RAW WATER MANAGEMENT AND PROTECTION IN DRINKING WATER SUPPLY

Yung Savitri[1*], Mochamad Azwar[2]

[1]Sekretariat Daerah Kabupaten Lombok Barat, Nusa Tenggara Barat, Indonesia 83363, [2]Institut Teknologi Sepuluh Nopember Surabaya, Jawa Timur, Indonesia 60111
Email: yungsavitri4@gmail.com*

ABSTRACT
Scarcity of clean water is one of the main problems in several regions in Indonesia. One of the causes of water scarcity is the availability of raw water sources that are less fulfilling human needs. Raw water with quality, quantity, continuity and affordability are needed as population growth continues to increase. In some areas experiencing water crises, water shortages have occurred almost every year. Thus, the availability of sources of raw water is very important in providing clean water for the community. Selection of the source of raw water for drinking must be qualified in terms of quantity, quality, continuity and affordability (accessibility). Raw water management tailored to the type of raw water used. Raw water sampling conducted using raw water unit building, namely intake, broundcaptering, wells and rainwater. Protection of raw water sources to do with the division of water protection zones that are based with the health and biological factors. Preparation of Raw Water Master Plan has also become one of the solutions for the protection of raw water and mapping potential sources of raw water.
Keywords: *raw water, criteria of raw water, raw water protection*

BACKGROUND

Scarcity of clean water is one of the main problems in several regions in Indonesia . One of the causes of water scarcity is the availability of raw water sources that are less fulfilling human needs . Raw water with quality , quantity and quantity is needed in line with population growth . The need for clean water is increasing, while the supply of raw water to clean water has declined in terms of both quantity and quality. Technological developments also played a role in increasing water demand in several sectors, such as domestic needs, industry, agriculture, hydroelectricity, agriculture , etc (Alobaidy, dkk., 2010).

Changes in land use also affect the quantity of raw water source. Changes in land use in the upstream to downstream resulting in fluctuation of raw water in the rainy season and the dry season was very large. Changes in land use into residential or industrial land leads to reduced water catchment area, resulting in a drop in groundwater. If this is the case in the waterfront area, it will cause lait water intrusion into the groundwater. In addition, the decline in water levels also cause the concentration of pollutants in water bodies increasingly concentrated , so that the water quality decreases.

In some areas experiencing water crises, water shortages have occurred almost every year. To get water, people must buy water from water vendors at a high enough price, whereas for people who are not able to switch to using that water quality is not feasible to meet water needs. That phenomenon may cause a decrease in socio-economic conditions and public health. Clean water supply problems also occur in rural areas. Although the rural areas have a source of water (surface water, ground water and spring water), but the infrastructure is not adequate drinking water, so that the public is still difficult to obtain clean water .

Based on Law No. 11/1974 about Water, water resources must be protected

and secured, maintained and preserved, in order to fulfill its function. Protection of water resources is done by water rescue efforts, security and control of water resources, prevention of water pollution, as well as safeguards against the building of irrigation. The intensity of land management in both the upstream or in downstream river for subsistence has a negative influence on the hydrological conditions of water resources. Handling issues critical land or water conservation partially been done so far, but has not been able to overcome these problems. Thus, the handling should be done with the implementation of the development strategy of conservation of water resources through a holistic approach with a focus on resources. Soil conservation programs and water resources required thorough and innovative in planning the utilization of these resources.

In Law No. 23/1997 about Environmental Management stated that the conservation of natural resources is done to ensure the continuous availability of resources. Water conservation through effective management and efficient use is very necessary and urgent activities. Water management based on its existence as a natural resource is a part of a water conservation program that fully maintain, rehabilitate, maintain and utilize the resources available water effectively and efficiently for the welfare of society. This activity is required to reduce Revolution and pollution of water resources due to overexploitation treatment in order to meet the needs of the increasing.

