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Examining Association Between Peoples' Livelihood Assets and The Adoption of Treated Wastewater in Ruai, Kenya

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Abstract
Several households in Ruai use or have ever used the treated wastewater from the Ruai Wastewater Treatment Plant either directly or indirectly for various livelihoods' activities. This study investigated how their various livelihoods assets influenced the adoption of the treated wastewater (TWW) in Ruai, between October, 2018 and April 2019. The study employed a cross-sectional design. A sample size of 360 households was selected using both stratified and systematic random sampling methods. Raw data were collected through surveys and observations, then subjected to both descriptive and correlational analyses using both the Ms Excel and the SPSS software Version 20.0. Pearson's Chi-square test of independence and Cramer's *V* coefficient were used to estimate any association and its interpretation & strength respectively between households' adoption of (using) the treated wastewater and their identified livelihood assets. Results showed that the availability of wastewater, peoples' past experience and skills of its use, availability of reserve lands, their social/groups networks among friends, relatives and other co-users of the wastewater have moderate to high positive associations with their adoption of TWW use in Ruai. The study findings provide crucial information hitherto unavailable that could be used to inform the formulation of a policy on appropriate management and utilization of the treated waste water in Ruai ecosystem that integrate possible re-use scheme where the community members would leverage these assets inter alia, for enhancing their livelihoods. The findings can also be used as a reference in the creation of awareness to the community members among other audience on the possibility of adoption of treated wastewater by exploiting their potential livelihood assets for enhanced livelihood outcomes.
Keywords: Adoption, Treated Wastewater (TWW), Livelihood, Livelihood assets, Association.
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1.0 Introduction

1.1 Background

In the wake of fresh water scarcity, wastewater is becoming a reliable alternative source of water for people's livelihoods, especially in many semi-arid and arid regions of the world (Mahjoub, Mekada & Gharbi, 2016; Khalil and Kakar, 2011; Mekala, Davidson, Samad, & Boland, 2008; Buechler, 2004). According to Kaluli *et al.,* (2011), Kenya is a water-scarce country with the capital city, Nairobi, receiving less than 100 l/capita/day. Potable water for irrigation and industrial use is generally unavailable, calling for alternative water sources. This has resulted in the consideration of wastewater as an alternative water source to be used in various livelihood activities such as the irrigation of over 720 ha in urban farms in Nairobi, despite its use being illegal in Kenya (ibid). In Ruai ward, in Nairobi county, about 35.6% of the households have adopted the use of the treated wastewater (TWW) from the neighbouring wastewater treatment plant, for their livelihoods (Maina, *et al.*, 2020). Toward this end, and to sustain their livelihoods and therefore enhance their welfare, the community members applies several assets as resource endowments and capabilities.

Assets are the resources and capabilities that people have and draw upon to build and sustain their livelihoods and to enhance their welfare (Oduro, *et al.,* 2015; Moser and Dani, 2008). Accordingly, there are five different types of livelihood assets (or capitals) which include human, social, physical, natural, and financial capital. Human asset assumes a combination of skills and knowledge, education, health, nutrition, capacity to work, and capacity to adapt which enable households and individuals to make livelihoods and attain secure livelihood outcome. Social capital, includes: networks and connections (patronage, neighbourhoods, kinship), relations of trust, mutual understanding and support, formal and informal groups, shared values and behaviours, common rules and sanctions, collective representation, mechanisms for participation in decision-making, leadership. Then there is the natural asset which is a collection of natural resources in the physical environment which humans act upon to create livelihoods. These endowments include, among others, rivers, land and produce, water and aquatic resources, trees and forest products, wildlife, wild foods and fibres, biodiversity, and environmental services. Physical asset means the required accessibilities to facilities needed by households or individuals like, infrastructure (transport, roads, vehicles, secure shelter and buildings, water supply and sanitation, energy, communications), tools and technology (tools and equipment for production, seed, fertilizer, pesticides, traditional technology). Lastly, financial asset is a collection of the ways by which an individual or

household make income to sustain livelihoods and invest to acquire more assets which includes; savings, credit and debt (formal, informal), remittances, pensions, wages (Ibrahim, *et al.,* 2017; Moser and Dani, 2008; Carney, 1998).

