Formulation of Attributes for Decision Support System for Drinking Water Infrastructure Developments Priority

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Abstract. Infrastructure development carried out by the Central Government should be aimed at the public interest. In the field study at the Ministry of Public Works and Public Housing (PUPR), it was found that the process for determining drinking water infrastructure development priority had not considered the social aspects and the people’s needs. The Central Government simply classified the district and the city priorities for the infrastructure development by the mandatory document that they prepared. Unnoticed by them, this method of classifying had not yet considered the people’s needs. To respond to that issue, research needs to be done regarding the criteria that can be used for classifying and/or prioritizing the development of drinking water infrastructure in a district/city to be more pro-people. The stages of the research are as follows: direct interview and field study at the Directorate General of Human Settlements (DGHS) of the Ministry of Public Works and Public Housing (PUPR). The field study process produced criteria and methods for making priority scale on the drinking water infrastructure development that have been currently used by the Central Government. While the direct interview produced additional criteria from the experts in the drinking water and infrastructure development programming field within the DGHS. Based on the results of the interviews and the field studies, a literature study and research were conducted to produce pro-people criteria and their measurement methods for the determination of the drinking water infrastructure development priority level. This research produced three major criteria with twenty sub-criteria following them. The three criteria are Central Government Priority Programs, Local Government Technical and Financial Conditions, and Socio-economic Conditions of the Peoples. With these new criteria, people’s conditions are taken into consideration for determining the drinking water infrastructure developments priority level in a district/city level, without ignoring the Central Government programs and the Local Government conditions.

1. Introduction
Access to decent drinking water that is usually provide by the drinking water supply system (SPAM) is very important for people’s livelihood. Hence, infrastructure development in the decent drinking water sector needs to be prioritized for the people who need it the most. Therefore, it is necessary to examine the procedures for determining the priority level of the drinking water infrastructure development that is carried out by the Central Government to be more pro-people. Before entering the procedures, the criteria to be used must be formulated first.
Muntasar [1] conducted research on priority scale determination of road construction projects in Banggai Island district using the Analytic Hierarchy Process (AHP) method. This research produced five criteria for determining the priority scale of road construction, which are road conditions, population size and growth, regional economic potential, costs, and level of interest. Meanwhile, Girsang [2] did a similar research in the priority scale determination criteria in National road handling project but produced different five criteria. They are accessibility, mobility, road flow, road section, and maintenance costs. Although both examined the criteria for the priorities in road construction, they produced different criteria. In the drinking water sector, no research on the criteria for priority scale determination in the drinking water infrastructure development had yet to be found. Therefore, this research is aimed at examining what criteria can be used for the drinking water infrastructure development priority scale and determining the measurement method for each them, in favor of preparing it for the Decision Support System (DSS).

DSS is an interactive information system that provides information, models and manipulates data. DSS is generally used to assist in decision making, both in semi-structured situations and in unstructured situations, where no one knows for sure how to make decisions based on these conditions [3]. In using DSS to help in decision making with many specific criteria, the Multiple Criteria Decision Making (MCDM) method is known as one of the best methods for it. In producing a decision, MCDM has two approaches. The first is to aggregate decisions that are relevant to all objectives for each alternative. Then the second one is to rank each alternative from the decision based on the results of the decision aggregation. Therefore, in determining a decision, it is necessary to have criteria related to the goals to be formulated first.

2. Methods and techniques

2.1. Field study and interview

To be able to produce more pro-people criteria for determining priority scale of drinking water infrastructure development in the district / city level, firstly we had to look at the existing criteria that had been currently used by the Central Government. These criteria were obtained by conducting field studies. Field studies were conducted on the Government Work Unit which, according to the researchers, are the most authorized units for determining the priority level of the drinking water infrastructure development by the Central Government. The units targeted for field studies are the Programming Integration Sub-Directorate of the Housing Infrastructure Integrity Directorate, which functions as a compiler for the integrated annual funding program sourced from the APBN. The second target is Sub-Directorate of Technical Planning of the Directorate of Drinking Water Supply System Development which has the authority to carry out the preparation of policy making and strategy, technical planning, evaluation and reporting of the development of drinking water supply systems and the development of technological innovations [4].

Furthermore, additional criteria from experts in the field of settlement infrastructure programming and drinking water experts were obtained through an interview mechanism. If a field study had been previously conducted on a Work Unit which was the most authorized unit for determining the priority level of the drinking water infrastructure developments by the Central Government, interviews were carried out on the authorized and experienced officials from that Unit.