Based on the above problems, it is necessary to do studies focused on the management of various types of raw water source. Availability of raw water is very important to meet the needs of clean water for the community. In order to maintain the quantity, quality, and continuity of raw water, it is necessary to the protection or conservation of raw water.

THEORETICAL

2.1 *Raw Water's Source*

The raw water was water taken from surface water sources to meet various needs (government regulatoryNo. 6/2011). Based on Government Regulation No. 82/2001 on Water Quality Management and Water Pollution Control, for drinking water is water that can be processed into a viable water as drinking water by processing in a simple manner to filtration, disinfection, and boiled .

Source of raw water to clean water can be broadly classified into four parts namely sea water, the atmosphere, or rainwater, surface water and ground water each characteristics that vary in terms of quality and quantity (TotokSutrisno , et al , 2004)

1. Groundwater

In general, groundwater has pretty good quality and if it is done making a good and free from contamination can be used directly. To protect from the dangers of contaminated water consumption through water chlorination process is required. According TotokSutrisno, groundwater is divided into three major parts, namely the shallow ground water, ground water and springs .

2. Surface Water

Surface water is water flowing on the surface of the earth. In general, these will be the surface water contamination during streaming, such as mud, logs, leaves, dirt industrial city, household domestic waste and so on. The type of dirt staining is a physical, chemical and biological. Surface water is the source of water relatively large, but because the quality is not good then the necessary treatment, the surface of the water there are two kinds:

a. River Water

In the use of river water as drinking water, must undergo an appropriate treatment given that the river water generally has a high degree

of fouling. While debit is available to meet the demand for drinking water in general be sufficient .

b. Swamp Water

Most colored swamp water caused by organic substances are decomposed , for example humus acid soluble in water which causes the yellow color brown. With the decay, high levels of organic matter, the content of Fe and Mn the soluble , so to capture the water should be at a certain depth in the middle so that deposits of Fe and Mn not get carried away.

3.The atmospheric water or rainwater

In a pure state, rain water is very clean, the air pollution caused by industrial dirt / dust and so forth. Rainwater has an aggressive nature of the pipe - conduit and reservoir tanks for rain water generally has a low pH, so it can accelerate corrosion. Rainwater also has pliancy (soft water) for less contains dissolved salts and minerals, so it would be wasteful in the use of soap and tasted less than fresh.

4. Sea Water

Having a salty nature, because it contains salt NaCl .NaCl salt content in seawater 3 %. With this state of the sea is rarely used as raw water for drinking water purposes because it does not qualify for drinking water.

2.2 Raw Water Criteria

Not all of the raw water can be processed, and therefore a provision as raw water quality standards that can be processed. Based on ISO 6773 : 2008, the technical requirements of the raw water quality that can be processed by the Drinking Water Treatment Plant is :

1. Turbidity , maximum 600 NTU (nephelometric turbidity units) or 400 mg / l SiO2
2. The content of the original color (appearent color) does not exceed 100 Pt Co and color while following the turbidity of raw water.
3. Other elements eligible raw raw water in Government Regulation No. 82/2001 on the Management of Water Quality and Water Pollution Control.
4. In the case of river water content of a particular area has color , iron and organic material or exceed the above requirements but low turbidity (< 50 NTU) then used IPA Systems DAF (Dissolved Air Flotation) or other system that can be accounted.

According to Sumantri (2010) water intended for consumption must come from a source that is clean and safe . Restrictions sources of clean water and a safe , among other things :

1. Freedom from contamination or germs.
2. Free from harmful chemical substances and toxic.
3. There is tasteless and odorless.
4. Can be used to meet the needs of domestic and household.
5. Meet the minimum standards set by the WHO (World Health Organization) or the Department of Health.

METHODS

3.1 Data Types and Data Collection

This study included the type of literature .The study of literature which collects data by reading and studying the theories and literature relating to raw water, raw water management, and the protection or conservation of raw water. The method used in this study is descriptive method. In this method, the data related to the research problem comes from the book, module, research journals, legislation and regulations. In this study there is the attempt to describe, record, and Interpret the current conditions were then evaluated.

