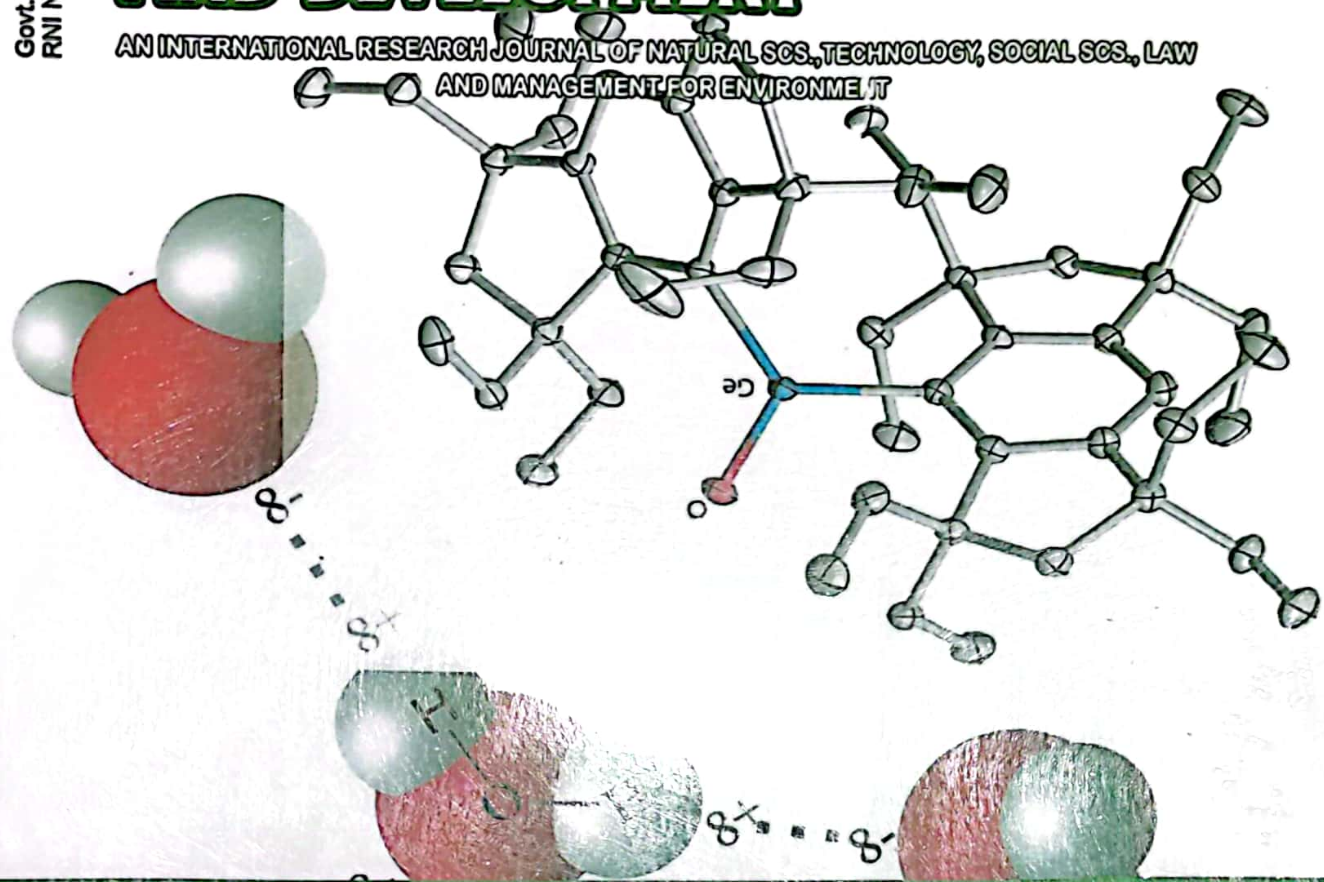
E-ISSN 2319-5983
ISSN 0973-6921
Volume - 07
Number - 03
Periodicity - Quarterly
January-March 2013
Impact Factor - 0.157

Govt. Of India, New Delhi
RNI No. MPBIL/2006/18581

JOURNAL OF ENVIRONMENTAL RESEARCH AND DEVELOPMENT

AN INTERNATIONAL RESEARCH JOURNAL OF NATURAL SCS., TECHNOLOGY, SOCIAL SCS., LAW AND MANAGEMENT FOR ENVIRONMENT



Abstracted and Indexed in CAS (USA), CAB Abstracts (UK), ISA (INDIA) ResearchGate(GERMANY), Google Scholar(USA), SCIndeks(SERBIA), evisa (GERMANY) & DiVA (SWEDEN)

INTER-DISCIPLINARY JOURNAL

Under aegis of

G.SEED

Global earth Society for Environmental Energy and Development
E-mail : hljerad2012@gmail.com, editor@jerad.org

www.jerad.org

MEMBERSHIP	ANNUAL	LIFE	FELLOW
Individual :	₹ 1,500/- (US$ 150)	₹ 15,000/- (US$ 700)	₹ 35,000/- (US$ 1,300)
Institutional :	₹ 3,500/- (US$ 300)	₹ 25,000/- (US$ 1,200)	₹ 50,000/- (US$ 2,000)

Printing Charges : Per double space typed page : ₹ 350/- (US$ 20)
Single Copy : Individual ₹ 800/- (US$ 50), Institutional ₹ 1,000/- (US$ 100)
Packaging and Postal Charges : India : ₹ 150/- , Foreign : US$ 30 (surface mail), US$ 50 (Air mail)

Fellow members of the Journal are privileged to write the title F.I.C.E.R. (Fellow, International Congress of Environmental Research) with their names, besides the other benefits. Similarly life members are privileged to write the title A.I.C.E.R. (Associate, International Congress of Environmental Research) with their names. Foreign subscription includes air mail charges.
All remittances should be made by Online Payment/Bank Demand Draft/ E-money transfer/Western Union money transfer in favour of Global earth Society for Environmental Energy and Development, payable at S.B.I. Main Branch, T.T. Nagar, Bhopal (India), along with Membership Form.

