

Seminar: Wastewater and health – managing risks, seizing opportunities



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ABSTRACT VOLUME

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Water and waste: reduce and reuse

Seminar: Wastewater and health – managing risks, seizing opportunities

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A health risk assessment of wastewater use in Ghana



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Highlights

- Produce contamination should be managed at all domains along the food chain, although prioritising markets and kitchens would be a more cost-effective approach.
- Awareness of wastewater irrigation health risks alone is insufficient for vendors and consumers to adopt risk reduction measures, or influence them when buying produce or prepared salad.

Introduction and objectives

Wastewater use in urban agriculture is common as a result of rapid urbanisation, water scarcity, and the high cost of treating urban wastewater. The use of wastewater holds clear benefits to farmers, but also poses serious health risks to farmers and consumers of wastewater irrigated produce. This study aimed at identifying key risk factors for produce contamination at different entry points of the food chain. It also assesses participants' awareness and knowledge of wastewater irrigation practices, associated health risks, and the adoption of health protective measures.

Methodology approach

In the period from September 2012 to August 2013, over 500 produce and ready-to-eat salad samples were collected from fields, markets, and food stalls in eight neighborhoods in Accra, Ghana during two cropping seasons, and over 300 soil and irrigation water samples were collected. All samples were analysed for *E. coli*, human adenovirus and norovirus using standard microbiological procedures. In addition, almost 700 participants including wastewater farmers, market and street food vendors, chefs and consumers were interviewed and observed to assess critical exposures associated with the transmission of faecal pathogens in farmers and consumers.

Analysis and results

The results showed that over 80% of produce samples were found to be contaminated with *E. coli*, with median concentrations from 0.64 to 3.84 Log *E. coli*/g produce. Street food salad was found to be the most contaminated (4.23 Log *E. coli*/g), and that consumption of salads did not meet health standards. No street food sample was found positive for viruses, while less than 10% of produce from farms and markets were positive for adenovirus. Key risk factors identified for produce contamination included farm soil, the use of wastewater for irrigation, poor food and environmental hygiene, and operating with a hygiene permit. Awareness of the source of irrigation water was found to be low, but despite the high awareness of health risk, consumers did not prioritize health indicators when buying produce from vendors but were motivated to buy produce, or prepared food based on taste, friendship, cost, convenience and freshness of produce. For example, only 2% of street food consumers relied on health indicators when buying food from vendors. Similarly, farmers' awareness of health risk did not influence their adoption of safer farm practices.

Conclusions and recommendation

The study findings suggest that farmers, vendors and consumers may not necessarily adopt risk reduction measures based only on their awareness or knowledge of wastewater irrigation health risks. The study recommends the promotion of interventions that would result in more direct benefits to producers and vendors, together with hygiene education and inspection, hygiene certification and enforcement of food safety byelaws in order to increase the uptake of the WHO multiple-barrier approach recommended for the safe use of wastewater for agriculture. Access to credit schemes and improved land security are also recommended to encourage farmers to adopt risk reduction measures.

Development of a sanitation safety plan for peri-urban areas, Tanzania



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Highlights

- The research address the question of sanitation planning in peri-urban areas of low income countries
- Strengths and weaknesses of CLUES and SSP methodologies are examined within their application to a case study in Tanzania
- The combined use of the tools is shown as successful in potentiate their effectiveness.

Introduction and objectives

The rapid urbanization occurring in most areas of developing countries contribute to worsen the problem of adequate sanitation infrastructures and services, in particular in peri-urban areas. The study aims to explore the domain of recent approaches to sanitation planning for improving the sanitation system in peri-urban wards of the Municipality of Iringa, in Tanzania. In particular, the Sanitation Safety Plan (SSP) approach was tested to investigate how it could be adapted to a specific context and used for supporting the planning of an improved sanitation system focused on the safeguard of public health and environment.

Methodology approach

The research was conducted within an international cooperation project under development in peri-urban wards of Iringa, selected as case study. Two approaches were tested: the Community-Led Urban Environmental Sanitation (CLUES) and the Sanitation Safety Plan (SSP). The SSP was developed based on guidelines of the WHO manual at research level and adapted for the specific context. A simplified matrix for semi-quantitative risk assessment and a tool for prioritizing control measures based on weighted criteria were developed for the case study. Strengths and weaknesses of these approaches applied in field were evidenced and a methodology foreseeing their integrated use was proposed.

