



Environmental Health Risk Assessment (EHRA) to Achieve the Target of Universal Access 2020 on Domestic Waste Water Sector in Blitar Districts

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Abstract: Development of urban city is commonly followed by steady growth of economic condition, population density, and negative impact of environmental condition. Reduction quality of environmental condition stimulates the occurrence of environmental degradation within society. Low quality of waste water system, management of garbage, limitation of green areas, and low concern of society toward climate change are example of environmental issues that need to be solved by the government as soon as possible. The succession in achieving aims of Millennium Development Goals (MDGs) is continued by Sustainable Development Goals (SDGs) program from 2015 to 2030. SDGs have numerous action plans in achieving its goals for instance Environmental Health Risk Assessment (EHRA) for waste water system in Blitar District. Research methods that use in the present study are as follow (i) Field study named Environmental Health Risk Assessment (EHRA), and (ii) data collection, entry data, data cleaning, data processing and data analysis. The present study concludes numerous results achievement for waste water access are follow: very high (180 villages or 72.58 %), high (26 villages or 10.48 %), medium (28 villages or 11.29 %), low (14 villages or 5.65 %). It can be concluded that the achievement for SDGs for waste water system has been achieved.

Keywords: Environmental Health Risk Assessment (EHRA), Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs), Sanitation Sector

1. Introduction

This waste water can be determined as water disposal that comes from industrial, residential, restaurant, stationary, commerce, apartment, and dormitory. Numerous forms of waste water are dirt matter, urine, bathroom waste, and kitchen leftover. The number of these waste are increasing time by time since it is influenced by the increasing of population density coupled with its activities. When the number of waste water is not balance with environmental capability in absorbing the waste, it creates natural damage of the environment. Moreover, environmental damage can decrease health level of human who live within this environment. Therefore, proper actions need to be conducted in order to prevent degradation of environmental damage and health level of human.

Waste water channel system is a structural channel system that has function to decrease or dispose waste water from industrial and residential. This system commonly uses close channel by enhancing tube to distribute waste water from interceptor tank to drainage channel or main channel in which waste water will be recycled.

Sanitation issues become national concern which not only experience by people who live in east part of Indonesia and pedestrian areas but also in urban areas. Study conducted by Basic Human Services (BHS) portray people behaviour in washing their hand as follow: (i) after defecation (12%),(ii) after cleaning baby dirt (9%), (iii) before meals (14%), (iv) before feeding baby (7%), and (v) before preparing meals (6%) [1]. Furthermore, more than 11,5 billions of household in Indonesia or 18.88 % do not possess private toilet to conduct defecation or in other words, those people are conducting defecation in open/public areas [2]. It is supported by research conducted by Pro Air which stated that access of water and basic sanitation in Indonesia still low [3].

Study mentioned above shows that development of sanitation will increase numerous aspects such as social, health, and economic mainly in developing country [4]. Mara and Alabaster [5] stated that waste water disposal is determined by each house hold which based on the regulation that enact by the government. Commonly, household is utilizing off-site disposal system such as condominial [6]-[8] or on-site disposal system such as VIP toilet, closet, and ecological sanitation (eco-san) toilet [9], [10].

Environmental Health Risk Assessment (EHRA) need to be conducted in order to achieve Sustainable Development goals (SDGs) target which is Universal Access 2020. The present study is an example of EHRA utilization for waste water sector in Blitar.

2. Background

Problems related to drinking water and sanitation are a huge challenge facing the Indonesian people at this time [1]. This problem is a national issue that is not only experienced by some people in eastern Indonesia and rural areas, but also experienced by urban communities. This is confirmed by the final report of the Millennium Development Goals (MDGs) that access to water and basic sanitation resources in Indonesia is still low [2]. The study conducted by the Indonesia Sanitation Sector Development Program (ISSDP) showed that 47% of the population still defecated into rivers, rice fields, ponds, gardens and other open spaces [3]. Studies conducted by Basic Human Services (BHS) show that people's behavior in hand washing is as follows: (i) after defecation, 12%, (ii) after cleaning of infants and toddlers' feces, 9%, (iii) before eating, 14%, (iv) before feeding the baby, 7%, and (v) before preparing food, 6% [4]. Around 11.5 million households in Indonesia or 18.88% do not have latrines / latrines or open defecation (BABS) practices.

