

# FIRST 2016

Forum In Research, Science, and Technology

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## Renewable Energy for Sustainable Development

# PROCEEDING INTERNATIONAL CONFERENCE

OCTOBER 18-19, 2016



Held by:



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International Conference  
**Forum in Research, Science, and Technology (FIRST) 2016**

October 18 – 19, 2016  
Palembang, Indonesia

Held by:



State Polytechnic of Sriwijaya – Indonesia

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## REMARKS FROM DIRECTOR



AssalamualaikumWaRahmatullahiWaBrakatuh,  
In the Name of Allah, the Most Beneficent, the Most Merciful  
May the peace, the mercy, and the blessing of Allah be upon you.

Distinguished Participants, Ladies and Gentlemen,  
On the behalf of State Polytechnic of Sriwijaya, I would like to welcome you all to the  
International Conference FIRST 2016 on Renewable Energy for Sustainable  
Development

Forum in Research, Science, and Technology (FIRST) is a meeting organised to accommodate researchers, academics, businessman, and government to follow up research results, to identify industry needs and to keep updated with the government policies. This forum has moved from national scale into an international conference which is conducted annually by State Polytechnic of Sriwijaya. This year, FIRST brings a theme "Renewable Energy for Sustainable Development". It is realised that efforts to solve environmental problems that we are facing today need long term potential actions for sustainable development; And renewable energy resources is one of the most appropriate solutions. Therefore discussing about renewable energy automatically deals with sustainable development.

All papers presented in the conference are documented in proceedings. The proceeding features 71 papers divided into several fields including Environment, Biomass to Energy, Renewable Energy, Audit Energy, Technology for Energy, Design/Modelling, Economic Sustainability and Management. In brief, the relations between renewable energy and sustainable development are described with practical cases and several issues relating to renewable energy, environment and sustainable development from both current and future perspectives.

Our thanks are conveyed to the Governor of South Sumatera for providing us direction and views related to the importance of renewable energy resources. Also appreciation and gratitude to the keynote speakers, H. Alex Nurdin, Governor of South Sumatera Province, Prof. TjandraSetiadi, Ph.D., ITB, Indonesia, and Prof. Dr. Werner Rammensee, Cologne University, Germany. Also to invited speakers, Prof. Dr. Erry Yulian Triblas Adesta, International Islamic University, Malaysia, Christian Overfeld, Lucas Nuelle, Germany, Dr. Sonny Zuhuda, International Islamic University, Malaysia, Ir. Tri Mumpuni, Kementerian ESDM dan IBEKA, Indonesia, Ir. Fahrurrozi, M.Si., Business Head Chemicals Group, PT. BASF Indonesia and Head of Business Development, Federasi Industri Kimia Indonesia on their presentation related to renewable energy for sustainable development.

Further we extend deepest gratitude and high appreciation to all presenters and contributors to make this conference possible and these proceedings published. It is realised that publication of these proceedings are still far from being perfect; however, hopefully it will be useful for energy scientist, engineers, policy makers and any other readers as references for enriching their knowledge .

May God bless us all with the health to make this event a successful and enjoyable one!

Thank you.

Dr. Ing. Ahmad Taqwa, M.T.  
Director of State Polytechnic of Sriwijaya

## MESSAGE FROM THE CHAIRMAN

BISMILLAHIROHMANIRROHIM,  
ASSALAMUALAIKUM WW.,  
Good Morning Everyone  
May the peace, the mercy, and the blessing of Allah be upon you.

**The honorable governor of South Sumatra Province, Bapak H. Alex Noerdin**  
**The honorable Director of State Polytechnic of Sriwijaya, Bapak Dr. Ahmad**  
**Taqwa**  
**Distinguishedspeakers, Presenter, Guests, and Participants,**

It is my great pleasure to welcome and thank you very much for your contributions to this renewable energy conference. This conference which will take place on 18 up to 19 of October 2016, is conducted firstly this year through the initiation of Chemical Engineering Department, State Polytechnic of Sriwijaya, aims to exchange the ideas from governments, non-governmental organizations, research and academic institutions, international organizations, and industries, to learn from each other and build on successes that advance renewable energy for sustainable development.

I am very happy to inform that the committee is very lucky to have 3 keynote speakers, i.e Bapak H. Alex Noerdin, the governor of SS province, Prof. Chandra Setiady from ITB Bandung and Prof Werner Ramensee from Cologne University of Germany, who supported us from the very beginning with their capabilities to present, sharing knowledge and experiences with us here as well as the invited speaker i.e Prof. Dr. Erry Yulian Triblas Adesta, International Islamic University, Malaysia, Christian Overfeld, Lucas Nuelle, Germany, Dr. Sonny Zuhuda, International Islamic University, Malaysia, Ir. Tri Mumpuni, Kementerian ESDM dan IBEKA, Indonesia, Ir. Fahrurrozi, M.Si., Business Head Chemicals Group, PT. BASF Indonesia and Head of Business Development, Federasi Industri Kimia Indonesia.