2.2. Literature study

Based on several official literature of the Ministry of Public Works and Housing (PUPR) that have been studied by researchers, it has been determined that the literatures to be the source for producing “pro-people” criteria for the DSS are the Drinking Water Development Guide Book by the DGHSH and the Guidelines for the Development of Drinking Water Facilities and Infrastructure by the Research and Development Agency (Balitbang) of PUPR. Both literatures were chosen because implicitly, they have several pro-people criteria in determining the direction of drinking water infrastructure development priority.
2.3. Determining new and fair measurement methods

All the criteria produced were studied more deeply related to the regulations, standards, and guidelines that cover them. Based on the results of this research, a fair measurement method for each criterion was produced, so that no one would be advantaged or disadvantaged in determining the priority level of the drinking water infrastructure development within a district / city in Indonesia.

3. Results and discussions

3.1. Criteria and Sub-criteria Produced

From the interview, the field study and the literature study, the criteria and sub-criteria for the DSS of drinking water infrastructure development in the a district / city were obtained. These criteria and sub-criteria can be seen in Table 1.

Table 1. Criteria and Sub-criteria for the DSS of drinking water infrastructure development – Part 1

| Criteria | Sub-criteria | Underlying norms, standards, guidelines, regulations | Measurement methods | Linguistic value | Numeric value |
|----------|--------------|------------------------------------------------------|---------------------|-----------------|---------------|
| Central Government priority programs | National Strategic Area (KSN) | PP No. 13 of 2017 | KSN Single | 3 |
| | | | KSN Joint | 2 |
| | | | KSN In part | 1 |
| Strategic Development Area (WPS) | Permen PUPR No. 08 of 2018 | Newly growth WPS | 4 |
| | | Developing growth WPS | 3 |
| | | Balance connectivity for developing growth WPS | 2 |
| | | Integrated growth WPS | 1 |
| Underdeveloped Regions | Kepmendes No. 126 of 2017 | - | % underdeveloped village |
| Border Area | Perka BNPP No. 1 of 2011 | - | Number of Sub-district categorized as border area |
| Fisheries and marine area | Letter of Ministry KKP No. B348/Men.KP/VI/2016 | - | % fisherman population |
| Tourism area (The combination of KSPN, KSPN-Priority and KPPN) | PP No. 50 of 2011 | National Tourism Strategic Area(KSPN) | 2 |
| | PP No. 3 of 2016 | KSPN Priority | 3 |
| | PP No. 50 of 2011 | National Tourism Development Zone (KPPN) | 1 |
| Outermost Small Island (PPKT) | Keppres No. 6 of 2017 | - | Value of base point distance |
| Stunting Handling Priority | 160 Regencies / Cities for the Stunting Handling Priority | - | Percentage of occurrence of malnutrition infants |
| Development of New Cities | RPJMN DJCK 2015-2019 | - | New City Area (Km²) |
| Local Government technical and finance conditions | Regional Fiscal Capacity | Eksisting criteria used | - | Regional Fiscal Capacity Index (IKFD) |
| | RISPAM Documents | Eksisting criteria used | - | % value of RISPAM document form DGHS |
| Water Stress Level | Eksisting criteria used | High | 3 |
| | | Medium | 2 |
| | | Low | 1 |
| Existing coverage of the decent drinking water services | Percentage of coverage published by BPS | - | % of recent coverage |
| PDAM Leakage Level | PDAM performance assessment book by BPPSPAM - cooperate with BPKP | - | % leakage |
| PDAM Condition | - | PDAM Performance Value |

Source: Processing result (2019)
Table 1. Criteria and Sub-criteria for the DSS of drinking water infrastructure development – Part 2

| Criteria | Sub-criteria | Underlying norms, standards, guidelines, regulations | Measurement methods |
|----------|--------------|------------------------------------------------------|---------------------|
| Socio-economic condition of the peoples | Population | Metropolitan 6 | Linguistic value |
| | | Big 5 | |
| | | Medium 4 | |
| | Age structure | Small village 3 | |
| | | Village 2 | |
| | | Small village 1 | |
| | Education level | - | % productive age |
| | | Education level | % residents with min. high school education level |
| | Poverty level | - | % poor people |
| | Per capita income | - | Per capita income divide by 1000 |

Source: Processing result (2019)

From the Table 1 it can be seen that there are three criteria formulated for the DSS of drinking water infrastructure development in a district/city. Those three are: Central Government Priority Program, Local Government Technical and Finance Conditions and Socio-economic condition of the people.

