The applied technologies to access clean water for remote communities

I B Rabindra
Landscape Architecture Department, Faculty of Landscape Architecture and Environmental Technology, Universitas Trisakti, Jakarta, Indonesia

Corresponding Author: ib.rabindra@trisakti.ac.id

Abstract. A lot of research is done to overcome the remote communities to access clean water, yet very little is utilized and implemented by the community. Various reasons can probably be made for, which is the application of research results is assessed less practical. The aims of this paper is seeking a practical approach, how to establish criteria for the design can be easier applied, at the proper locations, the simple construction, effectively producing a volume and quality of clean water designation. The methods used in this paper is a technological model assessment of treatment/filtering clean water produced a variety of previous research, to establish a model of appropriate technology for remote communities. Various research results collected from the study of literature, while the identification of opportunities and threats to its application is done using a SWOT analysis. This article discussion is looking for alternative models of clean water filtration technology from the previous research results, to be selected as appropriate technology, easily applied and bring of many benefits to the remote communities. The conclusions resulting from the discussion in this paper, expected to be used as the basic criteria of design model of clean water filtration technologies that can be accepted and applied effectively by the remote communities.

Keywords: access, applied technology, clean water, less practical, remote communities

1. Introduction
Overcoming the limitations of public access to get clean water, has been very much a design model research of filtering dirty water into clean water (water filtration) which is offered for the people that need it (see: figure 01)[1]. Among them there are some draft model from the previous study already applied and is functioning quite effectively so that the benefit of a particular community. On the other side, not a few are also the design of the model of the research results are applied but less successfully give optimum benefits or at least meet the expectations of its users sake then left not working. The results of the research-based chemicals, such as technology known as Colloidal Applications i.e. wrapping with deposition or blob substances (coagulant) in conventional filtration process, relative simple technology as commonly used by regional drinking water company (PDAM) in Indonesia [2]. In the current study did not mention how the composition of the substance deposition such as alum, activated carbon, chlorine/chlorine, lime and tohor sand needed for unit volume of dirty water that are processed, and how the resulting clean water volume in units of time [2].

Model research based on the results of the process of gravity through the three stages of Deposition Tank – Filtering Tank – Shelter Tank. On the deposition tank contains material Stone tubs/coral as the material required to be able to deposit the sludge and other heavy material; On the tub filled various filtering materials respectively Palm fiber, smooth sand, Palm fiber, smooth sand, coconut shell.
Charcoal, gravel and stone/coral (source: Kemdikbud document/water filter by natural material) [3], [4]. The model is simple and environmentally friendly real relative easy applied, because its material and natural system, widely available and easy to obtain. Resistance on the uncertainty of processed water volume in comparison with the volume of the filter material is required, the speed of the process of filtration and system maintenance [4]. Model Sieve Rock, the results of other studies which have already successfully applied on a community in the village of Kerobokan – Bali, is the water treatment systems that use a single material i.e. the Padas are local Stone called Jempeng. With the basic material 'jempeng' Balinese-sieve rock/stone who has special natural characteristics with the diameter of the pores of the standard filtering clean water, developed two variants of the model form of ‘U’ and ‘W’ shape of the model [5]. Although water filtration applications are rated quite effective, it turns out that this model was developed in other regions is difficult outside the Bali Island [6].

This paper aims at finding the reason why such a very view water filtration research model applied by the people who need it, from the very large number of such alternative and variant of the model water filtration research results are offered? Identification of problems occurred will be relied upon to improve the draft clean water filtration model which will be easily applied by the people who need it. The study will include a search problem of occurrence of resistance of the application model in field, then formulate a solution through a more comprehensive approach was not limited to technical issues alone.

2. Research Method

Previous research on the system and the process of water treatment is generally done in special cases by the method which is also very special, for example, in a case of water pollution at the time of the flood where it needs to be done in emergency water treatment process by using a chemical process. This research was conducted to find instead a model system and a water treatment process can be applied in General in cases of difficulty of remote communities to get access to clean water. The characteristics of the subject of the observation is certainly more common in nature, which means that in many cases the onset of difficulty community get access to clean water. More specifically the research subject is the need of access to clean water for communities in remote areas or isolated, where the characteristic of their social, economic, and cultural into consideration major approach to solving the problem.

Data collection was done through literature review, good secondary data regarding the condition of the social, economic and cultural community, including a variety of background conditions of geographic, topographic, geological, hydrographic as well as its physical environment natural climatologic. Data on social, economic and cultural community desolate analyzed by using SWOT analysis, which identified the various strengths, weaknesses, opportunities and threats facing remote communities to be able to accept, apply, utilize and manage optimally clean water filtration technology model for the fulfillment of his needs would be clean water. Data concerning the various results of previous research and several cases of success and failure of the application model research in the community, the use of secondary data is also done with a review of the literature. Data on the alternative specifications model water filtration technologies tested its opportunity to applied on remote communities, through the analysis of S-O which identify opportunities based on the strengths – social, economic and cultural community. So instead, via the analysis of W-T identified a variety of barriers to acceptance, application, utilization and management model of water filtration technology in remote communities.