The Community Based Total Sanitation (STBM) approach can be used to control this condition. A study conducted in 2003 by the World Health Organization (WHO) in 2003 showed that the incidence of diarrhea surged 45% with the behavior of handwashing with soap, 32% by increasing public access to basic sanitation, and 39% of the behavior of safe drinking water management in households. If the three intervention behaviors were integrated, the incidence of diarrhea decreased by 94% [5]. The results of the Santosa and Hermana study in 2011 showed that the mapping of risk areas to environmental health in Suarbaya City was as follows: high risk areas (18%), moderate (22%), low (45%) and not risky (14%) from area of Surabaya City [6]. Further research shows that the risk areas for environmental health in the City of Surabaya are as follows: Less Risk Areas (Index 1) there are 9 villages or 5.84%, Medium Risk Areas (Index 2) there are 67 villages or 43.51%, High Risk (Index 3), there are 61 villages or 39.61%, and Very High Risk Areas (Index 4) there are 17 villages or 11.04%. High risk areas are slum areas on the coast, downstream of the river and areas along the waters and high population density. Whereas those that are not at risk are residential areas arranged with better sanitation facilities and low to moderate population densities [7].

The Office of Public Works Cipta Karya and Spatial Planning - East Java Province to improve wastewater services from 72.15% in 2013 to 73.40% in 2015 required funds of 2.3 billion [8]. Several studies that have been conducted prove that the development of good sanitation will be able to improve social aspects, health aspects, and even improve the economy, especially in developing countries [9].

The problem of sanitation in Indonesia generally lies in the area both in urban and rural areas, access to clean water, and waste water disposal [10]. Research in disposing of waste water is determined by the owner of the house and of course in accordance with the regulations determined by the government [11]. Such disposal facilities such as off-site systems such as condominial sewers [12-16] or on-site systems consisting of VIP toilets, toilet and ecological sanitation (ecosan) toilet [17]. Although in the end, the results of this process must be disposed of to the final processing site.

The Sustainable Development Goals (SDGs) include 17 sustainable development goals with 169 target groups that are integrated and inseparable from each other. Seventeen sustainable development goals include: 1. Eradicate poverty in all its forms everywhere, 2. Alleviating hunger, achieving food security and improving nutrition and promoting sustainable agriculture, 3. Ensure healthy life and promote well-being for all at all ages, 4. Ensure the quality of education that is inclusive and equitable and promotes lifelong learning opportunities for all, 5. Achieve gender equality and empower all women and girls, 6. Ensure the availability and management of sustainable water and sanitation, 7. Ensuring affordable, reliable, sustainable and modern energy access for all, 8. Promote the sustainability of sustainable and inclusive economic growth, full and productive employment opportunities, and decent work for all, 9. Building infrastructure resilience, advancing inclusive and sustainable industrialization and paying attention to innovation, 10. Reducing inequality within countries and between countries, 11. Creating cities, settlements that are inclusive, safe,

resilient and sustainable, 12. Ensure sustainable consumption and production patterns, 13. Take immediate action to combat climate change and its effects, 14. Preserving and wisely utilizing oceans, seas and marine resources for sustainable development, 15. Protecting, restoring and prioritizing the use of terrestrial ecosystems wisely, managing and maintaining the sustainability of forests, combating land clearing, stopping and restoring land degradation and stopping the loss of biodiversity, 16. Promoting a peaceful and inclusive society for sustainable development, providing access to justice for all and building effective, accountable and inclusive institutions at all level, 17. Strengthening the means of implementation and revitalizing global partnerships for sustainable development. Objective 6. Clean water and sanitation, as well as clean water, are specifically discussed at the six goals of Sanitation and Sustainable Development Goals (SDGs), although it remains to be noted that these objectives actually constitute a unity. In explaining the purpose of six, the targets or achievement targets are set out as follows: (i) In 2030, achieving universal and decent drinking water access that is safe and affordable for all, (ii) In 2030, achieving adequate and adequate access to sanitation and hygiene for all, and ending open defecation (BABS), paying special attention to the needs of women and girls and people in vulnerable situations, (iii). In 2030, improving water quality by reducing pollution, eliminating waste generation and reducing chemical disposal dangerous, and reducing up to half the proportion of untreated wastewater and increasing reuse and recycling safely globally, (iv) By 2030, substantially increasing the efficiency of water use in all sectors and ensuring the sustainability of fresh water supply and supply to overcome water scarcity and substantially reduce the number of people who suffer water scarcity , (v) By 2030, implementing integrated water resource management at all levels, including through appropriate cross-border cooperation, (vi) By 2020, protecting and improving water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes, (vii) In 2030, expanding cooperation and capacity building for international support for developing countries in activities or programs related to clean water and sanitation, including water source maintenance, desalination, water efficiency, wastewater treatment, recycling technology repeat and reuse, (viii) In 2030, support and strengthen the participation of local communities in improving water and sanitation management.

