiri sunan plants increases the monetary value of at least a large area of land.

4. Conclusions

Farmers dominate the livelihood-based community characteristics with 3-5 dependents. Apart from farmers, most of them also work as companies in all areas of the Kelara watershed. The Kelara watershed community generally combines types of LPG and firewood to meet the energy needs of households. The highest LPG energy consumption is in the downstream area of 124,474 kcal/day, while the highest fuelwood consumption in the upstream area is 686,780 kcal/day. The potential for biofuel development in the Nyamplung type is 10,130 hectares with an area of 5,477 hectares in critical lands. The potential for the Development of kemiri sunan biofuels is 17,370 ha with an area of 3,479 ha. The Nyamplung and kemiri sunan plants have the potential to develop in the Kelara watershed. These biofuel crops serve economically as a source of income for the community and ecologically improve soil conditions, carbon storage sources, and functional hydrology.

2

Acknowledgment

The author would like to thank Hasanuddin University for the support of facilities and the Education Fund Management Institute for the assistance of research scholarships to complete this research.

References

- [1] ESDM-SDE 2013 *Kajian Supply dan Demand Energi* (Jakarta)
- [2] Kehutanan K 2008 *Litbang Kehutanan Temukan Sumber Energi Biofuel dari Biji Nyamplung*
- [3] Ong H C, Mahlia T M I, Masjuki H H and Norhasyima R S 2011 Comparison of palm oil, *Jatropha curcas* and *Calophyllum inophyllum* for biodiesel: a review *Renew. Sustain. Energy Rev.* **15** 3501–15
- [4] Bustomi S 2012 *Yamplung (Calophyllum inophyllum L.): sumber energi biofuel yang potensial* Badan Penelitian dan Pengembangan Kehutanan, Pusat Penelitian dan Pengembangan Peningkatan Produktivitas Hutan
- [5] Mukhlisi M and Sidiyasa K 2011 Aspek ekologi nyamplung (*Calophyllum inophyllum L.*) di Hutan Pantai Tanah Merah, Taman Hutan Raya Bukit Soeharto *J. Penelit. Hutan dan Konserv. Alam* **8** 385–97
- [6] Friday J B and Okano D 2006 *Calophyllum inophyllum* (kamani) *Species profiles Pacific Isl. Agrofor.* **2** 1–17

- [7] Faria R P V, Pereira C S M, Silva V M T M, Loureiro J M and Rodrigues A E 2013 Glycerol valorization as biofuels: Selection of a suitable solvent for an innovative process for the synthesis of GEA *Chem. Eng. J.* **233** 159–67
- [8] Van der Vossen H A M and Wessel M 2002 *Plant Resources of South-East Asia (14)* (Bogor (ID): Prosea Foundation)
- [9] Pranowo D, Herman M and Syafaruddin S 2016 Potensi pengembangan kemiri sunan (Reutealis trisperma (Blanco) Airy Shaw) di lahan terdegradasi *Perspekt. Rev. Penelit. Tanam. Ind.* **14** 87–101
- [10] Barkey R A, Malamassam D, Mukhlisa A N and Nursaputra M 2020 Land use planning for floods mitigation in Kelara Watershed, South Sulawesi Province, Indonesia *IOP Conference Series: Earth and Environmental Science* vol 575 (IOP Publishing) p 12132
- [11] Division of Technology, Industry and Economics 2010 *Pedoman efisiensi energi untuk industri di Asia* UNEP Thailand
- [12] Narendra B H 2010 *Kajian Kesesuaian Jenis-Jenis Penghasil Energi Nabati Untuk Rehabilitasi Lahan Kritis 01 Ball Dan NTB* (Lombok Barat)
- [13] Herman M, Syakir M, Pranowo D and Saefudin S 2013 Kemiri sunan (reutealis trisperma (blanco) airy shaw) tanaman penghasil minyak nabati dan konservasi lahan *IAARD Pr Jakarta, Indones.*
- [14] Muis M F, Barkey R A, Arsyad U and Nursaputra M 2020 Analysis of micro-hydro potential based on landuse planning in the Kelara watershed *IOP Conference Series: Earth and Environmental Science* vol 575 (IOP Publishing) p 12134

ORIGINALITY REPORT

9%

SIMILARITY INDEX

8%

INTERNET SOURCES

8%

PUBLICATIONS

6%

STUDENT PAPERS

PRIMARY SOURCES

1	opinvisindi.is Internet Source	4%
2	Chairil, R A Barkey, D Malamassam, A N Mukhlisa, M Nursaputra. "Land use planning for floods mitigation in Kelara Watershed, South Sulawesi Province, Indonesia", IOP Conference Series: Earth and Environmental Science, 2020 Publication	2%
3	eprints.covenantuniversity.edu.ng Internet Source	1%
4	lppm.ub.ac.id Internet Source	1%
5	Submitted to University of Lancaster Student Paper	<1%
6	id.wiktionary.org Internet Source	<1%
7	www.springerprofessional.de Internet Source	<1%

8	rjoas.com Internet Source	<1 %
9	doc-pak.undip.ac.id Internet Source	<1 %
10	repository.tudelft.nl Internet Source	<1 %
11	tutcris.tut.fi Internet Source	<1 %
12	R A Barkey, M Nursaputra. "The Detection of Forest Health Level as an Effort to Protecting Main Ecosystem in the term of Watershed Management in Maros Watershed, South Sulawesi", IOP Conference Series: Earth and Environmental Science, 2019 Publication	<1 %

Exclude quotes On

Exclude bibliography On

Exclude matches < 5 words