Access to, control over, and ownership of assets enable people create stable and productive livelihoods and that their distribution within the household is critical to household and individual well-being (Meinzen-Dick as cited in Kidula-Lihasi, Onyango and Ochola, 2016). This study therefore sought to analyse the assets available to households in Ruai in Nairobi Count, Kenya and relating them to the adoption of the treated waste water resource available in their neighbourhoods for their livelihood purposes. Besides, in the absence of a wastewater policy in Kenya (Kaluli, *et al.,* 2011), this kind of information is crucial in informing policy formulation regarding proper use and management of the TWW at Ruai. Additionally, such information is useful in the creation of awareness to the community on leveraging their assets for enhanced livelihoods that depend on TWW use, more so at a time when the scarcity of fresh water in the area has been a recurring reality.

1.2 Objective of the study

The objective of the study was to determine the association between household livelihood assets and the adoption of TWW among communities in Ruai, Kenya. Consequently, we hypothesized that there is no statistically significant association between the household livelihood assets and the adoption of TWW among the communities in Ruai.

1.3 Theoretical Framework

The study adopted the Sustainable Livelihoods Approach (SLA), (Carney, 1998) to take a fresh look at the association between the adoption of TWW use by the Ruai community and their livelihoods assets.

According to the British Department for International Development [DFID], (2000)

"*a livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks maintain or enhance its capabilities and assets, while not undermining the natural resource base."*

The framework, as depicted in Figure 1, shows how, in different contexts, sustainable livelihoods are achieved through access to a range of livelihood assets which are combined in the pursuit of different livelihood strategies such as agricultural intensification, and livelihood diversification. People and their access to assets are at the heart of livelihoods approaches (DFID, (1999), and just as Ibrahim, Hassan, Kamaruddin, & Anuar, (2017), asserts, SLA is used to report on the association between livelihood strategies and livelihood asset as a capital and capabilities framework. Several examples to illustrate this assertion will suffice; a household may choose to reinvest its income in productive assets (such as land and equipment) in order to generate more income hence livelihood, and accumulate more assets (Oduro, Adamtey, and Ocloo, 2015; DFID, 1999). Likewise, water as a key asset in most human livelihoods (Buechler, 2004) has been use around the world in a variety of socio-economic sectors including agriculture, mining, commercial fisheries, recreation and tourism, forest generation, inter alia (Kabul, 2011; Winpenny, Heinz & Koo-Oshima, 2010). Wastewater on the other hand, has also been used as an asset to derive livelihoods in various activities - that directly or indirectly depend on it - such as horticulture, fodder production, agroforestry, orchard keeping, floriculture, aquaculture and cereal production in urban and peri-urban farmers, transportation of produce to markets in Asia and Africa (Buechler *et al*., 2014; Buechler, 2004).

