Seminar: Harnessing opportunities for the safe reuse of wastewater in agriculture

ABSTRACT VOLUME

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Water and waste: reduce and reuse

Seminar: Harnessing opportunities for the safe reuse of wastewater in agriculture

Contents

Connecting practitioners across the Asia Pacific - the Kini Initiative

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Highlights

Agriculture requires 80% of water resources in the Asia Pacific. The Kini Initiative connects practitioners and brokers knowledge between Australia and the rest of the Asia Pacific to share and promote effective best practices for water management in the Asia-Pacific, a key component of which is water recycling and reuse.

Introduction and objectives

The Kini Initiative is a research-based knowledge sharing initiative that brokers knowledge and connects practitioners to support improved, integrated water management in practice. This presentation shares key knowledge and insights from the Kini Interview series, and looks at the priorities and opportunities for improved water and wastewater governance and management to address water scarcity and drought, particularly in the agriculture sector in the Asia Pacific. The Kini Initiative is a joint activity of the Australian Water Partnership and the International WaterCentre Alumni Network.

Methodology approach

Extensive research has been undertaken to understand (1) knowledge needs and (2) mechanisms for accessing knowledge by practitioners in the Asia Pacific. The Kini Interview series provides long-form interviews with leading water management practitioners in Australia and throughout the Asia-Pacific to identify innovative approaches and evidence-based best practices to addressing water management and water scarcity challenges throughout the region, particularly in the agriculture sector.

Analysis and results

At the time of writing, research is ongoing, however key themes have emerged to support knowledge management and water management.

In terms of knowledge management, learning through virtual means must be complemented by face-to-face interaction. High-value content (such as the Kini Interviews and supplemental articles) should be shared through existing means (e.g., no new platform is required).

For water management, three key themes have emerged:

1. Understanding the resource is the essential first step to managing water and wastewater. Not only should this understanding include quantifiable data and relevant information, but it should also include an understanding of the users and stakeholders, the values associated with water, and the benefits derived from water.
1. Cross-sectoral approaches are what will allow for the full realization of benefits (including associated health, food, energy, waste, WASH).
2. Knowledge exchange helps stakeholders to be able to think strategically, and when needed, change behaviors/act accordingly in order to effectively tackle water management challenges.

Conclusions and recommendation

Relationships are at the core of knowledge transfer, and the Kini Initiative works to link practitioners throughout the Asia-Pacific to support learning and the implementation of Integrated Water Management to address water scarcity challenges, particularly in the agricultural sector. Where Australia has developed technologies, policies, and tools for addressing water scarcity challenges (including wastewater recycling and reuse), the transfer of this knowledge and its eventual uptake requires a long-term, integrated approach.

Global spatial assessment of indirect wastewater reuse in irrigated croplands

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Highlights

This study develops the first spatially-explicit estimate of irrigated croplands with a high likelihood of irrigating with untreated, although often diluted urban wastewater. 35.9 Mha of irrigated croplands were located in catchments highly influenced by urban wastewater flows. 29.3 Mha were located in areas with low levels of wastewater treatment.

Introduction and objectives

Urban population growth is rapidly outpacing the development of infrastructure for the safe collection and treatment of wastewater, leading to the widespread discharge of untreated or partially treated wastewater to surface water bodies. Downstream of many urban areas are large areas of irrigated croplands reliant on these same surface water sources. Urban wastewater is a reliable, nutrient rich source of water for downstream farmers, but can present health risks without appropriate protections. Our study presents the first spatially-explicit global estimates of the magnitude and distribution of irrigated croplands with a high likelihood of irrigating with untreated, although often diluted, wastewater.

Methodology approach

Case studies document the widespread use of untreated wastewater in irrigated agriculture, but due to the practical and political challenges of conducting a true census of this practice, its global extent is not well known except where reuse has been planned. Cognizant of the limitations of past attempts to characterize wastewater irrigation, we instead opted to develop a GIS-based decision tree classification algorithm. These methods were developed to primarily quantify indirect reuse. Major sources of data used in this analysis included MIRCA2000 (irrigated croplands), WRI AQUEDUCT database, AQUASTAT and other compilations on wastewater treatment.

Analysis and results

Our study presents the first spatially-explicit global estimates of the magnitude and distribution of irrigated croplands (a) influenced by urban wastewater flows; and (b) having a high likelihood of irrigating with untreated, although often diluted, wastewater.