Analysis and results

The CLUES approach was applied involving stakeholders and communities of peri-urban wards of Iringa and participatory methods were used for selecting feasible and acceptable sanitation options for designing an improved sanitation system, named S1. A SSP was developed for the current sanitation system in place, named So. A risk assessment was conducted for So for each step of the sanitation chain identifying exposure groups and routes, as well as hazards and related hazardous events. For each risk obtaining high level, additional control measures were identified and integrated in the design of S1, applying a multi-barrier perspective. The application of these planning tools resulted in the design of an improved system, and in the development of an action plan and a monitoring and verification plan for its implementation.

In its application in field, CLUES showed to be a strong tool for involving local communities and institutions in understanding sanitation problems and defining shared solutions. The SSP demonstrated to be complementary to CLUES in addressing specifically health risks and issues, assuring that all measures needed to control and reduce risks for health and environment in the whole sanitation chain were considered.

Conclusions and recommendation

The application of planning tools to the case study permitted to evidence strengths and limits of both methodologies in the specific context, and the added value of combining them for designing an improved sanitation system with a strong participatory component and based on a multi-barrier approach, for guaranteeing the health risks control along the whole sanitation chain. The innovation suggested by this research is the proposal of the integrated use of CLUES and SSP for the design of improved sanitation systems in peri-urban areas which could be useful for others facing the challenge of sanitation in similar contexts.

Effects of fecal sludge in wastewater stabilization ponds: Port-au-Prince, Haiti



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Highlights

- Characterized the influent waste (including fecal sludge) arriving at a wastewater lagoon facility in Port au Prince, Haiti
- Evaluated the performance of the lagoon facility in treating waste
- Recommended potential modifications for existing and future lagoon designs to treat high strength waste that includes fecal sludge

Introduction and objectives

Most residents of Port au Prince, Haiti, rely on on-site sanitation facilities such as latrines, septic tanks, or cesspools which require regular emptying and disposal due to their location in dense urban areas. At the request of the National Water and Sanitation Agency of Haiti (DINEPA), a performance evaluation of one disposal site, a non-discharging wastewater stabilization pond (WSP), was conducted to determine if the facility was operating in accordance with its design, to better characterize the influent waste, and to assess the effect of high-strength fecal sludge on treatment.

Methodology approach

In order to assess the performance of the WSP, grab samples were collected from trucks transporting fecal sludge (both from septic tanks/cesspools and latrines) to the facility, and from pipes between each lagoon cell at the facility. On each sampling visit (four total), we collected one sample from each lagoon process step, as well as samples of septic tank/cesspool waste and latrine waste. As biochemical oxygen demand (BOD₅) was the main criteria used in the design of the facility, this was also the primary indicator used to assess performance, although analysis of other parameters was also included.

Analysis and results

While the volume of waste entering the WSP is less than what it was originally designed for, the estimated volumetric loading rate of BOD₅ is approximately at capacity. This is primarily due to the high strength of the fecal waste from latrines. The range of values for BOD₅ found in latrine waste was approximately 5,000 to almost 40,000 mg/L, which is much higher than previous literature would suggest. The facility does appear to be performing approximately as designed in terms of overall BOD₅ reduction, although reductions in each lagoon cell do not conform to the design.

Accumulation of sludge in lagoon cells has been a significant challenge at the facility, and emptying sludge from the anaerobic ponds has been required multiple times. Not only can the sludge accumulation increase the operation and maintenance challenges at the facility, but it may also it may decrease the effectiveness of treatment.

Although more sampling is required to confirm these results, this evaluation does suggest that design values for BOD₅ in this facility and others receiving fecal sludge from latrines may need to be modified, depending on the proportion of waste that comes from latrines.

Conclusions and recommendation

Characterization of the strength of fecal sludge and treatment of high-strength fecal sludge in traditional wastewater treatment facilities are not well understood, and more research is needed on these topics. Possible modifications to this existing facility to help prevent solids overloading include adjusting grates to prevent larger solids entering the system or pretreatment of high strength fecal sludge in drying beds or by other means. More routine monitoring of this facility than was possible in this project, including building local laboratory capacity to perform regular analysis of key parameters, is also needed.