For the effectiveness and efficiency of interventions for villages that are able to achieve the targets of the sanitation Sustainable Development Goals (SDGs), an Environmental Health Risk Assessment (EHRA) Study for Achieving the Targer Universal Access 2020 Waste Water Sub-Sector in Blitar District. To evaluate the achievement of this target, a mapping of risk areas will be carried out first using the EHRA method. With this research, high, medium, low risk and not risky areas of sanitation will be obtained as a reference for intervention.

3. Materials and Methods

3.1. Field Study

First method uses in the present study is field study in which it is conducted by analyzing primary data taken from study of Environmental Health Risk Assessment (EHRA). The primary data contains of information about availability of sanitation services for household within districts or regions. The stage is analysis of secondary data which collected from numerous environment institution.

3.2. Population and Sample

Eq. (1) is used to determine the number of respondents:

$$n = \left(\frac{Z_{\alpha/2} \sigma}{SE} \right)^2 \quad (1)$$

where n = number of sample j, $Z_{\alpha/2}$ = value of standard or normal distribution which connected with confidence degree $(1-\alpha)$, σ = deviation standard of population, and SE = allowed sampling error. Population that use in the present study is household based on census conducted in 2015 around 1.145.396 persons consist of 573.707 male and 571.689 female citizens with sexual ratio around 100,35 % [18]. In other words it can be said that within 100 female citizens there are 100-101 male citizens with deviation standard around 0,564, meanwhile confidence degree $(1-\alpha)$ around 97%, and sampling error (SE) around 3%. Sample for the present study around 9920 respondents or 40 respondents for each villages. Calculation of sampling within EHRA is as follow [19]:

$$n = \left(\frac{Z_{0,012} \sigma}{SE} \right)^2 = \left(\frac{2,17 \times 0,564}{0,03} \right)^2 = 9920 \quad (2)$$

Respondents in the present are housewife or daughter (married) around 18 to 60 years old with total number of respondents are 400 respondents. Meanwhile, number of neighbors that use as sample are 8 neighborhoods in which there are 5 neighborhoods in each neighbors chosen as the sample. Therefore, the total respondents for each village is 40 household.

4. Results and Discussion

4.1. General Description of Research Location

Research is conducted in Blitar which consists of 220 villages and 28 districts within 22 regions. Blitar is located in south of the equator located at 111°40'-112°10' Easy Longitude and 7°58'-8°9'51" South Longitude.

4.2. Mapping of Target Achievement

There are four achievement indicators that measured in the present study which are: clean water, waste water, waste, and drainage. Classification of achievement is clustered as follow: score 1 (low), score 2 (medium), score 3 (high), and score 4 (very high). Calculation of achievement is gained by counting respondents answer in each variable and research indicator in which all results will be scored in order to determine minimum and maximum score coupled with to determine range score in defining the limitation. Result of the study is presented in Fig. 1.