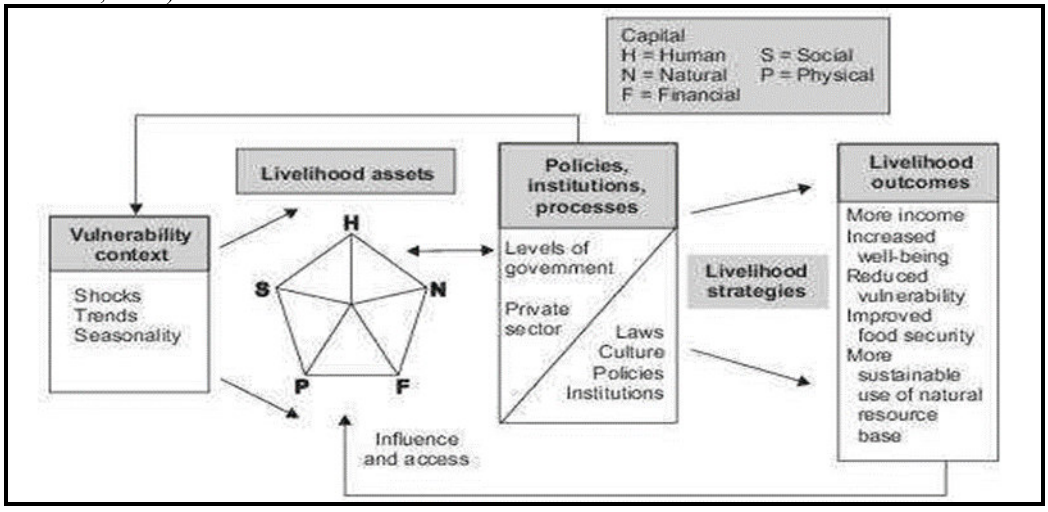

Figure 1: SLA Framework Adopted From DFID, 1999

2 Material and Methods

2.1 Overview of the Study Area

This study was carried out in Ruai Ward, Nairobi County between October, 2018 and April 2019. Ruai is in Embakasi Sub County in Nairobi East, about 20 km from the city centre (Figure 2). It lies between latitudes $1^{0}14'0''S$ and $1^{0}18'0''S$ and longitudes $36^{0}56'0''E$ and $37^{0}6'0''$ E. It borders the following sub-counties: Thika to the north, Kangundo to the East, Kathiani to south and Njiru location in the west. Ruai has two administrative units (formerly referred to as sub-locations); Ruai and Ngundu and is connected to city centre through Kangundo, Outering and Jogoo roads (Sigoria, 2012). The Ruai administrative unit (hereafter referred to as sub-ward) covers an area of 49.0 sq. kilometres with a population density of 540, a total population of 26,448 and 7316 households (Kenya National Bureau of Statistics (KNBS), 2009).

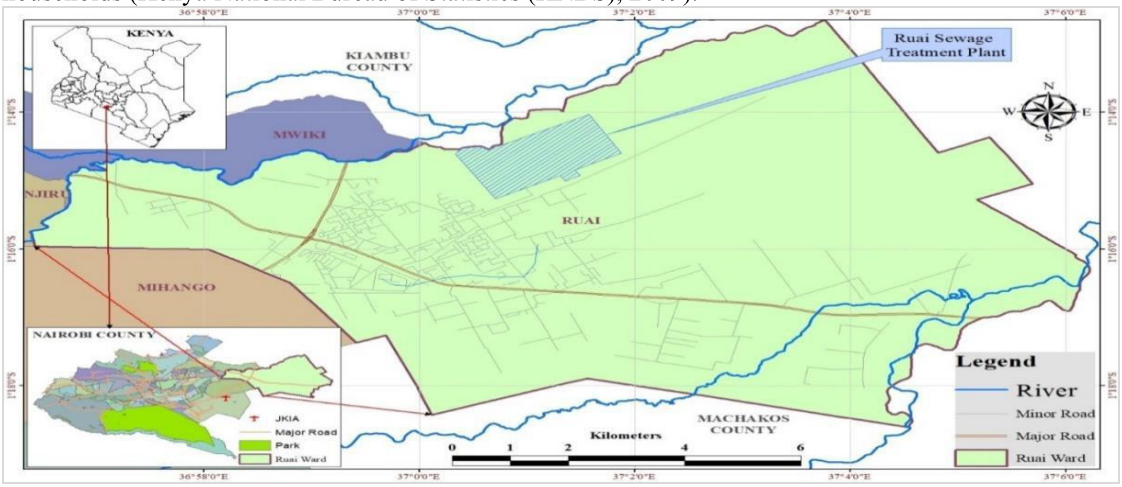

Figure 2: Map of the Study Area [Ruai Ward, Nairobi County]
Source: Researcher/Author*.

2.2 Research Design

The study was both a descriptive and a predictive research in design and adopted a cross-sectional and correlational methods which as stipulated by Privitera, (2014), are often applied together. A cross-sectional survey is most commonly used in social sciences and best suited to studies aimed at finding out the prevalence of a phenomenon, situation, problem, attitude or issue (Kumar, 2011).