Identifying water quality hotspots for contacts with contaminated surface waters



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Highlights

Severe pathogen pollution affects around one-third of all river reaches in Latin America, Africa and Asia; Cities are hotspots of wastewater generation and intake but also rural population is exposed through direct contact to polluted surface waters;
Modelling can contribute to integrated assessment identifying river reaches potentially at risk

Introduction and objectives

The ongoing socio-economic development together with urbanization presents a challenge for water quality worldwide, especially in developing and emerging countries. The amount of wastewater from domestic and industrial sources is rising, which can lead to an increased risk of surface water quality degradation, if the wastewater is not sufficiently treated before returned to water bodies. This in turn has impacts on ecosystems and human health. The newly adopted targets for sustainable development include protection of water quality and sustainable use of water resources. To achieve these goals, appropriate monitoring strategies and the development of indicators for water quality are required.

Methodology approach

In the pre-study for a 'World Water Quality Assessment' a methodology for assessing freshwaters was developed in order to distinguish river stretches potentially at risk due to degraded water quality. The continental scale WorldQual model simulates loadings and in-stream concentrations to provide insight into main sources of pollution and status of water quality. The exposure is described by direct human contact with potentially polluted surface waters using faecal coliform bacteria (FC) as indicator. High FC levels correlate with presence of dangerous pathogens. For the assessment a benchmark for safe and unsafe FC levels was determined from existing water quality standards.

Analysis and results

The pre-study results indicate that severe pathogen pollution already affects around one-third of all river stretches in Latin America, Africa and Asia. The number of people at risk to health by coming into contact with polluted surface waters may range into the hundreds of millions on these continents. The temporal trends from 1990 to 2010 reveal that FC loadings have increased on the average in all three continents. Most of the FC pollution in Latin America comes from sewered domestic wastes (81%). For Africa, the majority of FC comes from non-sewered domestic sources (56%), Sub-Saharan countries having the lowest levels of sanitation coverage. In Asia, about half of FC comes from sewered domestic waste. Only about one-third of all wastewater in Asia is treated. Among the most vulnerable groups are women and children. Women are at particular risk because of their frequent usage of water from rivers and lakes for cleaning clothes and collecting water for cooking and drinking in the household. Children are also at particular risk because of their play activities in local surface waters and also because they often have the task of collecting water for the household.

Conclusions and recommendation

The results indicate the key role of domestic wastewater as source for FC loadings which are high in areas of high population density like cities. In general, the manufacturing and agricultural sectors are minor pollution sources. However, these sectors are at risk if using polluted water for further processing. It is not only about drinking water, this study highlights the exposure of rural population through direct contact to water. Because sanitation and water use practices are of major importance, the improvement of wastewater management is crucial for pollution prevention. Modelling can be used to run scenarios on improved treatment effects.

Making pathogens visible to guide investment in what matters



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Highlights

Liquid streams (effluent, leachate, unintended leakage) from onsite and networked water-based sanitation systems can pose a significant health hazard, but have received little attention. A new heuristic draws attention to pathogens, synthesising health and engineering science with local knowledge to help decision-makers avoid investing in technologies that increase unsafe return.

Introduction and objectives

Liquid streams (effluent, leachate, unintended leakage) from onsite and networked treatment systems for water-based sanitation can pose a significant health hazard, but to date have received little attention in Indonesia. The recent focus of development partners and policy makers on faecal sludge management has led to essential gains, yet reaching 'safely managed' sanitation requires a step further, through making pathogen hazards visible in all discharges, assessing all local exposure paths. Because measuring pathogens is complex and costly, and significant gaps remain in data and scientific understanding, this can only be achieved through 'first principles', translating existing knowledge into actionable directives.

Methodology approach

This paper (based on Mitchell et al. (2016) *Waterlines* 35(2):163-181) proposes the Pathogen Hazard Diagram (PHD) to describe, visualise and assess pathogen removal/survival through common wastewater treatment systems and remaining hazards, particularly those in liquid streams. Firstly we identify the accidental misunderstandings generated by common representations of pathogen removal. Secondly, we use available scientific evidence on pathogen hazard reduction mechanisms and treatment efficacy of different technologies and management approaches (encompassing the diversity of viral, bacterial, protozoan, and helminth responses) to populate the new heuristic tool. The tool is then applied to assess water-based sanitation systems and policies in urban Indonesia.