55.1 Mha of irrigated croplands were located within 40 km downstream of or within an urban area. This area of downstream irrigated croplands (DSIC) constitutes approximately 26 percent of the global irrigated croplands identified by Portmann et al. We found 35.9 Mha (65%) of DSIC were located in catchments with high levels of dependence on urban wastewater flows. These same catchments were home to 1.37 billion urban residents. 91% of wastewater dependent DSIC were located within 10 km of urban areas. Of these irrigated croplands, 86 percent (29.3 Mha) are located in countries where less than 75 percent of wastewater receives some form of treatment. Five countries, China, India, Mexico, Pakistan, and Iran, accounted for 25.1 Mha (85.7%) of DSIC with a high likelihood of untreated reuse.

Conclusions and recommendation

Considerable strides have been made in increasing access to improved sanitation in urban areas, but investments in wastewater treatment continue to lag behind. Even when untreated wastewater constitutes a small percentage of flow, concentrations of pathogens in irrigation water can far exceed those recommended in WHO guidelines. This study sheds further light on the often complicated ways in which urban areas impact agricultural water quality in downstream peri-urban and rural environments. Further work is needed to ensure that urban sanitation policies not only address the protection of surface water quality for ecological reasons, but also recognize the water quantity and quality needs of downstream farmers.

Irrigation with wastewater – experiences from Nigerian Fadama development project

Presenting Author: Prof. Sridhar Mynepalli, Nigeria, University of Ibadan, Ibadan

Co-Authors:

Highlights

- Nigeria embarked on Fadama farming since 1996 resulting in improved food security and quality of life of farmers.
- Wastewaters, municipal and industrial effluents were widely used for irrigation which became risk factors.
- There is need for improved irrigation water quality and implementation of stringent water quality guidelines.

Introduction and objectives

Nigeria is a beneficiary of National Fadama (low-lying flood plains) Development Project, initiated in 1990s by the World Bank. The project is in Phases I, II and III , covering all 36 States and further funded by African Development Fund and other Donors. Simple and low-cost improved irrigation technologies were adopted. Farmers, however, practiced use of wastewater, effluents and polluted waters for irrigation and realized increased economic crops: up to 65% (Vegetables), 334% (wheat) and 497% (Rice) with improved quality of life. This paper described the quality of irrigation waters being used and their impacts.

Methodology approach

Exhaustive data were collected from various States in northern, middle and southern belts, but this paper limits to Taraba State. Data collection methods included community visits, in depth interviews and sampling of irrigation water samples. Standard methods followed using American Public Health Association. Water quality assessment was made using pH, Electrical conductivity, Chloride, major cations (Na+, Mg_2+, Ca_2+, K+), zinc (Zn), manganese (Mn), iron (Fe), copper (Cu), chromium (Cr), and nickel (Ni). In addition, boron, CO_3, HCO_3 and NO_3 were measured. Water quality risk factors were computed.

Analysis and results

The critical parameters of irrigation water are the salt content, toxic chemicals, carbonates and bicarbonates and essential nutrients. The pH values 5.86±0.15 and 5.60±0.05 obtained from Taraba River (Gassol) and ground water (Bali) were below the permissible limit. The electrical conductivity, CO_3, HCO_3, Mg, Na, K, and Cl were low; Zinc, Manganese, Iron and Nickel were within the permissible limits, Copper was higher (mg L-1) in Garin Dogo (Stream, 3.10±0.10), Garin Dogo (Ground water, 10.23±0.21) and Garin Dogo (Tube well, 1.31±0.03); Cr levels in Taraba river (Gassol), Garin Dogo (Stream), Garin Dogo (Ground water), Bali (Ground water) and Garin Dogo (Tube well) ranged between 1.19±0.004 and 1.51±0.01 which were above permissible levels. The risk factors are open defecation, discharge of municipal, industrial, and livestock wastes, and navigation. Eutrophication and growths of aquatic macrophytes were conspicuous and Water-borne infections (Schistosomiasis, diarrhea) were common. The serious emerging risk factors were technology related agrochemicals arising from excessive use of fertilizers and pesticides. Use of Gammaline for fishing was widely practiced resulting in elevated levels in fish: Gamma BHC 5.4 to 35.2, and dieldrin 1.2 to 10.2 mg/Kg-1.

