# GENERAL RAINFALL INTENSITY PATTERN ENFORCEABILITY EMPIRICAL

## (Verification and Adaptation for Java Region and Central and Eastern)

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***Abstract*- this study entitled "Development of Rain intensity Formula Pattern Based on Empirical and Virtual Zone Fisiomorfohidro in Java" is planned for a period of 3 (three) years. The research was conducted within the framework of formulating a more accurate rainfall intensity in accordance with the characteristics of the area concerned. Basic initial development of this research is that some formulations of determining the pattern of rainfall intensity as proposed by Talbot, Sherman, Ishiguro and Mononobe discount some weaknesses that such formulations were developed outside of Indonesia, so that when it is applied to the area of Indonesia should be an adjustment to be applied in Indonesia appropriately. The main objective of the implementation of this research is to develop and define the areas that have the characteristics of the physiographic, topographic and Isohyets (fisiomorfohidro) are the same, decisive pattern (equation) rainfall intensity representing every region (zone) fisiomorfohidro, and specify zoning rainfall intensity in Java Central. The results of this review helpful to various aspects of the field of water resources engineering and also can be applied as updating and development of geography, particularly with regard to the science of hydro-climatology. Another advantage of this research is in terms kebaharuannya in the fields of research, such as originality, which, after the analysis has been no similar studies that develop and also the result of constant and accommodate differences in the characteristics of the region. Results of the study showed that while Central Java has 66 units fisiomorfohidro. Final equation to model the rainfall intensity as a function of the probability (p) and duration (t) of rain is: I _ ((t, p)) = 26,431e ^ (- 0.016 p) -38,826e ^ (- 0,015 p) t ^ ( -0.25). Model rainfall intensity as a function of probablitias (P) and duration (t) of rain accurate for use in the prediction of rainfall intensity in the area surrounding the station location recording rain is the source of data modeling intensity of rain.**

*Keywords; rainfall intensity, distrubusi rain, rain formula, fisiomorfohidro, rain empirical, Central Java, Java.*

## I. INTRODUCTION

The rain is a natural phenomenon that is dynamic. Existence will change following perunaha environmental conditions. Many scientists argue that the current natural conditions, a rainy one, has experienced the movement of anomaly, ie, toward an unpredictable pattern as before. This has become one of the factors why the phenomenon of rain is always interesting to study.

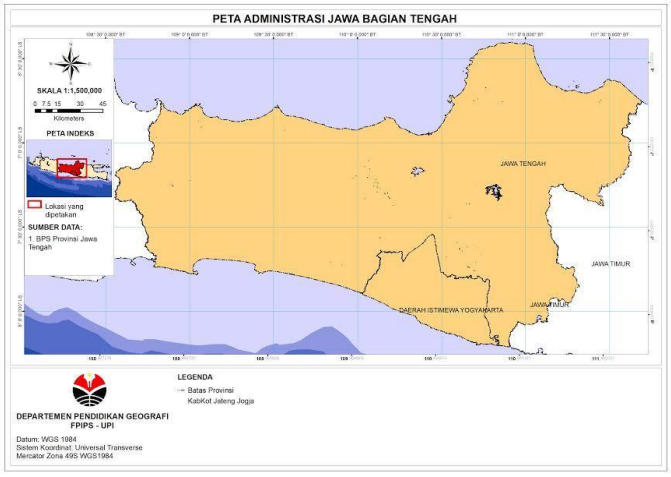
In 2006 until 2010, Rohmat been researching and formulating a general pattern of rainfall intensity as a function of duration and probability of rain that developed in West Java and Banten. Kemudin in 2014. In 2014, compilation and compilation maps fisiomofohidro inensitas rainfall patterns for the region of western part of Java Island (Prov. Of West Java and Banten). In this year also created a development to see the representation of the pattern of rainfall intensity approach to the development of rainfall station virtual island of West Java.
The challenge berikitnya was to test the applicability of these results in other regions, especially for the area of Java island, namely, Java Island Central. Verification keberalakuan pattern of rain intensity is very important for the Central part of Java Island, considering the geographical characteristics very different from the western part of Java Island. If the results of the verification requires correction and adaptation, hence in this research will be conducted, in order to obtain a common pattern and constant rainfall intensity that apply to the entire area of the island of Java.
The general objective of the study is to compile the map Fisiomorfohidro for the entire territory of the island of Java, and developed a formula rainfall intensity in order apply comprehensively in the various characteristics of the area of Java. The general objective is achieved through specific objectives are as follows:

Develop Map Fisiomorfohidro in Java Island Central Section, as has been done for the island of West Java.