Analysis and results

The term 'pathogen' is often absent: wastewater system design/performance focuses on chemical/biological pollutants, not microbiological. When pathogen numbers are noted, exponential terms are used because the numbers are large: every day an infected person produces 10^4 - 10^6 helminth eggs. Similarly, expected treatment performance is communicated in log reductions: sealed tanks reduce helminths by $0.2 \log_{10}$. 2 log removal corresponds to 99%, which sounds effective. But are we concerned about reduction in relation to influent, or hazard in the effluent? The minimum infective dose is 100-101, meaning 100-10,000 (10^2 - 10^4) doses leave the tank. Communicating treatment performance in terms of potential infective doses discharged focuses on what matters most for human safety.

We propose a new heuristic tool, the PHD, as a prototype for assessing local hazards in the absence of pathogen data. Responses to particular removal/inactivation mechanisms often vary between viruses, bacteria, protozoa, helminthes classes. In contrast, filtration and sorption are efficacious across all classes. The PHD combines existing health and engineering science with local knowledge and system contexts to assess pathogen treatment efficacy. It reveals Indonesia's policy of replacing traditional unsealed pits that

facilitate filtration/sorption with well-sealed septic tanks could increase 'unsafe return' (where treatment units are above groundwater).

Conclusions and recommendation

A decade ago WHO defined the key determinants of pathogen risk, but these do not seem to be part of sanitation planning and implementation, in Indonesia and perhaps elsewhere. Explicitly considering pathogens in terms of the hazard that remains, including in intended and unintended liquid discharges, can guide investment towards wastewater treatment systems that reduce the hazard to public health where exposure paths exist. As a stopgap until better/local data is available, the PHD is an attempt to make this possible for local sanitation planners, delivery partners, and policy makers, requiring only local knowledge and general sanitation reference knowledge.

Modelling impacts of waste treatment options



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Highlights

The impact of poor waste management on environment and public health is well documented. Cities face the twin challenges of providing safe sanitation and improved environment. The model framework of SaniPlan provides a tool for simulating outcomes of various options and enables informed decision making.

Introduction and objectives

It is critical to plan for safe wastewater conveyance, treatment and reuse. The model, Saniplan, is an aid to decision makers to choose appropriate sanitation technology that is efficient (in service provision) and affordable. The model SaniPlan simulates impacts of various options on service outcomes. The health impacts are captured through impact of technology selection on environmental parameters. The model also takes into account capital and operating costs of various options and enables design of a financing plan.

Methodology approach

The tool SaniPlan developed at CEPT University under the PAS Project, is a modular tool that help iterative decision making towards achieving safe sanitation. Health outcomes are captured through impacts on environmental parameters. The assessment module analyses the entire sanitation service chain of sanitation. Service levels are measured through specific performance indicators. These indicators are linked to the Performance Assessment System (pas.org.in) which is an exercise carried out in India. The tool incorporates various improvement actions (e.g. actions related to septage collection, conveyance, treatment, septic tanks refurbishment etc.) that cities can choose to implement as part of their sanitation improvement plan. An environment and health impact assessment module has been overlaid to the model.

Analysis and results

The tool has been successfully used in two small cities in India to plan for improving sanitation situation across the whole service chain. These two cities, Wai and Sinnar in Maharashtra, are dependent on onsite sanitation. Open defecation, practiced by 10% of the population has been curbed. The challenge now is to plan and implement a safe system for conveyance, treatment and disposal of waste. The SaniPlan model was used to formulate a viable fecal sludge management plan. This plan is currently being implemented.

The SaniPlan model is designed to simulate service level impacts of various actions. Recognising that it becomes difficult for city level decision makers to run the Excel based model and see the impacts of various actions, a simple dashboard was linked to this model. The dashboard helped the decision makers to understand financial and service level impacts of various actions.

Conclusions and recommendation

Evidence-based decision making is advocated by city governments. However, there are no ready tools that support such decision making. Application of SaniPlan in small towns in Maharashtra, India suggests that decision-makers are receptive to such comprehensive frameworks that can assess service outcomes, costs and financing plan leading to design of tariffs.

National standards for wastewater treatment - what is "safely treated"?



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Highlights

SDG Indicator 6.3.1 calls for the measurement of “safely treated” wastewater. But what is safely treated? Safe for public health, safe for ecosystems or both? What do countries national standards consider safe? And what can be used as an international benchmark for “safely managed reporting under the SDGs? This paper presents finding from analysis of national standards and discusses implication for global reporting, regulation, and implementation of quality monitoring.