Conclusions and recommendation

Fadama initiative by the Nigerian Government since 1996 is most welcome by the farming populations. Where there is water, there is food and farmers enjoyed improved quality of life economic gains. However, with subsidized farming inputs and irrigation equipment, farmers used any available waters such as wastewaters, effluents from small and medium scale industries, and polluted and eutrophic water bodies for irrigation thus compromising water quality and public health risks. There is need to improve irrigation water quality through technology use and implementing stringent water quality guidelines for effective reuse of precious water resources.

Leveraging traceability to promote agricultural use of wastewater treatment biosolids

Presenting Author: Ms. Maelenn Poitrenaud, France, SEDE Environnement

Co-Authors:

Highlights

In order for a sustainable and economic land application of treated sludge, a robust method to verify and validate the supply chain and life cycle from plant to land is necessary. This includes traceability, action where violations and discrepancies occur, and effective measurement and reporting.

Introduction and objectives

The wastewater treatment process produces biosolids as a by-product. Biosolids have significant fertilizing and organic value, and can be used in agriculture for fertilization of plants and soils (by composting). Because of the inherent risks that could be present, proper management of the material and credible tracking of use is necessary. SEDE -VEOLIA is the European market leader in the recovery of organic wastes produced by communities and industries. To support controlled and safe reuse of biosolids, traceability of the quality and use is key. The authors will describe the SUIVRA software created by SEDE-VEOLIA.

Methodology approach

SUIVRA can monitor any type of products, on both quantitative and qualitative basis, over a period of several years. The software can be linked to a geographical information system that can display the plots used for land application on a map base. The functional developments incorporated for connectivity with GIS make Suivra a high-performance and user-friendly software program. The two applications are closely linked and guarantee the traceability of the land application operations. SUIVRA's functionalities enable users to check the regulatory compliance status of sludge and by-products at any time, relative to expectations.

Analysis and results

Proper land application of sludge may replace on average 30% of Potassium and Magnesium, 40% of Nitrogen and 100% of Phosphorous of the needed fertilization in regions where this land application practice is common. SUIVRA provides farmers, waste producer and local authorities with a comprehensive record of the land spreading campaign, with various reports. SUIVRA is also an ideal tool for the establishment of the nutrient management plans. Analyses are performed to determine the optimized nutrient balance and the heavy metal content of the soil, and the results are automatically imported into SUIVRA. This land-plot management system is used to establish the spreading schedule. The quantities of sludge required to fertilize the crops are determined for each plot of land. Where necessary, the balance of nutrients to be supplied in chemical form following land spreading is also calculated.

Today, SUIVRA data base integrates:

- 3 million tonnes of solid urban and industrial by-products
- 5 million m^3 of food industries effluents processed
- 10 000 farmers over 1 000 000 ha of landbank

Conclusions and recommendation

Software applications such as SUIVRA allow land use application of biosolids to be done in a traceable and verifiable manner. This traceability helps alleviate concern over misuse and pollution impacts. As a result, a very sustainable use of a waste product can be more widespread. Currently, SUIVRA is being applied in France, Belgium, United-Kingdom and in the Republic of Ireland. The software is conducive for use by regulatory agencies in every country.

Reuse of wastewater in agriculture in Bangladesh

Presenting Author: Prof. Mohammad Habibur Rahman, Bangladesh

Co-Authors:

Highlights

- Context of wastewater reuse in agriculture and aquaculture and its pros and cons.
- Critical evaluation of present practices associate to fecal contamination of greywater and its impact on health and environment.
- Recommendations for safe and sustainable reuse of wastewater.

Introduction and objectives

Worldwide feresh water sacarcity is compelling the reuse (combining water and nutrient recycling) of wastewater, greywater and fecal sludge in agriculture and aquaculture at a rapid pace. In Bangladesh, wastewater, greywater and fecal sludge are being traditionally used in agriculture by the farmers in rural as well as in peri-urban areas, particularly in the drought-prone parts. But this may pose risks to human health and ecosystem. This paper attempts to identify the benefits, challenges, social acceptance and institutional arrangements of wastewater reuse in the country and identify the management initiatives for its sustainable reuse.

Methodology approach

Most of the data in this study were collected from two Bangladeshi cities, Dhaka and Rajshahi. Statistically representative wastewater samples were collected randomly towards the end of dry season in 2015 for laboratory analysis. The study also presents findings of a questionnaire survey having a total sample of 250 households for Dhaka and 150 households for Rajshahi that were selected and interviewed using a semi-structured questionnaire focusing wastewater disposal and fecal sludge management. Then governance issues and secondary data are reviewed particularly for rural areas, where wastewater is reused in agriculture and aquaculture to address the situation coherently.