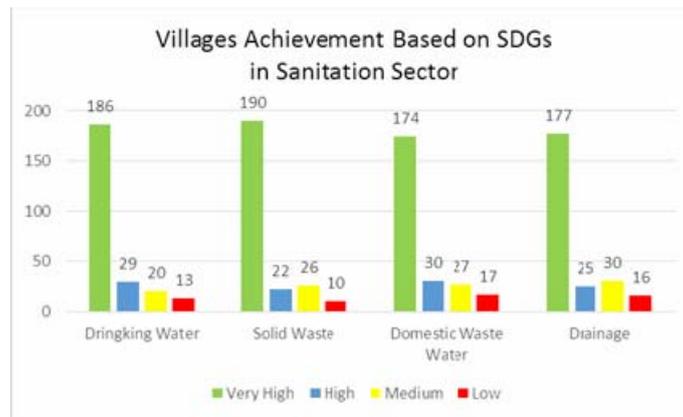


Fig. 1 - Villages achievement based on SDGs in drinking water and sanitation sector

4.3. Achievement of Clean Water

Table 1 shows that Blitar has 13 villages which possess low access of clean water, 186 villages determined as villages that possess very high access for clean water, 29 villages determined as villages that possess high access for clean water and 20 villages achieved medium score for clean water access. This achievement can be determined as good since 98.70 % of villages in Blitar able to access fresh water. Degradation level of environmental health causes numerous diseases. Lenton and Wright stated that issues within development of water access and fruitfulness of sanitation program depend on various aspects such as economics, organization, technic, and politics [13]. More clearly, the achievement of clean water for Blitar District can be seen in Fig. 2.

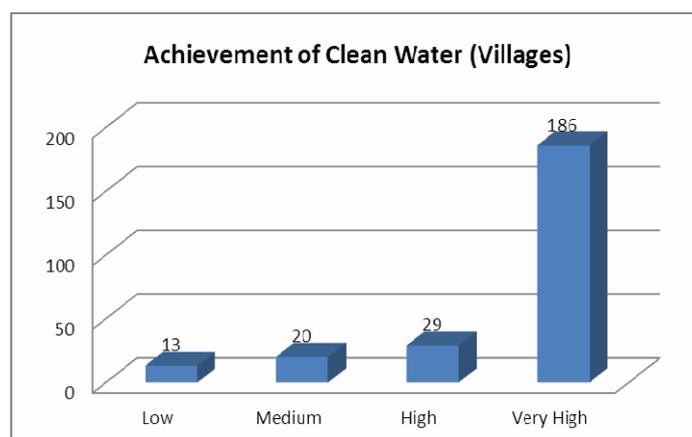


Fig. 2 - Achievement of Clean Water

4.3. Achievement of Domestic Waste Water

Issues concerning people behavior related to clean and healthy life are commonly about defecation in open areas or public areas. This behavior stimulates endemic disease in which it is mainly caused by imbalance economical condition within the society. The development program concerning waste water management is less prioritized in numerous areas

in Indonesia [20]. Moreover, the present study concludes that waste water management system can be determined as good since there are 17 villages determined as low score. Meanwhile, there are 174 villages determined as very high score, 30 villages achieved medium score and 27 villages determined as high access. It is determined as good since 95.45% villages in Blitar possess domestic waste water access. Fig. 3 shows the achievement of domestic waste water for Blitar District.



Fig. 3 - Achievement of Domestic Waste Water

4.4. Sewerage / Sewage and Defecate matter

Defecate waste is a waste that comes from the disposal of human defecation in form of liquid or solid. Management of defecation requires special treatment because defecate contains pathogenic bacteria that can transmit diseases such as Thypus, Hepatitis, Diarrhea and so on.

The practice of defecation in an inadequate place is one of the factors which stimulate the risk of public health status. Moreover, defecation issues are also the main factors that contaminate the sources of fresh water for residents. Inadequate defecation sites are not only open defecation areas such as rivers / sewers / gardens but also latrines in homes that may be considered convenient but it lacks of proper storage container and processing facilities. Lacks of proper storage container and processing facilities that are not waterproof and located too close with the fresh water source can be regarded as sanitation issues which contaminate fresh water source.

People are commonly underestimate children's disposal since defecation of children are considered different from adult. It is considered harmless and can be disposed anywhere within open areas such as rivers, ditches, terrain, or household trash cans. This assumption is very wrong, because the disposal of children and adults can be regarded as sanitation problems that need extra attention because it is very dangerous and can pollute the environment with various pathogens that cause diseases. Based on the EHRA's survey results, about the adults defecation sites in Blitar Villages, can be seen in Fig. 4.

