

INTERNATIONAL CONFERENCE



The Second International Conference on
Engineering and Technology Development

2nd ICETD 2013

27, 28, 29 August 2013, Bandar Lampung, Indonesia



PROCEEDINGS



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Hosted by :

Faculty of Engineering and Faculty of Computer Science,
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2nd ICETD 2013

THE SECOND INTERNATIONAL CONFERENCE
ON ENGINEERING AND TECHNOLOGY DEVELOPMENT

28 -30 January 2013
Bandar Lampung University (UBL)
Lampung, Indonesia

PROCEEDINGS

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PREFACE

The Activities of the International Conference is in line and very appropriate with the vision and mission of Bandar Lampung University (UBL) to promote training and education as well as research in these areas.

On behalf of the Second International Conference on Engineering and Technology Development (2nd ICETD 2013) organizing committee, we are very pleased with the very good response especially from the keynote speaker and from the participants. It is noteworthy to point out that about 80 technical papers were received for this conference.

The participants of the conference come from many well known universities, among others : University Kebangsaan Malaysia – Malaysia, APTIKOM – Indonesia, Institut Teknologi sepuluh November – Indonesia, Surya Institute – Indonesia, International Islamic University – Malaysia, STMIK Mitra Lampung – Lampung, Bandung Institut of Technology – Bandung, Lecture of The Malahayati University, B2TP – BPPT Researcher – Lampung, Starch Technology Center – Lampung, Universitas Islam Indonesia – Indonesia, Politeknik Negeri Malang – Malang, University of Kitakyushu – Japan, Gadjah Mada University – Indonesia, Universitas Malahayati – Lampung, Lampung University – Lampung, Starch Technology Center – Lampung, Universitas Riau – Riau, Hasanuddin University – Indonesia, Diponegoro University – Indonesia, King Abdulaziz University – Saudi Arabia, Parahyangan Catholic University – Indonesia , National Taiwan University– Taiwan, Surakarta Christian University – Indonesia, Sugijapranata Catholic University – Indonesia, Semarang University – Indonesia, University of Brawijaya – Indonesia, PPKIA Tarakanita Rahmawati – Indonesia, Kyushu University, Fukuoka – Japan, Science and Technology Beijing – China, Institut Teknologi Sepuluh Nopember – Surabaya, Researcher of Starch Technology Center, Universitas Muhammadiyah Metro – Metro, National University of Malaysia – Malaysia.

I would like to express my deepest gratitude to the International Advisory Board members, sponsor and also to all keynote speakers and all participants. I am also grateful to all organizing committee and all of the reviewers who contribute to the high standard of the conference. Also I would like to express my deepest gratitude to the Rector of Bandar Lampung University (UBL) who give us endless support to these activities, so that the conference can be administrated on time

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Table Of Content

Organizing Committee	i
Table Of Content.....	v

Keynote Speaker

1. Recent Advances in Biofuel Cell and Emerging Hybrid System Abdul Aziz Ahmad and Raihan Othman	1
2. Waste Utilization Study Tailing Gold Mine in Way Linggo-Lampung, as Fine Aggregate Materials for Producing Mortar Materials based on concept of Green Technology Lilies Widodojoko & Susilawati	8
3. Infrastructure Health Monitoring System (SHM) Development, a Necessity for Maintance and Investigation Prof. Dr. Priyo Suprobo, Faimun, Arie Febry	17
4. Four Phases Quality Function Deployment (Qfd) By Considering Kano Concept, Time And Manufacturing Cost Prof. Dr. Moses L Singgih, Dyah L. Trenggonowati, Putu D. Karningsih	22

