COMPARISON OF RAINFALL DATA MANAGEMENT BETWEEN INDONESIA AND JAPAN

Intan Supraba[1]

[1]Civil Engineering and Environmental Departement, Universitas Gadjah Mada, Yogyakarta
E-mail: intan.supraba@ugm.ac.id

Abstract. President Joko Widodo administration has launched infrastructure megaprojects development in Indonesia such as build of 3,733 kilometers of new toll roads, 49 dams, bridges, and mega power plant projects with a total capacity of 35,000 megawatts. Civil construction requires rainfall data to design road drainage channel, to calculate reservoir water level fluctuations, to determine the distance between the bottom of the bridge and the water surface, to simulate flood, and to manage water resources. As rainfall data has an important role in infrastructure development, this study aims to compare the rainfall data quality and the ease of access to get that data based on case study between Japan and Indonesia by doing literature review. Results showed that in Japan, hourly rainfall data can be easily and freely accessed from Water Information System website provided by Ministry of Land, Infrastructure, Transportation, and Tourism. Flood warning also can be simply accessed in Japan Meteorological Agency website. In Indonesia, hourly rainfall data is not available in the website, thus users need to submit an official request for obtaining the data. Comprehensiveness of data is questionable. Thus, data management including adding observatory facilities should be improved to support acceleration of infrastructure development in Indonesia.

Keywords: case study in Japan and Indonesia, literature review, rainfall data management.

I. INTRODUCTION

Year 2017 is the third year of National Development Plan for the period from 2015 to 2019. President Joko Widodo administration has launched infrastructure megaprojects development in Indonesia to increase Indonesia economic growth around 5.14% in the year 2017. The projects including construction of 3,733 kilometers of new toll roads, 49 dams, bridges, and mega power plant projects with a total capacity of 35,000 megawatts.

Civil construction requires rainfall data to design road drainage channel, to calculate reservoir water level fluctuations, to determine the distance between the bottom of the bridge and the water surface, to simulate flood, and to manage water resources. To design a drainage channel, the length of annual maximum daily rainfall data at least 20 years. However, the rainfall data availability in Indonesia is questionable. Indeed, it is common that users need to pay to the relevant agency for obtaining the required data. Compared to Japan, the rainfall data can be freely accessed in the website (http://krjogja.com/web/news/read/783/Mitigasi_Bencana_Alam).

Thus, the aims of this study are to compare the rainfall data quality and the ease of access to get that data based on case study between Japan and Indonesia by doing literature review.

II. RAINFALL DATA IN JAPAN

Rainfall data in Japan is provided at Water Information System produced by Ministry of Land, Infrastructure, Transport, and Tourism at the online website (http://www1.river.go.jp/) (see Figure 1).

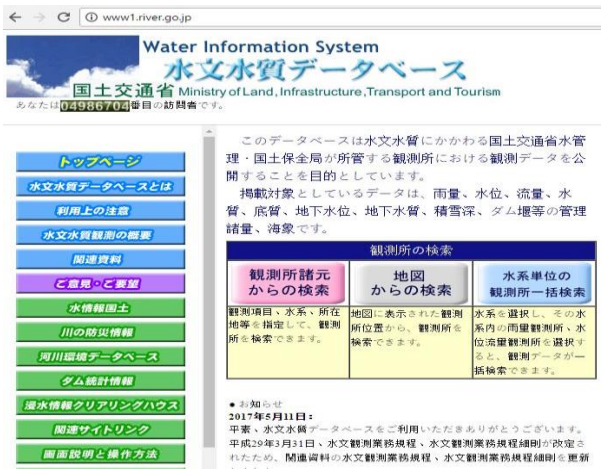

Figure 1. Water information system in Japan

e-ISBN: 978-979-587-734-9

There are several observation stations such as rainfall observatory, water level observation station, water quality observatory, ground water level observatory, snow depth observatory, dam, and oceanographic observatory as presented in Figure 2.