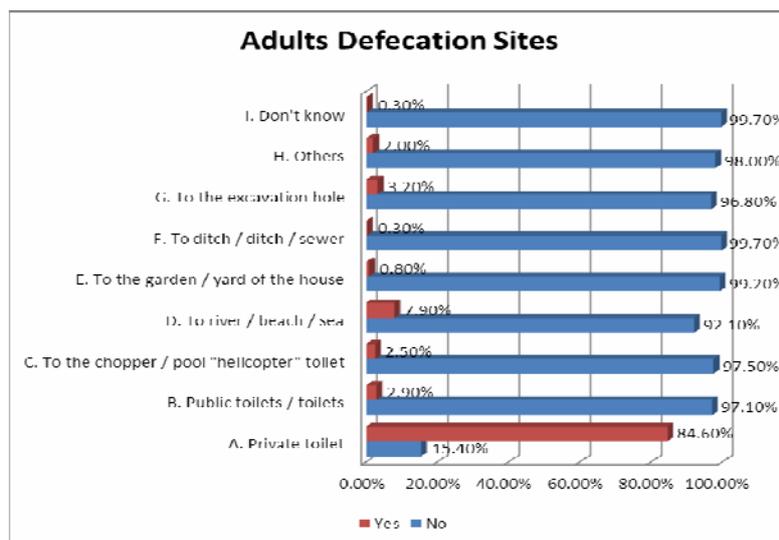


Fig. 4 - Adults defecation sites

From Fig. 4, it can be seen that most adult defecation sites are in private latrines (84.6%), rivers / beaches / seas (7.9%) and in the pit (3.2%). From these data, it can be seen that there are still people who defecate not in a safe place (13.4%), therefore counselling is needed to change their defecation behavior in order to direct them to defecate in a safe place, namely a private toilet. Whereas for the final disposal of defecation in Blitar District scale can be seen in Fig. 5.

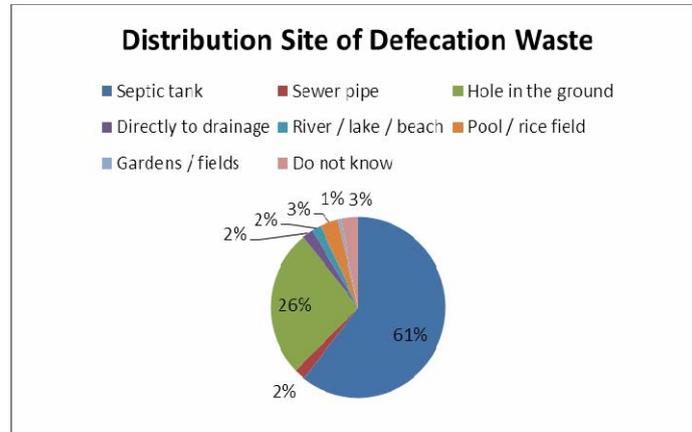


Fig. 5 - Distribution site of defecation waste

From Fig. 5, it can be seen that most of the final discharge stools are septic tanks (60.7%), hole in the ground / pit (26.5%), ponds / rice fields (3.3%), and rivers / lakes / beaches (1.7%). From these data, it can be seen that there are still many households whose final exhaust stool is disposed of in an unsafe place namely 'cubluk' / pit, and river / lake / beach which are at risk of contaminating the water sources. The purgation status of the Septic Tank in Blitar District can be seen in Fig. 6.