1) Verify keberlakauan general pattern of rain intensity in the area of Java Central Section, based on empirical data area concerned
2) Adapting the general pattern and kosntanta the rainfall in Java Island Central Section, if the results of verification needed.
3) Develop map Fisiomorfohidro Java Island, as the results of previous studies
4) Recommends enforceability pattern of rain intensity for the whole island of Java.

## II. METHOD

### A. Location




*Source: research Findings, 2016*

Figure 1: Map of Central Java Administration

research location is in Central Java. The choice of location for the test keberakuan previous research to be used for the entire island of Java.

### B. Method

Process pelaksnaan overall study is as follows:

1) Inventory of rainfall data in the duration menitan and hourly (5-10 years) representing the zoning of the island of Java Central, and Eastern.
2) Grouping rainfall intensity data according to the duration of the group menitan andhourly.
3) Analysis of the data to get the value constants probability and duration of rainfall
4) circuit analysis phase are:
   - *Test of homogeneity of*data;the data that are *outliers* excluded from analysis.
   - *Test data*normality;done to see if the data are normally distributed or not. If the spread is normal, then the transformation semilog. In this case the transformation of the logarithm base 10 of the rainfall intensity data.
   - *Ordering*data.In each group duration of rainfall, rainfall intensity sorted from high intensity to low intensity *(descending).*
   - The calculation of the probability of rain by using equation (6),

     $$p = \frac{m}{N+1}\ x\ 100\%$$

     with p = probability (%); m = the serial number of the data after the data is sorted in *descending*order;and n = number of data.
   - The formulation of the equation the relationship between the probability of rain with rainfall intensity, for each group duration of rainfall, so the equation $It = f(p) It = f(p)$
   - Calculating the value of rain intensity projection for the value of a certain probability. In this case calculated for p = 5 up to 95% at intervals of 5%, so that the value projected rainfall intensity according to the value of interval probabilities of rain are in each group t.
   - Formulation of linear equations between rainfall intensity as a function of t at each interval values probability of rain. To obtain a good relationship patterns, duration of rainfall t, transformed into (1 / t). Retrieved linear $Ip = a + b\ .(1/t)$ $Ip = a + b\ .(1/t)$relationship.
   - Values coefficients a and b of the equation (relationship) above linear probability interval can be sorted by value.
   - The formulation of the relationship between: (A) p with coefficients a; and (B) p with coefficients b. In the case of this form of relationship is an exponential relationship.
5) Analysis of the data to get the full intensity of the formula which is a function of the probability and duration of rainfall that represent each zoning Central Java and East Java. The activities include:
   - Preparing the similarities end, includes the substitution of the equation (A) and (B) in the form of the $Ip = a + b\ .(1/t)$ $Ip = a + b\ .(1/t)$equation;
   - Simplifying the equation to obtain It, p = f (t, p).
6) Verification and adaptation equations / formulas:
   Verification is done in two ways , namely: comparing the intensity of rainfall rainfall intensity model results with empirical ($I_e$)as a baseline; and comparing the intensity of the rainfall model results with the results of the calculation of other existing methods (Talbot, Sherman, and Ishiguro).

## III. RESULTS AND DISCUSSION

### *C. Overview Research Area*

Research location is in Central Java, which surrounds Yogyakarta and Central Java Province. Rain station which is used as basic data for the research that station and the station Ahmad Yani Rain Rain Tegal. The physiographic conditions in the study area is dominated by alluvial plains of Central Java, Java depression Twngah, Volcano Quaternary, South Mountain Java, and South Serayu Mountains. (See Figure 2). Sedangkah study area rainfall is 1000-6500 mm / year. But is dominated by rainfall from 2000 to 2500. (See Figure 3).