Speaker

1. Comparative Analysis for The Multi Period Degree Minimum Spanning Tree Problem
Wamiliana, Amanto, and Mustofa Usman..... 39
2. Choosing The Right Software In Supporting The Successful of Enterprise ERP Implementation
Yodhie Yuniarthe, Idris Asmuni..... 44
3. Climate Adaptive Technology In Maintaining Vernacularism Of Urban Kampong Case study: Kampung Adat (Indiginous) Mahmud, Bandung District, West Java
Marcus Gartiwa..... 50
4. The Prospect Of Diesohol In Facing Fossil Fuel Crissis
M.C. Tri Atmodjo..... 63
5. The Potential Of Agriculture And Forestry Biomass Wastes As Source Of Bioenergy
Hardoyo..... 66
6. The Importance of Education Facility as Sustainable Urban Generation Tool
Fritz Akhmad Nuzir, Haris Murwadi and Bart Julien Dewancker 71
7. The implementation of Secton Method for Solving Systems of Non Linear Equations
Nur Rokhman 80
8. Quality Control Analysis Into Decrease The Level Defects On Coffee Product
Heri Wibowo, Sulastri and Emy Khikmawati 85
9. Public Transportion Crisis In Bandar Lampung
Ida Bagus Ilham Malik 89
10. Geospatial Analysis of Land Use Change in Way Kuripan Watershed, Bandar Lampung City
Candra Hakim Van Rafi'il., Dyah Indriana Kusumastuti2., Dwi Jokowinarno..... 99
11. Material Utilization Technology Of Agriculture And Forestry Waste
Hardoyo..... 105
12. The Supply Chain System Of Cassava On The Tapioca Industry
Hardoyo..... 108
13. Glass Technology In Natural Light Glasses On Aperture Element In The Architecture World
Muhammad Rija & MT Pedia Aldy 113

14. An Eksperimental Permeable Asphalt Pavement Using Local Material Domato Stone On Quality Of Porous Asphalt Firdaus Chairuddin, Wihardi Tjaronge, Muhammad Ramli, Johannes Patanduk	117
15. Coordination Of Architectural Concepts And Construction Systems Eddy Hermanto.	129
16. Seismic Assessment of RC Building Using Pushover Analysis Riza Ainul Hakim.	136
17. Viscosity and Liquidity Index Relation for Elucidating Mudflow Behavior Budijanto Widjaja and Shannon Hsien-Heng Lee.	143
18. The Use of Pozzolanic Material for Improving Quality of Strontium Liquid Waste Cementation in Saline Environment during Nuclear Waste Immobilization Process Muhammad Yusuf, HayuTyasUtami, Tri SulistiyoHariNugroho, SusetyoHarioPutero	148
19. Geospatial Analysis Of Land Use And Land Cover Changes For Discharge At Way Kualagaruntang Watershed In Bandar Lampung Fieni Yuniarti, Dyah Indriana K, Dwi Joko Winarno.	153
20. Wifi Network Design For High Performance Heru Nurwarsito, , KasyfulAmron,BektiWidyaningsih	161
21. Studi on The Efficiency Using Nature Materials in The Structural Elements of Reinforced Concrete Beam Yasser , Herman Parung , M. Wihardi Tjaronge, Rudy Djamaluddin.	167
22. The Research Of Slow Release Nitrogen Fertilizer Applied In Sugarcane (Saccharum Officinarum) For Green Energy Bioethanol M.C. Tri Atmodjo, Agus Eko T. Nurul Rusdi, Sigit Setiadi, and Rina.	179
23. Energy Utilization Technology Of Agriculture And Forestry Waste Hardoyo.	185
24. Implementation Of Fuzzy Inference System With Tsukamoto Method For Study Programme Selection Fenty Ariani and Robby Yuli Endra.	189
25. The Analysis of Video Conference With ITU Standarization (International Telecommunication Union) That Joining in Inherent At Bandar Lampung University Maria Shusanti F, Happy Reksa	201

