The Contribution of Wastewater farming activities to the household wellbeing in Dodoma Municipality, Tanzania

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Abstract

This paper assesses the contribution of wastewater farming activities to the household wellbeing in Dodoma Municipality. Specifically, the study intended to: (i) assess the ability of wastewater users to meet their basic needs (ii) analyse types of assets obtained through wastewater farming activities (iii) assess food security status of wastewater users.. A multi-stage sampling technique was employed to select respondents of the study. The first step involved selection of streets namely Swaswa Bwawani, North and Mbuyuni using purposive sampling technique from which sample households of wastewater users were obtained. The second step was to select household heads involved in wastewater farming activities from the list of wastewater users by using stratified sampling technique. Quantitative and qualitative data were collected from key informants and 204 wastewater users. Data were collected through questionnaires and checklists. Statistical Package for Social Sciences (SPSS) was used for descriptive analysis. Results show that only 70.6% of respondents could pay for transport facilities and 59.8% could afford preferred food stuff. Little changes observed to education (16.0%), health facilities (28.9%) and communication (32.85%).Therefore wastewater farmers should improve farming practices such as irrigation technology, use of improved seeds, seek for financial and technical support on crops processing and market acquisition for wastewater product.

Keywords: Wastewater, Farming activities; Household wellbeing

1.0 Introduction

In recent times, the presence of different pressures in agriculture, water abstraction, population growth, increasing urbanization, drought, reduced run-off, water quality deterioration has put a major strain on water supply globally (FAO, 2010). Worldwide, there is increasing gap between the water supply (63 billion cubic meters) and demand (64 billion cubic meters) per annum due to increase in population (UNEP, 2002). It has been predicted that by 2050, economic growth, changing consumption patterns, climate change and population growth will increase global water demand by 30-40%. The level of water abstraction is reaching its natural limits, and this calls for a dramatic shift in wastewater utilization (UNEP, 2002). In this case, the use of urban wastewater which is generated daily in cubic meters by a rapidly growing population is currently receiving special attention in many arid and semi-arid regions.

The use of urban wastewater supports wellbeing and generates considerable value in urban and peri-urban agriculture despite the health and environmental risks associated with this practice. Though pervasive, this practice is largely unregulated in low-income countries, and the costs and benefits are poorly understood (Scott *et al.*, 2007). Often the households in urban and peri-urban rely on wastewater resource for income generation and food security needs. In Dakar, Senegal, urban wastewater farming activities have been shown to provide both income to farmers and a source of nutritious food to the poor (Faruqui, 2001). Further, Koundi (2001) reported that wastewater irrigation assists in combating unemployment in Cape Town city, South Africa which stands at a rate of 26%.

In Tanzania, the use of wastewater for economic activities is not well documented. Similarly, the contribution of wastewater farming activities to the households wellbeing is not fully acknowledged. In spite of the large volumes of wastewater being discharged in the urban areas of Tanzania (greater than 41,703,016 m^3) and its potential in terms of supporting economic activities, its utilization as physical resource for improving wellbeing of the households around Waste Stabilization Ponds in Tanzania areas is not well known. Therefore, the study intends to assess the contribution of the economic activities utilizing wastewater in improving wellbeing of the surrounding communities in the target research area.

2.0 Methodology

2.1 Location of the study area

Dodoma Municipal Council is located 486 kilometres East of Dar-es-Salaam and 441 kilometre South of Arusha, the Headquarter of the East African Community. It covers an

area of 2,669 square kilometres of which 625 square kilometres are urbanized. According to the National Census of 2012, Dodoma urban district had a total population of 4,956.

The study was conducted at Dodoma Municipality due to the following reasons. First; Dodoma being the capital of Tanzania, is a fast growing urban area, a factor that drives expansion in volumes of wastewater resource. Taking into consideration the current expansion of higher learning institutions in the municipality, it is anticipated that demand for water resource would increase in the near future. This situation will again increase the volume of wastewater discharge in the municipality and hence help to improve wellbeing at households' level.

Secondly, Dodoma is a semi-arid area which is characterized by low humidity and long dry spell. This situation gives insights on the need to use alternative water sources such as wastewater instead of relying heavily on rainwater for promoting socio-economic activities. In respect to this, Swaswa wastewater wetland is one of the reliable water sources for promoting socio-economic activities in Dodoma municipality.