2.3 Data collection

A survey was carried out to collect social data on the livelihood assets: human, natural, physical financial and social assets among the household respondents, for establishing their association with the adoption of TWW use as described in Curtis, *et al*., 2016; Kumar (2011); Polland (2005). The specific method for primary data collection was the administration of semi-structured questionnaires. Photography and observations were also used to capture the reality on the ground and for triangulation purposes as stated in Gay, Mills, & Airasian, (2012).

2.4 Target Population

The target population for the study comprised households in seven estates (Table 1) that live within an approximately four (4) kilometres radius from the Ruai wastewater treatment plant where treated wastewater is produced and hence could be used economically as observed by UN-WWAP (2017). The total number of households in these estates was 3261 (Kenya National Bureau of Statistics [KNBS], (2009).

2.5 Sampling Procedure and the Sample Size

The targeted population was stratified into the seven estates as aforementioned where all the households in the strata became potential units of observation. The sample size of the households in each stratum was then worked out proportional to the total number of households in the stratum (Table 1). Then, from each stratum a simple random sampling was used to select the households from which the household heads or their representatives became the respondents. This is an easier and less costly method of sampling and can be conveniently used even in cases of large populations and would reduce bias (Kothari, 2004).

Based on the method described above, the study used a sample size of 360 households, worked out following the formula recommended in (Kothari, 2004) and Bartlett *et al.,* as cited in Taherdoost, (2017):

$n = \frac{Z^2.p.q.N}{e^2\,(N-1)+Z^2.p.q}$, For finite population (N).

Where: *N is the target population which is known, n is the desired sample size, of the study, Z is the statistical value corresponding to the level of confidence required of 95% (or 0.95) which is 1.96, P is the proportion of the target population estimated to have the characteristic being measured. According to Mugenda and Mugenda (2003), "if there is no estimate available of the proportion in the target population assumed to have the characteristics of interest, 50% should be used". This results in the maximization of variance and produce the maximum sample size as described in Bartlett et al., (2001) and as cited in Taherdoost (2017), q = 1- p, and* e^2 *is the level of significance set (for this study, it is 0.05 level).*

Thus, the study sample size was calculated as:

n = $[(1.96)^2$. * 0.5*0.5*3261] / $[(0.05)^2(3261-1) + (1.96)^2$. * 0.5*0.5 = 344.

A higher sample size of 360 was considered to cater for non-responses which is an approach used in other similar social studies (Maina, *et al*., 2020) One individual in each household was selected as the respondent.

Table 1: Households size and samples in the selected estates

S/no	Estate / Stratum	Total number of households*	Proportion (%)	Sample size
1	Kamunyonge	504	0.15	56
2	Gituamba	667	0.20	74
3	Katworo	359	0.11	40
4	Sewage IDP/Sewage	606	0.19	67
5	Bondeni	687	0.21	75
6	Dan Bull	247	0.08	27
7	Bypass	191	0.06	21
	Total	3261	1.00	360

Note. *[Source: Adapted from Kenya National Bureau of Statistics, 2009 Census]

2.6. Data Analysis

Both descriptive and correlational analyses were conducted on the data collected using both the Ms Excel and the SPSS (IBM SPSS Statistics for Windows, Version 20.0) software. The inferential statistical tests were conducted at a 0.05 level of significance. Specifically, Pearson's Chi-square test of independence and Cramer's V coefficient were used to estimate any association and its interpretation & strength respectively between households' adoption (using) the treated wastewater and their associated assets for carrying out their livelihood activities, using contingency tables, as recommended by McHugh, (2013); Kothari (2004). According to McHugh, (2013), the Chi-square test of independence, a non-parametric test, is one of the most useful statistics for testing hypotheses when the variables are nominal. The study's variables; livelihood assets were also nominal. The test of independence assesses whether an association exists between the two nominal (categorical) variables by comparing the observed pattern of responses in the cells to the pattern that would be expected if the variables were truly independent of each other using a contingency table as described in Shapiro, (2015) and McHugh, (2013). The Chi-square can provide information not only on the significance of any observed differences, but also provides detailed information on exactly which categories account for any differences found rendering it one of the most useful tools in the researcher's array of available analysis tools (McHugh, 2013).