26. The E-internal audit iso 9001:2008 based on accreditation form assessment matrix in study program for effectiveness of monitoring accreditation Marzuki, Maria Shusanti F.	207
27. The Developing Of e-Consultations For Effectiveness of Mentoring Academy Ahmad Cucus, Endang K	214
28. The Evaluation of information system performance in higher education case study with EUCS model at bandar lampung university Reni Nursyanti, Erlangga.	221
29. The Analysis Of History Collection System Based On AndroidSmartphone With Qr Code Using Qr CodeCase Study: Museum Lampung Usman Rizal, Wiwin Susanty, Sutrisno.	230
30. Application of Complaint Handling by Approach Model of ISO 10002 : 2004 to Increase Complaint Services Agus Sukoco and Yuthsi Aprilinda.	235
31. Towards Indonesian Cloud Campus Taqwan Thamrin, Iing Lukman, Dina Ika Wahyuningsih	252
32. Bridging Router to ADSL Modem for Stability Network Connection Arnes Yuli Vandika and Ruri Koesliandana.	257
33. The Effect of Use Styrofoam for Flexural Characteristics of Reinforced Concrete Beams Yasser , Herman Parung, M. Wihardi Tjaronge, Rudy Djamaluddin	261
34. The Estimation Of Bioethanol Yield From Some Cassava Variety M.C. Tri Atmodjo	273
35. Effect of Superficial Velocity of Pressure Difference on The Separation of Oil And Water by Using The T-Pipe Junctionl Kms. Ridhuan and Indarto.	277
36. The use of CRM for Customer Management at Cellular Telecommunications Industry Ayu Kartika Puspa.	293
37. Indonesian Puslit (Centre Of IT Solution) Website Analysis Using Webqual For Measuring Website Quality Maria Shusanti Febrianti and Nurhayati.	297
38. The E-internal audit iso 9001:2008 based on accreditation form assessment matrix in study program for effectiveness of monitoring accreditation Marzuki, Maria Shusanti F.	307

39. Enhancing Quality Software Through CMMI-ISO 9001:2008 and ISO 9126 Agus Sukoco	320
40. Value Analysis Of Passenger Car Equivalent Motorcycle (Case Study Kartini Road Bandar Lampung) Juniardi, Aflah Efendi	337
41. Alternative Analysis Of Flood Control Downstream Of Way Sekampung River Sugito, Maulana Febramsyah.	347
42. Analysis Of Fitness Facilities And Effective Use Of Crossing Road Juniardi, Edi Haryanto.	353
43. Study On Regional Development Work Environment Panjang Port Lands In Support Bandar Lampung City As A Service And Trade Ir. A. Karim Iksan, MT, Yohn Ferry.	359
44. Analytical And Experimental Study Bamboo Beam Concrete Hery Riyanto, Sugito, Juli	370
45. Comparative Analysis Of Load Factor Method Static And Dynamic Method (Case Study Akdp Bus Route Rajabasa - Bakauheni) A. Ikhsan Karim, MT., Ahmad Zulkily.	378
46. Optimization Utilization Of Water Resources dam Batutegi Using Method Of Linear Program Aprizal, Hery Fitriyansyah	386
47. Characteristics Generation Traffic Patterns And Movement In Residential Area (Case Study Way Kandis Residential Bandar Lampung) Fery Hendi Jaya, Juniardi,	392
48. Use Study On Slight Beam Reinforced Concrete Floor Plate in Lieu Of Secondary Beam Hery Riyanto, Sugito, Lilies Widodjoko, Sjamsu Iskandar	399
49. Observation Of The Effect Of Static Magnetic Field 0.1 Mt On A-Amylase Activity In Legume Germination Rochmah Agustrina, Tundjung T. Handayani, and Sumardi.	405
50. Effectiveness Analysis Of Applications Netsupport School 10 Based Iso / Iec 9126-4 Metrics Effectiveness Ahmad Cucus, Nelcy Novelia	413
51. Comparative Performance Analysis Of Banking For Implementing Internet Banking Reza Kurniawan	418

