People-Centered Approaches in Sustaining Water, Food and Environmental Sanitation in the Philippines: A Review

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Abstract
Clean water, food safety and sanitation are integral components of the strategies for reducing poverty and achieving Millennium Development Goals in developing countries, like the Philippines. With increasing waterborne and foodborne diseases coupled with health risk of local and imported food products and water demand among competing users, there is a need to adopt a more integrated, holistic people-centered approaches and management of our water resources, food products and sanitation. Such systems approaches provide ways of representing and sharing various perspectives and understandings of the same issue by a variety of people's preferences. This calls for systems approaches which integrate data, information and tools to support policy decision making which requires a radical change in professional's attitudes from service provision towards participatory service creation and sustainability. Centering of people as the decision maker on integrated systems approaches resource management, the potential health benefits of reduced pathogenic and toxic chemical contamination of water, food products and the importance of community participation will ensure sustainability of water, food supply and environmental sanitation. Thus, this paper presents case studies for critical *state-of-the-art* review of complex issues, challenges on water, food and environmental sanitation in the Philippines.

Introduction
There are three serious issues to get across about the water, food and sanitation situation in the Philippines: (1) widespread water scarcity and multiplicity in water governance; (2) the existing water systems are not much geared for the urban as well as rural poor; and (3) the food safety, sanitation and sewerage requirements have been grossly neglected (FDC, 2004). The emergence of modern environmental hazards (e.g., improperly disposed hazardous substances from industries and households, vehicular and industrial emissions) and the persistence of traditional hazards such lack of access to fundamental resources such as safe water, safe food products, sanitation and housing, *Filipinos* face the burden of both communicable diseases, which are closely linked with traditional hazards, and non-communicable diseases, which are associated with modern hazards (World Bank, 2003). Under these circumstances, impoverished communities that have yet to acquire the basic needs essential for healthy living like water, food, shelter and sanitation facilities experience greater difficulties and risks. The big challenge is how the government acts on water-borne, food-borne diseases and sanitation problems? This calls for systems' approach which integrates voluminous database, complex issues, and analytical modeling methods such as artificial intelligence, decision analysis, optimization, risk analysis, modeling, transdisciplinary, etc. to support decision making for sustainability. Thus, this paper presents a critical *state-of-the-art* review of complex issues, challenges on water, foods and sanitation. Case studies research method was used in this paper. A process which was specifically chosen and conducted in order to increase overall understanding of the research problem, maximize the content in the gathered data from the field, internet search, interviews to key informants and finally enhance the quality of the data analysis. This research study is focused on qualitative data, through interviews and observations, and quantitative data, where

cause and effect is sought to produce generalizations. A few case studies on people-centered systems approaches on water, food safety and environmental sanitation are presented to exchange views, experiences, share information and search for knowledge. To be relevant to the theme of this paper, this will highlight the people's preference on access of clean/safe water, food safety and sanitation facilities to attain a more sustainable and healthy water environment among stakeholders. This paper is focused on qualitative data, through interviews and observations and quantitative data, where causes and effects are sought to produce generalizations. Some case studies on people's preferences on water refilling stations and sanitation as well as cGMP and HACCP on food product development are presented and discussed in the succeeding sub-sections.

Water Supply and Sanitation

Households with access to safe drinking water have increased for both urban and rural households (NDHS, 2003). The proportion of households within 15 minutes from water supply facilities increased from 86.2 percent in 1998 to 89 percent in 2003. The proportion of households with water supply coming from safe sources also increased from 81.7 percent in 1998 to 89.3 percent in 2003. Piped water supply into dwelling, plot or yard has increased from 36.8 percent in 1998 to 39.6 percent in 2003. In urban towns outside Metro Manila, piped water supply coverage leaped from 77.6 percent in 1998 to 88.1 percent in 2000.Within Metro Manila, the result of privatization of the water distribution system has been encouraging as the service coverage by the two concessionaires increased from 67 percent in 1997 to 90 percent in 2001. There is also the issue of drinking water quality and sustainability of water resources. The principal source of water in most towns outside Metro Manila is groundwater. The unabated water extraction from the ground has resulted in the rapid decline of quality due to pollution and saline intrusion of groundwater and the unsustainable depletion of this resource. Coupled with access to safe drinking water is the issue of access to sanitary toilet facilities. The percentage of population with access to sanitation facilities has increased from 81 percent in 1998 to 85 percent in 2003 (NDHS, 2003). Households with access to sanitary toilet facilities have increased for both urban and rural areas. Household coverage for public sewerage system has not improved in the past 20 years. Water and sanitation sector has focused predominantly on service provision of domestic drinking water and improved sanitation.