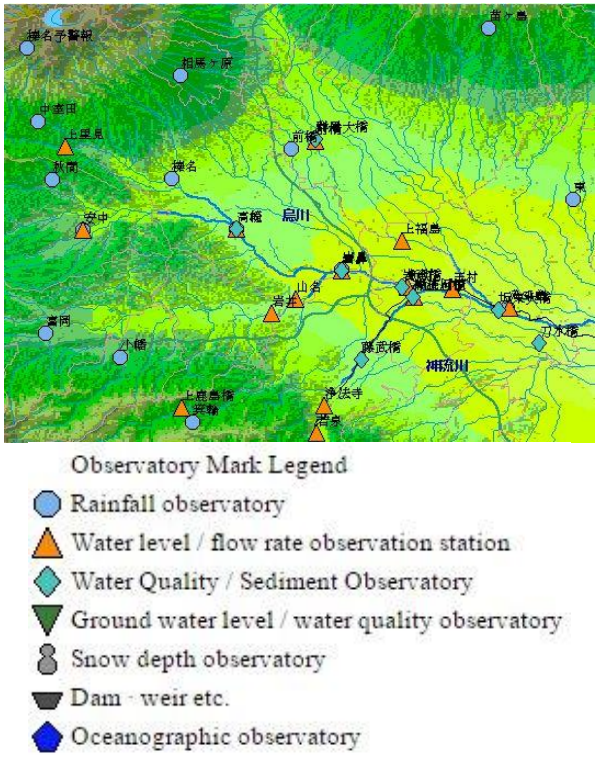

Figure 2. Observatory stations in Japan

When one of the symbols in Figure 2 is clicked, then the information can be obtained. For example, when the symbol of rainfall observatory is clicked, then the information of name and number of rainfall observatory will be appeared (see Figure 3).

Observatory symbol	Observatory classification	Observatory name	More detail
101031281101700	The rainfall measured sightseeing	South Naganuma	More detail

Figure 3. Name and number of rainfall observatory

When the "more detail" in Figure 3 is clicked, then information as can be seen at Figure 4 will be appeared

水文水質観測所情報

観測所名	南長沼（みなみながぬま）
観測項目	雨量
観測所記号	101031281101700
水系名	石狩川
河川名	千歳川
所在地	北海道夕張郡長沼町883番の3
緯度経度	北緯 42度56分56秒 東経 141度43分04秒

位置図 観測所詳細諸元

雨量月表検索 雨量年表検索 経年雨量状況検索 任意期間雨量検索 リアルタイム雨量 川の防災情報

Figure 4. Details information of observation

Although that information is written in Japanese, but it can be automatically translated into English. By clicking the symbol circled in red (see Figure 4), then Figure 5 will be appeared.

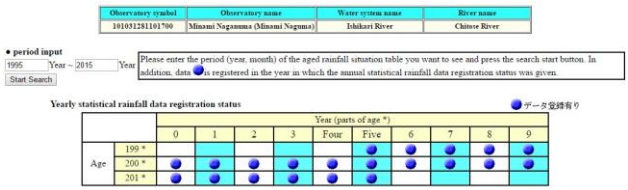

Figure 5. Information of a selected rainfall observatory

By inserting data of the rainfall period into the column "period input" in Figure 5, and click the "Start Search" button, then the rainfall data can be obtained as presented in Table 1. Some information is annual precipitation (mm/year), the number of rainy days in a year, annual maximum monthly precipitation (mm/month), annual maximum daily precipitation (mm/day), and annual maximum hourly precipitation (mm/hour) including the occurrence time.

The information of annual maximum hourly precipitation is the required input data for calculating peak discharge. The peak discharge can be calculated by using a rational method as follows:

$$Q = 0.278CIA \quad (1)$$

Which:

Q = peak discharge (m^3/s)
C = surface runoff coefficient
I = rainfall intensity (mm/hour)
A = catchment area (km^2)

After obtaining the value of peak discharge using Eq. 1, then the dimension of drainage channel can be simulated. There are many types of drainage channel such as road drainage channel, airport drainage channel, and soccer field drainage channel.