From The Editor's Desk

Taenia solium infections are called as taeniasis and Neurocysticercosis (NCC) and are major public health problems especially in the developing world. Neurocysticercosis is considered to be the most common helminthic parasitic infection of the central nervous system in human with tremendous morbidity. The route of infection is fecal-oral through contaminated environment. Most of the research studies are being conducted in pig farming community of developing countries to determine risk factors associated with T. solium infections.

Demographic, clinical and epidemiological data were collected from enrolled subjects. A very interesting and remarkable research work has recently been performed by the Department of microbiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, India where stool specimens from 924 subjects were examined for eggs of T. solium and other parasites. During the survey 91 patients with active epilepsy were identified. All such patients with active epilepsy were evaluated for NCC based on clinical, immunological, neuro imaging and epidemiological criteria.

T. solium taeniasis was detected in 18.6 % of the population. Factors associated with taeniasis were age above 15 years, history of passage of Taenia segments in stool, undercooked pork consumption and poor hand hygiene. Active epilepsy was identified in 5.6% of the population and 48.3% of them had NCC. Epilepsy in the family and no separate place for pigs were identified as risk factors for NCC clustering in the family. Approximately 29% individuals from the families of patients with NCC related seizures had silent NCC.

JERAD

GROW WITH TREES

The research data and results obtained are very similar to the other parts of developing world. However, percentage of patients varies from place to place.

The present study demonstrated that poor sanitation, poor hand hygiene, no separate place for pigs and free roaming of pigs in the community increases the risk for T. solium infections. Health education, mass anthelminthic therapy and other preventable measures like safe water supply and proper sewage systems are required to control this readily preventable and potentially eradicable disease.

Subhash C. Pandey

JOURNAL OF ENVIRONMENTAL RESEARCH AND DEVELOPMENT

(An official publication of Natural Sciences, Technology, Social Sciences, Law and Management for Environment)

J. Environ. Res. Develop.

URL : www.jerad.org ISSN 0973 – 6921 E-ISSN 2319-5983

Abstracted and Indexed in CAS (USA), CAB Abstracts (UK), ISA (INDIA), ResearchGate(GERMANY), Google Scholar(USA), SCIndeks(SERBIA), evisa(GERMANY) & DIVA (SWEDEN).

Volume : 07 Number : 03 January-March 2013

CONTENTS

NATURAL SCIENCE

Full Length Papers **:**

1. **Carbon dioxide utilization using combined reforming** 1153-1164
K. Moon, N. Madhu and Ganesh R. Kale

2. **Evaluation of land suitability and potential production of Jatropha (*Jatropha curcas* L.) : A biodiesel resource in solok regency, West Sumatra, Indonesia** 1165-1173
Juniarti, Harianti Mimien, Chan Almughfirah, Darfis Irwan, Emalinda Oktanis, Masuda Taizo, Nishimura Kazuyuki and Itani Tomio

3. **Reuse of domestic waste water for industrial purpose** 1174-1182
Mehta Komal P. and Patel A. S.

4. **Synthesis, characterization, morphology, thermal, electrical and chelation ionexchange properties of acopolymer resin** 1183-1192
Gurnule Wasudeo B., Makde Charulata S. and Ahmed Mudrika

5. **Effective utilization of yeast sludge in decolourization of melanoidin pigment modelling, biokinetic and thermodynamic studies** 1193-1200
Ravikumar R., Sridhar A., Preethi S., Rasika Gopalakrishnan and Vasanthi N.S.

6. **Forskolin : An effective growth and development inhibitor of *Tribolium confusum*** 1201-1208
Vasudha Lingampally, V. R. Solanki and Sabita S. Raja

7. **Trace element accumulation in the leaves of *Azadirachta indica* and *Pongamia glabra* collected from different environmental sites** 1209-1215
Ravikumar M., Sarita P., Naga Raju G. J. and Bhuloka Reddy S.

8. ***In vitro* propagation of *Bambusa tulda* : An important plant for better environment** 1216-1223
Sharma Pratibha and Sarma K. P.

Short Communications :

9. **Determination of biochemical quality in Malaysian fermented products** **1224-1227**
Karim Nurul Ulfah

10. **Effect of sugar factory effluent on glycogen, protein and free amino acid content in tissues of the fish *Lepidocephalus thermalis*** **1228-1230**
Hyalij M.T.

TECHNOLOGY

Full Length Papers :

11. **Nanotitanium dioxide solar cell using recycle battery** **1232-1236**
Daut I., Fitra M., Irwanto M., Gomesh N. and Irwan Y. M.

12. **2D pollutant transport analysis of different discharges of a river Estuary** **1237-1245**
Thinakaran E. and Jothiprakash V.

13. **Physiological and biochemical responses of a Malaysian red alga, *Gracilaria manilaensis* treated with copper, lead and mercury** **1246-1253**
Zakeri Hazlina Ahamad and Shuib Nor Shuhanija

14. **A novel CMOS based continuous temperature monitoring system for life saving drugs** **1254-1261**
Supraja S., Gowtham R. and Kausalya R.