Outside Metro Manila, sewerage services are almost non-existent. There are only three public sewerage systems that operate and provide limited residential coverage. This has left urban population with few options for safe excreta disposal. Urban households have responded by building their own sanitation facilities like septic tanks. However, there is general non-compliance in the use of effluent disposal systems required by national regulations. In terms of households with access to safe water supply, the provinces with the highest coverage are Southern Leyte, Rizal, Pangasinan, Cavite and Surigao del Norte while those with the lowest coverage are Zamboanga Sibugay, Sulu, Masbate, Batangas and Pampanga (Fig. 1). Coverage of households with sanitary toilet facility is highest in the provinces of Batanes, Agusan del Norte, Ilocos Sur, Pangasinan and Siquijor while coverage is lowest in the provinces of Sulu, Zamboanga Sibugay, Pampanga, Masbate and Western Samar (Fig. 1). The only region that has achieved more than 90 percent coverage of households with sanitary toilet is the Ilocos Region. On the other hand, three regions have achieved an average of more than 90 percent coverage of households with access to safe water supply, namely, CAR, Ilocos and Northern Mindanao (FHSIS, 2002). There are knowledge, policy, capacity and financing gaps that must be addressed to lessen the constraints and improve water and sanitation services. Investments and political support are not tied with the needed reforms. There is a need for government subsidy targeting the poor since water and sanitation services are not actually reaching them. For the past years, the government has engaged the private sector more aggressively in financing water and sanitation projects. As a result, indiscriminate disposal of inadequately treated effluent and untreated

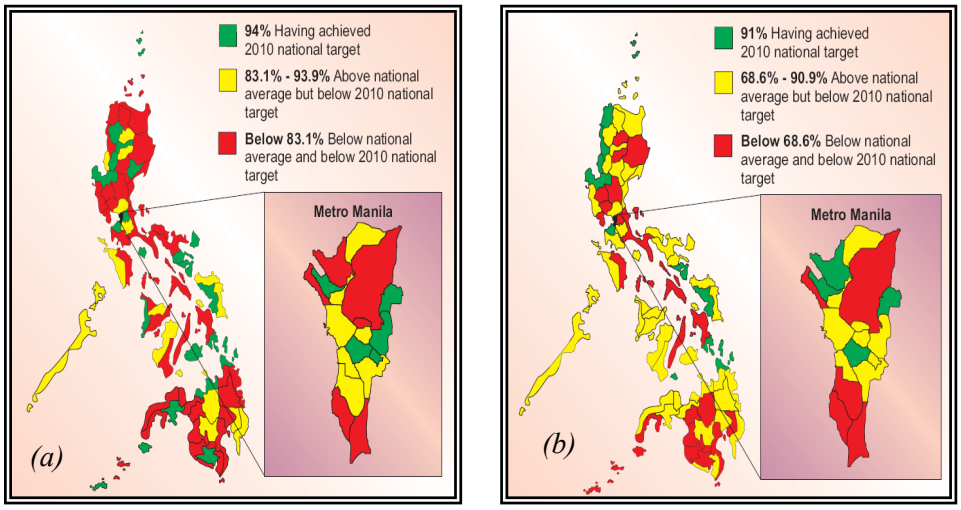

Fig. 1. Household access to: (a) safe water; and (b) sanitary facilities by province in the Philippines

sludge is widespread, with serious consequences for both water quality and public health. Access to safe water should always be linked with sanitation and personal hygiene as an approach to addressing water-related diseases such as diarrhea, cholera, typhoid fever, Hepatitis A, skin diseases and dengue fever, among others. In general, water piped into dwelling has been associated with the lowest prevalence of disease while households with doubtful sources of water supply have been associated with the highest. Likewise, skin diseases and diarrhea are more common among households without toilets. To many of the developing world, water has a far greater value than just a service. It is a key resource to reduce the global burden of disease, increase productivity and improve livelihoods. This is to believe that people are the key to the creation of development. To sustain such development can only be sustainable if people are central in its sustainability.