The value of annual maximum hourly precipitation is also used for water conservation study to know how much water can be stored in the ground when it rains. Water conservation is the new drainage concept which rain water does not quickly drain out to the nearest drainage channel, but it is artificially infiltrated to the ground especially if the soil profile is sand type.

And by getting the information of hourly precipitation, a study of potential catchment storage for 23 catchments in Japan has been conducted with result showed that the catchment capacity to store rain water when it rains varied from 81.8 mm to 170.9 mm (Supraba and Yamada, 2015). By knowing the storage capacity of a catchment, then it can be predicted that the remaining water that cannot be stored then will be overflow and contributes to the flood event.

The information of the rainfall data is also being used for flood early warning system as can be seen at Japan Meteorological Agency website (http://www.jma.go.jp/jma/indexe.html). The warning whether a region is having emergency warning (purple

color), warning (red color), advisory (yellow color), or no warning at all (grey color) is provided every time based on real time monitoring as can be seen at Figure 6.

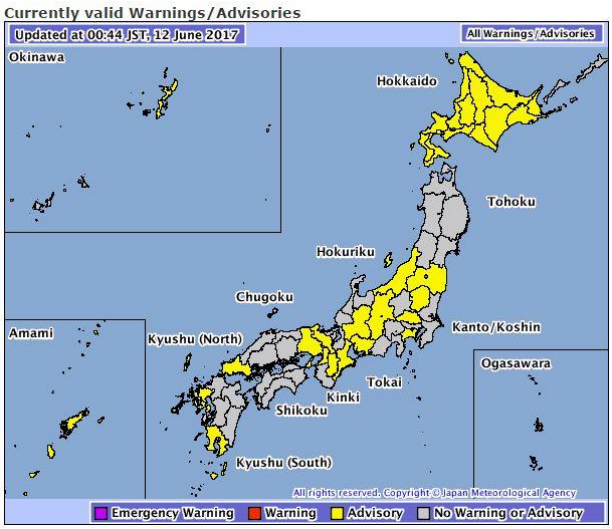

Figure 6. Early warning system of flood disaster (Source: http://www.jma.go.jp/en/warn/)

The warning of flood disaster in Figure 6 is taken on 12 June 2017 at 00:44 JST. It showed that Hokkaido Island and some regions in Honshu Island under category advisory as presented in yellow color.

The rainfall data is observed by using The Automated Meteorological Data Acquisition System (AMeDAS). The AMeDAS observation network is presented in Figure 7.

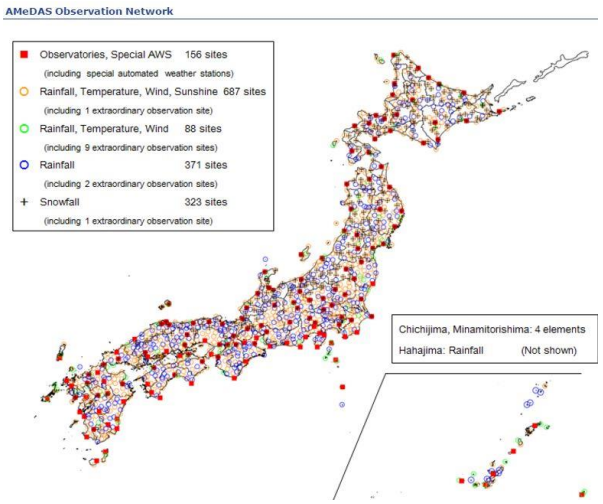

Figure 7. AMeDAS Observation Network (Source: http://www.jma.go.jp/jma/en/Activitiesamedas/amedas.html)

The hourly rainfall data in Figure 8 is taken on 12 June 2017 at 00:55 JST. It showed that the maximum hourly rainfall during that time was 50 mm/h. As in the Yamanashi Prefecture and Saitama Prefecture, the hourly rainfall during that time was in the range of 1-10 mm/h.

The recorded temperature on 12 June 2017 at 01:00 JST showed that many prefectures in Honshu Island experienced 20°C during that time (see Figure 9).