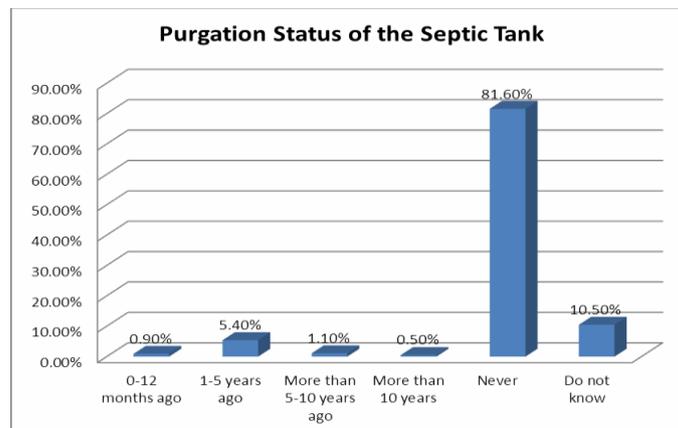


Fig. 6 - Purgation Status of the Septic Tank

From Fig. 6, it can be seen that 81.6% of respondents said that they never emptied septic tanks and 10.5% said they did not remember. Thus, it was seen that only 7.9% of respondents had ever emptied the septic tanks with various time variations, namely 0-12 months ago 1-5 years ago, more than 5 years but less than 10 years, and more than 10 years year. From the various variations in the emptying time of the septic tank, it turned out that most respondents stated that 1-5 years ago the last septic tank was emptied (5.4%). The practice of emptying the Septic tanks in Blitar District can be seen in the bar diagram as in Fig. 7. It can be seen that most of the respondents stated that they did not know who did the septic tank emptying (58.3%). It was also seen that emptying the septic tank was done by paying handyman (25.5%) and using stool suction services (11.0%). Only a small number of people do their own to empty the septic tanks (5.2%).

As for the quality of septic tanks owned by households on the scale of Blitar District can be seen in the pie chart as shown in Fig. 8. It can be seen that the quality of the septic tank are mostly safe (66.8%) while the rests are unsafe (33.2%). Whereas, for the practice of children under five years' (toddlers) waste disposal in the respondent's house, which has toddler at his house, on the scale of Blitar District can be seen in the pie chart below. In Fig. 9, it can be seen that most children's stools are dumped into toilets (62.8%) and into rivers/sewers /ditch (6.0%). On the other hand, the domestic wastewater risk areas based on the EHRA study in Blitar District is tabulated in Table 1.