Review Paper :

15. **Benefits and impacts of scrap tyre use in geotechnical engineering** **1262-1271**
Das Tapas and Singh Baleshwar

SOCIAL SCIENCE

Full Length Papers :

16. **Fish bone waste utilization program for hydroxyapatite product : A case study of knowledge transfer from a university to coastal communities** **1274-1281**
Mamat Ibrahim Bin, Aisyah Dara, Sontang M., Rosufila Zuha and Ahmad Nina Marlini

17. **Inter-linkages of environment and socio-economic development of Madhya Pradesh, India** **1282-1293**
Jain Anjali and Jain Aditi

18. **Statistical analysis to identify the main parameters to the wastewater quality index of CETP : A case study at Vapi, Gujarat, India** **1294-1304**
Shah Abhishek and Khambete A. K.

19. **Quantitative evaluation of environmental impact through investigation of plastic products** **1305-1310**
Sharma Suman and Mane Patil Smita

20. **Evaluation of pollution status of Chakkamkandam lake, India using water quality index** **1311-1315**
Rakesh V.B. and Joseph Ammini

Short Communication **:**

21. **Spatial analysis of drainage network for ground water exploration in river basin using GIS and remote sensing techniques : A case study of Tons river in Allahabad, India** **1316-1319**
Mishra Shalu

— ***Conference Alerts*** **1231**

— ***Membership Opportunities*** **1272-1273**

—***Author Index*** **1320**

— ***Membership Form*** **1321**

EVALUATION OF LAND SUITABILITY AND POTENTIAL PRODUCTION OF JATROPHA (*Jatropha curcas* L.) : A BIODIESEL RESOURCE IN SOLOK REGENCY, WEST SUMATRA, INDONESIA

Juniarti*, Harianti Mimien, Chan Almughfirah, Darfis Irwan, Emalinda Oktanis[1], Masuda Taizo, Nishimura Kazuyuki and Itani Tomio[2]

1. Department of Soil Sciences, Faculty of Agriculture, Andalas University, Padang (INDONESIA)
2. Faculty of Life and Environmental Sciences, Prefectural University of Hiroshima, Nanatsuka, Shobara (JAPAN)

***E-mail :** yuni_soil@yahoo.co.id

Received August 10, 2012 *Accepted January 14, 2013*

ABSTRACT

Jatropha (*Jatropha curcas* L.) is a multipurpose, tropical plant with many favorable attributes and considerable potential. In particular, it can be grown as a commercial crop in low to high rainfall areas. In order to predict production potential of Jatropha (*Jatropha curcas* L.) in Solok Regency, West Sumatra, Indonesia. The climatic data, soil conditions and land management were investigated in this study. The soil samples were taken at depths 0-60 cm. Land suitability was evaluated using a method of Food and Agriculture Organization (FAO) of the United Nations. Quantitative model which combines environmental, climatic and soil condition data, so that production potential of an area based on climate, Climate Production Potential (CPP) can be measured quantitatively. By entering the real data on plant production into the model, The Real Field Plant Production or Land Production Potential (LPP) can be predicted. The results show that climate in Solok district are very suitable (appropriateness level S1) for growing Jatropha, and physical land conditions included S3f. Chemical fertilizer and organic matter should be applied to improve the production potential from the current 36-144 t ha^{-1} $year^{-1}$ to > 187 t ha^{-1} $year^{-1}$.

Key Words : Climatic Production Potential(CPP), Land Production Potential(LPP), Land Suitability(LS), Radiation Production Potential(RPP), Chemical fertilizer

INTRODUCTION

Jatropha (*Jatropha curcas* L.) is a multipurpose, tropical plant with many favorable attributes and considerable potential. In particular, it can be grown as a commercial crop in low to high rainfall areas. Thus, its cultivation could provide employment, improve the environment and enhance the quality of rural life. However, the establishment, management and productivity of Jatropha under various climatic conditions have not been not fully documented.[1]

Oil extracted from Jatropha was used in the manufacturing of biodiesel, varnishes, illuminants, soap, pesticides, medicine for skin diseases and purgatives. Approximately 31% to 37% of oil is extracted from the Jatropha seed. Biodiesel made from Jatropha oil can be used for any diesel engine without modification. Jatropha leaf and bark have various other industrial and medical uses in folk remedies for cancer. The leavings after extraction residue is an excellent source of organic manure.[2]

Jatropha can be grown throughout the tropical and subtropical zones and also in some temperate climate areas and some arid and sub-arid regions. The plant can be grown in places with an annual average temperature of 20° C. Regions have irrigation of water with soils, well aerate and low nutrient content are also suitable for Jatropha cultivation. Jatropha was grown in Africa, Asia, North America, South America and Australia.[3]

*Author for correspondence

One of the reasons for a soil survey is to determine the productive capacity of the land as measured by the crop yield that could be achieved on a given land type in order to measure the productive value areas of land.[4] Evaluate the productive capacity of land, developed a quantitative model that combines environmental, climatic and land condition data (physical and chemical characteristics).[5,6] The data are entered into several mathematical formulae to obtain the potential production of land based on climate or the Climate Production Potential (CPP).[7] Plant production data are then entered to calculate the potential production using the land or the Land Production Potential (LPP). The model assists local governments and farmers in planning the most effective use of land and by changing certain variables, the model can be used to predict plant production across a range of areas in different regions of the world.[8] Solok district is one of the areas in West Sumatra selected by West Sumatra Government for a pilot project to study the cultivation and supply of raw material for biodiesel production. Solok was chosen because Jatropha was grown in almost all parts the district, generally as a living fence to protect agricultural fields from grazing damage by cattle and goats.