Table 1. Rainfall data at Ishikari River water system

Year	Annual Precipitation (mm/year)	Precipitation (number of days)	Maximum month (mm/month)		Maximum day (mm/day)		Maximum time (mm/h)	
			Precipitation	Month of occurrence	Precipitation	Month of occurrence	Precipitation	Month of occurrence
1995	60	19	55	November	10	23-Nov	5	November 26th at 23.00
1996	645	88	130	August	70	23-Aug	23	August 23rd at 09.00
1997	850	86	258	August	66	10-Aug	33	July 29th at 13.00
1998	795	97	152	September	78	16-Sep	16	July 8th at 18.00
1999	924	143	211	August	66	02-Aug	39	August 6th at 09.00
2000	1264	174	251	July	106	13-May	19	July 25th at 06.00
2001	773	105	226	September	134	11-Sep	11	September 11th at 06.00
2002	895	151	163	October	55	11-Jul	14	June 16th at 06.00
2003	796	140	150	August	85	09-Aug	32	October 23rd at 05.00
2004	836	160	118	September	57	20-Aug	11	July 26th at 22.00
2005	984	157	216	August	99	07-Sep	20	August 2nd at 24.00
2006	889	170	149	November	56	18-Aug	19	August 18th at 03.00
2007	735	139	164	September	47	28-Jul	26	September 06th at 24.00
2008	725	166	145	August	56	29-Aug	18	August 29th at 05.00
2009	941	166	221	July	106	Sep-07	23	July 8th at 11.00
2010	Missing	Missing			43	12-Aug	13	September 28th at 21.00
2011	1099	168	239	September	40	04-Sep	19	July 10th at 01.00
2012	984	150	202	September	70	09-Sep	28	September 09th at 24.00
2013	1056	133	241	August	50	27-Aug	25	August 27th at 15.00
2014	871	119	212	August	73	12-Jun	43	September 11th at 07.00
2015	946	116	190	September	85	03-Jun	31	March 06th at 18.00

e-ISBN: 978-979-587-734-9

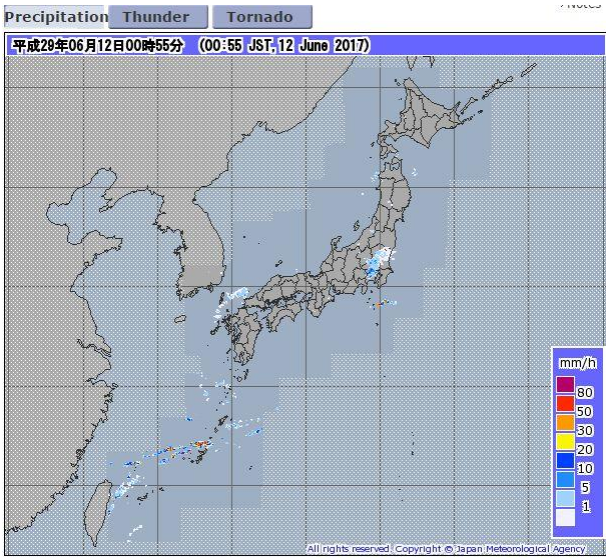

Figure 8. Hourly rainfall data obtained from weather radar (Source: http://www.jma.go.jp/en/radnowc/)

