Wastewater management alternatives in refugee camps

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Abstract
According to the humanitarian response within a refugee camp situation, two phases occur most of the time, the emergency and a stabilization phase. The first one refers to relief operations when actions are taken in order to provide quick solutions to satisfy essential needs. The second one occurs once the situation is perceived as a non temporal camp; the quick solutions improvement and other needs are required and considered. Wastewater comes naturally along with the use of water in both stages of a refugee camp. It can be divided into three categories: domestic, human excreta and rainwater. There are multiple options for dealing with produced wastewater in a refugee camp considering that every option has to be analyzed by experts and consulted with refugee population since the solution should take into consideration not only costs and viability, but also cultural acceptance. When human excreta disposal and wastewater treatment solutions involve materials and experts; experts should train the population on how to manage and maintain the infrastructure before the humanitarian assistance leaves. Environmental sanitation is an important part within the refugee camp process in order to assure good health in the refugee population and to improve their life quality.

Keywords: Refugee camp, Domestic wastewater, Sewage, Rainwater, Human excreta disposal, Wastewater treatment.

Alternativas de manejo de aguas residuales en campos de refugiados

Resumen
De acuerdo con la respuesta humanitaria dentro de la situación de un campo de refugiados, dos fases ocurren en la mayoría de los casos, las fases de emergencia y estabilización. La primera se refiere a operaciones de ayuda cuando las acciones son llevadas a cabo para proveer soluciones rápidas que satisfagan necesidades esenciales. La segunda ocurre una vez que la situación es percibida como un campo no temporal, las mejoras de las soluciones rápidas y la atención a otras necesidades son requeridas y consideradas. Las aguas residuales son parte del uso de agua en las dos fases de un campo de refugiados; se pueden clasificar en tres categorías: doméstica, excreta humana y agua pluvial. Existen múltiples opciones para tratar las aguas residuales producidas en un campo de refugiados, considerando que cada opción debe ser analizada por expertos y consultada con la población refugiada ya que la solución debe tomar en consideración no sólo costos y viabilidad sino también una aceptación cultural. Cuando tanto la disposición de excreta humana como el tratamiento de aguas residuales involucran el uso de materiales y expertos, los expertos deben capacitar a la población en el manejo y mantenimiento de la infraestructura antes que la ayuda humanitaria se retire. El saneamiento ambiental es una parte importante dentro del proceso de un campo de refugiados para asegurar una buena salud en la población refugiada y para mejorar su calidad de vida.

Palabras clave: Campo de refugiados, Aguas residuales domésticas, Aguas negras, Agua pluvial, Disposición de excreta humana, Tratamiento de aguas residuales.

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Introduction

A refugee is a person who, "owning to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country" (UNHCR 2007). Refugees need suitable sites to stay and shelter; therefore, it is recommended to use longer terms when planning, even when the refugee situation is expected to be temporary. Most refugee operations last longer than anticipated, therefore cost-effectiveness, sustainable infrastructure and shelter should be properly planned from the start. One of the most important decisions of a refugee camp is the site selection. It will define the conditions of all the following steps in its installations and these installations are very difficult to reverse. The layout, infrastructure and shelter of an emergency camp will have a major influence on the safety and well-being of refugees, so these factors must be coordinated with other factors in the humanitarian response, such as community services, water supply, environmental sanitation, health, education, food distribution, logistics, forestry and the environment (UNHCR 2007).

In the initial stages of an emergency response, such as the one for refugees, water supply and sanitation are critical for survival due to the susceptibility of people in these emergency situations from illness and death caused by diseases related to lack of sanitation, inadequate water supplies and poor hygiene (UNICEF 2005). Overcrowding, harsh environment and disruption of normal sanitation habits can also threaten the lives and well-being of the refugees. The main objective when dealing with environmental sanitation is to prevent the spread of disease and promote a safe environment for the refugees (UNHCR 2007).

The implementation of sanitation programs in refugee camps can be difficult mostly due to unfavorable environmental factors or unfavorable socio-cultural habits. Other constraints include: limited time for communities to get organized, lack of qualified personal and lack of space. The cooperation with the refugees in the development of sanitation services is important to overcome the traditional practices if necessary. Nevertheless, good sanitation depends both on the attitude of the community and the system developed. The latter has to be able to operate effectively with a minimum of outside involvement (UNHCR 2007).