Introduction and objectives

SDG Indicator 6.3.1 calls for the measurement of “safely treated” wastewater. A definition of safely treated is needed in order to classify data and have met the SDG target. Yet, desired levels if wastewater treat vary depending on the intended next use and exposure environment. In 2016 a treatment working group (TWG) recommended normative definitions of safe treatment to using a treatment ladder with rungs according data type of increasing relevance for public health.

This study gathered and reviewed national standards on wastewater treatment with the objective of comparing with TWG recommendations for globally comparable reporting and asks what is “safely treated”? Safe for public health, safe for ecosystems or both? What do countries national standards consider safe? And what can be used as an international benchmark for “safely managed reporting under the SDGs? This paper presents finding from analysis of national standards and discusses implication for global reporting.

Methodology approach

The TWG recommendation of a treatment ladder with rungs according data type of increasing relevance for public health was used a point of departure. A systematic search for national standards was conducted through WHO country office and national counterparts and well as internet searches. Data on treatment requirements was extracted from the national standards retrieved and classified according to the proposed ladder rungs – no treatment, technology based (eg primary, secondary tertiary treatment), environmental compliance based (BOD, COD, SS) and Public Health compliance based (e.g. e.coli).

Analysis and results

Analysis in ongoing at the time of submission. Preliminary findings indicate that:

- National standards are predominantly based on environment parameters (BoD, CoD)
- Regional reporting initiatives such as the EU Urban Wastewater directive seeks technology based data although countries have more detailed national standards and compliance reporting covering environmental and often public health parameters.
- Some countries (proportion TBD in final analysis) have a ranges of treatment qualities based on the receiving environment and human exposure scenario.

Conclusions and recommendation

Conclusions and recommendations of relevant for 6.3.1 “safely treated” classification will be added in July when the research is complete.

Processes and challenges of faecal sludge management in Odisha, India



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Highlights

This article provides an overview of the processes and challenges of implementing faecal sludge management in Odisha State, India. The key processes are selection and establishing a low cost system for faecal sludge treatment and engaging a private operator to run the cesspool fleet to transport the sludge.

Introduction and objectives

About six million urban residents of Odisha state in India rely on onsite sanitation facilities. Over time, large quantity of partly digested faecal matter are accumulated in them. Effluent containing high BOD and pathogens spills to the immediate environment posing grave danger to human health. Episodes of jaundice were reported in many towns in the summer of 2014 with few deaths due to contamination of drinking water pipelines. This article provides the processes followed and challenges faced during implementation of the faecal sludge management (FSM) project in the State.

Methodology approach

In 2015, the state decided to implement FSM in its urban areas. In Odisha, nearly half of the urban population live in its 9 big towns. So, initial thrust was given to providing FSM service in the nine populated towns. Best practice and field study on full FSM service elsewhere in Asia were studied as the same were not available in the country. The existing state sanitation strategy was reviewed and FSM was incorporated as a key component to achieving city sanitation. FSM guideline was formulated to assist urban local bodies.

Analysis and results

The pilot sanitation survey revealed that discharge of untreated faecal sludge from household into open drains have deteriorated the water quality in four perennial rivers serving as source of raw water for seven towns. For maximum impact of FSM service, nine populated towns out of total 110 towns of Odisha were chosen sheltering nearly half of urban population. The adopted faecal sludge treatment units consist of sludge receiving chamber, screen channel, settling cum thickening tank, sludge drying bed and co-composting of dried sludge and, anaerobic baffled tank, horizontal constructed wet land, and a polishing pond for treatment of liquid effluent. Transparent public procurement processes were followed for (i) construction of treatment facility, (ii) procurement of cesspool vehicles and (iii) engaging private operators to manage fleet of cesspool vehicles in these towns. The towns received capex grant from the government for the first two activities considering their weak financial base. The households pay fee towards faecal sludge emptying/collection service. The fee shall cover the cost of operation and maintenance of the vehicles for transport of faecal sludge to the treatment plant. In the future, a part of the fee will go towards operation of the treatment plant.

Conclusions and recommendation

The challenges faced during implementation of the project was majorly related to availability of land for construction of treatment facility. To avoid land disputes, site for treatment facility henceforth shall be located near the solid waste management facility. Community participation is very important for the FSM project. The FSM project is now planned for adoption in small towns of Odisha. The cesspool vehicles and treatment facilities will be operated by private players. The State will provide fund to close the gap between revenue generated and actual expenditure to keep the system functional and viable.