**Distinguished Guests, Presenter, and Participants,**

On this special occasion, I would like to report that the conference manage to succesfully attract more than 71 academician to present their abstract, i.e from Kuwait, Germany, Algeria, Malaysia, Cambodia and of course Indonesia. Amongst others there 69 abstract to be presented in this seminar under professional selective review. And for that reason, I personally would congratulate you all as distinguished speaker to this event.

This conference has collaborated with two international journal i.e Journal of Engineering and Technological Science, ITB and Gadjah Mada International Journal of Business. All selected papers are then peer-reviewed to meet the publication standard. The peer reviewer of each manuscript is rigorous and concentrates on objective and technical concern to determine whether the research has been sufficiently well conceived, executed and described.

### **Excellencies, Distinguished Guests, Ladies And Gentlemen**

I would also like to give special welcome to Lucas Nuelle, PT. Merck Chemicals and Life Sciences, CV. BestariSetiaAbadi, PT. BangunEnergi, PT. Ditek Jaya, PT. Bank MandiriTbk., PT. Indofood SuksesMakmur and individual who support this conference through sponsorship. I believe that we could never thank you enough for that.

Finally, I expect all participants have memorable moment through this conference and enjoy your stay in Palembang, South Sumatra Province, Indonesia. Thank you.

Sincerely  
Chairman of Organizing Committee  
H. Firdaus

**KEYNOTE SPEAKER**



H. Alex Noerdin  
Governor of South Sumatera



Prof. Tjandra Setiady, Ph.D  
ITB, Indonesia



Prof. Dr. Werner Rammense  
Cologne University, Germany

## INVITED SPEAKER



**Prof. Dr. Erry Yulian Triblas Adesta**  
International Islamic University,  
Malaysia



**Christian Overfeld**  
Lucas Nuelle, Germany



**Dr. Sonny Zulhuda**  
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**Ir. Tri Mumpuni**  
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**Ir. Fahrurrozi, M.Si.**  
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# HYDROGRAPH PERFORMANCE OF BENDUNG WATERSHEED IN PALEMBANG CITY

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**Abstract.** During the rainy season, floods has become routine events in several cities in Indonesia. Various reasons to trigger the occurrence of flooding, among other drainage network system capacity is decreased, increasing water flow, or a combination of both. The capacity of the drainage channel has been calculated based on the design criteria to accommodate the flow of water occurs so that the area is not experiencing inundation or flooding. The reduced system capacity due to, among others, many precipitates, physical damage or their network systems and illegal buildings on the system network. While the cause of the discharge increases, among others, high rainfall out of habit, changes in land-use, environmental damage to the watershed in a region.

Cases like mentioned above also occur in Bendung watershed, so it is necessary to study the drainage network system performance evaluation based on the concept of sustainable drainage based on community participation. Good and bad, high and low of the drainage network system performance is large determined by community participation in management, especially with the lack or absence of funds from Palembang city government for the management of drainage network system. Drainage system performance can be evaluated from the technical aspects as well as non-technical. One technical aspect is the frequency analysis to look at the picture unit hydrograph. Analytical results from this study may be that the maximum flow of 25 m<sup>3</sup> per sec at peak hours at the time of 4.8 hours and then slowly starting to go down at a time to 24 hours.

**Keywords:** inter relation, drainage network system, unit hydrograph

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## I. INTRODUCTION

The flood disaster became a regular phenomenon in the rainy season which is spread in different watersheds in most region of Indonesia. Total incidence of flooding in the rainy season over the last 3 years as well as the increasing number of human casualties and loss of property and facilities from public / social, transport infrastructure and infrastructure for agriculture / irrigation.. In addition to the problem of precipitation as factors, the incidence of disasters cannot to be separating from environmental damages to ecosystems that occur in the watershed and poor management of water resources. Their land damage may lead to increased surface runoff coefficient greater. The area upstream watershed is an area of a particle will be increasingly vulnerable to drought, precisely the opposite downstream areas prone to flooding. Flooding is a flow that causing economic losses or even cause loss of life. [2]

Flow can occur because of the outburst in the area in the right or left of the river due to river channel does not have enough capacity for the flow rates through. Flooding is not only experience by urban area located in the lowlands, even experienced area located in the highlands. Flooding or inundation in a region occurs when the system that serves to accommodate the inundation was not able to accommodate the discharge flow, it is the result of three possibility occur : the capacity of the system to decrease the flow rate of water increases, or a combination of both. Understanding the system here is a system of drainage network in a region. [10]

While the drainage system can be generally defined as a series of waterworks that serve to reduce and/or remove

excess water (flooding) of a region or land, so the land can function optimally, so the drainage system is an engineering infrastructure of the region to cope with the inundation floods. [14]

Drainage network system in a region already properly designed to pond normal flow rates, especially during the rainy season. This means that the capacity of the drainage channel is already taken into account to accommodate the flow of water occurs so that the area is not experiencing inundation or flooding. If the capacity of a drainage channel system decreases due to various reasons, the normal discharge even can be accommodating by the existing system.