AIMS AND OBJECTIVES

The purpose of this study was to assess the suitability of land and climate in Solok for Jatropha production.

MATERIAL AND METHODS

The research consists of two phases : collecting primary production data by interviewing farmers and collecting secondary survey data. Selection of soil sampling location was based on geological and topographical information, as well as soil maps. Maps of the research areas are show in **Fig. 1**. Standard field tools, such as ground drill, hoe, knife, standard gauge, GPS, Munsell soil color chart, plastic buckets and ring samples were used in the field survey. A standard analyzer tool was used for soil analysis in the laboratory. Land form and soil morphology were observed in the field by making soil profiles and drilling core samples.

Soil analysis

Total organic carbon was determined by the Walkley and Black method.[9] Total N by the Kjeldahl method, soil pH by a pH meter and Cation Exchange Capacity (CEC) by leaching with ammonium acetate at pH 7.

GIS analysis for making soil maps

GIS software was used for data analysis (MapInfo™, ArcInfo™). A Geographic Information System (GIS) integrates hardware, software and data for capturing, managing, analyzing and displaying all forms of geographically referenced information.

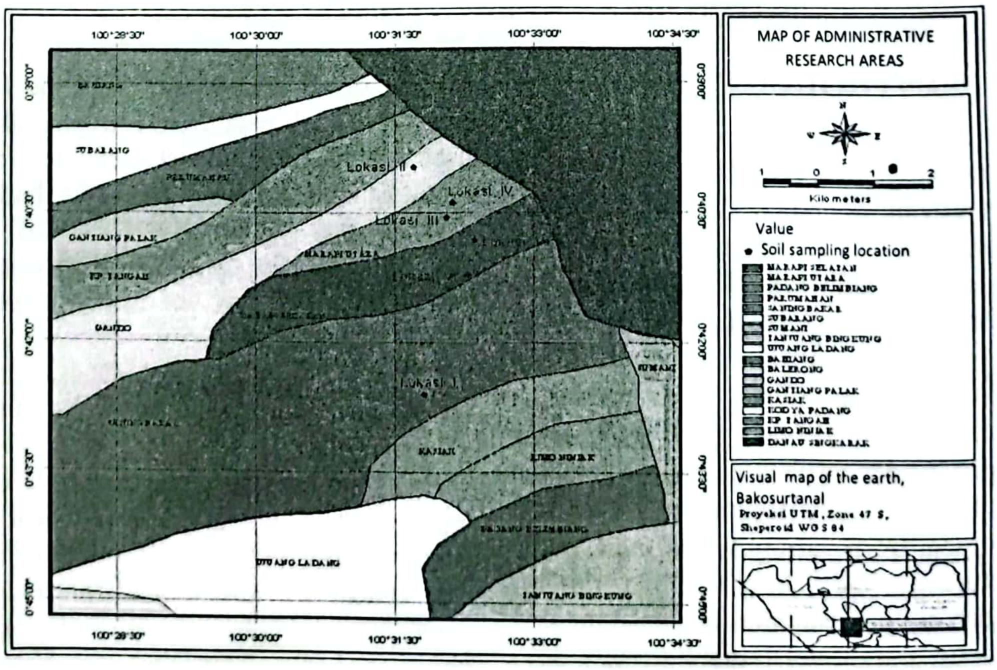


Fig. 1 : Administrative map of the study area, Solok, West Sumatra, Indonesia

Analysis of land suitability for Jatropha (data interpretation)

Land suitability classes reflect degrees of suitability. The classes are number consecutively by arabic numbers in sequence of decreasing degrees of suitability within the order. within the order suitable the number of classes is not specified. There might for example be only two SI and S2. The number of classes recognized should be kept to the minimum necessary to meet interpretative aims, five should probably be the most ever used. Three classes are recognized within the order suitable as can often be recommended, the following names and definitions may be appropriate in a qualitative classification shown on **Table 1.**

Table 1 : Land suitability classes reflect degrees of suitability

Class SI	Highly suitable	Land having no significant limitations to sustained application of a given use or only minor limitations that will not significantly reduce productivity or benefits and will not raise inputs above an acceptable level.
Class S2	Moderately suitable	Land are moderately severe for sustained application of a given use, the limitations will reduce productivity or benefits and increase required inputs to the extent that the overall advantage to be gained from the use, although still attractive will be appreciably inferior to that expected on Class SI land.
Class S3	Marginally suitable	Land having limitations which in aggregate are severe for sustained application of a given use and will so reduce productivity or benefits or increase required inputs that this expenditure will be only marginally justified.

(FAO, 1976)

Data were interpreted by comparing land characteristics with Jatropha production. Land suitability was measured in semi-detail at a map scale of 1:50,000. This measurement required data on (1) Climate, i.e., mean sunlight duration (hours/day); mean maximum air temperature (T_{max}), mean minimum air temperature (T_{min}), mean humidity (RH, %); means wind velocity and total monthly rainfall and total rain days. (2) Environment, i.e., soil parameters such as drainage, soil depth, period of flooding, land slope, surface rock (rock outcrop). (3) Soil characteristics, i.e., CEC, pH, total N, total C, available P_2O_5, available K_2O, soil water salinity and aluminum saturation, soil structure and soil consistency.

Estimation of Radiation Production Potential (RPP)

Data on production of biomass were used to determine RPP, which is obtained by the following formula :

$$RPP = Bn \times Hi$$

or

$$RPP = \frac{0.26 \times bgm \times KLAI \times Hi}{1/2 + (0.25: ct)}$$

$$bgm = f \times bo = (1 - f) \times bc$$

Where

f = Fraction of the day time that sky is overcast

bo = Maximum gross biomass production on overcast days

bc = Maximum gross biomass production on clear days

ct = Rate of loss of bgm by maintenance respiration at actual temperature.