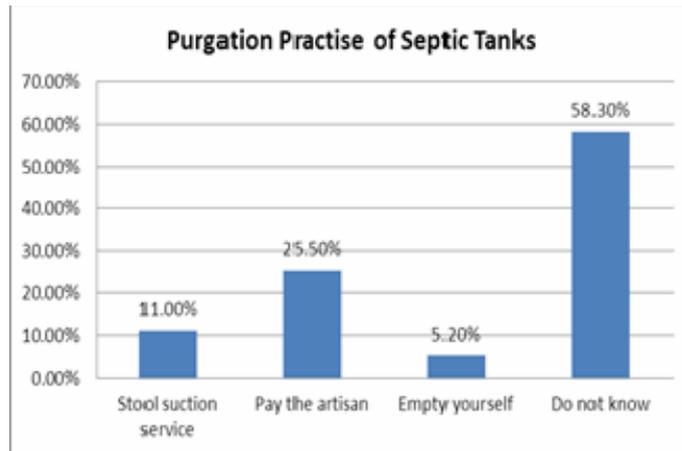


Fig. 7 - Purgation practice of septic tanks

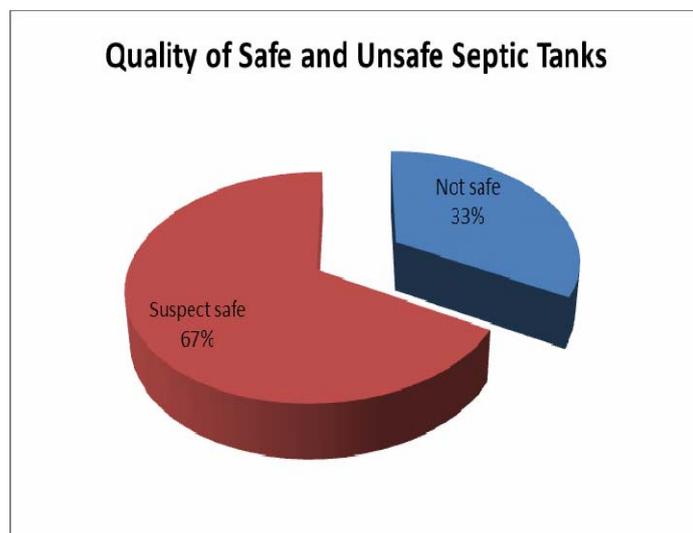


Fig. 8 - Quality of safe and unsafe septic tanks

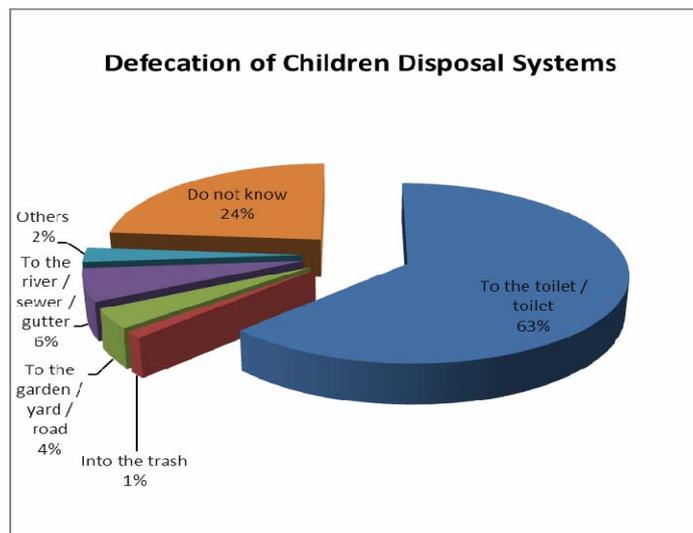


Fig. 9 - Defecation of children disposal system

Table 1 - Risk areas for domestic wastewater based on EHRA study results

			Total	
			n	%
1	The septic tank is suspected to be safe	Unsafe	329	33.
		Suspected	662	66.
2	Pollution due to disposal of septic tank	Unsafe	69	86.
		Sa	11	13.
3	Pollution due Sewers Waste	Unsafe	417	42.
		Safe	5749	58.0

4.5. Achievement of Garbage Disposal

Various studies show that garbage disposal is less prioritized compared to other waste management such as air and water pollutions. Meanwhile, the present study shows that Blitar able to achieve as good region since only 10 villages scored low access of garbage disposal management. Moreover, there are 190 villages scored as very high access, 22 villages scored as high access and 26 villages scored as medium access. This achievement can be determined as good since 98.05 % villages in Blitar possess access of garbage disposal. More clearly the achievement of garbage disposal for Blitar District is shown as shown in Fig. 10.

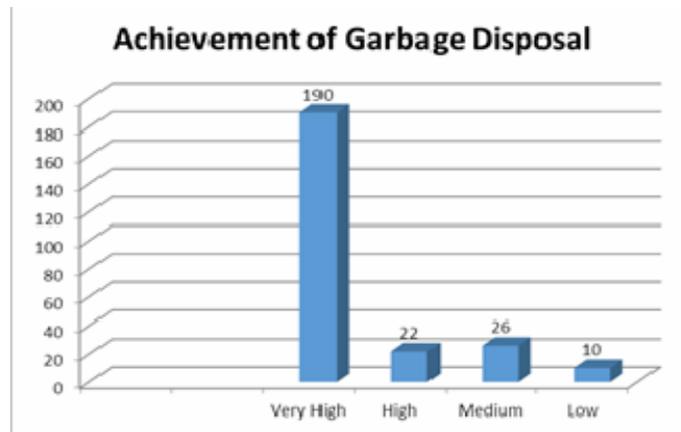


Fig. 10 - Achievement of Garbage Disposal

4.6. Achievement of Drainage

The present study shows that Blitar achieve good scored concerning access of drainage since it is only 16 villages scored as low access, 177 villages scored as very high access, 25 villages scored as high access meanwhile 30 villages scored as medium access. Moreover, this achievement can be determined as good since 97.40 % of villages in Blitar have drainage access. More clearly the achievement of drainage for Blitar District is shown as shown in Fig. 11.