While declined because drainage capacity, among others, there are many deposition, physical damage tissue system, the other buildings on top of the network system. At certain times during the rainy season is often an increase in the flow rate, or there has been increased discharge caused by various reasons, the capacity of the existing system can no longer accommodate the flow rates, resulting in flooding in a region. While the cause of the increasing discharge including high rainfall out of habit, changes in land use, environmental damage to the watershed in a region. Then if an urban or regional decrease system capacity at the same time an increase in the flow rate, the flooding is increasing, both the frequency, extent, depth and duration.

This means that the capacity of the drainage channel is already taken into account to accommodate the flow of water occurs so that the area is not experiencing inundation or flooding. If the capacity of a drainage channel system decreases due to various reasons, the normal discharge even

cannot be accommodating by the existing system. While declining because drainage capacities, among others, there are more deposition, physical damage tissue system, the other buildings on top of the network system. At certain times during the rainy season is often an increase in the flow rate, or there has been increased discharge caused by various reasons, the capacity of the existing system can no longer accommodate the flow rates, resulting in flooding in a region. While the cause increasing discharge including high rainfall out of habit, changes in land use, environmental damage to the watershed in a region.

## II. METHODS

### A. Location Research

The location research is Bendung watershed. The research location as in figure 3.1. (Figure 1. Map of the location study). [12]



Fig.1. Research location [9]

### B. Tools and Materials Research

The tools will be used in this study are shown in Table 1.

TABLE I  
LIST OF THE TOOLS USED IN THE STUDY

No.	Name tools	Number of uses	Description
1	Stationery	1 box	Data recording
2	Computer (RAM 2 GB)	1 unit	General perform model
3	Printer	1 unit	Display report form
4	Software GIS, Arc-View, MS-Excel	1 piece	To perform modelling and data processing
5	Laptop and Printer	1 unit	Assist in preparing report

Source: author's propose, 2016

## III. RESULTS AND DISCUSSION

### A. Bendung Watershed

Determine of flood discharge plan to do with method of Nakayasu Unit Hydrograph Synthetic. Before entering in the calculating of the discharge planned using data of Nakayasu Synthetic Unit Hydrograph are necessary length of Bendung river. Bendung watershed divided into sub watershed with the Global Mapper program. Bendung division can be seen in figure 2. [12]

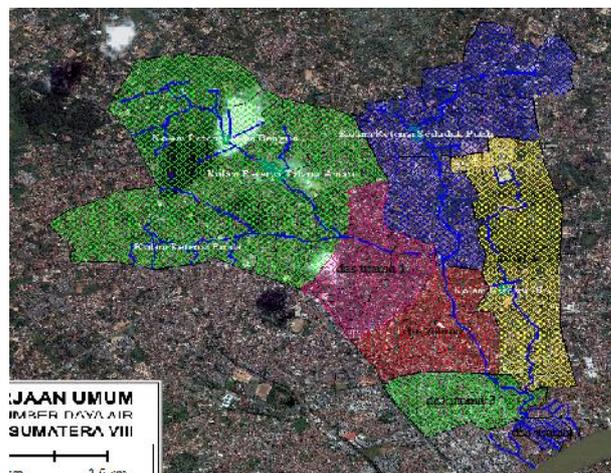


Fig. 2. Distribution of Bendung sub-watershed with Global Mapper program [5]

### B. Rainfall

Rainfall data used for 23 years, from 1991 through 2013. The data attached to the rainfall data hourly. Rainfall data can be seen in Table 2.

TABLE II  
SHORT-TERM DATA MAXIMUM RAINFALL

Years	Duration 60 minute	Years	Duration 60 minute
1991	73.50	2003	71.50
1992	80.10	2004	80.00
1993	55.70	2005	91.90
1994	48.50	2006	60.90
1995	60.00	2007	65.00
1996	47.20	2008	86.00
1997	91.80	2009	79.50
1998	52.30	2010	90.00
1999	73.50	2011	80.00
2000	70.40	2012	86.93
2001	77.00	2013	77.63
2002	60.90		

Source: BMKG Kenten, 2014

TABLE III  
RAINFALL INTENCITY

Years	Intencity (mm/hours)	Years	Intencity (mm/hours)
1991	73.50	2003	71.50
1992	80.10	2004	80.00
1993	55.70	2005	91.90
1994	48.50	2006	60.90
1995	60.00	2007	65.00
1996	47.20	2008	86.00
1997	91.80	2009	79.50
1998	52.30	2010	90.00
1999	73.50	2011	80.00
2000	70.40	2012	86.93
2001	77.00	2013	77.63
2002	60.90		

Source: BMKG Kenten, 2014

C. Frequency Analysis

Before analyzing rainfall distribution, first determine the parameters of existing statistics. Then calculate the total amount, the amount of data (n), the maximum data Ri average, standard deviation (S), Coeffisien of Variation (Cv), Coeffisien of Skewness (Cs), and Coeffisien of kurtosis (Ck).