GEOSPATIAL ANALYSIS OF LAND USE AND LAND COVER CHANGES FOR DISCHARGE AT WAY KUALAGARUNTANG WATERSHED IN BANDAR LAMPUNG

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Abstract—Land use and land cover change in a watershed might drive some impacts, such as high amounts of discharge fluctuations. Way Kuala Garuntang Watersheed is one of watershed in Bandar Lampung that has changed significantly. This study analyzed land use and land cover change to determine how much its influence on discharge fluctuations based on Geographics Information System. The method used in this study comprised of hidrology, spatial and sensitivity analysis. Hidrology analysis based on daily rainfall data. Spatial data analysis aims to present geospatial data related effects of land use and land cover change on the value of discharge. Sensitivity analysis is done by creating a land use and land cover simulation scenarios and sees its effect on the peak discharge events. The results of hidrology analysis in this study showed that the rainfall data obtained from the rainfall stations around the watershed were inconsistent and it needs to be repaired. It was found that the pattern of rainfall distribution in Bandar Lampung for 4 hours consists of 40%, 40%, 15% and 5% pattern. The results of spatial analysis in this study showed that there are 11 types of land cover on the existing condition and only has a protected area covering 4.72% of the total watershed. From the results of the sensitivity analysis showed that land use scenario with availability less than 30% of the area of green open space watershed may cause an increase in the value of the peak discharge. Instead, the scenario to maintain a 30% green open spaces of wide watershed did not make a significant change in peak discharge. This action is necessary to provide enough space for the infiltration of rain water on a particular area for the purpose of supplying the needs of ground water and flood control.

Keywords— land use and land cover change, discharge, Way Kuala Garuntang

I. INTRODUCTION

Land use and land cover change is an effect of the development by countries that are developing, including Indonesia. Land use and land cover changes are the most substantial influence on the increase in value of the coefficient of runoff that impact in increased discharge is the use of forests to other uses such as agriculture, residential or industrial. Industrial activities, animal husbandry, agriculture and settlements around the river produces a variety of wastes, both solid and liquid, into the river. This condition occurs more severe when the river reaches major cities in Indonesia .

Way Kuala Garuntang watershed is one watershed in Bandar Lampung which its direction flow through urban areas and has

change significantly. According to Megawati (2005), Way Kuala Garuntang watershed has experienced in deforestation. There are resident and industry activities which throw their waste to the river. From the research, Way Kuala Garuntang watershed still able to accommodate the calculated discharge. However, from the research also mentioned that if there are land use and land cover changes may cause increase run off coefficient. It means the situation will lead to the greater flooding value. Based on this condition, it is necessary for the analysis of changes in land use to determine how much its influence for the discharge fluctuations. In order to make hydrology analysis, the research used hydrological and watershed parameter.

Identification of land use and land cover change and hydrological function measurements in the field requires an understanding, so it consumes more effort, time and cost. Thus the availability of a system in the field of geospatial data presentation is supported by advances in computer network technology is indispensable. The ability of computer technology is growing to make today's computers can be used for a variety of fields, one of which is the field of geography, ie to create a geographic information system (GIS). GIS technology integrates common database operations operations, such as query and statistical analysis with visualization and analysis capabilities are uniquely owned by mapping (Sugandi, Dede and Sugito, NT, 2010) The ability is what distinguishes GIS with other information systems that make it a useful field presentation of geospatial data in order to assist us in studying the process of change in river flow due to changes in land use in a watershed.

II. METHODS

An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

This research was conducted in the Way Kuala Garuntang watershed in Bandar Lampung.

The primary data in this study include the Ground Control Point (GCP) of rainfall stations with the first survey point rainfall stations using Global Positioning System (GPS) for the coordinates plotted on a map.

Secondary data on the research include a river map, topography map and precipitation data. The river map rise from screen digitation which was referenced from google earth 2006 year and river data from central river region mesuji sekampung. While topography map was taken from 2010 spatial plan (RTRW) of BAPPEDA.

There are three types analysis in the research. Hidrology analysis, spatial data analysis and sensitivity analysis of Land use and land cover changes.

III.

IV. RESULTS AND DISCUSSION

From the result of the formation of Way Kuala Garuntang watershed can be seen that DAS Way Kuala Garuntang has 11 tributaries that Way Kemiling, Way Langkapura, Way Pemanggilan, Way Balau, Way Kedaton, Way Penengahan, Way Awi, Way Simpung, Way Halim, Way Kedamaian, dan Way Kuala. After adding the administrative boundary layer on the map can be seen that the upstream on Kemiling districts and downstream on Teluk Betung Selatan. From the result of the formation of Way Kuala Garuntang Watershed can be seen that the area of the watershed Way Kuala Garuntang is 60.39 km². Land use and land cover Data of Way Kuala Garuntang watershed is based on Bandar Lampung Spatial Data 2010. After showing land use /cover layer and Way kuala garuntang watershed layer, obtained land use and land cover in way Kuala Garuntang Watershed. From the formation of the land use and land cover data obtained 11 types of land use and land cover in the Way Kuala Garuntang Watershed that can be seen in appendix Land Use and Land Cover Map of Way Kuala Garuntang Watershed, with 0.4% is an area of mining, 54.14% is an area of residential, 4.10% is an area of industrial designation, 31.22% is an area of empty land, 1.79% is an area of trade area and services, 0.23% is an area of government offices, 0.04% is an area of tourism area, 0.38% is an area of industrial area, 0.46% is an area of protected area, 4.72% is an area of the land agriculture, 1.26% is an area of public services, 1.16% is an road area and 0.07% is a double railway line from Way Kuala Garuntang Watershed area of 60.392 km².