3.2. Central Government Priority Program Discussion

The Central Government Priority Program criterion has nine sub-criteria with different ways of measurement. Those nine are explained as follows:

- **National Strategic Area (KSN)**

  National Strategic Area, commonly abbreviated as KSN, has been established by the Central Government for as many as 76 regions/areas.[5]. The 76 KSNs are divided into five interest groups. Economic interests in 27 regions, environmental interests in 25 regions, natural resources and high technology interests in 8 regions, defence and security interests in 9 regions and socio-cultural interests in 7 regions. To determine the appropriate measurement method for this sub-criterion, we first looked at some examples of KSN which can be seen in Table 2.

Table 2. The several examples of KSNs and their types

| KSN Name | KSN Type |
|----------|----------|
| Bima region | Economic interests |
| Gerbangkertasusila region | Economic interests |
| Lake Toba and surroundings area | Environment interests |
| Bosscha star binoculars area | Natural resources and high-tech interests |
| The border regions in Kalimantan | Defence and security interests |
| Prambanan temple area | Socio-cultural interests |
| Borobudur temple area | Socio-cultural interests |

Source: processing result (2019)

By looking at some of the KSN examples in Table 2, it can be seen that there is quite unique differences between the examples. The Bima region is a city that stands alone as an autonomous region, while the Gerbangkertasusila region is a combination of 7 districts/cities in East Java, namely Gresik, Bangkalan, Mojokerto, City of Mojokerto, City of Surabaya, Sidoarjo and Lamongan. On the other hand, Prambanan temple area is only a part of an area of a district/city. Therefore, this criterion can be divided into three categories that can be seen in Table 1 - Part 1 in the first row.
In the first row of Table 1 - Part 1, we can see the three categories for KSN criteria with their priority rank and numeric value. The KSNs that stand alone as a district/city were categorized as KSN Single. KSNs with regions that are a combination of several districts/cities were categorized as KSN Joint. While the KSNs which is only a part of an area of a district/city were categorized as KSN In-part. In determining the drinking water infrastructure development priority level for these groups, the KSN Single must be a priority. This is because the KSN single is stand alone district/city in which the whole area of the district/city is included in the KSN area. So, it is worth giving it the highest priority value because of its stand-alone characteristic. Then, the second priority is the KSN Joint, because some regencies/cities share this KSN status together. Finally, the last priority is the KSN In-part, because it is only a part of a district/city that included into a KSN area.

- **Strategic Development Area (WPS)**
  This sub-criterion consists of 6 regions on the island of Sumatra, 8 regions on the island of Java, 5 regions on the islands of Bali and Nusa Tenggara, 4 regions on the island of Kalimantan, 5 regions on the island of Sulawesi, 2 regions on the island of Maluku and 4 regions on the island of Papua\(^6\). These 34 WPS are divided into 4 types of WPS by the current level of growth as listed in Table 5. Because the aim of this research is to produce pro-people criteria, the newly growing WPS should be at the top of the priority. In new areas that just started to grow, people tend to need more access to decent drinking water. In other words, the priority ranking of WPS criteria is determined by how advanced a WPS is. The more recent the WPS is, the higher priority it gets for drinking water infrastructure development by the Central Government. The priority rank and the numeric value for the WPS type are shown in the second row of Table 1 – Part 1.

- **Underdeveloped regions**
  This sub-criterion consists of 122 regions in Indonesia according to the underdeveloped region regulation issued by the Central Government. Every a year the ministry of Villages, Development of Underdeveloped Regions and Transmigration evaluates the regions consisted in this category\(^7\). The newest list of underdeveloped regions in Indonesia at the time of writing was recorded by the ministry of Villages, Development of Underdeveloped Regions and Transmigration in a decision published in 2017\(^8\). To be fairer, the list must be ranked. It was found that the priority ranking measurement method for this criterion could refer to the 2018 Village Development Index (IPD) book published by BPS on districts/cities where districts/cities were categorized as underdeveloped areas ranked based on the percentage of underdeveloped villages in the district/city. The higher the percentage, the higher the priority obtained.