In addition , this study also was supported by the data of legislation related to water resources :

- Act No. 11 of 1974 About Irrigation
- Act No. 23 of 1997 on Environmental Management
- Government Regulation No. 42 Year 2008 on Water Resources
- Regulation of the Minister of Public Works No. 3 Year 2015 About Technical Guidelines for Drinking Water Infrastructure DAK
- Regulation of the Minister of Public Works No. 6 / PRT / M / 2011 on Guidelines for the Use of Water Resources
- PP 82 of 2001 on the Management of Water Quality and Water Pollution Control

3.2 Data Analysis

The data were analyzed descriptively. Methods Descriptive analysis was done by decribing facts then do an analysis of the facts. Analysis of the data also comes with an understanding and explanation of the author.

RESULT AND DISCUSSION

4.1 Raw Water Intake

In taking a water source of drinking water as raw material, the selection of raw water is required in advance. In general, the selection of raw water should pay attention to the requirements of quality, quantity, continuity and accessibility.

a. Raw Water Quantity

Terms of the quantity of water resources must have a sufficient number to meet the overall needs (Kurniawan, 2011). The amount of raw water debt is also affected by technological progress and socio-economic level of society.

b . Continuity of water availability

Continuity of water availability is the condition of the water source that flows throughout the year , it will not fluctuate significantly. Raw water to clean water should be taken continuously, both in the rainy season and the dry season.

c. Water quality

The quality of raw water is a picture of raw water quality in terms of physical , chemical , and biological . Clean water quality standard based on the PP 82/ 2001. Physical parameters of water include: clarity, color, odor, taste, and temperature. Chemical parameters include: pH, solids, organic substances, hardness, and the amount of the chemical element. Biological parameters characterized by the presence of E. coli bacteria. Raw water quality will determine the type of raw water treatment required to produce drinking water

d. accessibility

Accessibility is a source of raw water affordability in terms of the location distance to the source of raw water services as well as the access road. Accessibility will affect the way the raw water flow to the processing unit. Accessibility is also influenced by the topography of the site raw water sources as well as the access road to the location of the raw water.

In taking the water as a source for drinking water, raw water required building unit. Building raw water unit is the first unit in a raw water supply system. Raw water building type adapted to the type of raw water source used . Here is a method to extract raw water to some of the raw water source.

a. Raw Water Intake of Spring

Catching water from springs must maintain the condition of the surrounding land. The water surface near the water source should not be permeated or mixed with spring water. Building catcher springs are generally known as bround

capturing. Buildings spring catcher should not lead to excessive pressure which can lead to missing or shifting of the springs . Spring catcher building requirements are:

- The shape is not binding, adapted to the topography and land situation
- Building cultivated elliptical obtuse angled or rectangular.
- Pipe out on collecting tubs of buildings should not be higher than the original face before it is built

b. Raw Water Intake of Water Surface

Building tapper or intake is a functioning unit of raw water for tap or take raw water from surface water bodies in accordance with the discharge of raw water is needed. Intake is usually used to extract raw water in rivers, lakes, swamps, or other surface water. Types intake :

- Intake Impounding Reservoir
  Intake is applicable where the surface water runoff in the spring kemarai lacking enough water needs. Taking into account the loss of water, the capacity of the reservoir impounding water intake should be sufficient for the maximum in the dry season.
- Canal Intake
  Canal intake is the intake structure that takes the source of raw water from a canal. Water taken from the canal is collected in a container, from the container and then flowed into the treatment plant.
- Direct Intake
  Intake structure directly applied in the river where the water is deep enough. These intakes are generally cheaper compared to other types of intake, because water drawn directly through the pipe. In addition, the soil conditions for the use of the direct intake should be strong and should be resistant to erosion cliffs.