Determination of rainfall stations whose data will be used for determination of rainfall on average watershed by first surveying point rainfall stations using GPS (global positioning system) to coordinate plotted on the map. From the results of plotting, can be seen that research area right in between of rainfall station and perfectly influenced by those rainfall stations, so the

rainfall data of the 4 rainfall stations that will be used in this research.

Determination of the Area of Effect Rain Stations in this study was calculated using the method Poygon Thiessen. So, it can be seen percentage of rainfall area's influence of each watershed.

From the existing rainfall data, should checked the availability of rainfall data and consistency test. Missing rainfall data can lead to inconsistent rainfall data and need to completed using the reciprocal method. It's done by calculating the distance between stations. The equation used is

$$P_x = \frac{\sum_{i=1}^n \frac{p_i}{L_i^2}}{\sum_{i=1}^n \frac{1}{L_i^2}}$$

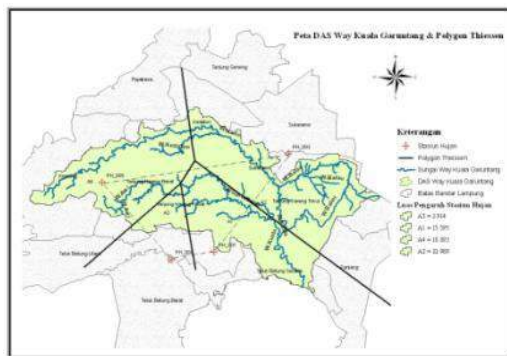


Fig.1 Way Kuala Garuntang Watershed and Polygon Thiessen

The distances between of rainfall stations can be seen on the map that was created using Geographic Information Systems. Rainfall data are already equipped need to test the consistency.

The analysis of rainfall area is intended to determine everage of ranfall that occurs in the watershed, such as by analyszing the maximum rainfall data that obtained from four rainfall stations. The method used in this analysis is the method of Thiessen Polygon as the following equation (Triatmodjo, 2008):

$$P_{rerata} = \frac{A_1 P_1 + A_2 P_2 + \dots + A_n P_n}{A_1 + A_2 + \dots + A_n}$$

To be able to change the design rainfall into hourly rainfall amount must be obtained in a pattern of hourly rainfall distribution. Distribution pattern for Way Kuala Garuntang watershed obtained by doing observation of large rain events. By averaging the observed rainfall distribution pattern, and then obtained a further distribution pattern is considered to represent average rainfall conditions and serve as a template for the design to distributed rainfall into hourly rainfall amount.

Analysis of rainfall distribution patterns calculated using rainfall data Kotabaru and Panjang. From the calculation of rainfall distribution pattern obtained 90% of the rain in Bandar Lampung occurred at 3 hours, 4 hours, 5 hours, 6 hours, 7 hours, 8 hours, 9 hours and 13 hours. However, most 90% of the rain events occurred at 3 hours, 4 hours and 5 hours. In Table 12, 13 and 14 are shown the results of the calculation of the percentage of hourly rainfall for 3 hours, 4 hours and 5 hours. From this point it is known that 90% of the rain in Bandar Lampung occurred within 4 hours with 40% in the distribution pattern of the first hour, 40% in the second hour, 15% in the third hour, and 5% in the fourth hour. The calculation of the intensity of rainfall using the rainfall distribution pattern that has been obtained and the calculation of the intensity of rainfall is presented in the following table:

TABLE 1.