- **Border Area**
  Border areas are found in 13 provinces, 41 districts/cities, 187 districts and 1702 villages\(^9\). The appropriate measurement method for this criterion is the number of sub-districts included in a border area in a district/city. The more sub-districts included in the border area category, the higher the priority given to the district/city for the drinking water infrastructure development.

- **Fisheries and marine area**
  This sub-criterion became one of the factors influencing decision making priority for the drinking water infrastructure development due to a request from the Minister of Maritime Affairs and Fisheries to the Minister of Public Works and Public Housing (Letter of Ministry of Maritime Affairs and Fisheries No. B348/Men.KP/VI/2016). The considerations of this criterion are the welfare of fishermen’s families. Therefore, it is necessary to consider the percentage of fishermen’s families in a district/city. The greater the percentage, the higher the priority level that the district/city should be given in this criterion. The percentage of the fishermen families’ population is the most suitable numeric value for this criterion.

- **National Tourism Strategic Area (KSPN), KSPN-Priority, National Tourism Development Zone (KPPN) / Tourism area**
  KSPN-Priority as the main tourism area’s priority of the central government is the top priority level followed by KSPN which is a tourism strategic area which has not yet become the highest priority.
of the central government. Then, the last one is KPPN which is a tourism area that is still in the development stage towards KSPN. With this priority ranking, the most potential tourism areas rank based on Central Government studies[10][11] becomes the priorities factor in the drinking water infrastructure development priority level. See Table 1 – Part 1 sixth row, to clearly see the priority rank and numeric value of these three sub-criteria combinations which can also be called the tourism area sub-criterion.

- **Outermost small island (PPKT)**
  There are 111 areas that are included in the outermost small island category[12]. This sub-criterion has several alternative measurement methods. First, we can use the number of islands that belong to the Outermost Small Island list. Second is using the Island’s base point distance. Base point distance is the distance between the island and the state administrative boundaries. The researcher decides to take the second alternative, because it is more representative of the intent of the outer small islands. The closer the island is to the state administrative boundaries, the more priority it receives.

- **Stunting handling priority**
  This sub-criterion is quite sensitive for people, because it talks about the growth and development of infants. Delay in the growth and development of infants that is commonly referred to as stunting, is very closely related to the access of decent drinking water. The use of unsafe water for the pregnant women and/or newborns can be one of the factors causing stunting in infants. The central government, in this case the Ministry of Health, annually sets the Stunting Coefficient (KS) in an area to the village level[13]. However, if we look at the formulation of the KS which is a combination of the number of poor people, poverty levels, and the number of incidents of infants with malnutrition/stunting, the KS number has become less representative for the stunting handling priority criteria. Because KS is not purely about counting the incidence of stunting babies. Researchers have concluded that the most appropriate measurement method for this criterion is to use the percentage of malnutrition/stunting babies compared to the birth of a baby in a district/city. Thus, the focus of priority is right on the stunting itself. The higher malnutrition baby’s incident occurred, the higher priority level that a district/city get, for the sake of reducing the stunting incident and the health of pregnant women and infants.

- **Development of new cities**
  There are eleven new cities planned by the Central Government[14]. Based on the results of the analysis, there are several types of these new cities. However, the types are not very suitable to be used as measurement method for this sub-criterion because it lacks diversity. There area only 2 varieties in the forms of the original district or reduction from the original city. Whereas if we look at another alternative way of measuring, there is the area of the new city which would be quite diverse. This diversity can increase the accuracy of the measurement. Hence the most appropriate way to measure this criterion is by using the new city’s area. The larger the new city area planned by the government, the higher the priority level would be obtained by the district/city.

### 3.3. Local Government Technical and Finance Conditions Discussion

The Central Government Priority Program criterion has six sub-criteria, also with its unique ways of measurement. Those six are:

- **Regional Fiscal Capacity**
  This sub-criterion can be measured using the Ministry of Finance’s regional fiscal capacity map[15]. In the regional fiscal capacity map, each district/city has a regional fiscal capacity index. This index can be used to measure this criterion. The higher the index is, the richer the district/city is. Therefore, a high financial capacity would lower the district/city’s needs to get help for the infrastructure development, since they would actually be able to build at their own expense. So, districts/cities with lower index will get more priority in this criterion.
• RISPAM Documents
RISPAM are documents of master plan for the SPAM infrastructure development. This document must be provided by each district/city according to the law. This document receives an assessment from the Ministry of PUPR as the authority holder of the development of a national SPAM as well as the management and development of cross-regional SPAMs, and SPAM for national strategic interests. Assessment results are given as a percentage. Therefore, the percentages can be used as a measure for this sub-criterion. A district/city with a high percentage of RISPAM documents assessment will receive higher priority for the development of drinking water infrastructure, because high assessment results indicate that the district/city has a good plan for the development of drinking water infrastructure.