Hi= Harvest index

ArcInfo™ or MapInfo™ was used to integrate this RPP calculation into a Geographical Information System (GIS).

Estimation of Climatic Production Potential (CPP)

The following parameters were used to calculate CPP : evaporation and transpiration (evapotranspiration) of reference crop (ET_0), evapotranspiration maximum (ET_m), crop coefficient (kc), total water available (Sa), i.e., the difference between soil water content at field capacity and permanent wilting point, (v) effective rainfall (P_{eff}).[10]

The formula for calculating CPP is :

CPP = RPP (1 – ET_a] / ET_{max})

Where

ET_a = Actual evapotranspiration.

Estimation of Land Production Potential (LPP)

LPP was calculated after determining the CPP value by considering the index of soil data (Sy) and the index of land management (My). The formula for LPP is

LPP = CPP × Sy

Where

My = Ya/(CPP × Syp)

Ya = Crop yield (kg/ha)

Sy = Soil index of which is obtained from approach formula in parametric, My is obtained from the FAO (1976) table on land management rating.

RESULTS AND DISCUSSION

Evaluation of climate for Jatropha growth and production in Solok Regency, West Sumatra, Indonesia

The climatic data (available water, air temperature) show that the land in the research area in Solok district is highly suitable (S1) for cultivating Jatropha. Precipitation at Solok was greater than Potential Evapotranspiration (PET) calculated according to Papadakis as shown in **Fig. 2**. Therefore, throughout the year, there was a water surplus and no dry season, and stable rainfall provides sufficient water for cultivating Jatropha.

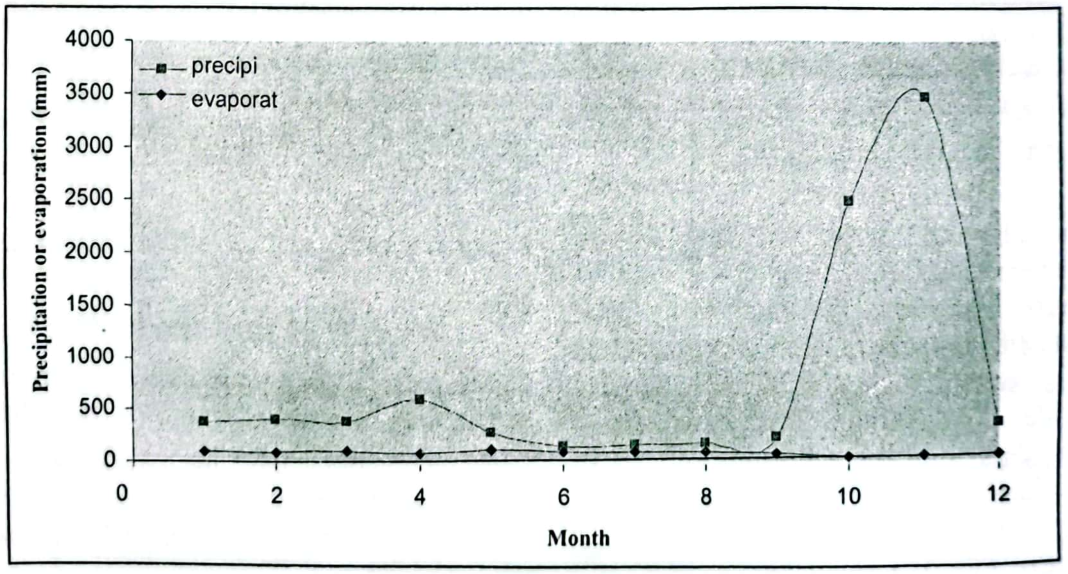


Fig. 2 : Water balance at Solok, West Sumatra Indonesia

ET_0 calculated according to Dorenbos and Pruitt was higher than PET calculated according to Papadakis, because the Papadakis method measures the amount of precipitation and average and air temperature while the Dorenbos and Pruitt method includes several other parameters such as RH, wind velocity, sunlight duration, daylength and solar radiation.[11] Similarly, the ET_0 of oil palm using the Dorenbos and Pruitt method is 3.23–8.58 mm day^{-1} and 100.14–257.56 mm $month^{-1}$, which is higher than the PET by the Papadakis method.Based on calculation of climatic parameters (including precipitation, maximum air temperature, minimum air temperature and average air temperature, sunlight duration, daylength, wind velocity and RH), potential production of Jatropha was categorized as suitability class (S1). Results for CPP and LPP of Jatropha are shown on **Table 2** and spatial data of RPP, CPP and LPP are shown in **Fig. 3** to **Fig. 5**.

Land characteristic observations and soil index calculation show that land in the research area in Solok was highly suitable for grow Jatropha. The real production value of Jatropha was not very different from the CPP and LPP values. These results show that use of climatic data in a land evaluation system for Jatropha cultivation would enable a more accurate interpretation of the results. LPP values show that soils in Solok have high production potential for Jatropha.