Domestic wastewater, sewage and rainwater

The wastewater aspect from the environmental sanitation should always be considered from the beginning, because the sources must be controlled as soon as possible. Moreover the difficulty in the corrective measures in the drainage system increases once shelter and other infrastructure have been built. Good drainage should be a priority at water points, sanitary facilities and shelters. Drainage or harvesting of rainfalls should also be considered (UNHCR 2007).

Rainwater can be harvested for drinking water but because of the lack of storage facilities this is often unrealistic. If rainwater collection is practiced it should take into account the surface covered roofs and then multiplied by 75% of the average annual rainfall or evaluating the quantity of rainwater harvested through households. If rainwater is not collected it should be taken into account in the wastewater drainage system, with a special planning and designing that takes into account potential rainwater run-off-failure, because this has make some refugee camps become flooded during rainy seasons. Drainage canals for wastewater should consider some factors such as ground soil conditions, sub-surface water table and its seasonal variation, topography and type of wastewater (UNHCR Water and Sanitation Unit, Public Health & HIV Unit 2008).

An important thing in the wastewater system design is that domestic wastewater (sullage) is classified as sewage when mixed with human excreta. Unless the settlement is sited where there is an existing sewerage system, domestic wastewater should not be allowed to mix with human waste. Sewage is more difficult and expensive to treat than domestic wastewater. At the water point sources, washing and bathing areas, the creation of small gardens to use wastewater should be encouraged. Also special attention is needed on washing and bathing areas to prevent the contamination of water sources. Where possible, and if favorable soil conditions exist, drainage from water point sources and washing areas should be on-site rather than thru open channels, which are difficult to maintain and often clogged. Simple and cheap techniques such as soak pits can be used for on-site disposal of wastewater. When off-site disposal is the only possibility, channels are preferred than pipes. Channels should be designed both to provide flow velocity for dry-weather sullage and to carry storm water. Where the slope is more than 5%, engineering techniques must be applied to prevent excessive erosion (The Sphere Project 2004, UNHCR 2007). In some circumstances, wastewater should be treated. There are some treatment package units but these are usually expensive and complex both to operate and maintain. However, there is a broad range of wastewater treatment technology available.

Human excreta disposal

Designing a wastewater system starts with the selection of a human excreta disposal system. In a refugee camp two situations may occur: the emergency phase and the stabilization phase. In this case, temporary systems that meet the most immediate needs, will have to be improved or replaced as soon as possible, in order to maintain adequate sanitation standards (UNHCR 2007).

The human excreta disposal systems in an emergency phase can be a shallow trench latrine and a defecation field. In the stabilization phase, the solutions are more complex and difficult to construct, however they offer greater assurance of proper operation and less intensive supervision (Darmawan et al. 2005). The following options are typically used: simple pit latrines, Ventilated-Improved Pit (VIP) latrine, borehole latrine, septic tanks and communal aqua-privies.

Some ecological sanitation (Eco-San) solutions are available but they are not appropriate in most emergency situations, only when the population is already used to using similar systems. These systems include double-vault urine and no-urine diverting latrine and the use of biogas generated by decomposing excreta (Harvey 2007).

Wastewater treatment

It is possible, in most emergency situations, to use on-site excreta disposal systems that do not require complex wastewater treatment. However, in some cases treatment prior to disposal is necessary. Some examples are: in heavily dense populated areas, in sites with terrains that do not allow pits digging or groundwater can be easily polluted, and in situations where the cultural resistance to those systems is too high. As shown, the septic tank is the most simple wastewater treatment system.