Water Refilling Station

The demand at the water refilling stations where water stores that sell purified water is now increasing. The quality of purified water conforms with the national standards for drinking water and is even better than the quality of water produced by traditional water supply systems in terms of removed impurities (WPEP, 2000) as cited by Magtibay (2004). Over the years, as the demand for cleaner water becomes higher, the price of household water purifiers and bottled water has become prohibitive. Water refilling stations managed by most private entrepreneurs offer a cheaper and more convenient solution to the public's drinking water needs than bottled water or the use of household filters. At present, more than 10,000 water refilling stations have proliferated nationwide. They sell purified water of comparable quality with bottled water at a lower price. For example, the current price per gallon of refilled purified water in Metro Manila ranges from P50 to P120 per 5-gallon container or about P2.50 to P6.00 per liter while the bottled water is sold at P12.00 to P25.00 per liter. Household filters, on the other hand, cost P5,000 to P25,000 per unit (1 US $ = P46 in 2007). The *potable water* supplied by the providers is then further purified by utilizing a combination of water treatment equipment, such as sediment filters, carbon filters, water softeners, reverse osmosis membranes, ultra-violet lamps, and ozone generators. Typical water refilling stations can produce 3,000 to 12,000 liters of purified water per day and such can be operated with a minimum area of at least 20-25 m^2. The main processes in a water refilling station are dictated by raw water quality. The typical steps are filtration (several stages), softening, and disinfection. The machines that could be installed for such processes are the following: (a) multi-media sediment filter-removes sediments

such as rust, sand and particles that are invisible to the naked eye; employs a total of 5 filters; (b) ion exchanger - replaces hard minerals with soft minerals; (c) activated carbon filter - removes all organic chemicals, herbicide, pesticide, offensive odor and bad taste; (d) reverse osmosis membrane - the heart of the system and the most expensive unit; removes inorganic minerals, bacteria and viruses while retaining its oxygen content (Magtibay, 2004). Since the filter size is very small at less than 0.05 micrometer, the product water could have a total dissolved solids of less than 10 ppm. The filtration process rejects about 50 percent of raw water volume; (e) post-carbon filter - improves the taste of water; (f) ultraviolet lamp - ensures that the water is free from disease-causing micro-organisms; and (g) ozone generator – inhibits the growth of bacteria in the product tank and prolongs the shelf life of water. However, such technology on filtration/purification treatment must be enhanced such as using ultra filtration systems membrane (with smaller pore size of 0.1 microns) forming a physical barrier to viruses, bacteria, *Crypotosporidium, Giardia*, and suspended solids. The efficiency of water purification system in removing impurities is high. Source water and product water are subject to regular monitoring by the local health office. The national standards for drinking water contain 54 parameters that must be complied with. Only DOH-accredited laboratories are allowed to conduct water testing and analysis. The frequency of monitoring is as follows: (a) bacteriological quality - at least monthly; (b) physical quality - at least every six (6) months; (c) chemical quality - at least every six (6) months; (d) biological quality - at least once a year; (e) monitoring of radioactive contaminants shall be done only if there is significant input of radiation from the surrounding environment (Magtibay, 2004).

Food Products and Water Supply

The Hazard Analysis Critical Control Points (HACCP) is in its infancy for the water industry but has provided controls for the safety of foods for over three decades. Developed by the WHO and adopted internationally, it is the primary risk management system for the food industry (FAO/WHO, 1996). The seven HACCP principles are: (1) conduct a hazard analysis; (2) determine the Critical Control Points (CCPs); (3) establish Critical Limits; (4) establish a system to monitor control of the CCP; (5) establish the corrective actions to be taken when monitoring indicates that a particular CCP is not under control; (6) establish procedures for verification to confirm that the HACCP system is working effectively; (7) establish documentation concerning all procedures and records appropriate to these principles and their application. Why might HACCP be necessary for our current drinking water systems, considering such sophisticated treatment technologies are available? In recent years, developed countries with conventional water treatment systems have still experienced water-borne disease outbreaks. The diverse range of waterborne hazards can be assessed individually or in some cases groups of microorganisms, or chemicals can be assessed. For instance, groups of bacterial pathogens transmitted by birds such as *Campylobacter* and *Salmonella spp*. might be assessed together. It is essential that the HACCP team includes representatives with the appropriate microbiological and chemical expertise to make these assessments (Hellier, 2005).