3. Results and Discussion

In general the results of previous research to divide the water source being processed into two levels: (first) The base material that is processed is salt water or brackish water, which through the process of with filtration system RO; or through the process of distillation with steam generator system; or through ion exchange process with heat exchange system, to produce standard quality drinking water. (second) The basic ingredients of water, fresh water is treated with acid/quality peat moss or turbid river water through a process of combination of coagulation-filtration produced water with clean water quality standards. The basic ingredients of water, smelling the soil contains iron and manganese,
carbon filtration through a process of manganese to be produced water with clean water quality. As well as the basic ingredients of groundwater are ‘hard’ is treated through system hard 'softener' could resulting water quality clean water (see Figure 1).

| SOURCE         | SALINITY LEVELS | TYPE OF PROCESSING AND WATER QUALITY | PROCESSING SYSTEM | QUALITY STANDARD |
|----------------|----------------|--------------------------------------|-------------------|-----------------|
| Raw Water      | Saltwater/Brackish | Filtration | RO System | The Quality of Drinking Water |
|                | Fresh water       | Distillation | Steam Generator | The Quality of Drinking Water |
|                |                   | Ion Exchange | Heat Exchangers | The Quality of Drinking Water |
|                |                   | Acid/Peat      | A Combination of  | The Quality of Clean Water |
|                |                   | Murky River Water | Neutronisation | The Quality of Clean Water |
|                |                   | Beach Sand/Gravel Water | Coagulation | The Quality of Clean Water |
|                |                   | Hard Soilwater | Filtration | The Quality of Clean Water |
|                |                   | Clean Water | Carbon-Manganese | The Quality of Clean Water |
|                |                   |                   | Heat Exchangers | The Quality of Clean Water |

**Figure 1.** Water quality processing system.

Model the process of filtering dirty water into clean water or drinking water as the development of various research results has been also applied. Some of them can be run effectively as planned, but not a few who failed and subsequently abandoned, because it judged less in accordance with the various application conditions. System of processing through a chemical approach, generally less applicable regions, particularly remote areas with communities in social-economical and cultural importance relative to traditional. One example of a popular relative model was developed by the Ministry of education and culture i.e. gravitational system with multi-level filtering through the various layers of a natural materials filter, such as: Palm fiber - fine sand - Palm fiber - fine sand – coconut shell charcoal – stone – pebbles (Figure 2). The same is also done a system process called Gravity-fed Water Filtering System, which uses basic ingredients of rock and sand as filtering materials (Figure 3).

Jempeng 'U' model is usually placed on the areas of standing water, like a river or pond in conditions always submerged, so can always available fresh water in it. The advantages of Jempeng 'U' is a very simple construction, pipeline system are not required for dirty water or clean water, jempeng 'U' weakness is clean water surface were never higher than the surface of the water place soaked. Jempeng 'W' models are usually built with mostly embedded in the land site of the House, it takes water pipe network system for dirty water inlet or clean water pipe outlet. In relatively more complex construction, but the volume capacity of clean water produced can be more.

Some models of research results in the form of technology devices in the form of processing units of clean water and drinking water has also been created, including by the environmental technology center (PTL) BPPT to overcome need clean water on a flooded area in Jakarta. Despite the proven processing unit can produce more than 300 cubic meters of clean water and decent drink in six days of operation (source: Humas BPPT), this unit is also not easy to implement a remote region. The cause is this unit has not been mass-produced so that the price is expensive, requires a trained operator, as well as other technical requirements such as the use of membrane ultra-filtration up to 0.0001 microns for Desalination plant reverse osmosis (RO). Other models even had enough detail, is already in the form of image work (Detail Engineering Design); Although the maximum capacity of processing units of about 100 cubic meters/day, but not the model dimension calculation formula outlined in relation to the desired capacity, so difficult to measure how large the model units can meet the needs of clean water a community. The model also does not indicate the use of specifically, besides the quality and feasibility of the use the clean water produced from each stage of the process (Figure 4).
Remote communities are groups of people who lived in an area that is difficult to reach by any mode of transportation, even though difficult to achieve enough on foot. Community groups this can be in the number of population which is pretty much that shaped village, but often that is only made up of dozens of individuals who comprise some families only. Location and geographical condition of natural environment is generally at a remote region (far from the city or village) and relative topographic area of undulating, with soil conditions are generally fertile, most close to the flow of the River, but rarely on dry land far from rivers. Living in dry areas or away from the flow of water of course they desperately needed water for life, even living near river flow is sometimes difficult to get a decent water consumed.