• Water Stress Level
Water Stress Level is divided into three categories that can be seen in Table 1 – Part 1 twelfth row. Each district/city is categorized into one of the three categories set by BPS. Districts/cities with high water stress level will be the main priority in this sub-criterion, while the second priority would be for districts/cities with medium water stress level and the last priority would be for districts/cities with low water stress level.

• Existing coverage of safe drinking water services
Existing coverage of the safe drinking water services are measured by the recent percentage of coverage in each district/city published by BPS. The lower the percentage, the higher the priority obtained by the district/city in the drinking water infrastructure development priority scale. This is intended to increase the percentage of service coverage as soon as possible.

• PDAM Leakage level and PDAM Condition
PDAM is a Local Government Water Company in Indonesia that are commonly responsible for the management of drinking water sector in a district/city. For the sub-criteria of PDAM Leakage level and PDAM Condition, there have already been measurement methods made by the Agency for the Improvement of Drinking Water Supply System (BPPSPAM) of DGHS in collaboration with Regional Financial Audit Agency (BPKP). Therefore, PDAM Leakage level and PDAM Condition would be measured using the value of PDAM performance and the percentage of leakage occurring in the PDAM Performance assessment book published by BPPSPAM.

3.4. Socio-economic Condition of the People’s Discussion
With two criteria and their fifteen sub-criteria explained above, the decision making of the priority level for the drinking water infrastructure development should have been very fair. But unfortunately, from the fifteen sub-criteria, there have not been any criteria that represent the people’s needs. The condition of the people in a district/city has not yet been considered in the priority level determination for the drinking water infrastructure development in a district/city. For this reason, this research was conducted to find criteria that can represent the people’s needs and their economic and social conditions.

Based on literature studies and analyses carried out, five sub-criteria have been found to represent the social and economic conditions of the people in deciding the priority level of drinking water infrastructure development. Those five are population, age structure, education level, poverty level and average income of a district/city’s residents.

• Population
The bigger the population in a district/city is, the more vulnerable the district/city in experiencing a drinking water crisis case. Therefore, districts/cities with bigger population should have higher priority level for the drinking water infrastructure development. To formulate a range of population in a district/city, we can refer to the table of drinking water needs based on the number of populations that was published by Kimpraswil Departement in 2003. The formula can be seen in Table 3.
### Table 3. Priority rank measurement method based on population in a district/city

| District/City Category | Population                  | Average drinking water needs (ltr/person/day) | Priority Rank | Numeric Value |
|------------------------|-----------------------------|----------------------------------------------|---------------|---------------|
| Metropolitan           | Above 1 million             | 190                                          | 1             | 6             |
| Big                    | between 500 thousand and 1 million | 170                                     | 2             | 5             |
| Middle                 | between 100 thousand and 500 thousand | 150                                    | 3             | 4             |
| Small                  | between 20 thousand and 100 thousand | 130                                 | 4             | 3             |
| Village                | between 10 thousand and 20 thousand | 100                               | 5             | 2             |
| Small village          | Under 10 thousand           | 60                                           | 6             | 1             |

Source: Kimpraswil Department (2003)

As explained in the previous paragraph, the ranking of priority level is based on the number of populations. Bigger populations get higher priority level. This measurement method has been reinforced by the average drinking water needs which can be seen in the third column of table 3. It show that the bigger a district/city population is, the more drinking water is needed by the people.

- **Age structure**
  The age structure of the population certainly affects the water use habits. Productive age population (between 15 and 64 years old), tends to use a lot of water. This is because at that age, a person tends to have a good understanding of cleanliness and health. Their daily activities are conducted in a high tempo. On the other hand, non-productive age population like children do not usually yet understand about hygiene and health. Therefore, the average water usage is generally less than that of the productive age population. Likewise, the elderly population, despite having high knowledge about the use of water for hygiene, has a low tempo daily activity. Hence, they are not expected to use much water. The measurement method for this criterion cantered in the amount of productive age population. The productive age’s percentage affects the priority rank. A higher percentage will result in a higher priority level. For the numeric value of this criterion, productive age population percentage can be used.