Thirdly, the availability and reliability of wastewater attract the majority of formal and informal employee as well as unemployed youth for wastewater farming activities.

2.2 Data collection methods

Data related to acquisition of household needs and assets obtained through utilization of wastewater were collected by using questionnaires

Purposive sampling technique was used to select streets where the sample wastewater users' households were obtained. These are Swaswa Bwawani, Swaswa North and Swaswa Mbuyuni. The choice of the streets was based on the availability of waste stabilization ponds which are used for wastewater farming activities. The second stage involved selection of different categories of respondents from the list provided by Mtaa Executive Officer. Stratified and purposive sampling techniques were employed to select the respondents and key informant respectively. The different categories of key informants selected were Village executive Officer (VEO), Ward Executive Officer (WEO), District Agricultural Officers (DAO), Waste Water Engineers (WWE). Krejcie and Morgan (1970) formula was used to get a representative sample of 204 households heads who were involved in wastewater farming activities as follows

$$n = \frac{N (Z)^2 p(1-p)}{(N-1) e^2 + p(1-p)(Z)^2}$$

Where:

n= required sample size

N=Number of population (for this case is 434)

Z= the area under normal curve corresponding to the desired confidence level which is

95% (Z=1.96)

p=Probability (=0.5)

e= is error due to sampling (in this study 0.05)

$$n = \frac{434x (1.96)^2 x (0.5) x (1-0.5)}{(434-1) x (0.05)^2 + (0.5) x (1-0.5) (1.96)^2}$$

n =204

Equal number of respondents was obtained from the three streets.

For data analysis, data were coded, cleaned and entered into the Statistical Package for Social Sciences (SPSS) for window 11.5 for analysis. Data were analysed for descriptive statistics such as means, frequencies and percentages. . Ratio of assets obtained before and after practising wastewater farming activities was computed.

3.0 Results and Discussion

This section intends to examine the contribution of wastewater farming activities to wellbeing of surrounding communities. Attention was given in assessing the extent of wastewater farming activities which enabled the sample respondents to meet basic needs, to own assets and acquire food security. The subsequent sections describe in details the empirical evidence pertaining to linkages between wastewater farming activities and wellbeing of the wastewater users.

3.1.1 Ability to meet basic needs

The respondents were asked to indicate their ability to meet different types of their basic needs prevailing at household level before and after being engaged in wastewater farming activities and the results are shown in Table 1.

Table 1: Respondents' basic needs before and after joining wastewater Farming activities in Swaswa Respondents (%)

Basic needs	SB		SN		SB	
	% B	%A	%B	%A	%B	%A
Education costs	20.50	32.30	30.7	40.99	20.2	57.00
Paying Health facilities	27.20	47.79	36.20	46.49	23.40	79.28
Transport costs	31.00	95.70	12.10	95.93	12.60	75.83
Clean water costs	46.40	99.34	11.50	55.62	22.03	95.83
Social costs	31.20	67.97	19.10	80.86	14.30	73.12
Food purchases costs	62.70	109.76	16.70	87.28	16.50	76.79
Communication costs	26.30	64.54	22.40	41.52	8.40	49.58
Housing rents	15.60	52.37	18.90	89.48	21.70	81.99
Clothes costs	37.50	66.91	20.40	82.17	27.70	87.99

A=After B=Before

SB Swaswa Bwawani SN=Swaswa North SMB =Swaswa Mbuyuni

The mentioned needs required at households include education, health services, transport, water, social costs (financial contribution in church, mosque, burial ceremonies food, mobile phone, housing and clothes. Thereafter, subtraction was computed by using basic needs before and after Swaswa wastewater activities to see if there are changes. The results are summarized in Table 2. It is of particular interest that the overall results in Table 2 revealed that relatively larger percentage of sample respondents were able to meet their basic needs after being engaged in wastewater farming activities compared to period before engagement. The largest percentage change observed on contribution of wastewater utilization to basic needs by 70.6% of respondents who could pay for transport facilities. This followed by 59.3% respondents who could purchase food, housing rent costs by 55.9% and clothes by 52.5%. Location wise drastic changes observed for health facilities (55.6%) and clean water (73.5%) at Swaswa Mbuyuni. As reported by respondents, positive changes occurred in their wellbeing after joining the wastewater activities. However, little changes were observed in payment of education (16.0%), health facilities (28.9%) and communication (32.85%). This entails more efforts should be done to improve wastewater farming activities for better changes of the identified needs.