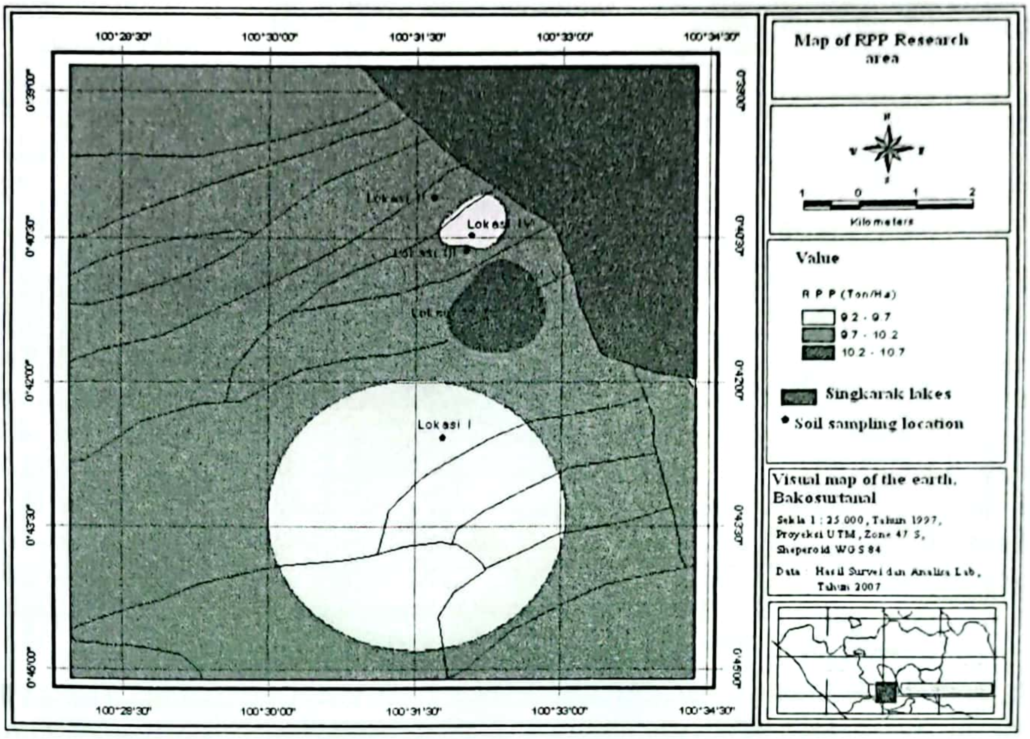


Fig. 3 : Spatial data of RPP at Solok, West Sumatra, Indonesia

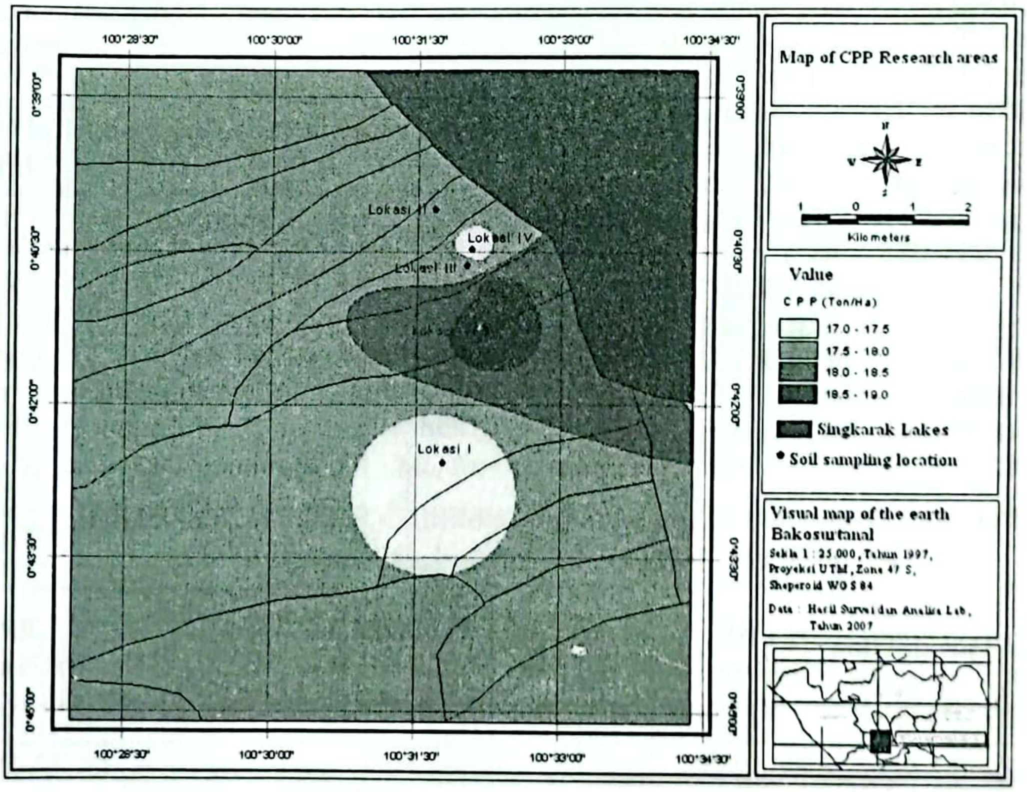


Fig. 4 : Spatial data of CPP at Solok, West Sumatra, Indonesia

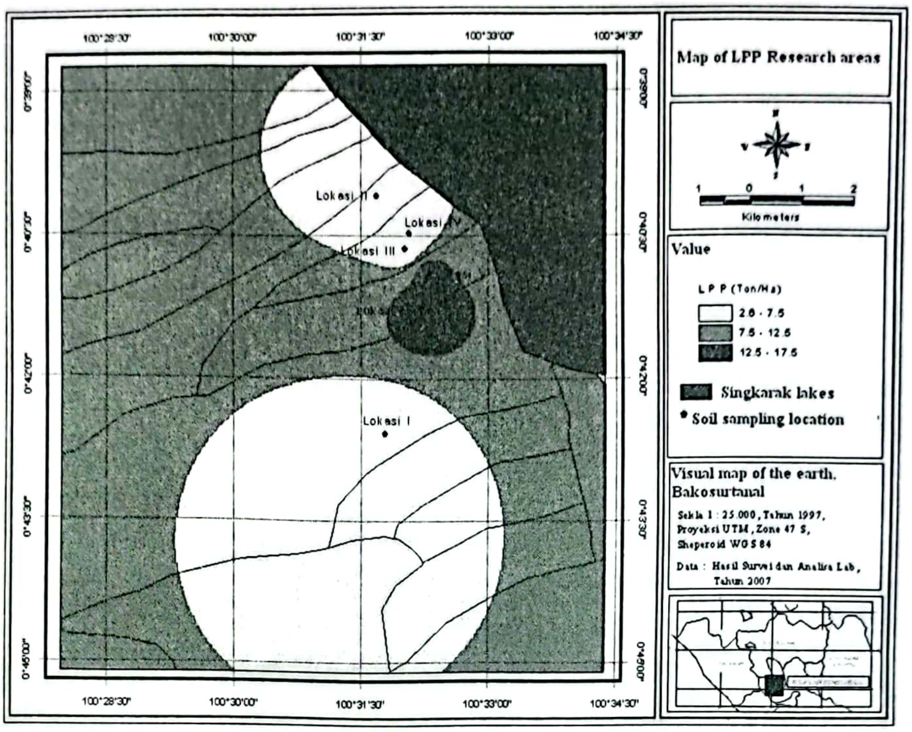


Fig. 5 : Spatial data of LPP at Solok, West Sumatra, Indonesia

The results from **Table 2** show that RPP and CPP values in Solok have different values although this area has the same variety. RPP values (110.9–126.7 t ha^{-1}) in the location is lower than CPP values (204 – 228 t ha^{-1}). The RPP values (110.9–126.7 t ha^{-1}) show that the area was ideal for Jatropha production, which is influenced by solar radiation, so that climatic conditions in Solok can support Jatropha yields of 110.9–126.7 t ha^{-1}. The low CPP value (204–228 t ha^{-1}) is influenced by rainfall in Solok. These results show that Jatropha production in Solok was influenced by climate, mainly sunlight duration and rainfall, which will influence photosynthesis. Furthermore, data on **Table 3** shows that the LPP of 38.8–186.9 t ha^{-1} at location is lower than RPP and CPP values. The LPP values represents the real production of Jatropha at this location. This difference is a result of differences in climate, land management and soil. LPP value of sample II is higher than that of sample VI.

Relationship between physical land conditions, soil fertility and Jatropha production

West Sumatra is predominantly mountainous. Land form in the research area was classed 2 types as physiographical type hill. Guguk, that is mostly steep slope (>60% = 27°) causes high surface flow and erosion. Because of this erosion risk such land cannot be used as farmland. Payakumbuh that land of which

Table 2 : Potential production of Jatropha (per month) in Solok based on climate (CPP) and potential production based on land management (LPP)