Analysis and results

The most important benefits of wastewater reuse have been found as the availability of wastewater over all seasons and reduced chemical fertilizer requirements. The farmers reported that the crops grown with wastewater irrigation are socially acceptable as they do not face any difficulty to sell them in the market. Interviews with the key stakeholders indicate that a long term institutional arrangement for sustainable reuse of wastewater is available. They identified various problems associated with wastewater that includes incidents of pest and excess weed in the crop field, smells, skin diseases, mosquito nuisance and damage to irrigation pumps due to the high solid waste content. Test results revealed that the biological quality parameters in the wastewater used in agricultural and aquacultural purposes do not satisfy the FAO and WHO guidelines values. This also has a very high degree of microbial contamination. More than 63% of the respondents in Dhaka expressed their concern that putting fecal sludge here and there contaminates greywater, affects human health and has negative consequences on environment in general. This percentage is lower (37%) in Rajshahi compared to Dhaka, but there is a certain level of awareness among people about the undesirable consequences of this act.

Conclusions and recommendation

Reuse of wastewater has an increased benefit due to higher crop production with minimum fertilizer cost in Bangladesh. But there are possibilities of incidents of pest and excess weed in the crop field as well as health impacts of farmers. Microbiological and biological quality parameters in the wastewater used in agriculture and aquaculture exceed FAO and WHO guidelines values. This demands much more attention on the implementation of simple yet cost-effective alternatives to wastewater treatment plants to improve wastewater quality, improving wastewater application methods, control of human exposure for their sustainable utilization in the context of ecosystem perspective.

Safe use of wastewater in LAC: status and capacity needs

Presenting Author: Mr. Javier Mateo-Sagasta, Sri Lanka, none

Co-Authors:

Highlights

- Great potential to safely reuse the resources embedded in the 30 km^3 of municipal wastewater produced every year in the region
- To reach its potential and meet the SDG 6.3 the region needs to develop capacities and facilitate the replication of the existing but still limited success stories

Introduction and objectives

LAC is the most urbanized region in the world. Its urban settlements produce more than 30 Km^3 of municipal wastewater every year. The resources embedded in these wastewater (e.g. water and nutrients) would be enough to irrigate and fertilize millions of hectares, but these resources remain greatly untapped. This presentation will review the available regional data on wastewater treatment and reuse in agriculture and analyze the key capacities that need to be developed to transition to a safer and more productive use of these waters in agriculture, all illustrated with sceptic examples form the region.

Methodology approach

We will present the results of a review of cases, literature and secondary data provided by a large number of regional stakeholders to answer the following questions:

- How much wastewater is produced, treated and reused in agriculture in the region?
- What are the key capacities that need to be developed for a safer and more productive use of wastewater in agriculture?
- What are some bright examples that if replicated across the region could accelerate the transition for more and safer reuse?

The capacity needs assessment is partly based on the consultative workshops undertaken under an FAO-WHO-UNEP-UNWDPC-UNU-INWEH-ICID-IWMI project.

Analysis and results

More than 60% of the 30 Km^3 of municipal wastewater produced in LAC every year is discharged to the environment without any treatment, missing opportunities for safe and planned reuse. As a result about 25% of the rivers in the region are affected by severe fecal pollution and an estimate of almost 2 Million hectares use polluted water to irrigate, posing relevant health and environmental risks. Nevertheless there are bright examples of economic and finance models, reuse safety plans, effective policies, technologies and cost-effective investments that if replicated across the region would accelerate the adoption of safe reuse practices.

Conclusions and recommendation

Countries in the region need to assess in depth their capacity needs for a safer and more productive use of wastewater in agriculture in at least these focus areas: i) better data and diagnosis of wastewater management, ii) more institutional coordination and policy integration, iii) broader use of the WHO 2006 guidelines and iii) better business models and incentives for safe reuse.

The region needs to design cooperative initiatives to promote that countries learn from each other and replicate success reuse stories across the region.

Sustainable wastewater reuse for agricultural application

Presenting Author: Ms. Aleksandra Lazic, Sweden, Xylem Inc.