Table 2: Contribution (% change) of wastewater utilization to meet basic needs

Need	Swaswa Bwawani (n=68)	Swaswa North (n=68)	Swaswa Mbuyuni (n=68)	Overall change
Education costs	11.80	10.29	36.80	16.00
Paying Health facilities	20.59	10.29	55.88	28.92
Transport costs	64.70	83.83	63.23	70.58
Cleanwater costs	52.94	44.12	73.53	50.49
Social costs	36.77	61.76	58.82	52.45
Food purchases costs	47.06	70.58	60.29	59.31
Communication costs	38.24	19.12	41.18	32.85
Housing rents	36.77	70.58	60.29	55.88
Clothes costs	29.41	61.77	60.29	50.49

3.1.2 Ownership of assets in the study area

Notably, people are required to own a wide range of assets to achieve their self-defined goals. In respect to this, sample respondents were requested to mention different types of assets owned before and after being engaged in wastewater farming activities. The data were presented in ratios as shown in Table 3. Apparently the results in Table 3 shows that land/plot acquisition before and after the respondent involvement in wastewater farming activities had ratio of 3.9. Furniture had 3.6, followed by Television (3.4) and Radio (3.3). Fascinatingly, the overall results from the Table indicate with exception of land relatively small number of sample respondents owned assets after being engaged at Swaswa wastewater farming activities compared to period before being engaged in that activities. Of all assets mentioned, the largest number of sample respondents owned land/plot compared to other assets indicating that land is vital asset for improving wellbeing among respondents in the study area. Similar argument was reported by Denys (2009) that land lies at the heart of social, political and economic life in most of African societies. This is partly due to the fact that land and natural resource are key assets for economic growth and households' wellbeing improvement. Conversely, small changes observed in bicycle, motorcycle and vehicle. Purchasing of these facilities needs lump sum amount of money that can take time to accumulate.

The ratio differ across the location where housing scored highly in Swaswa North (7.7), Land plot (4.6) in Swaswa Mbuyuni, and bicycle (3.8) in Swaswa North. The implication of this finding is that, wastewater activities have little impact to widen opportunity for

wastewater users to own a wide range of assets. This finding concurs with Scott *et al*. (2004) who reported that the use of wastewater for socio–economic activities in Pakistan improved households' wellbeing, including acquisition of assets.

Table 4: Respondents' status of assets ownership by location

Assets	Location			Overall Changes (After/Before)
	Swaswa Bwawani	Swaswa North	Swaswa Mbuyuni	
	Change (After/Before)	Changes (After/Before)	Changes (After/Before)	
Bicycle	2.4	3.8	2.8	3
Motorcycle	-	2	2	2
Vehicle	-	-	1	1
Furniture	4.1	3.7	4	3.6
Radio	2.6	3.6	3.6	3.3
Television	3.3	3.7	4	3.4
Land/plot	4.6	3.7	.2.1	3.9
Bank account	3.3	1.2	3.5	2.2
Jewellery	1.3	4	5	2.8
House	3.8	7.7	10	2.6

3.1.2.1 Type of houses

Further analysis was performed to verify the impact of wastewater farming activities on type of houses owned by sample respondents. These were categorised as permanent (have walls of cement blocks or burnt bricks, well cemented concrete floor and corrugated iron sheets roofing); Semi-permanent (have at least one of the three components of a permanent house and need replacement or repair annually and temporary (have walls of mud wood or un burnt bricks, mud or sand floor, thatched with mud, grass or polythene paper and need replacement or repair annually). The results presented in Table 5.