- **Education level**
  Education level criterion is very suitable to be measured by considering those with adequate level of education enabling them to have a good understanding about a clean and healthy lifestyle such as washing hands, bathing at least twice a day, brushing teeth, etc. High school education level is the minimum level where someone would have a good understanding of the importance of a clean and healthy lifestyle. They often use more water in everyday life. Therefore, this criterion can be measured by looking at the percentage of the population with a minimum of high school graduate education in a district/city.

- **Poverty level**
  The poverty level criterion is maybe the most important criteria in this research. This criterion represents poor people who are usually marginalized and have poor access to safe drinking water. The percentage of poor people is certainly the most appropriate measure for this criterion. The higher the percentage of poor people is in a district/city, the more priority level should be given in the drinking water infrastructure development. The numeric value of this criterion is simply the percentage of poor people in a district/city. List of percentage of poor districts/cities in 2015-2018 published by BPS are the most valid data for this criterion.

- **Per capita income**
  Per capita income is the average Gross Regional Domestic Product (GRDP) of a district/city. In other words, per capita income is a GRDP divided by the number of residents in the district/city. Per capita income of district/city residents can represent the daily activities of the population. Higher per capita income means that the district/city residents have a high amount of business activities. These activities certainly require higher access to safe drinking water than that of
districts/cities with less business activities. Therefore, higher per capita income must result in higher priority level for the drinking water infrastructure development. The appropriate numeric value for this criterion is the amount of per capita income of a district/city. Because per capita income in 2016 and 2017 published by BPS were still temporary numbers, then the valid data to be used in this criterion is per capita income of the year 2015 from BPS. The priority ranks in this sub-criterion consist of the highest to the lowest per capita income of a district/city.

4. Conclusions and future research

4.1. Conclusions

This research conclusions are as follows:

- Based on the results of the field study, it was found that the Central Government (DGHS) used four criteria to determine the priority of drinking water infrastructure development, namely: Eleven Central Government priority programs, regional fiscal conditions, water stress level, dan RISPAM documents.
- The Central Government had not yet used criteria that consider the needs of the people for determining the priority of drinking water infrastructure development.
- This research has produced ways of determining the priority of drinking water infrastructure development that are more pro-people and fairer and more pro-people measurement method for each criterion.
- The criteria and sub-criteria are listed in Table 1, which will become the new way of determining drinking water infrastructure development priority. The priority scale level produced will be more pro-people, with the social and economic conditions of the people criteria, without leaving the Central Government priority programs and the Local Government conditions.

4.2. Future research

Future research that can be done following this research are as follows:

- The criteria and sub-criteria listed in Table 1 can became criteria and sub-criteria to be used for the decision support system (DSS) for the drinking water infrastructure development priority. Therefore, the next step of this research is to determine the best multi-criteria decision making (MCDM) methods to be used in this case.
- After that, with the most suitable MCDM method for this case, the DSS for the drinking water infrastructure development priority can be built. This DSS shall be planned to provide the district/city priority level for the drinking water infrastructure development that are valid, pro-people, user friendly and easy to access.

References

[1] Muntasar T F, Kumaat E J and Mandagi R J M 2011 Penentuan Skala Prioritas Proyek Pembangunan Jalan Di Kabupaten Banggai Kepulauan Dengan Menggunakan Proyek Hirarki Analitik Jurnal Media Engineering 11 pp 38-46.
[2] Girsang L E P 2018 Kajian Kriteria Penentuan Skala Prioritas Pada Proyek Penanganan Jalan Nasional (Studi Kasus Satuan Kerja Pelaksanaan Jalan Nasional Wilayah II Provinsi Sumatera Utara) Politeknologi 17 pp 71-80.
[3] Alter S 2002 Information System, Foundation of E-Busines (London: Prentice Hall) in : Kusrini 2007 Konsep dan Aplikasi Sistem Pendukung Keputusan (Yogyakarta: ANDI).
[4] Ministry of Public Works and Housing, Republic of Indonesia 2019 Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia (PermenPUPR) Nomor 03/PRT/M/2019 tentang Organisasi dan Tata Kerja Kementerian Pekerjaan Umum dan Perumahan Rakyat (Jakarta: KemenPUPR RI).
[5] Government of the Republic of Indonesia 2017 Peraturan Pemerintah Republik Indonesia (PP)
Nomor 13 Tahun 2017 Tentang Perubahan Atas Peraturan Pemerintah Nomor 26 Tahun 2008 Tentang Rencana Tata Ruang Wilayah Nasional (Jakarta: Pemerintah RI).