On the other hand, the Cramer's V which is a form of a correlation and is interpreted exactly the same, is the most commonly used strength test for the Chi-square (ibid), see Table 2.

Table 2: How to Interpret Measures of Association

Measure of association (V)	**Qualitative interpretation**
$0 \leq V < 0.10$	Very Weak
$0.10 \leq V < 0.20$	Weak
$0.20 \leq V < 0.30$	Moderate
$V \geq 0.30$	Strong

Source: Marchant-Shapiro, (2015)

3.0 Results, Interpretation and Discussions

3.1 Response on adoption of TWW in Ruai.

A total of 354 out of 360 households (98.3% response rate) responded and provided the data for the subsequent analysis. From this 35.6%, (n=126) households had adopted the use of TWW for their livelihoods (adopter

households) while 64.4% (n=228) households had not adopted (non-adopter households), see Figure 3. A household was considered an adopter if they use wastewater now or at any other particular time in the past for their livelihood activities.

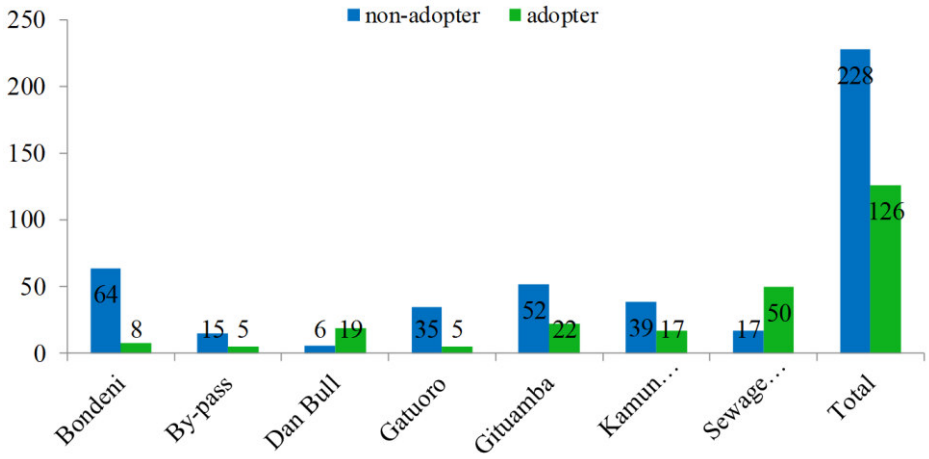

Figure 3: Respondents' status of adoption of wastewater for livelihood in Ruai.

3.2 Demographic Characteristics of The Households

Table 3 shows the demography of the household respondents and their adoption statuses. There are slightly more males than females aged between 18 and 82 years, a modal age bracket of 31-40 years. More males (42%) than females (28%) have adopted the use of TWW which could be attributed to the fact that men are having a wider variety of opportunities than women for possible uses of TWW over and above farming, such as building, car wash. Most of the adopters are aged between 41 and 50 years old (44%) followed closely by the age bracket of 51-60 years old. This could be because, hypothetically, this is the age at which most people are a lot more productive and busier in their careers (Maina, *et al*., 2020). The extreme age groups (both young and old) are non-adopters, could be because the young ones are already exploring more options of livelihoods with the older folks having lessened their parental obligations (ibid).