Sample	Real production (t ha^{-1})	RPP (t ha^{-1})	CPP (t ha^{-1})	Management Index (My)	Soil Index (Sy)	LPP (t ha^{-1})
1.	5	9.90	18	0.67	0.5	6.03
2.	12	10.56	19	0.82	1	15.58
3.	5.5	9.49	18	0.92	0.47	7.78
4.	4	10.04	19	0.47	0.5	4.46
5.	5	10.24	19	0.4	1	7.6
6.	3	9.24	17	0.5	0.38	3.23

Table 3 : Potential production of Jatropha (per year) in Solok based on climate (CPP) and potential production based on land management (LPP)

Sample	Real production (t ha^{-1})	RPP (t ha^{-1})	CPP (t ha^{-1})	Management Index (My)	Soil Index (Sy)	LPP (t ha^{-1})
1.	60	118.8	216	0.67	0.5	72.36
2.	144	126.72	228	0.82	1	186.96
3.	66	113.88	216	0.92	0.47	93.39
4.	48	120.48	228	0.47	0.5	53.58
5.	60	122.88	228	0.4	1	91.2
6.	36	110.88	204	0.5	0.38	38.76

16%–45% (7.2°-20.3°) was recommended only for permanent planting such as plantation for annual plants and forestry.

Land of which >60% is recommended only for forestry. However, if appropriate soil conservation was practiced the suitability level for Jatropha was S1 on land. Parent rock and land form affect soil formation and also soil fertility in the research area. Observations indicate that the soil has a clay texture was acidic and generally low in nutrients, cations, organic matter and CEC. **Table 4** shows how topography affects soil characteristics i.e. soil pH, moderate C- organic, moderate total N and low CEC and base saturation. Soil pH in the research area was 4.9 – 5.3 (acid), different of value because of different topography and land management. Erosion is common on the sloping area where Jatropha grows because of the small crown of the plant, which reduces soil pH. Furthermore, available P in the research location is approximately 48.50–55.67 and soil CEC 8.12–9.67 that is low and covers area 2000 ha. The soil of the research area was classified as Inceptisols.[12-14] Because Inceptisols have Cambic horizons, the soil need management to avoid soil management problems and so that the appropriate crop type was grown.