THE CALCULATION RESULT
RAINFALL INENSITY

T	R	90%.R	Rainfall Intensity			
			1hr	2hr	3hr	4hr
2	68,52	61,67	24,67	24,67	9,25	3,08
5	76,96	69,27	27,71	27,71	10,39	3,46
10	81,12	73,01	29,20	29,20	10,95	3,65
25	85,30	76,77	30,71	30,71	11,52	3,84
50	87,84	79,06	31,62	31,62	11,86	3,95
100	90,02	81,02	32,41	32,41	12,15	4,05
200	91,91	82,72	33,09	33,09	12,41	4,14

To determine the magnitude of the peak discharge rate changes that occurred in

the Way Kuala Garuntang watershed due to land use and land cover changes need to be simulated with some scenarios of land use change. Scenarios does are :

1. The making of Scenario I: change 30% of empty land into green open spaces.
2. The making of Scenario II: change 30% of empty land in existing condition into green open spaces and convert 50% of agricultural land in existing condition into a residential area.
3. The making of Scenario III: change 30% of empty land into green space, 50% of agricultural land into residential areas and the remaining empty land into residential areas
4. The making of Scenario IV: change all the empty land in existing conditions into residential areas.
5. The making of Scenario V: change all the empty land in existing conditions into commercial areas and services.
6. The making of Scenario VI: change all the empty land on the existing condition into residential areas and 50% of residential areas in existing condition into industrial area.
7. The making of Scenario VII: change all the agricultural land in existing condition into residential areas and change a half of empty land into an industrial area

Run Off coefficient can be used to determine the physical conditions of the watershed. From the run off coefficient for 0,561, it can be stated that Way Kuala Garuntang watershed have unfavorable condition. This is consistent with the statement (Kodoatie and Syarif, 2005 at Girsang 2008) which states that the runoff coefficient is an indicator to determine the physical condition of a watershed. C values ranged between 0-1. Value of $C = 0$ indicates that all the rain water infiltrated into the soil and have interception, contrary to the value of $C = 1$ indicates that the rain water as surface runoff. The good watershed,

C values close to 0 and getting worse of watershed C value closer to 1.