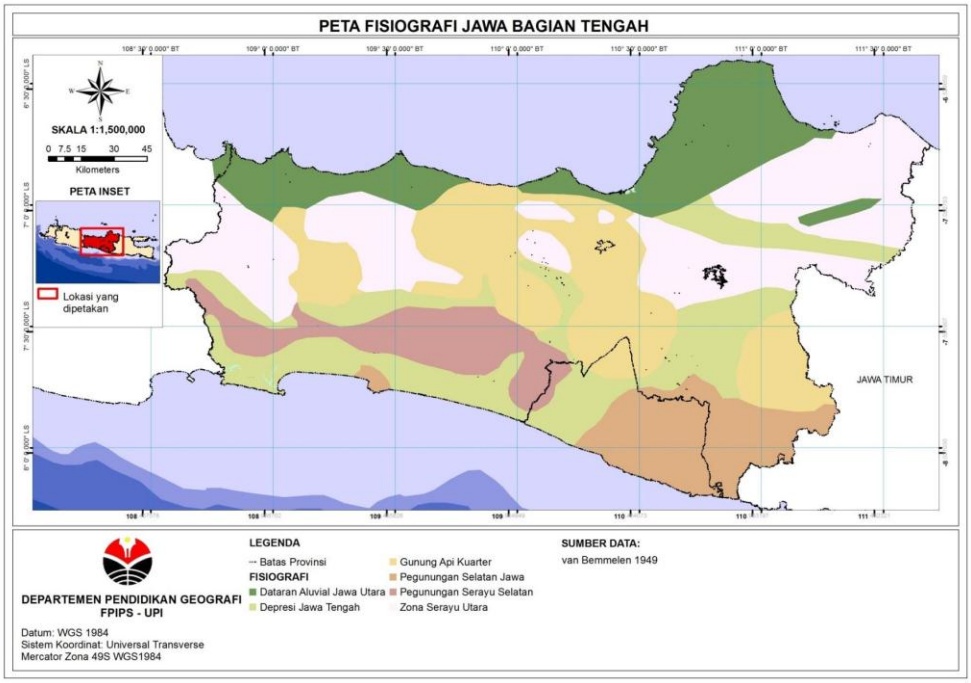



Figure 2: Map Physiographic Central Java

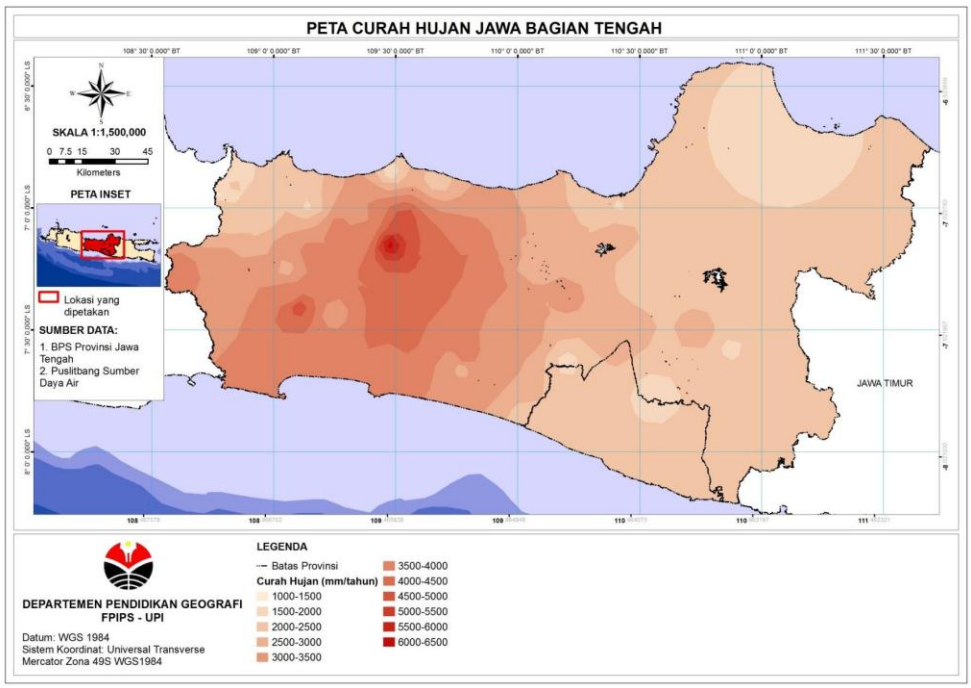



Figure 3: Map of Rainfall Central Java

*D. Mapping Fisiomorfohidro Central Java*

Mapping fisiomorfohidro using overlaying system. Tumpangsusun map is the process of combining multiple maps at the same location and scale. The maps are in overlaykan consists of a topographical map, and maps Isohyets physiographic map that was created earlier. For the purposes of the application used Geographic Information Systems (GIS). Results overlaying a map is a map of composite / composite per unit of land in it is a combination of morphological conditions, altitude and rainfall.

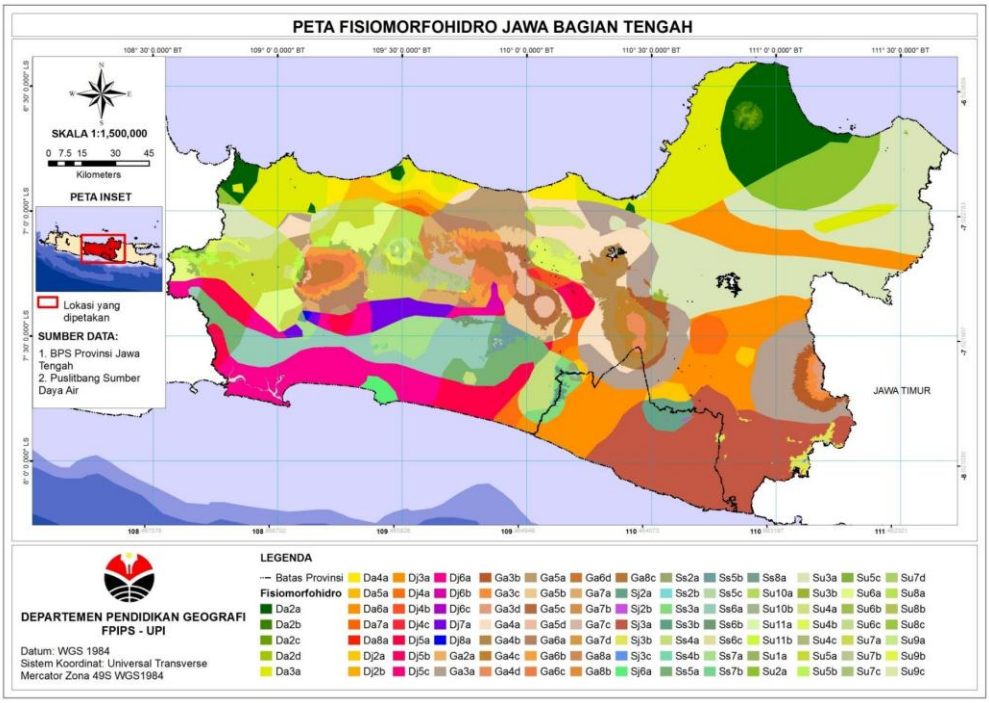



Figure 4 Map Fisiomorfohidro Central Java

In Figure 4 can dilihatsebaran fisiomorfohidro region of Central Java. The map was created Based on physiographic conditions, rainfall, and topography. With the following information.

- The symbol first two letters indicate the condition of the physiographic
- symbol both shows rainfall
- third symbol shows the topography

According to analysis performed using mapping software with the system overlaying, there are 135 zones fisiomorfohidro in Java Midsection.

*E. Modeling intensity of rains*

Modeling done through several stages. Among them is the homogeneity test data is the intensity of the rain, the normality test of data, sorting data, calculating the probability of rain, formulation relational equation of probability with the intensity of the rain, in order to obtain projections of rainfall intensity (I) using the final equation as follows.