The result of the calculation as follows:

- a. Total amount = 1660.26 mm / hour
- b. Total rainfall data, n = 23
- c. On average Ri = 72.18 mm / h
- d. The standard deviation (S) = 13.66
- e. Variation Coeffision (Cv) = 0.19
- f. Skewness Coeffision (Cs) = -0.34
- g. Kurtosis Coeffision (Ck) = -0.90

D. Intensity Rainfall

The intensity of rainfall that is used is the rainfall intensity data from the calculation of the Normal Distribution.

TABLE IV  
RAINFALL INTENSITY

R (Year)	X <sub>T</sub> (mm/hours)
2	72.18
5	83.66
10	89.67
20	94.59
50	100.19
100	104.01

Source: analysis result, 2016

Period re-elected for further calculations that the return period of 2 years.

E. Runoff Coefficient

Runoff coefficient reflects the state of the surface flow area. Drainage coefficient, C is the ratio of the volume of water that reached the mouth of the river basin with the volume of water that fell on the watershed. Value for C drainage coefficient, be see in Table 5.

Data obtained from Bappeda Kota Palembang, extensive land use for residential areas :

Size high density = 7.09 km<sup>2</sup>

Extensive catchment area = 7.37 km<sup>2</sup>

Comprehensive trade area = 4.73 km<sup>2</sup>

Based on the flow coefficient table 5 for residential areas with a high density area and retrieved 0.70 to 0.20 wide catchment areas taken as well as to extensive trade area taken 0.90.

Then the value Cw: runoff coefficient values obtained, Cw = 0:56 and in the calculation taken Cw = 0.60.

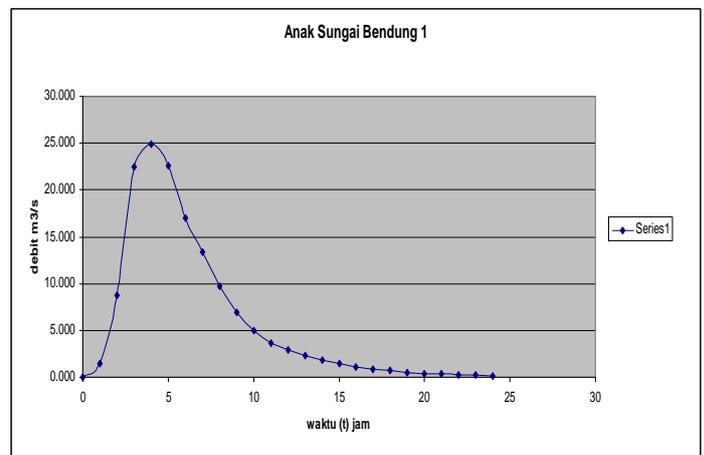
TABLE V  
RUNOFF COEFICIENT

Region	Land use	Cw
Urban	Rural Settlement Region:	
	- Low density	0,25-0,40
	- Middle density	0,40-0,70
	- High density	0,70-0,80
	- With wells impregnation	0,20-0,30
	Trade zzone	0,90-0,95
Rural	Industry region	0,80-0,90
	Parks, green lanes, gardens, etc.	0,20-0,30
	Hills, slopes < 20 percent	0,40-0,60
	Canyons region, the slope of > 20 percent	0,50-0,60
		0,25-0,35
	Land with terracing Rice fields	0,45-0,55

Source: PUBM-SDA, 2014

D. Discharge Curve

Once the entire value discharge curve for each interval time is unknown, enter this value in the table below to get the value of run-off that occurs on an hourly basis with certain variations in rainfall. Unit hydrograph of Bendung watersheed can be seen figure 3.



Source: analysis result, 2016

Figure 3. Uunit Hydrograph Synthetic of Bendung watershed [12]

## IV. CONCLUSIONS

Cases like mentioned above also occur in Bendung watershed, so it is necessary to study the drainage network system to evaluation performance on the concept of sustainable drainage based on community participation. Drainage system performance can be evaluated from the technical aspects as well as non-technical. One technical aspect is the frequency analysis as a figure of unit hydrograph where the result from the figure that the maximum flow of 25 m<sup>3</sup> per sec at peak hours at the time of 4.8 hours and then slowly starting to go down at a time to 24 hours. [12]

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