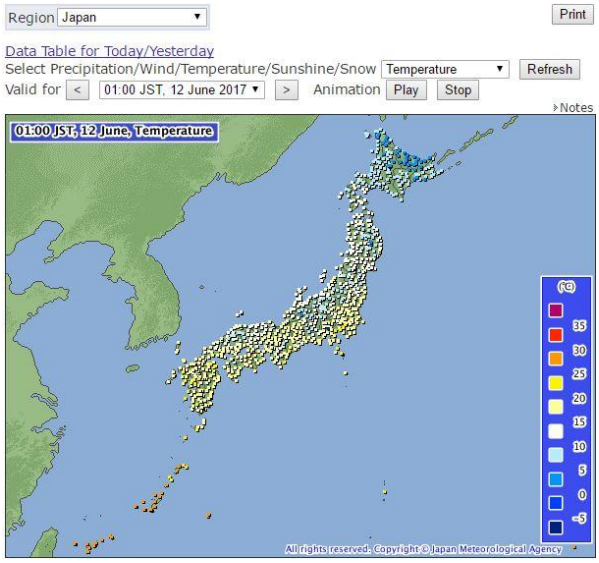

Figure 9. Temperature on 12 June 2017 at 01:00 JST (Source : http://www.jma.go.jp/en/amedas/)

III. RAINFALL DATA IN INDONESIA

In Indonesia, hydro meteorological data is provided by Badan Meteorologi, Klimatologi, dan Geofisika (http://www.bmkg.go.id). The weather forecast for temperature on 11 June 2017 at Yogyakarta city is shown at Figure 10.

Weather radar image taken on 11 June 2017 at 16:37 UTC is presented in Figure 12.

Rainfall intensity measurement by using weather radar is measured based on reflectivity having unit dBZ (decibel). A bigger value of dBZ reflectivity shows a bigger value of rainfall intensity. The scale of dBZ in the map legend is in the range of 5 - 75 that is showed in the color gradation ranging from blue to purple. If the color gradation tends to the purple color, then the rainfall intensity tends to be higher. Conversion value of rainfall intensity from dBZ unit to mm/h unit is shown at Table 2.

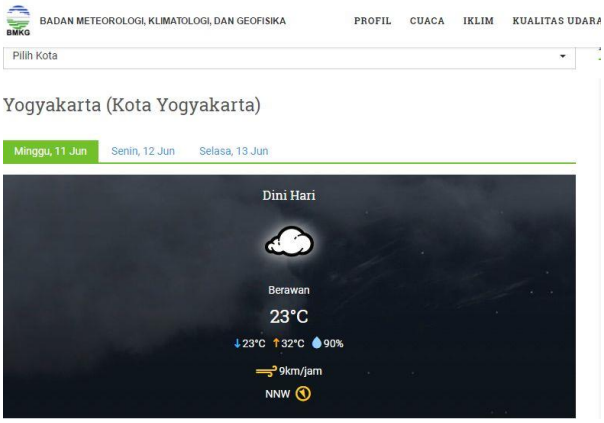

Figure 10. Temperature on 11 June 2017

In the website, the analysis of rainfall intensity on April 2017 is provided (see Figure 11).

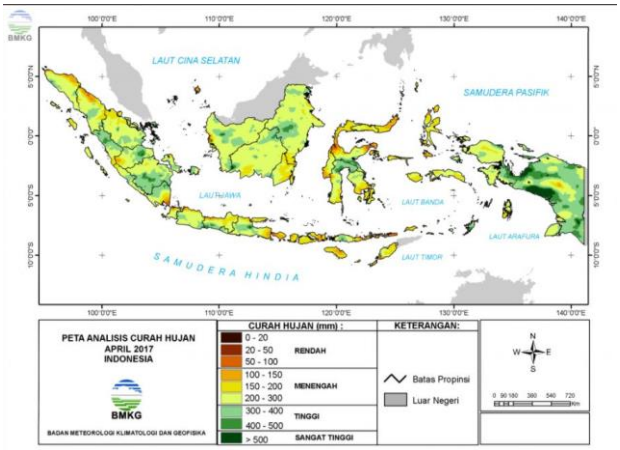

Figure 11. Map of rainfall intensity analysis on April 2017 (Source : https://prosesweb.bmkg.go.id/wp-content/uploads/2017.04_CH_GSMAP.png)

Figure 12. Rainfall intensity measured by weather radar (Source : www.bmkg.go.id/cuaca/citra-radar.bmkg)

However, the hourly rainfall intensity as provided in Japan is not available. Whereas as explained before, the required data for designing is hourly rainfall intensity. By searching rainfall data in the website of Badan Meteorologi, Klimatologi, dan Geofisika in a specific province such as Nusa Tenggara Barat province, it was informed that to obtain the rainfall data for non-commercial purpose, the applicant should submit some documents such as a cover letter from the

Rector/Dean/Head of Department, a statement letter, research proposal, and to fill online registration as can be seen at Figure 13.