Co-Authors: Mr. Christian Baresel, Sweden, IVL Swedish Environmental Research Institute

Highlights

Reuse of municipal wastewater is the responsible solution to manage water scarcity, but configuring the most sustainable treatment system is challenging. This study offers an approach based on sustainability tools (e.g. environmental and economic evaluations, effluent performance and plant size) in the configuration of the agriculture reuse treatment systems.

Introduction and objectives

Water reuse for agriculture can be achieved with additional tertiary and disinfection steps, however it is important to analyze these steps from both environmental and economic outcomes.

The goal of this project is to optimize wastewater treatment processes for sustainable agriculture reuse of treated wastewater. The starting point is to assess the environmental and economic profile of two treatment trains that combine the secondary treatment (sequencing batch reactor, SBR) with two different tertiary treatment technologies. The environmental impact assessment of the treatment trains is done using life cycle assessment. The economic evaluation was performed using life cycle cost.

Methodology approach

Two (2) different treatment trains for water reclamation for agriculture and urban use were evaluated for three different full-scale sizes 20,000, 100,000 and 500,000 PE.

The environmental assessment is carried out with LCA methodology according to ISO 14044 (2006). The goal is to compare the environmental profiles of treatment lines, which deliver reclaimed water for the same purpose.

The upstream boundary of the assessed system is the wastewater at the point of intake to the SBR. The downstream boundary considers all the effluents including reclaimed water and sludge treatment (aerobic sludge stabilization step (AD), thickening (TH) and dewatering (DW)).

Analysis and results

Results of the study allowed designing a sustainability tool integrating the environmental, economic and treatment performances of the two selected treatment lines and three studied plant sizes. The outcome of the tool provides a comprehensive understanding of the degree of sustainability of the treatment train for a specific application and raises visibility of the factors that have the greatest effect on the environmental impacts, the investment and operational costs.

Generally, tertiary treatment steps with disinfection have only a small impact on the overall environmental impact even though those steps upgrade the water quality to non-potable water reuse standards. Within the tertiary treatment and disinfection step, energy consumption of UV contributes the most.

Evaluation of the Life Cycle Cost revealed that for each of the selected treatment trains, the operating cost (OPEX) is larger than the investment cost (CAPEX) over the 20 years of lifetime of the plant. In addition, the energy consumption accounts for more than 50% of the total operating costs based on European energy and labor prices.

Conclusions and recommendation

This study shows that various wastewater treatment trains can achieve the same reuse effluent quality while having different environmental and economic impacts. Sustainability tools (effluent quality, LCA, LCC, energy consumption, footprint, water efficiency) can be used to provide a more complete understanding of the environmental, economic and social impacts when selecting the most sustainable reuse treatment train of certain size.

Wastewater reuse for community livelihood enhancement Wadi Musa case study

Presenting Author: Dr. Loay Froukh, Jordan, JWSRO/NGO

Co-Authors:

Highlights

This paper presents a success story for sustainable development project in Wadi Musa where wastewater reuse is used to alleviate the poverty and create jobs for the local community.This will to support Jordan wide strategy to encourage beneficial reuse of wastewater and will contribute to achieve SDG's 1 (poverty), 2 (food security) and 6 (water and sanitation).

Introduction and objectives

Wastewater reuse in Wadi Musa is a landmark water reuse pilot project which aimed at enhancing the livelihood in the local community. The project main objectives are:

- To help improve the livelihoods of the local community
- To reduce the pressure on the groundwater
- To protect health and environment in Wadi Musa area

The project is located approximately 10 km north of Petra and it was the first community based project established in Jordan. Up to 100 hectares is irrigated with reclaimed water for growing fodder crops mainly AlfaAlfa. 80 farmers and their families benefited from this project.

Methodology approach

Using the integrated rural water management approach and adopting the water conservation and reuse strategy,Wadi Musa wastewater reuse project was established to irrigate 100 hectares in the first phase. A main conveyance system (3 km) with booster stations to pump water from Wadi Musa wastewater treatment plant to farms downstream. In order to run the project an NGO farming Association was established to be responsible on the project.The Women form 20% of the farmers.The HF and JWSRO provided the technical support to farmers to maintain the irrigation system and so it can provide optimum use of wastewater.