Poster: Effective managing risks in cascade of reservoirs



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Co-Authors:

Highlights

New approach and model are presented for prognostication of concentrations of contamination in rivers and reservoirs. It gives effective strategy of pollution reduction in surface water for sustainable development and health-protective wastewater management. Cascade of the Dnieper reservoirs (Ukraine) was analyzed.

Introduction and objectives

The Dnieper basin includes nearly 50% of the total area of Ukraine and contributes with about 80% of the total volume of Ukrainian water resources. It is possible to decrease negative influence of work of industry on Dnepr by optimization of management by a flow for sustainable development. For practice a task of pollution reduction is important in connection with the necessity of prognostication of the state of water resources, to their fitness for the use, possible influencing of contamination on population on an environment, and also estimation of efficiency, possible water safe measures.

Methodology approach

A mathematical model which united exactness one-dimensional, simplicity and small time of computer realization of the simplified (by an ordinary chamber) model was developed simultaneously overcoming failings each of them.

A model is foreseen description of conduct of contamination in running reservoirs in solution, on suspension and in the layer of the ground deposits, an exchange takes into account water-bottom, water-suspension, time of transporting on a reservoir and influencing of diffusion, what is provide possibility of design of wide spectrum of contaminations for more effective impact assessment and safety planning.

Analysis and results

Water of Dnepr is used for the supply about 30 million people, 50 cities and industrial centres, about 10 000 industrial enterprises, 2200 agricultures, 1000 communal services, 50 large irrigational systems. Presence hydroelectric power plants (HPP) enable to utilize their modes of operation for adjusting of contamination of reservoirs. Changes of the modes exploitation HPP can be applied for diminishing of the harmful influencing of contaminations on a population and environment. On the basis of research of influencing of the modes of exploitation HPP on the size of concentration of contamination possibility of application of the offered model is shown for determination of influencing of water protection measures on quality of water. At the use of model by varying of the hydrological mode requirements and limitations, laid on different water users, can be easily taken into account, the ecological consequences of the different modes of exploitation are quickly counted HPP and the optimum mode of operation is certain. There are conflict of interest practitioners and policy-makers: hydropower companies, irrigation, industry, water supply, fishing, water transport, recreation, ecology.

Conclusions and recommendation

The main problem - coexistence different practitioners and policy-makers in control of cascade of the Dnieper reservoirs. The work demonstrates some possibilities to improve communication of practitioners and policy-makers in the Dnieper basin. Accurate modeling and system approach can provide with more effective impact assessment on contaminations in wastewater systems and health-protective wastewater management.

Poster: Evaluating hazards and risks of water sources in Sultan Kudarat



Presenting Author: Mr. Yolwin Jed Perales, Philippines, University of the Philippines- Diliman

Co-Authors:

Highlights

- Sultan Kudarat heavily relies on water sources studied for food, water and household chores.
- There is no current research on the potential risks and condition of these water sources in Sultan Kudarat.
- The province needs to make and revise policies based on the results of the research.

Introduction and objectives

Water pollution is one of the major concerns in the Philippines most especially in rural areas where proper healthcare, sanitation and water purification are often expensive and limited. This study aims to quantitatively determine the levels of toxic heavy metals cadmium and lead from two major fresh and two major seawater sources in the province of Sultan Kudarat. This study also aims to calculate the projected blood levels of the heavy metals to children and correlate the presence of these metals to common health and biodiversity problems encountered by the communities living beside the water bodies.

Methodology approach

The research used an experimental design in determining the amount of heavy metals in the four bodies of water concerned by obtaining appropriate amount of sample using proper sampling techniques replicated three times. Atomic Absorption Spectroscopy (AAS) was used to measure the amount of metals in the samples. A through historical and archiving research supplemented by interviews and surveys were also conducted to government officials and residents living around the vicinity of the bodies of water studied to gather data of health and biodiversity problems they encountered and related it to the results of the instrumental analysis and current industrial operations in the area.