1. Meteorological Station Ahmad Yani

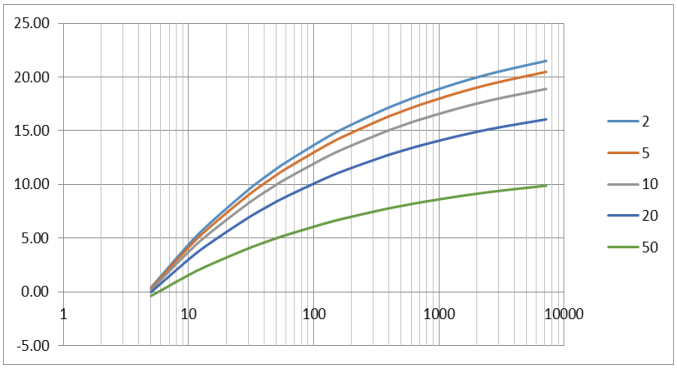
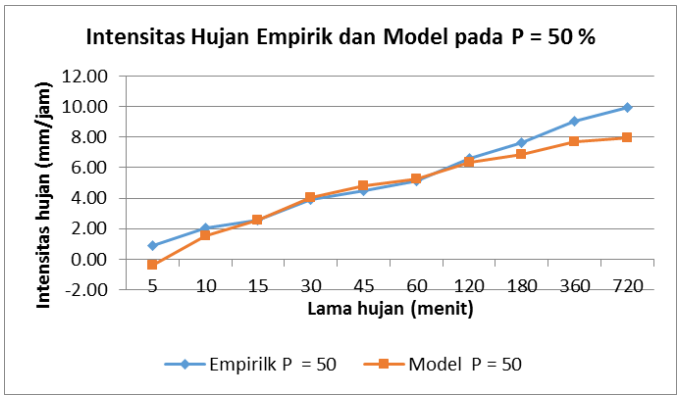


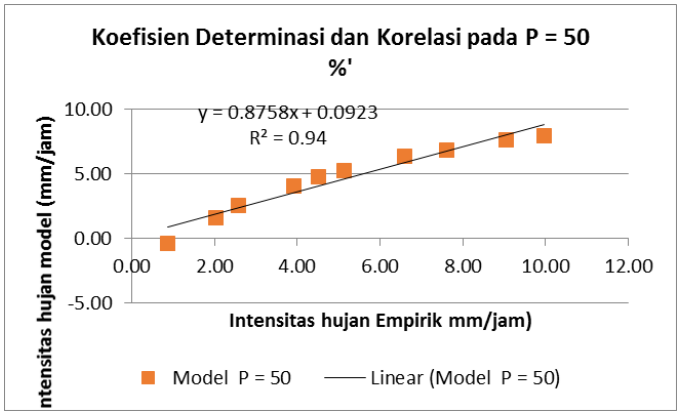

Figure 5 Graph Intensity rain as a function of the probability (P) and duration (t)

Further test vaidasi to find a model rainfall empirically as follows.




*Source: Research Findings, 2016*

Figure 6 Plot Data intensity rain Results Model and intensity of rain empiric at p = 50%




*Source : Research, 2016*

Figure 7 the R2 for rain intensity empirical Data and Model at P = 50%.

the coefficient of determination ($R^{2)}$for the connection of empirical rainfall intensity data and models at the p = 0.94 or 50% is the value of r = 1. therefore, the two sets of data have very high levels of closeness, such results also occur in rainfall intensity data for other probability values as presented in the following table.

table 1 Values R2 and r to some value P

| T | P (%) | R ^ 2 | r |
|---|---|---|---|
| **2** | 50.0 | 0.9400 | 1 |
| **5** | 20.0 | 0.9306 | 1 |
| **10** | 10.0 | 0.9549 | 1 |
| **20** | 5.0 | 0.9255 | 1 |
| **50** | 2.0 | 0.9207 | 1 |

*Source: Results Sports Data*

The result gave the conclusion that the model of rainfall intensity as a function of probablitias (P) and duration (t) of rain accurate to be useful in predicting the intensity of rainfall in the area surrounding the station location recording rain is the source of data modeling intensity of rain.