Table 3: Demographic factors of Household Respondents and their Adoption Status

		Adoption		
Demographic factor (Variable)		**no**	**yes**	**Total**
Gender	Female	115	44	159
	Male	113	82	195
Marital Status	not yet married	30	9	39
	Married	172	98	270
	Separated	14	15	29
	Divorced	2	2	4
	single mother /never married	6	2	8
	No response			4
Age bracket	≤ 20	1	1	2
	21-30	60	21	81
	31-40	66	37	103
	41-50	50	39	89
	51-60	30	19	49
	61-70	19	7	26
	71≤	2	2	4
Highest	primary school	73	58	131
Education level	secondary / high school	78	49	127
	Tertiary	48	10	58
	University	17	2	19
	Other	12	7	19
Occupancy	Owner	123	62	185
	Tenant	84	52	136
	Other	15	11	26
	no response	6	1	7
Main	Formal / salaried employment	38	6	44

Demographic factor (Variable)		Adoption		Total
		no	yes	
Occupation	Farmer	45	59	104
	Business	60	16	76
	Transport	16	4	20
	casual labour	35	20	55
	grocery vendor	7	4	11
	construction / masonry / carpenter / mechanic	25	14	39
	Any other	2	3	5

Note. Values are expressed as the number of cases (*n*).

In terms of marital status, out of 354 respondents, (11.0%) were not yet married, (76.3%) were married, (8.2%) separated, (1.1%) divorced and 8 (2.3%) single mother. More of the separated and divorced respondents are adopters (52% and 50% respectively) than non-adopters in the same marital status. This could be attributed to the fact that they single-handily fend for their households and have independence in making decisions. Cumulatively, they could also be having fewer livelihood options than their married counterparts as noted in Maina, *et al*., 2020.

Their highest formal education levels decreased from the lowest level - primary school (37.0%) to the highest level - university (5.4%). This indicates that there is generally low higher education (tertiary level and above) in the area. As the level of formal education rises, the adoption of TWW use reduces. The level of education is known to influence the level of knowledge, attitude and perception (Njagi, 2013) which might have contributed to low adoption status on the ground.

Most of the respondents were landowners (52.3%), tenants, and (38.4%) while others, (7.3%), either living in their parents' compounds but fending for themselves or just caretaker of the absentee owners. Their adoption statuses are more or less the same.

The respondents in Ruai engage in various occupations with the majority doing farming as their main occupation (29%), which also recorded the highest percentage of adopters (57%) with the lowest percentage of adopters coming from formal employment (14 %). This is consistent with findings in other studies which noted that more urban households engaged in agricultural activities (Scheierling *et al*., 2010) and are in most cases unemployed (Kihila, *et al.,* 2014).

3.3 Association between the Respondents' Human Capitals and Adoption of TWW

Results of chi-square test of independence (Table 4) show significant relationships (p <.05) between respondent's knowledge on the beneficial use of wastewater, experience in using wastewater, possession of necessary skills, availability of human labour whenever needed and adoption of TWW among the households.

Prior experience and possession of skills on waste water use had strong positive relationship with adoption of the TWW. On the other hand, there was no significant relationship (p > .05) between respondent's ability to work by themselves and possession of good health and the adoption of TWW in Ruai.

Table 4: Association between Human Capitals and Adoption of TWW Use in Ruai

Human capital	χ2	df	*p*-value	Cramer's *V*	Strength of association [c]
Knowhow	24.92	1	0.000	0.27	weak positive
Experience	336.88	1	0.000	0.98	strong positive
Ability	.40	1	0.527	0.03	very weak positive
Good health	.013	1	0.909	0.01	very weak positive
Skills	210.78	1	0.000	0.77	Strong positive
Human labour	18.411	1	0.000	0.228	weak positive

Note. [c] Marchant- Shapiro (2015). Significant at $p \leq .05$

3.4 Association between the Respondents' Natural Capitals and Adoption of TWW

The study was conducted on two natural capitals of interest (land and water) in relation to the adoption of TWW use for livelihoods among the respondents, as shown in Figure 4. Availability and accessibility of the TWW and the reserve land along Nairobi River (adjacent the wastewater treatment plant) serves as key natural assets for the adoption of TWW among the respondents, which corroborated with the fact that majority of the respondents (96%, n=341) perceived the wastewater as a valuable resource for livelihoods.