More complex treatment technologies can be used to treat larger volume of sewage and include two phases, the removal and the actual treatment (Harvey 2007). The chosen removal system has to be able to remove wastewater without polluting the local environment. This can be done by an open channel, a gravel drain or a pipe drain. The open channel is the most simple and economic technique and should be used only for draining rainwater or wastewater over short distances. The channel should be made out of cement with enough slope to be self-cleansing. A gravel drain is the improvement of an open channel by lining it with plastic sheeting and filling it with coarse gravel. Finally it is covered with soil material. In this system, wastewater should never contain suspended material because it is impossible to unblock. Lastly the pipe drain is the most effective way of removing wastewater but also the most expensive. The pipes can be made of polyvinyl chloride (PVC), polythene, cement or fibrocement among other options and the system must consider the slope to be adequate for the flow. Regular maintenance in order to deal with blockages is necessary (Darmawan et al. 2005).

Once removed, collected and transported, the wastewater may be disposed off or treated. Although when in an emergency situation, simple disposal may be the only option, it is not recommended and it must be improved in a second stage of the emergency. It also has to be taken into consideration that all wastewater treatments produce sludge and that it requires careful handling and final disposal. This final disposal can be in a pit, an incinerator or on agricultural land (Harvey 2007). The most basic way of wastewater treatment system, beside the septic tank, is the infiltration system. This system uses the natural capacity of the soil to fix particles present in water and to purify the water by a process of biological decomposition capable of destroying microorganisms and chemical pollution. This system is used in the following techniques (Darmawan et al. 2005).

- A soak-away pit: this pit or trench is covered to prevent vector access and might be filled with gravel. In this system, the water seeps into the soil, mostly into the sidewall of the pit as the bottom usually seals up due to particles in the sullage.
- An evaporation bed field: the beds are 3 by 3 meters, the surface area must be leveled and the factor is 1m^2 per 20 liters of sullage per day. The beds are separated so that the sullage can be directed to anyone of the drying beds, which have a small dike around their perimeter. If the beds are used properly, they create no insect hazard and only slight odors.
- A drainage field or an infiltration trench: this consists of gravel-filled underground trenches into which the liquid effluents coming from a septic tank are led through open-jointed (stoneware) or perforated PVC pipes, allowing the effluents to infiltrate into the ground.

Finally, there are more complex wastewater treatment systems, and therefore more expensive, which can be found in commercial systems units (Harvey 2007). Some of these are:

- Rotating Biological Contactors (RBC): treats the waste by having many disks mounted on a shaft which rotates slowly to alternatively submerge and aerate the biomass on these disks.
- Biological Aerated Filters or Submerged Aerated Filters (BAF/SAF): mobile or fixed submerged media are in a tank where the biomass is attached and is continuously aerated form diffusers underneath it.
- Membrane Bioreactors (MBR): submerged membranes within an aerated tank that essentially

filter the incoming wastewater.

- Activated Sludge: continuous aeration followed by a settling stage to recover the biomass.

The utilization of one of these systems relies on many factors, mainly the economic capacity, but also the availability of experts to install it and instruct the final users on how to manage and maintain it. It also requires a high quantity of water and energy to function. Normally these systems fail if the energy power is not constant or continuously interrupted, and both of these situations occur in refugee camps.

Whichever system is adopted, it has to be the most suitable for each refugee camp and it must not be generalized.

Conclusion

Even though complex or advanced technologies are available, it is not always suitable to be used in refugee camps, due to a number of reasons which include economic, cultural and environmental reasons. When these technologies are in fact implemented in refugee camps, a number of steps have to be taken in order to assure the proper functioning, such as capacitating the receiving population for the use and maintenance so that external help is not needed after the installation of the system. Although, the most important factor will always be the acceptance of the refugees because they are the ones that will use the systems installed.

Due to the emergency factor the phrase "act first, improve later" plays an important role, hence drastic measures are taken without the agreement of refugee population. Although the people's culture and way of living are not taken into consideration initially, it is done afterwards for long term improvements. In spite of this, long term planning has to be considered from the beginning because there might be refugee camps that become temporary, semi-permanent or permanent. When temporal, these situations have always an impact both in the environment and in the people that lives in it.

Water supply is one of the most important factors to deal with a refugee situation and in a refugee camp operation. Wastewater treatment becomes a vital component in a refugee camp to safeguard the health and surroundings of the population.

Whatever system is implemented for excreta disposal and wastewater treatment, it has to ensure the safety of the people but also that it will not be a problem for them. Hence, making their life easier and improving their life quality.

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