A GPS-guided survey for about 237 food processors in Ilocos Norte was conducted by MMSU researchers to assess their food processing and explore to improve their food products packaging and development for food safety and enhanced their income (Pascual, *et al.*, 2007). At MMSU, initiative is being done to conduct current good manufacturing practices (cGMP) and HACCP on food and water refilling projects for MMSU and for food processors of vinegar/wine, *empanada,* local sausage and other local food products in the community (Table 1). Thus, a mobile packaging facility for liquid and solid will be piloted to improve the packaging of these local food products with cGMP and HACCP principles to empower small entrepreneurs in the locality.

Thus, the aforementioned people-centered approaches are complemented through the adaptation of HACCP principles, used successfully in the food industry to safeguard the food supply, as well as on drinking water systems. The HACCP approach is one model that could be used to help identify the

risk assessment and management systems required to provide safe drinking water and at what stages those systems should be put in place (Barry, 1998).

Table 1. Comparison between local, national and international standards on some physical and chemical property values of some food products taken from food processors and water sources at MMSU, Ilocos Norte, Philippines from July-August 2007.

PROPERTY	FOOD PRODUCT /VALUE	NATIONAL STANDARD VALUE[1]	INTERNATIONAL STANDARD VALUE
	Empanada[2]		
Mold and Yeast Count, cfu/g	<10	10	n/a
Salmonella, cfu/g	zero	zero	n/a
S. aureus, cfu/g	zero	zero	n/a
	Sugarcane Wine		n/a
%Vol of Ethyl Alcohol at 20^0C	10.36	7-16	n/a
	Sugarcane Vinegar		
Acetic Acid, g/100 mL	5.70	4.0	n/a
	Local Sausage		
Salmonella, cfu/g	absent	absent	n/a
Staphylococcus, cfu/g	0	0	n/a
Coliform Count, MPN/g	<1.8	<1.8	n/a
	Crispy Pork		
Salmonella, cfu/g	absent	absent	n/a
Staphylococcus, cfu/g	0	0	n/a
Coliform Count, MPN/g	<1.8	<1.8	n/a
	Water		Water[3]
Total Coliform Count,mpn/100 mL	<1.1 (negative)	<2.2	zero
E. coli Count, mpn/100 mL	<1.1 (negative)	<2.2	zero
Heterotrophic Plate Count, cfu/ml	<1.0	300	n/a
pH, mg/L	7.33	6.5-8.5	6.5-8.5
Acidity, mg/l as $CaCO_3$	<1	n/a	n/a
Chloride, mg/L	38.77	250.00	250.00
Sulfate, mg/L	43.77	250.00	250.00
Total Dissolved Solids, mg/L	473.33	500.00	500.00
Total Hardness, mg/L	350.00	300.00	n/a

[1]*Based from the Bureau of Food and Drugs and Philippine National Standards, Philippines;* [2]*Favorite local food meal snacks made from local sausage, egg, grated mungbean and papaya, enclosed in rice flour and deep-fried in boiling cooking oil. All properties were measured using standard methods by accredited regional testing laboratory;*

[3]*Taken from:* http://www.epa.gov/safewater/contaminants/index.html#listmcl

Conclusion

Water, food and sanitation are crucial to life and all forms of socioeconomic and environmental development that needs sustainability. Safe water, food and sanitation are prerequisite for achieving the MDGs and for sustaining good health, quality of life and to ensure wealth creation in developing countries. The capacity of the national, regional and local levels to address water, food and sanitation for environmental health problems needs to be strengthened. More personnel need to be trained in environmental epidemiology, environmental health impact assessment, and environmental toxicology, economic valuation of environmental health, waste water treatment, food product development, and food safety. Water refilling stations can be a good source of safe/clean drinking water in the Philippines. The efficient water purification processes can make the quality of water superior to the traditional water systems. However, the risk of contamination is possible if the handling practices are not closely monitored. To ensure water safety and prevent water-borne and food-borne diseases, the government should regulate the operation of water refilling stations. Ultimately, there is a need to improve the microbiological safety of drinking water to provide a harmonized framework and scientific basis for quantitative microbiological risk assessment of drinking water. The experience of HACCP has demonstrated how water authorities can successfully adopt HACCP and overcome the aspects of water supply systems that differ from the food industry. HACCP, as a process control oriented management system, can therefore help water and food authorities to coordinate the functions of their various water and food quality management systems to provide assurance of safe products. For this reason, there is an urgent need to promote and enforce the more recent environmental laws and technologies to address access to clean water, safe foods and sanitation for people's preferences at its fullest.

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