As figure 4 shows, the availability and accessibility of land reserve or other (communal, squatter) lands greatly incentives the adoption of wastewater among the respondents. Possession of self-owned land does not

necessarily result in the adoption of TWW use for livelihoods. Most respondents who don't use land as a resource for their livelihoods are non-adopters of TWW use in Ruai. Perhaps, this could indicate a lost opportunity for livelihoods by the households in Ruai as land is the most important resource in Kenya, from which the country generates goods and services for the people, especially where water (including potential usable wastewater) is available (Kenya Land Alliance, nd).

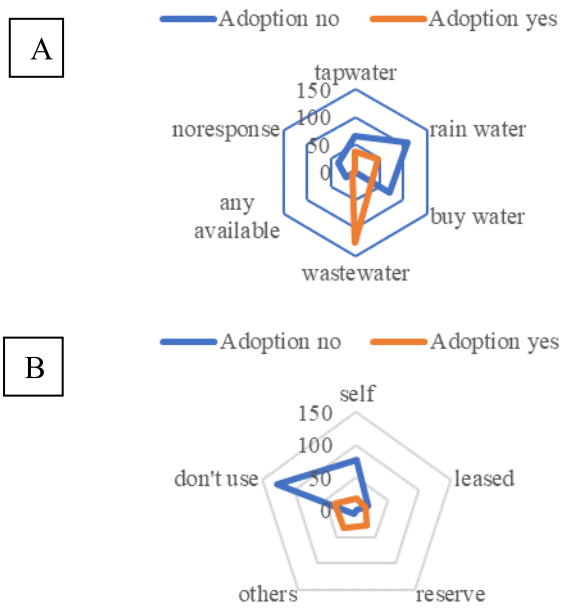

Figure 4: Natural Capitals, A (water) and B (land) and the Adoption of TWW Use

The results further show that water as a natural capital is generally a scarce commodity among the respondents, despite their varied sources, most of which are available to about one-third or less of the households. This confirms the observations made in Kaluli *et al.,* (2011), that like the rest of Nairobi County, Ruai relies heavily on Nairobi City Water and Sewerage Company for its freshwater supplies, which besides being insufficient, it is meant to be used for domestic purposes only. Thus, wastewater becomes a reliable alternative source of water for use especially in non-portable uses in the locality, as averred in (Mahjoub, *et al.,* 2016). Most of the respondents to whom other sources of water (rain, tap, boreholes, and water-vendors) are accessible for livelihood activities are non-adopters of TWW use.

Results in table 5 show a significant positive relationship ($p \leq .05$) between respondent's land ownership (except leased) and adoption of TWW in Ruai. The availability of reserve and other (communal, idle, squatter) lands had a strong association with the adoption of the wastewater in Ruai. Respondents not using land per se but instead providing off-farm services such as casual labour, transport and market/vegetable vending had a moderate association with the adoption. However, there was no significant relationship ($p >.05$) between respondent's type of water accessible for their livelihoods and the adoption of TWW in Ruai. Wastewater availability provided an almost perfect association with its adoption.

Table 5: Association between land &water and adoption of TWW use in Ruai

Natural Asset		**χ2**	**df**	***p*-value**	**Cramer's V**	**interpretation** [c]
Land	Self	14.35	1	.000	.20	weak
	leased	1.19	1	.275	.06	very weak
	Reserve	52.89	1	.000	.39	strong
	Other	45.32	1	.000	.36	strong
	Don't use land	26.20	1	.000	.27	moderate
Water	Tap water	.057	1	.811	.01	very weak
	Rain	3.34	1	.068	.10	very weak
	Vendor	.56	1	.456	.04	very weak
	Wastewater	354.0	1	.000	1.00	perfect
	Any available	2.45	1	.118	.08	very weak

Note. [c] Marchant- Shapiro (2015). Significant at $p \leq .05$

3.5 Association between the Respondents' Physical Capitals and Adoption of TWW

Figure 5 presents the current physical capitals among the households in relation to the adoption of TWW use. Common physical inputs for livelihoods purposes available among the respondents include livestock (cows, goats, sheep, and poultry) and farming tools and equipment. There are minimal storage facilities and extension services available among the respondents. More respondents with an access to requisite farming inputs including seeds, pesticides than those without them are adopters of use TWW in Ruai.