[6] Ministry of Public Works and Housing, Republic of Indonesia 2018 Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia (PermenPUerp) Nomor 08/PRT/M/2018 tentang Perubahan Atas Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 13.1/PRT/M/2015 Tentang Rencana Strategis Kementerian Pekerjaan Umum dan Perumahan Rakyat Tahun 2015-2019 (Jakarta: KemenPUerp RI).

[7] Government of the Republic of Indonesia 2015 Peraturan Pemerintah Republik Indonesia (PP) Nomor 131 Tahun 2015 Tentang Penetapan Daerah Tertinggal Tahun 2015-2019 (Jakarta: Pemerintah RI).

[8] Ministry of Villages, Development of Underdeveloped Regions and Transmigration, Republic of Indonesia 2017 Peraturan Menteri Desa, Pembangunan Daerah Tertinggal, dan Transmigrasi Republik Indonesia (Permendes) Nomor 126 Tahun 2017 tentang Penetapan Desa Prioritas Sasaran Pembangunan Desa, Pembangunan Daerah Tertinggal, dan Transmigrasi (Jakarta: Kemendes RI).

[9] National Border Management Agency, Republic of Indonesia 2011 Peraturan Kepala Badan Nasional Pengelola Perbatasan (Perka BNPP) Nomor 01 Tahun 2011 Tentang Kesepakatan Batas Wilayah Negara dan Kawasan Perbatasan Tahun 2011-2025 (Jakarta: BNPP RI).

[10] Government of the Republic of Indonesia 2011 Peraturan Pemerintah Republik Indonesia (PP) Nomor 50 Tahun 2011 Tentang Rencana Induk Pembangunan Kepariswataan Nasional 2010-2015 (Jakarta: Pemerintah RI).

[11] Government of the Republic of Indonesia 2016 Peraturan Pemerintah Republik Indonesia (PP) Nomor 03 Tahun 2016 Percepatan Pelaksanaan Proyek Strategis Nasional (Jakarta: Pemerintah RI).

[12] Government of the Republic of Indonesia 2011 Keputusan Presiden Republik Indonesia (Keppres) Nomor 06 Tahun 2011 tentang Kepulauan - Pulau Kecil Terluar (Jakarta: Pemerintah RI).

[13] National Team for the Acceleration of Poverty Reduction, Republic of Indonesia 2017 Ringkasan 100 Kabupaten/Kota Prioritas Untuk Intervensi Anak Kerdil (Stunting) (Jakarta: TNP2K RI).

[14] Directorate General of Human Settlements (DGHS) of Ministry of Public Works and Housing (PUPR), Republic of Indonesia 2015 Rencana Strategis Direktorat Jenderal Cipta Karya Tahun 2015-2019 (Jakarta: KemenPUerp RI).

[15] Ministry of Finance, Republic of Indonesia 2019 Peraturan Menteri Keuangan Republik Indonesia Nomor: 126/PMK.07/2019 tentang Peta Kapasitas Fiskal Daerah (Jakarta: Kemenkeu RI).

[16] Government of the Republic of Indonesia 2015 Peraturan Pemerintah Republik Indonesia (PP) Nomor 122 Tahun 2015 Tentang Sistem Penyediaan Air Minum (Jakarta: Pemerintah RI).

[17] Directorate General of Human Settlements (DGHS) of Ministry of Public Works and Housing (PUPR), Republic of Indonesia 2018 Kinerja PDAM 2018 (Jakarta: KemenPUerp RI).

[18] Directorate General of Human Settlements (DGHS) of Ministry of Public Works and Housing (PUPR), Republic of Indonesia 2007 Buku Panduan Pengembangan Air Minum (Jakarta: KemenPUerp RI).

[19] Research and Development Agency (Balitbang) of Ministry of Public Works and Public Housing (PUPR), Republic of Indonesia 2012 Pedoman Pembangunan Sarana dan Prasarana Air Minum (Jakarta: KemenPUerp RI).