2. StationsTegal meteorological

Substitutionequation (A) and (B) to an equation Ip = a + b. (1 / $t^{0.25)}$generate rain intensity models:

$$I_p = 29,735e^{-0,016\,p} + 44,166e^{-0,016\,p}\ (\frac{1}{t^{0,25}})$$

$$I_p = 29,735e^{-0,016\,p} + 44,166e^{-0,016\,p}\ (\frac{1}{t^{0,25}})$$

**(2)**

Model the rainfall intensity equation can be simplified to it, p = f (t, p) as follows.

$$I_{(t,p)} = 29,735e^{-0,016\,p} + 44,166e^{-0,016\,p}\ t^{-0,25}$$

$$I_{(t,p)} = 29,735e^{-0,016\,p} + 44,166e^{-0,016\,p}\ t^{-0,25}$$

**(3)**

equation (3) is the final equation to model the rainfall intensity as a function of the probability (p) and duration (t) of rain.

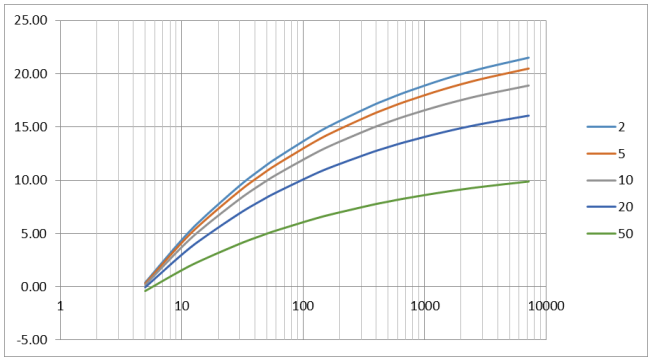



Figure 8 Graph intensity rain as a function of the probability (P) and duration (t)

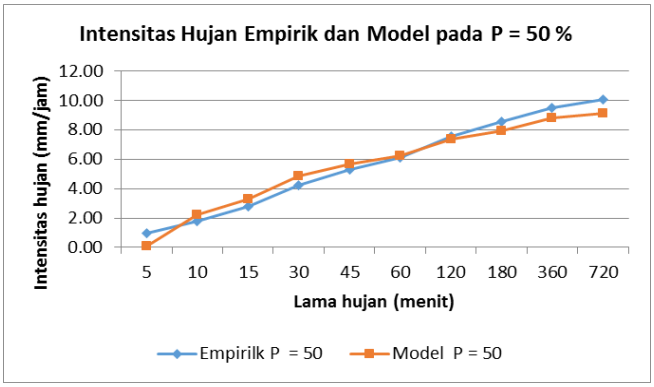



Figure 9 Plot intensity rain Results Model and Results empirical at p = 50%

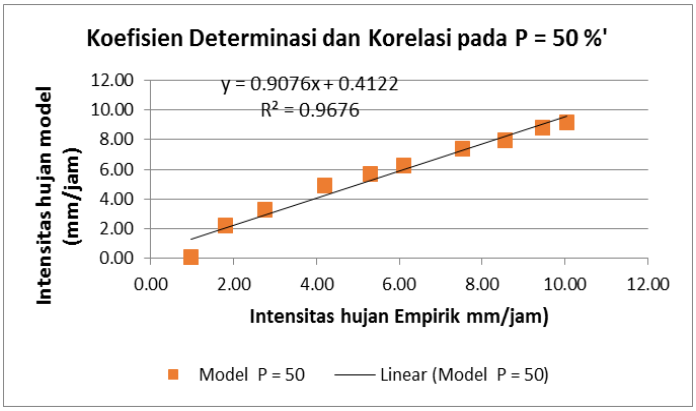



Figure 10 the R2 for Data intensity rain empirical and Model at P = 50%

coefficient of determination (R2) for the data relationship rainfall intensity empirical and model of the p = 0.94 or 50% is the value of r = 1. therefore, the two sets of data have very high levels of closeness, such results also occur in rainfall intensity data for other probability values as presented in the following table.

table 2 the R2 and r for some value P

| T | P (%) | R ^ 2 | r |
|---|---|---|---|
| | | | |
| | | | 2 50.0<br>0.9676<br>0.9837 5<br>20.0<br>0.9634<br>0.9815 |
| | | | |
| | | , 9535 | 0.9765 |
| **50** | 2.0 | 0.9626 | 0.9811 |

*Source: Data Sport*

the result gave the conclusion that the model of rainfall intensity as a function of probablitias (P) and duration (t) of rain accurate for use in the prediction of the intensity of the rain on the region about the location of stations recording rainfall which is the source of data modeling intensity of rain.

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