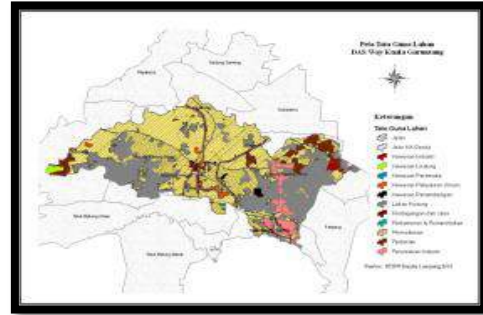


Fig.2 Land Use and Land Cover Of Way Kuala Garuntang Existing Condition

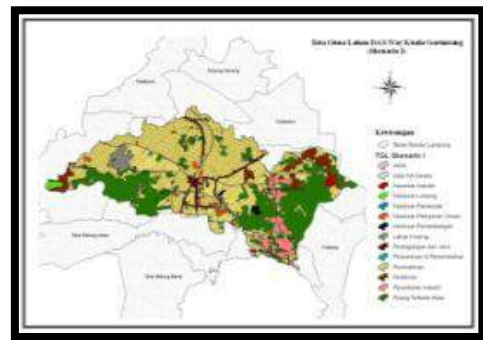


Fig.3 Scenario I Land Use and Land Cover Way Kuala Garuntang

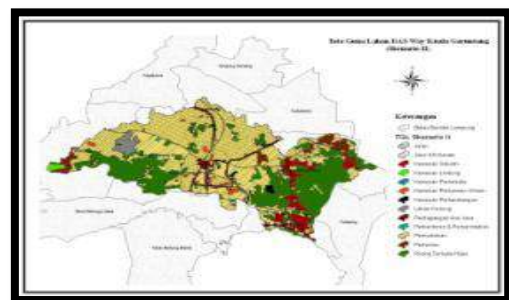


Fig.4 Scenario II Land Use and Land Cover Way Kuala Garuntang

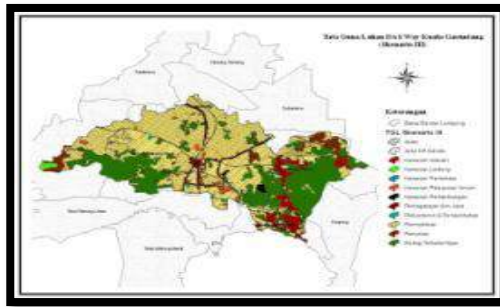


Fig.5 Scenario III Land Use and Land Cover Way Kuala Garuntang

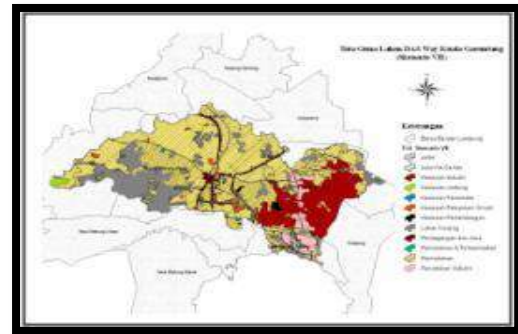


Fig.9 Scenario VII Land Use and Land Cover Way Kuala Garuntang

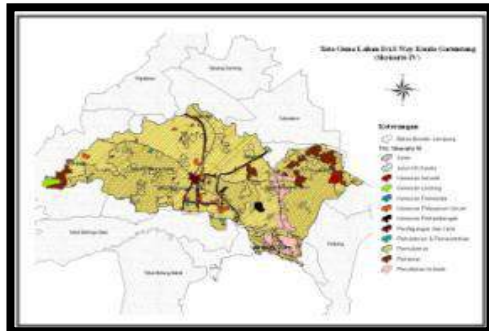


Fig.6 Scenario IV Land Use and Land Cover Way Kuala Garuntang

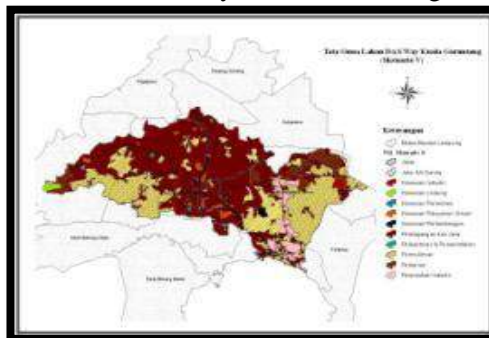


Fig.7 Scenario IV Land Use and Land Cover Way Kuala Garuntang

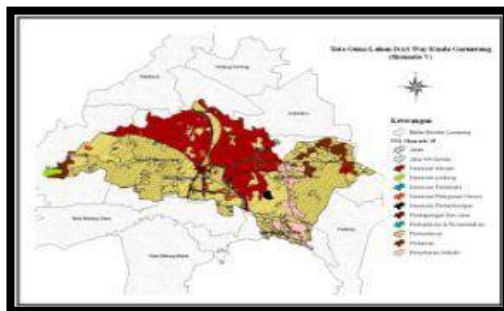


Fig.8 Scenario VI Land Use and Land Cover Way Kuala Garuntang

TABLE 2

RECAPITULATION OF LAND USE AND LAND COVER CHANGES EFFECT FOR DISCARGE

Ret. Per.	Discharge (m ³ /det)							
	Exist. Cond.	Scen I	Scen II	Scen III	Scen IV	Scen V	Scen VI	Scen VII
2	232,30	207,4	215,4	216,1	264,6	298,2	286,4	265,1
5	260,93	233,0	242,0	242,7	297,2	335,0	321,6	297,7
10	275,01	245,5	255,1	255,8	313,2	353,0	339,0	313,8
25	289,18	258,2	268,2	269,0	329,4	371,2	356,5	330,0
50	297,81	265,9	276,2	277,0	339,2	382,3	367,1	339,8
100	305,19	272,5	283,1	283,9	347,6	391,8	376,2	348,3
200	311,61	278,2	289,0	289,9	354,9	400,0	384,1	355,6