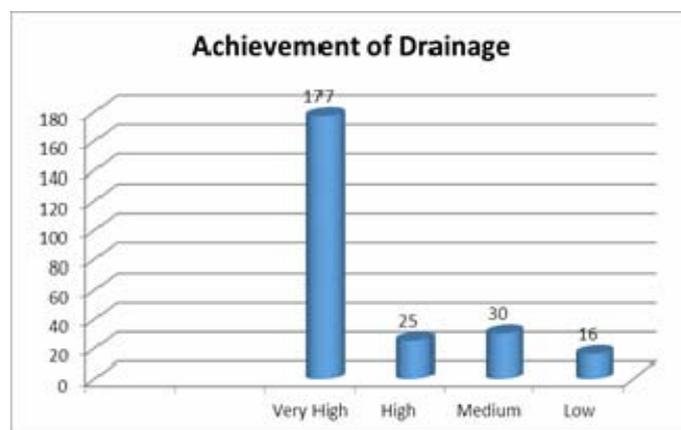


Fig. 11 - Achievement of Garbage Disposal

5. Summary

Based on the present study, the achievements of Blitar are as follow: Very high are 180 villages or 72.58 %, High are 26 villages or 10.48%, Medium are 28 villages or 11.29 %, and Low are 14 villages or 5.65 %. Result of the present study can be used as reference to manage and solve sanitation issues in Blitar Districts and high priority in solving sanitation issues can be given to 13 villages that achieved low score.

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References

- [1] Strategi Nasional: Sanitasi Total Berbasis Masyarakat (2008), Departemen Kesehatan Republik Indonesia, Jakarta.
- [2] Proyek Penyediaan Air Bersih dan Sanitasi Pedesaan di Nusa Tenggara Timur (ProAir) (2011), Kerjasama Bilateral Bilateral Pemerintah Republik Indonesia dengan Pemerintah Republik Federal Jerman.
- [3] Indonesia Sanitation Sector Development Program (2006), Lessons in Urban Sanitation, Water and Sanitation Program, World Bank.
- [4]. Basic Human Services (2006), Survey Rumah Tangga tentang Perilaku Kesehatan Ibu dan Anak serta Pola Pencairan Pengobatan di Tingkat Masyarakat, Departemen Kesehatan Republik Indonesia dan Pusat Penelitian Kesehatan - Universitas Indonesia.
- [5] World Health Organization (2003), The World Health Survey Programme, Geneva.
- [6] Santosa, F.R.E and Hermana, J. 2012. Mapping of Environmental Health Risk Area for Surabaya City as an Evaluation of Millenium Development Goals 2015. International Journal of Academic Research. Vol. 4. No. 1. January, 2012.
- [7]. Santosa, F.R.E. (2016). Profil Sanitasi Wilayah untuk Penentuan Sistem Air Limbah Domestik (Studi Kasus: Kota Surabaya). (Disertasi).
- [8] Dinas Pekerjaan Umum Cipta Karya dan Tata Ruang – Provinsi Jawa Timur. 2015). Rencana Kerja – PU Cipta Karya dan Tata Ruang
- [9] Mara, D., D., Lane, J., Scott, B., and Trouba, D. (2010). Sanitation and Health.
- [10] Carter, R.C., (1999), Impact and sustainability of community water supply and sanitation programmes in developing country, Journal of the chartered institution of water and environmental management, vol. 13, pp: 292-296. Conditions for Physical Sustainability. PhD Thesis, University of Leeds, Leeds,
- [11] Mara, D., D. and Alabaster, G. (2008). A New Paradigm for Low-cost Urban Water
- [12]. Neder, K., D. and Nazareth, P. (1998). Condominial Sewer Systems for the Federal
- [13] Mara, D., D., Sleight, A., and Tayler, K. (2001). PC-based Simplified Sewer Design. Plas Medicine, Vol. 7, issues 11, pp: 1-7
- [14] Mara, D., D. and Alabaster, G. (2008). A New Paradigm for Low-cost Urban Water
- [15] Mara, D., D., Lane, J., Scott, B., and Trouba, D. (2010). Sanitation and Health. Plos
- [16] Mara, D., D., Sleight, A., and Tayler, K. (2001). PC-based Simplified Sewer Design. Plas Medicine, Vol. 7, issues 11, pp: 1-7.
- [17] Mara, D., D. (1996). Low-cost urban sanitation. John Wiley and Sons, Chichester,
- [18] Magnani, R., Sampling Guide (1997), Food and Nutrition Technical Assistance.
- [19] Badan Pusat Statistik Kabupaten Blitar 2015 (2015).
- [20] Nurhidayat, A dan Hermana, J. (2009), Strategi Pengelolaan Air Limbah Domestik dengan Sistem Sanitasi Skala Lingkungan Berbasis Masyarakat di Kota Batu Jawa Timur, Prosiding Seminar Nasional Manajemen Teknologi X, Program Studi MMT-ITS.