c. Raw Water Intake of Groundwater

Intake of raw water from groundwater wells can be shallow and deep wells. The use of raw water wells in the decision based on the depth and quality of well water that has been existing in the vicinity of the location. In the manufacture of the well, casing pipe material selection and filter should be attention to the content of mineral and biological groundwater that will be taken as well as the magnitude of the force at the time of the burden in the soil. In planning the building of wells, several factors need to be considered are:

- Types of regional aquifer to be made well, low and high permeability, increase in water, and groundwater levels
- This type of pump in determining the diameter of the pipe
- Water flow needed

Selection of well locations should consider the distance from the source of potential contaminants that can cause contamination in wells to be built. Well locations based on the distance to the sources of pollution are presented in the following table.

Table 1. The minimum distance wells from pollution sources

length (m)	potential pollution sources
100	Landfills, garages, gas stations, industrial activities that generate pollutants, storage of hazardous and toxic materials
59	Waste water catchment wells
30	wc, livestock barns, farm or land by artificial fertilizers and compost
15	septic tanks, water bodies (rivers, swamps, lakes, or ponds)
7	drainage channels, ditches or home

Source: Drilling and Well Construction Manual

Planning and construction of deep wells including job categories with high risk of failure and requires knowledge and special equipment, therefore it should not be implemented by the community itself and must be under supervision by consultants. Contractor deep wells should be well qualified expertise in the field of drilling deep wells.

d. Raw Water Intake of Rain Water

Design of rain water reservoir must meet a minimum volume of 15 l / person / day for the needs of the dry season the maximum number of months in a year. Bak made simple container made of water-resistant materials such as masonry, concrete or fiberglass. Using the combined roof houses, mosques, village offices or other public buildings as a rainwater catcher.

4.2 Raw Water Protection

Water Source Protection is part of a strategy for implementing environmentally sound management of ground water, which needs to be done correctly by improving coordination of the various levels of authority, as well as to improve the utilization of groundwater data and information in an integrated manner. Efforts and handling rehabilitation of groundwater and springs are part of the target achievement of water security in RPJMN 2015 - 2019 but the conditions can be obtained through the protection, management, and supervision of the spring not quite optimal. Therefore it is necessary ketetatapan arranged springs area that needs to be given protection treatment, management, and supervision. The capacity of the national standard water based Nawacita of 7.02 m3 / sec.

Damage control springs and groundwater influenced by environmental pressures, environmental problems and ecological disaster. Of these three factors, which will influence the condition of springs and groundwater. This condition is further classified into three (3) classes, grades Safe - Prone - Damaged. The function of the classification of this class will be a consideration decision to undertake the appropriate action for each class condition. For dense residential areas, the use of groundwater as a last option after surface water or other sources. In groundwater should be done in the dry season, because during the rainy season while reducing the amount of water is abundant groundwater consumption. Therefore it can be developed also by the application of technology for the manufacture of 'tent water' and 'business rainwater'. To restore ground water can not be done in shallow soil.

Strategic issues regarding the availability of raw water for drinking water

is the protection and preservation of water sources use raw water allocation planning is not optimal. These problems often lead to conflicts of interest at the user level. In addition, local authorities and organizers of Drinking Water Management Systems do not have a plan on the raw water requirement for drinking water. The use of raw water source runs out of balance due to the imbalance between the availability of water and raw water requirements for drinking water are high enough in line with the increase of population. Thus, cooperation is needed unified in overcoming the shortage of raw water for drinking water, including by building reservoirs in areas prone to water, the use of ponds as a container of processed waste water, protection of raw water from domestic sewage and garbage, as well as the program development plan Security water that is integrated from upstream to consumers