Analysis and results

Results showed that the two heavy metals are present in all four water bodies with varying concentrations. All fresh water and one seawater body went above the allowed safety limit of 0.005 ppm and projected blood safety level of 10ug/dL for lead. On the other hand, all fresh water samples and one seawater sample exceeded the allowed safety limit for cadmium of 0.005 ppm but had an acceptable projected blood level. It was also been found from the historical research that the number of marine species thriving into the fresh water bodies in 1980s was around 50-60 before quarrying, logging and other industrial processes were conducted in the area. Currently, only 20-30 marine species could be found in these fresh water bodies. On the other hand, there are also above average number of cases of diarrheas, frequent fever and nausea most especially on children of the residents living near the bodies of water from year 2000 onwards, which can be side effects of the high presence of heavy metals in the water. One of the seawater is also notably cleaner and having lower concentrations of heavy metals compared to the other because of the intensive fishing and other marine commercial activities conducted on the latter seawater body tested.

Conclusions and recommendation

It can be concluded that all water bodies studied are not safe and risky for human and animal consumption. These bodies of water are also experiencing deterioration of biodiversity as well as impacting their neighboring habitats through disruption of food chain. Industrial processes conducted in the community where water bodies are located contributed a lot in degrading the quality of the waters. Stricter policies should be implemented to preserve the biodiversity of these bodies of water, to alleviate the health risks that may cause by excessive heavy metals concentration and to preserve the quality of the waters.

Poster: Wastewater reuse and the burden of parasitic diseases in Nigeria



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Highlights

The presence of the metacercariae of *Fasciola gigantica* and the infective stages of other parasites in irrigation water was investigated. The study revealed that life cycle stages of *Fasciola gigantica*, eggs of *Ascaris lumbricoides* as well as infective larvae of hookworms and *Strongyloides stercoralis* were recovered from the water sources.

Introduction and objectives

Most rural farmers in eastern Nigeria villages practise some form of irrigation for their crops. Thus, water from broken drains, run-off from open defecation sites and night soil dumps are carried in channels through the farmlands causing potential risk of infection with parasitic helminthes. The infective stages attach to the surfaces of the vegetables. In addition, the soil and water bodies are seeded with parasite eggs and larvae thereby exposing the farmers to multiple infection. Irrigation of farmlands in developing countries including Nigeria is done using untreated wastewater and raw manure of domestic animal origins as fertilizer. Mitigation measures are needed.

Methodology approach

Soil-transmitted helminthiasis have remained a common health problem of rural farmers in southeast Nigeria. The study was conducted by investigating the life cycle stages of the parasite in irrigation water sources using sedimentation, centrifugation methods and microscopic examination respectively. Ten rural farming communities in southeast Nigeria were selected for the study. The study revealed that life cycle stages of helminthes are present in irrigation water bodies in both wet and dry seasons between February, 2013 to January, 2016. The analysis of variance showed that there is a statistical significant difference between water sources in having life cycle stages of the parasite ($P < 0.05$).

Analysis and results

The study revealed that eggs, cercaria and metacercaria stages of *F. gigantica* and the infective stages of *Ascaris lumbricoides*, hookworms and *Strongyloides stercoralis* parasites implicated in irrigation water. Therefore, the recurrent transmission of helminthiasis among rural farmers in these areas may be as a result of regular contact with infested water sources used for the cultivation of vegetables and other crops. This situation is worsened by ignorance. The seasonal distribution of the parasitic stages of *Fasciola gigantica* and other parasites as recorded in the present study showed that rainy season favours the presence of these parasites. This agrees with earlier documented works showing that infective forms are more abundant during the wet seasons. The highest prevalence of these parasites was recorded in rainy season (99.9). This is characterized with abundant rain, high moisture contents and low temperature suitable for optimum development of the parasite life cycle stages. It was also established that metacercaria of *Fasciola* species may survive for more than one year on pastures depending on moisture and temperature. This is supported by Weldesilassie (2010) on the examination of vegetable collected from commercial markets which showed that the vegetables were contaminated with many types of parasite eggs and cysts.

Conclusions and recommendation

The transition from a rain-fed to irrigation agriculture favours the development and propagation of water-borne infections to both humans and livestock. The present study identified parasitic contaminants of irrigation water, organic manure and sewage for vegetable production; suggesting that the parasites identified may pose. Occupational risks to the farming communities and consumers. The practice of using wastewater for irrigation offers many opportunities, but poses human health risks which is associated with consumption of contaminated vegetables irrigated with wastewater. Safe and adequate drinking water should be provided in order to reduce the use of contaminated water which is highly incriminated with parasitic helminthes.