Analysis and results

It was found that the treated wastewater was suitable for growing fodder crops in Wadi Musa farms. The yield of the crops is higher by 20-30% from using freshwater. This is basically due to high nutrients such as N and P in the water. The avergae generated income per farmer is around 500 Jordanian Dinar which is more than poverty limit (150 Jordanian Dinar per family). This provided the farmers with a sustainable source of income and contributed to drop in migration from rural/remote areas to cities.

However, the main challenge was to control the rise in salinity. In year 2014 to 2016 the salinity levels are increasing with time (some records in recent years reached 1000 ppm) which affected the efficiency of the irrigation system by blockage of drip irrigation network by 20-30%. It also affected the booster stations efficiency to drop by 10-20.

Conclusions and recommendation

The Wadi Musa case study is a success reuse story which lead to;

- A source of income for the local community members has been secured
- A revolving fund has been established which will invest at least 20% of the annual revenues of the cooperative to support the future expansion
- Social stabilization and reduction of migration from rural to urban.
- Women farmers involvement in farming activities and association decision process
- Protection of the tourism environment around Petra
- Contribution to achieve SDG's: 1 (poverty), 2 (food security) and 6 (water and sanitation).

Poster: Effect of urine on maize yield - Prospects for food security

Presenting Author: Dr. Oliver Odikamnoro, Nigeria, Ebonyi State University

Co-Authors: Ms. Oluchukwu Odikamnoro, Nigeria, Ebonyi State University

Highlights

The effect of human urine on the growth and yield of three local varieties of maize was investigated on the research farm of the Faculty of Agriculture, Ebonyi State University, Abakaliki, southeast Nigeria. Results revealed that human urine significantly influenced the growth rates and yield of the varieties of maize.

Introduction and objectives

Human urine is rich in nitrogen and can be used to fertilize crops. It also contains nutrients like phosphorus, potassium, magnesium, and calcium. Urine constitutes only 1% of the total wastewater generated. However, it contains the largest proportion of plant nutrients found in wastewater. Reuse of the nutrients contained in urine will reduce environmental pollution. The advantages of urine as fertilizer will be immense as it will serve as a substitute to commercial fertilizer. It can be of great use in meeting the fertilizer demands of rural farming communities in developing countries. In Nigeria, maize remains a major cultivated cereal

Methodology approach

The experiment was designed to determine the effectiveness of human urine as a viable and beneficial source of plant nutrients in comparison to other sources of nutrients. The experiment was a 5x3 factorial laid out in a randomized complete block design (RCBD). It had factor A as five sources of fertilizer (human urine, poultry manure, urea, NPK 15:15:15, and control). Factor B was three local maize varieties. This gave a total of 15 treatment combinations replicated three times, giving a total of 45 plots. Urine treatment was applied on all three varieties of maize and compared with other nitrogen sources.

Analysis and results

The results of the experiments clearly showed that all three maize varieties responded positively to the treatments (human urine, poultry manure, urea, NPK 15:15:15) except the control that had no form of fertilizer applied to it.It was shown that human urine significantly influenced the growth rates and yields of all three maize varieties, followed closely by NPK 15:15:15, urea, and lastly poultry manure. Maize varieties fertilized with human urine produced similar results as those fertilized with other sources of nitrogenous fertilizer. This agreed with earlier documented works by other authors which affirmed that the urea or ammonium-N in urine compares well with that of urea and inorganic fertilizer. In the taste assessment test, tasters could not differentiate between maize treated with human urine and those grown with other sources of fertilizer. Thus, tasters did not prefer any particular maize sample as all the maize were evaluated as being good-tasting. This showed that human urine does not affect or alter the taste of any crop it is fertilized with. This experiment was able to show the viability of the use of human urine as fertilizer. This means that human urine can be used at the convenience of a home to grow crops.

Conclusions and recommendation

Previous documented works by different authors have successfully demonstrated the benefits of using human urine as fertilizer. The results of this study affirmed these earlier works. Urine can be harvested by constructing community urine diverting latrines in residential neighbourhoods. Simple and water-less urinals can be constructed near the garden for collecting the urine for use in the field. Urine can also be collected from private homes and stored before use. This work has high implication for policy. Governments at all levels should promote ecological sanitation and en-corporate it into relevant agricultural, health, and environmental policies and programmes.