Program Drinking Water Safety Plans are being developed DGHS as prevention, protection, and control of water services from the source of raw water to the homes through a risk management approach. It aims to ensure the achievement of drinking water that meets the quality, quantity, continuity and affordability (accessibility) or 4K. Raw Water Master Plan is a solution that can be done in the framework of planning the utilization and protection of water resources sustainable raw. Raw Water Master Plan prepared in accordance with RISPAM district / city / province, so as to map the availability and potential of raw water for drinking water for areas prone to water, the outer islands, and coastal areas (CiptaKarya, 2014)

According to Heru (2000), the source of water used to meet community needs to be protected from the pollution. One way raw water source protection is to establish a water source protection zones. Determination of Water Source Protection Zone are based on factors and biological health. In Germany and the European countries are generally known three kinds of Raw Water Source Protection Zone:

- Protection Zone I: the area of the protection that aims to protect the water from all the contaminants that directly or indirectly causes the degradation of water quality, with a radius determined as far as 10-15 meters from the water source.
- Protection Zone II: the area of the protection that aims to protect the raw water source of the danger of contamination of bacterial pathogens that can cause degradai water quality, broadly calculated based on mileage coli bacteria for 50 (fifty) days to the sources of raw water.
- Protection Zone III: the area of the protection that aims to protect raw water sources from pollution and radioactive chemical which can't be degraded in a short time, with an area determined by the catchment area.

CONCLUSIONS

Based on the analysis and discussion, we concluded as:

1. Selection of the source of raw water for drinking must be qualified in terms of quantity, quality, continuity and affordability (accessibility). Raw water management tailored to the type of raw water used. Raw water sampling conducted using raw water unit building, namely intake, broundcaptering, wells and rainwater.
2. Protection aims to maintain the raw water quantity, quality, continuity and affordability of raw water sources. Protection of raw water sources to do with the division of water protection zones that are based with the health and biological factors. Preparation of Raw Water Master Plan has also

become one of the solutions for the protection of raw water and mapping potential sources of raw water.

REFERENCES

Aditya, N. 2015.PemilihanLokasiSumber Mata Air Untuk Pembangunan Jaringan Air BersihPedesaanDenganMenggunakanMetode TOPSIS. Seminar NasionalTeknikSipil V Tahun 2015 UMS ISSN: 2459-9727

Alobaidy, A. H. M. J., Maulood, B. K., Kadhem, A. J. 2010. Evaluating Raw and Treated Water Quality of Tigris River within Baghdad by Index Analysis. Journal Water Resource and Protection 2010, 2, 629-635.

DirektoratJenderalCiptaKarya. Workshop Sinkronisasi Program Penyediaan Air Baku Untuk Air MinumTahun 2014

Hendrayana, H. 2000. ZonaPerlindunganSumber Air Baku.JurusanTeknikGeologi. UniversitasGadjahMada. Yogyakarta.

Kurniawan, D. 2011. PenentuanSkalaPrioritasLokasiSumber Air Baku Bagi PDAM Kota Pontianak. Program StudiTeknikSipilUniversitasTanjungpura Pontianak

Oryzatin, F. A. 2015. UpayaPeningkatanKualitas Air Baku Konservasi Pro Air denganFiltrasiBantaran Sungai. Program Diploma InstitutPertanian Bogor. Bogor.

REKOMPAK-JRF.PedomanPerencanaanPengadaan Air BersihPedesaan Program JRF-REKOMPAK.NMC CSRRP DI Yogyakarta

Sallata, M. K. 2015. KonservasidanPengelolaanSumberDaya Air BerdasarkanKeberadaannyasebagaiSumberDayaAlam. Info Teknis EBONI Volume 12 Nomor 1 Juli 2015: 75-86.

Sumantri, A. 2010.KesehatanLingkungan. Kencana: Jakarta

Sumarman. 2006. KajianKompensasi Air Baku untuk Air BersihdariPemerintah Kota Cirebon kePemerintahKabupatenKuningan. Tesis program PascaSarjanaUniversitasDiponegoro. Semarang.

Sutrisno, T. C. 2004. TeknologiPenyediaan Air Bersih.RinekaCipta: Jakarta