Table 5: Types of houses (%) owned by respondents by location

Types of houses	Respondents%			Total sample (N=204)
	Swaswa Bwawani (n=68)	Swaswa North (n=68)	Swaswa Mbuyuni (n=68)	
	%change (A-B)	%change (A-B)	%change (A-B)	%change (A-B)
Permanent	7.4	8.8	33.9	16.2
Semi-permanent	20.6	22.1	-26.5	8.3
Temporary	-28	-30.9	-7.4	-24.5

With regard to this, the overall results in the table indicate that there was high percentage change for majority of sample respondents who own permanent houses by (16.2%) and semi-permanent by houses (8.3%) after being engaged in wastewater farming activities compared to the period before. A negative change which entails decrease of (-24.5%) was observed in temporary houses. The decrease of temporary houses and increase of permanent and semi-permanent houses entails the contribution of wastewater in economic terms. A similar pattern was observed across the study locations. More specifically, results in the same Table disclosed that larger percentage change of sample respondents at Swaswa Mbuyuni (33.9%) owned permanent houses after being engaged with wastewater farming activities compared to their counterparts living at Swaswa Bwawani (7.4%) and Swaswa North (8.8%). The reason behind is that partly the area is connected with social services which attract for more income generating activities. Additionally, discussion with focus group members often acknowledged tremendous improvement in the condition of houses owned by people in the study area especially after being engaged in wastewater farming activities as opposed to the period before. These findings partly suggest that wastewater activities has important role to play in terms of improving the house condition of wastewater users across all categories of income earners and location.

3.1.3 Food security

Food security was assessed based on ability of sample respondents to meet their food requirement in terms of purchasing power, frequency of consuming balanced diet, number of meals consumed per day and quantity of food intake. The results are presented in Table 6.

Table 6: Contribution of wastewater farming activities on food security

Description	Respondents (%)			Total sample N=204
	Swaswa Bwawani n=68	Swaswa North n=68	Swaswa Mbuyuni n=68	
	%Change(A-B)	%Change (A-B)	% Change (A-B)	Overall % Change (A-B)
Description				
Ability to purchase food stuff:				
Monthly	30.4	26.6	10.2	22.1
Affordability of consuming balanced diet:				
Protein food stuff				
Easily affordable	51.5	50	77.9	59.8
Vitamins food stuff				
Easily affordable	27.9	39.7	92.6	53.4
Fat and oils food stuff				
Easily affordable	39.7	67.7	41.2	49.5
Carbohydrates food stuff				
Easily affordable	2.9	28	4.4	11.8
Roughages food stuff				
Easily affordable	20.6	36.8	29.4	28.9
Number of meals consumed per day:				
Three meals	48.8	79.3	22.1	53.5
Quantity of food stuff intake:				
Satisfied	43.6	41.1	20.5	34.8

A-After Swaswa = Before Swaswa

In this study, balanced diet was measured by assessing affordability in consuming varieties of food nutrients such as protein, vitamins, carbohydrate, fats, minerals and roughages as perceived by sample respondents. The overall results from Table 6 revealed that with exception of protein food stuff (59.8%), vitamin (53.4%), fats and oil (49.5%) which had large proportion change, wastewater farming had little change in food security. These findings suggest that wastewater farming activities had little contribution toward enabling wastewater users to attain balanced diet at household level.

Apart from balanced diet, sample respondents in the study area indicated the number of meals consumed per day at households before and after being engaged in wastewater farming activities. The overall results in Table 6 suggest that there was average change of sample respondents' composition (53.5%) that was able to consume three meals per day after being engaged in wastewater farming activities compared to the period before engagement in those activities. These findings suggest that wastewater farming should be improved so as to play role in terms of ensuring food requirements for wastewater users and therefore promoting their wellbeing at household level.

4.0 Conclusion and Recommendations

Wastewater resource plays a little contribution towards improving wellbeing at household level. This was observed through basic needs, assets acquisition, improving housing quality, food security, health and water services acquisition. It was noted that some very important assets such as vehicle, motorcycle, radio and bicycle which are useful for economic development were limited to respondents. In addition the percentage change of permanent house is low at Swaswa Bwawani and Swaswa North compared to their counterpart Swaswa Mbuyuni. With regards to percentage change of carbohydrates foods before and after respondents migrating to Swaswa, low percentage was observed to all locations. Therefore study recommended that wastewater farmers should improve their farming activities by acquiring trainings relating to wastewater use. Thus the agricultural extension officers should provide training on advanced irrigation technology and encourage the use of improved seeds. Furthermore, farmers should form groups which will help them to acquire credit for expanding their activities. Also, the government should support farmers in vegetable processing and acquisition of market for wastewater vegetables.

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