Against the background of such an environment, social living conditions they are generally included in the category of pre-prosper. Their education level is generally very low, very little of which had education bench, although elementary school level though. However, they were included in a society that is able to survive in situations of hardship and deprivation, the community also has a very close kinship system also reflects.
In a variety of limited knowledge and understanding of technology, remote communities would be very difficult to accept advanced technology as an alternative so that they gain access to clean water. The difficulty in understanding the system and work process models, of course, will have difficulty in making application, use or maintenance. Economic conditions that fall into the category of pre-prosperous, they will of course deny that require model construction materials that must be drawn away from their communities. Model that uses a material that must be imported from outside the territories of the community they surely will be rejected because it is very expensive and the value of economical becomes very low. With an abundance of natural materials such as stone, sand, Palm fiber, coconut shell charcoal and so on, of course they would prefer clean water filtration technology model that more use of natural materials. Nevertheless the design model construction need to be tailored to the capabilities of the technology that they mastered, as well as little as possible the use of materials that must be imported, such as cement, pipes network and so on. The cement can be replaced with a mixture of clay and limestone, while the pipes can be replaced with bamboo that generally widely available.

The greatest strength of the remote communities of the society is the physical fitness in the form of a strong power and endurance of body height (not easily tired) as well as staunchly moral because it is very usual the face of hardship. On the other hand they also reflects such a sense of community, is another strength where they very humble ready to help each other, as well as the form of cooperatives or other sub communities according to the wishes and expectations of them. Based on the identification of opportunities and barriers to the results of the SWOT analysis against remote communities such as the above characteristics, then the assessment of some alternative model water filtration technologies that are offered are as follows: (1) Model no chemical-based technology-based; (2) no Model-based advanced technology or use fuel/electrical power; (3) Construction does not use ingredients that are hard to come by in to location; (4) the draft construction easy to read, understood and applied; (5) the construction and materials as much as possible the use of materials that are widely available on location; (6) how to use, management and maintenance of the required no cost; (7) the use, management and maintenance of the construction based on nature of community and kinship in the community; (8) the determination of the construction site are submitted on a decision shared by the community.

4. Conclusion
Clean water filtration model acceptable, to apply, it is managed and maintained by the community, in accordance with the various identification of constraint that occur due to distance and travel time to, the degree of knowledge and technical skills in the community, the limitation of individual and collective economic society, is as follows: (1) Model should be built, operated and maintained using only local ingredients, not the product that was imported; (2) the technology used are not advanced technology and have to be appropriate, in order to be easily built, managed and maintained by a community self-help basis. Whereas in accordance with the identification of strengths and
opportunities owned by the community who have the ability and endurance of physical excellence and are also reflects, are: (3) models and technologies that can only be built, managed and maintained use together; (4) the placement of the location of the application model should be on the middle point of the mileage each Member of the community, in order to awake community colectifity.

References
[1] Departemen Permukiman dan Prasarana Wilayah, Departemen Kesehatan, Departemen Dalam Negeri, & BAPPENAS. Kebijakan Nasional Pembangunan Prasarana Dan Sarana Air Minum Dan Penyehatan Lingkungan Berbasis Lembaga. 2003.
[2] http://kelair.bppt.go.id, [4, 5 and 15 July 2017].
[3] http://www.google.com/ DokumenKemdikbud: water filter by natural material, [5 July 2017].
[4] http://www.sribd.com/, Makalah Pengolahan Air Bersih. [5 July 2017].
[5] http://www.google.com/,[4, and 5 July 2017].
[6] http://aimyaya.com/id, accessed on 4th July 2017.
[7] Kementerian Pekerjaan Umum Kajian Keterpaduan Pengembangan Air Baku, Air Bersih Dan Sanitasi, 2010.
[8] Peraturan Menteri Kesehatan Republik Indonesia Nomor 492/MENKES/PER/IV/2010 tentang Persyaratan Kualitas Air Minum. 2010.
[9] Vol. V, No. 07/I/P3DI/April/2013, Introduction to Water Treatment TL 4001, Rekayasa Lingkungan 2009, Program Studi Teknik Lingkungan ITB, 2009.
[10] Wikantiyoso, Respati, Tutuko Pindo, Local Wisdom: In Urban Planning and Design, to Realize Sustainable Urban Architecture. Universitas Merdeka, Malang, 2009.
[11] Sayuti S A, Towards a Cultural Aware Situation: Between 'the Other' and Local Wisdom, 2005.