TABLE 3

RECAPITULATION OF LAND USE AND AND COVER CHANGES FOR PERCENTAGE OF DISCHARGE

Ret. Per.	Exist. Cond. Q	Discharge Changes (%)						
		Scen I	Scen II	Scen III	Scen IV	Scen V	Scen VI	Scen VII
2	232,4							
5	260,8							
10	274,8							
25	288,8	10,69	7,239	6,967	13,916	28,394	23,287	14,138
50	297,3							
100	304,6							
200	311,0							

From the simulation results can be seen that the ratio of the smallest discharge occurs in a condition in which scenario I made changes on empty land into an open green space. By doing simulations using this scenario I can be seen that the fluctuation of discharge becomes smaller because of the declining value of the run off coefficient (C),

more water can be infiltrated by the land. Another simulation is done by keeping open green spaces are scenarios II and III. However, this scenario does not show a great influence. The result of discharge ratio is not much different from the first conditions, where the ratio of consecutive debits were -10.69%, -7.23% and 6.96%. It is because of the green area which is still 30% than watershed area. Moreover, the pattern of land use and land cover in scenarios II and III are not much different from first condition. An open green space is the area of land around the town whose existence must be established permanently and supported by strong regulations as green areas and free from building structures.

From the result of scenario simulation can be concluded that the actions that keeping the green open space for Way Kuala Garuntang Watershed very necessary. This action need to do for giving a sufficient space for rainfall infiltration in a particular area for the purpose of supplying the needs of ground water and flood mitigation, both the lower and the area concerned.

In the fourth scenario condition, discharge ratio reached a value of 13.91%. It can be interpreted that in this condition the discharge reaching unspread fluctuations. In this condition the availability of 30% green spaces was not kept because there was a conversion all the empty land into residential area.

Land use and land cover alternative scenarios that show the ratio of great discharge occurs in scenario V and VI, where the ratio that resulting are 28,38% and 23,287%. In this condition the actions taken are equally partial change the residential area into commercial and service areas and also industrial areas, in addition to change a half of empty land into residential areas. Further more, there is no green spaces kept in this scenario. The result of this action is less water that soil can do a retention, so greater the rainfall that directly into discharge. The discharge will be higher in rainy season and lower in dry season due to reduced of groundwater recharging. It proves how the green spaces contribution for the

water conservation, especially in relation to supply of stored water.

Scenario VI and VII that do not change the empty land into green space indicates the condition are not too different although still an increase in the ratio compared to scenario I, II and III that keeps the existence of a green space as much as 30% of watershed. This interpreted that changes in agricultural land into residential area or changes in empty land into residential area showed effects that are not much different to discharge fluctuations.

V. CONCLUSIONS

Way Balau, Way Kedaton Way Kuala Garuntang watershed is one of the major watershed in Bandar Lampung with an area 60,39 km² with 11 tributary.

Accordance with Bandar Lampung Spatial Plan 2010, Way Kuala Garuntang Watershed has 11 land cover types other than road and rail links with protected areas covering 4.72% of the total watershed.

After completion of missing rainfall data and consistency test, rainfall data in 2000 for the fourth rainfall stations can not demonstrate consistency of data there is no more rainfall data from four rainfall stations in that year.

Rainfall pattern in Bandar Lampung distributed to 40% in the first hour, 40% in the second hour, 15% in the third hour, and 5% in the fourth hour.

Accordance with Bandar Lampung Spatial Plan 2010, Way Kuala Garuntang watershed have run off coefficient (C) of 0.56.

Measures to maintain the green space for DAS Way Kuala Garuntang is necessary to provide enough space for the infiltration of water rainfall on a particular area for the purpose of supplying the needs of ground water and flood control.

Based on the simulation results using the scenarios I, II and III land use and land cover that keep 30% of the total watershed is green open space, seen a decrease in peak discharge and peak discharge changes significantly.

From the calculated discharge using the broad land use scenario IV, V, VI and

VII are no longer retain wide open green space as much as 30% of the watershed, seen a rise in the value of the peak discharge.

The most extreme flow changes seen in the changing scenario in part V of vacant land into residential areas and some residential land to the trade and services.

The less extensive green open spaces and protected areas in a watershed change in the value of the peak flow will increase.

The use of geographic information systems in the analysis of land use and land cover change on discharge of a watershed is very helpful and makes the system more efficient analysis processes.

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