Poster: Evaluating filtration types of wastewater for agricultural irrigation systems

Presenting Author: Mr. Michael Davidson, United States, Davidson Consultants

Co-Authors:

Highlights

This presentation provides a comparative study of three filtration systems of wastewater for agricultural use. This research includes: a taxonomy and description of the properties of wastewater salient for agricultural use; a comparison of the amount of water disposed during operation; available options for wastewater filtration; and generalizable outcomes

Introduction and objectives

The reliance on wastewater for agricultural use is increasing and it is imperative to understand how this water resource should be optimally managed. A key element for utilizing wastewater is filtration. This study evaluated the utility of automatic self-cleaning filtration of wastewater in agricultural settings using three case studies. The objectives of the presentation include: explain and discuss the properties of wastewater; explain the properties, characteristics, types and options of filtration; explicate the filtration requirements for all irrigation regimens; conduct a cost-benefit comparison of typical filtration options; and compare the disposal characteristics of flush water.

Methodology approach

This study compared the performance of three methods of filtration for agricultural use of wastewater in California. This is a quantitative comparison of sand media filtration, automatic self-cleaning disk filtration and automatic self-cleaning screen filtration. The purpose of the study was to determine the rate of flushing, quantity of flushing effluent, time for flushing sequence. The source for all three system is the same; wastewater provided by Ventura County. Each system had identical inputs: flow, filtration degree, water source, pressure and operative demands. The evaluation covered one irrigation season of 100 days.

Analysis and results

The three filtration options performed well. The objective was to evaluate the flushing performance of each filter system. Each filter option provided equivalent degrees of filtration and performed well in the eyes of the grower. The sand media filter system flushed about 4 times per day (424 times per season); the disk filter system flushed about 11 times per day (1144 times per season); the screen filter flushed about 15 times per day (1515 times per season). Each flush of the sand media filter took 12 minutes and flushed 11340 liters; the disk filter took 3 minutes to flush and flushed 2268 liters; and the screen filter took 0.25 minutes to flush and flushed 95 liters. For the season, the media filter flushed 4,808,160 liters; the disk filter flushed 2,594,592 liters and the screen filter flushed 143,925 liters. Each filtration flush disposes of effluent water. Even though the screen filter flushed 3.5 times more frequently than the sand media system and 1.3 times more frequently than the disk filter system, it disposes about 3% of the total water disposed by sand media filters and about 6% of the total water disposed by disk filters.

Conclusions and recommendation

Wastewater is of significant utility for agricultural purposes. A key consideration for irrigation system using wastewater is filtration type. An important characteristic of filtration systems is the amount of water that is disposed during the automatic flushing sequence. It is important to reduce the amount of wastewater that is disposed and, conversely, make greater use of total available wastewater. This research illustrates important inferences about the utility of self-cleaning screen filtration. Self-cleaning screen filters provide a reliable and generalizable solution for reducing wastewater disposal for irrigation systems.

Poster: Strategic approach for waste water reusing in agriculture in Palestine

Presenting Author: Mr. Bahaa Obaid, Palestinian Territories, OBAID Integrated Solutions

Co-Authors: Dr. Basheer Obaid, Germany, OBAID Integrated Solutions
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Highlights

This research presents a new approach to encourage the society and farmers to use treated waste water through public awareness, Farmers incentives and sustainable treated water supply for agriculture.

Introduction and objectives

In Palestine, 70% of water is used in irrigation. Reusing of wastewater will reduce the scarcity of Water and reducing salinity of Groundwater. This research presents a new approach to encourage the society and farmers to use treated waste water through public awareness, Farmers incentives and sustainable treated water supply for agriculture.

Methodology approach

Research methodology is based on three phases: Survey analysis for 100 farmers, Intensive Public awareness and Implementing approach on selected Pilot area in North Gaza.
This paper presents a pilot study in Gaza and will address Public Awareness Program implemented in pilot area. This paper also shows the analysis of Detailed social-cultural Survey about using of treated water in Agricultural.

Analysis and results

69% of participation agree to use treated water in agriculture uses when there a sustainable supply for it. 75% of farmers agree to use treated water when there is incentives for that. Majority of farmers selected Installing pipes and reducing treated water tariff as the most important incentives. The reused water quality was observed in the pilot area which is acceptable and according to international standards. Several parameters have been measured such as salinity, chloride, nitrogen, heavy metalsnow and etc.

Conclusions and recommendation

Public awareness is an important role to use treated water in agriculture as an alternative water resources. Incentives encourage farmers to use treated water. Using of treated water will reduce the health risks and ground Water contaminations.