Table 4 : Soil chemical properties of area

Soil chemical	Area	
	>60% (> 270)	16%–45% (7.20-20.30)
pH	4.90 m	5.3 m
C-org (%)	1.98 r	2.50 s
N_tot (%)	0.12 r	0.27 s
P available (ppm)	55.67t	48.50 t
CEC (me/100 g)	8.12r	9.67 r
Base saturation (%)	39.55s	40.86 s
K (me/100 g)	2.01 st	1.75 st
Na (me/100 g)	2.69 st	2.41 st
Ca(me/100 g)	26.02 st	29.99 st
Mg (me/100 g)	8.83st	6.71 t

m = acid, sr = very lower, r = lower, s = netral, t = high, st = very high

The classification of climate suitability for Jatropha in Solok based on the Storie method and Square Root method is shown in **Table 5**. The climate index rating of 75/78 shows that the climate in the research area is highly suitable

(S1) for Jatropha cultivation. Favorable climatic elements are precipitation, moderate air temperature and maximum air temperature. Estimated land suitability rating for cultivation of Jatropha based on Storie method and Square root method was 85/92 **(Table 5)**.

Table 5 : Classification of climate suitability and estimation of land suitability for Jatropha in Solok

Sim	Climate characteristic	Value	Class	Limit level	Rating
C	Precipitation (mm)	2238.77	S1	0	100
C	T_{mean}	26.75	S1	0	100
C	T_{max}	33.27	S1	0	100
C	T_{min}	20.19	S1	0	100
C	n/N	97.67	S1	1	85
Climate index		Storie method/Square root method			75/78
Climate rating		Storie method/Square root method			85/92
Climate class		S1/S1			S1

Sim=symbol,C=climate,n/N=daily

Based on land class suitability criteria, the research area was categorized as S3f, its mean the land was need some fertilizer (f) to improve the soil fertility. Therefore, to redress these limitations to Jatropha production, chemical fertilizers and organic matter need to be applied.

For areas with similar climate and soil conditions to those of the research area, model parameters can be changed according to these areas' soil and environmental conditions. RPP, CPP and LPP values provide useful basic data that can be applied in other areas of West Sumatra to help in land use planning for improved agricultural production, especially for Jatropha.

To develop land with a slope index of >50% and land suitability of S3f, land should be improved by applying fertilizer and organic matter, thereby increasing future production of Jatropha. Solok district was included into land suitability class S3f, which means that the area is suitable for growing Jatropha with a limiting factor of low nutrient retention. Chemical fertilizer and organic matter should be applied to improve the production potential from the current 36-144 t ha^{-1} $year^{-1}$ to > 187 t ha^{-1} $year^{-1}$.

CONCLUSION

The climate conditions in Solok district are very suitable (appropriateness level S1) for growing Jatropha, and physical land conditions class included S3f. Chemical fertilizer and organic matter should be applied to improve the production potential from the current 36-144 t ha^{-1} $year^{-1}$ to > 187 t ha^{-1} $year^{-1}$.

ACKNOWLEDGEMENT

We are very grateful to the Directorate of Higher Education of Indonesian Government. We also thank to Mr. Sugeng Nugroho for his assistance and suggestions during the research.

REFERENCES

1. Openshaw K., A review of *Jatropha curcas* : An oil plant of unfulfilled promise, *Biom. Bioengin.*, **19(1)**, 1–15 **(2000).**
2. Sharma G.D., Gupta S.N. and Khabiruddin M., Cultivation of *Jatropha curcas* as future source of hydrocarbon and other industrial productions, In : Gubitz G.M., Mittlebach M. and Trabi M. **(Ed.)** *Biofuels and Industrial Products from Jatropha curcas*, Managua-Nicaragua, 19, **(1997).**
3. Kempf M., *Jatropha production in semi-arid areas of Tanzania*, Rural Livelihood Development Company, 1-37, **(2007).**
4. Rossiter D.G., Economic land evaluation : Why and how, *Soil Use Manag.*, **11(3)**, 132-140. **(1995).**
5. Sys C., Van Ranst E. and Debaveye J., *Land evaluation part I, principles in land Evaluation and crop production*, Brussels-Belgium, 274, **(1991).**
6. FAO., *A Framework for Land Evaluation*, Soil Bulletin No. 29. Rome, 72, **(1976).**

7. Sys C., Van Ranst E., Debaveye J. and Beernaert F., Land evaluation. Part III. crop requirements, Agriculture Publications, General Administration for Development Cooperation. *Place du Champ de Mars 5 bte 57-1050,* Brussels-Belgium, 274, **(1993).**
8. Fiantis D., Development of geographic information systems land volcanic west sumatra to increase production of horticulture crops. *The proposal of Riset Unggulan Terpadu IX.* Andalas University, Padang, 13, **(2001).**
9. Walkley A. and Black I.A., An examination of the degtjareff method for determining 10 organic carbon in soils : Effect of variations in digestion conditions and of inorganic soil constituents. *Soil Sci.*, **63**(2) ,251-263. **(1934).**
10. Van Ranst E., Land Evaluation, *Lecture Notes. ITC for Post-Graduate.* Soil Scientists University of Ghent, 512, **(1991).**
11. Dorenbos J. and Pruitt W.O. *Guidelines for predicting crop water requirements. Irrigation and drainage paper* 24, **2nd Ed.,** UN-FAO, Rome, Italy, 238-251, **(1977).**
12. Soil Survey Staff, Keys to Soil Taxonomy. Agency for international development United States Department of Agriculture. Soil Management Support Services. SMSS. *Technical monograph, 3rd printing,* Cornell University, **(1987).**
13. Mathiyazhagan M., Arun M., Jeyaraj M., Senthilkumar T. and Ganapathi A., Performance and emission study of diesel engine using environmental friendly biodiesel fuel from *Jatropha curcus* oil, *J. Environ. Res. Develop.*, **6**(1), 132-138,**(2011).**
14. Kumar Sunil, Chaube Alok and Jain Kumar Shashi, Economic sustainability of Jatropha biodiesel in India, *J. Environ. Res. Develop.*, **3**(1), 292-300, **(2008).**