Table 2. Conversion value of rainfall intensity from dBZ to mm/h

Category of rainfall intensity	dBZ value	Rainfall Intensity in mm/h
Light rain	30-38	1-5
Moderate rain	38-48	5-10
Heavy rain	48-58	10-20
Very heavy rain	> 58	> 20

Figure 13. Request form to obtain rainfall data for non commercial purpose

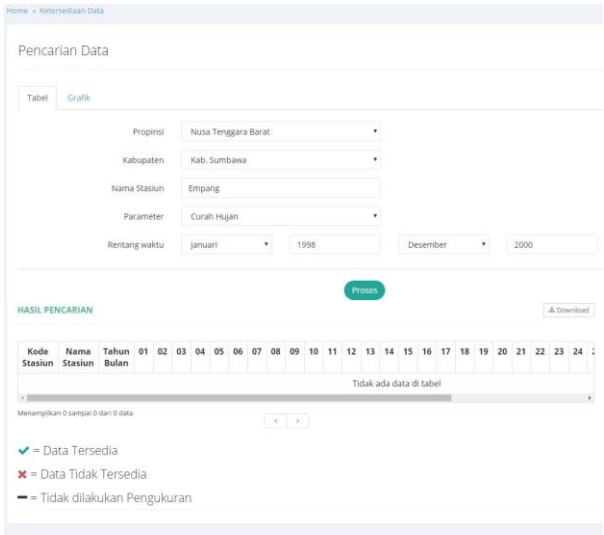

Figure 14. Searching result of rainfall data Source : http://dataonline.bmkg.go.id/ketersediaandata

There is another website about online database provided by Badan Meteorologi, Klimatologi, dan Geofisika to search the data availability by giving information about the selected province, station name, and the selected parameter such as temperature, humidity, wind speed, rainfall intensity, and wind direction (http://dataonline.bmkg.go.id/ketersediaan_data).

However, after putting in the required information, the rainfall data was not available (see Figure 14).

IV. CONCLUSIONS

Continuous hourly rainfall data is needed for many purposes including for designing a drainage channel for flood mitigation, and for early warning system for flood by providing real time monitoring. In Japan, hourly rainfall data can be accessed easily and freely by browsing in the Water Information System website. Those data can be accessed by everyone and has been used for various purposes such as to determine the potential catchment storage and to determine flood warning. In Indonesia, such data is not available in the online website yet. The number of rain gauges that are still working is also unclear. Indeed, when the data is available, we need to submit an official request form together with some requirements, and we need to pay to obtain the data. The agency observes rainfall data by using state government budget. Thus, it is the responsibility of the meteorological agency to open the data for public use for free of charge. It is also recommended that meteorology agency in Indonesia can add the number of rainfall stations to cover up all regions in Indonesia.

REFERENCES

Badan Meteorologi, Klimatologi, dan Geofisika, http://www.bmkg.go.id/ (diakses 12 Juni 2017).

Japan Meteorological Agency, http://www.jma.go.jp/jma/indexe.html (diakses 11 Juni 2017).

Ministry of Land, Infrastructure, Transport, and Tourism, Japan, *Water Information System*. http://www1.river.go.jp/ (diakses 11 Juni 2017).

Supraba, I. & Yamada, T.J., 2015, "Potential Water Storage Capacity of Mountainous Catchments Based On Catchment Characteristics", *Journal of Japan Society of Civil Engineers, Ser.B1 (Hydraulic Engineering)*, Vol.71, No.4, p.I_151-p.I._156.

Supraba, I., 2016, *Mitigasi Bencana Alam*, Kedaulatan Rakyat. http://krjogja.com/web/news/read/783/Mitigasi_Bencana Alam (diakses 11 Juni 2017).