Results in table 6 show a significant relationship (p <.05) between respondent's accessibility to tools and equipment [$\chi 2$ (1) = 7.9, p = .005] as well as input for production [$\chi 2$ (1) = 30.24, p < .05] and adoption of TWW in Ruai. Although, livestock systems which offer significant opportunities for improving the livelihoods of poor people (Herrero, Thornton, Gerber, and Reid, 2009) and are a popular asset in Kenya and a major contributor to household livelihoods, both in terms of income as well as food (Gikonyo and Felis, 2018), they have no significant association with the adoption of wastewater in Ruai. Generally, there is weak positive association between the physical assets in the study and the adoption of TWW among the respondents in Ruai.

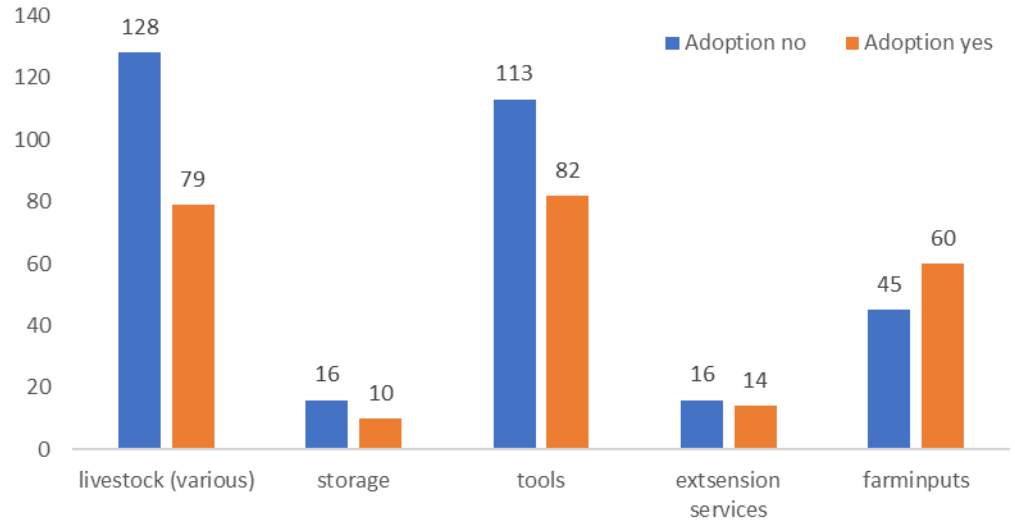

Figure 5: Physical Capitals and Adoption of TWW

Table 6: Association between physical capital and adoption of TWW use in Ruai

Physical capital	**$\chi 2$**	**df**	***P* Value**	**Cramer's V**	**Qualitative interpretation [c]**
Livestock	1.810	1	0.179	0.07	very weak
Storage	.101	1	0.751	0.02	very weak
Tools	7.899	1	0.005	0.15	weak
Extension services	1.753	1	0.185	0.07	very weak
Farm inputs	30.24	1	0.000	0.29	moderate

Note. [c] Marchant- Shapiro (2015). Significant at $p \leq .05$

3.6 Association between the Respondents' Social Capitals and Adoption of TWW Use

Figure 6 presents the social capitals in the study among the households in relation to the adoption of TWW use. Key among them includes social networking (n=323) which involved social networks with friends, relatives, and neighbours, with whom they have social relations on crucial matters goods and services pertaining to wastewater use (such as availability of farm inputs, labour and market) and who can help them when they are in need (Mega, 2018), general security (n=303) which include peaceful environment to work in devoid of conflicts and non-discrimination on whatever basis (n=315). However, there is minimal common rules and participation in collective decision-making processes among the respondents.

However, as results in table 7 show, most of the social assets were statistically insignificant (p> .05) in the adoption of TWW use among the respondents. There was a significantly moderate relationship [$\chi 2$ (1) = 15.32, p ≤ .05] between respondents' social networks, and adoption of TWW in Ruai. All the other social assets as aforementioned also showed weak association with adoption of TWW use among respondents.

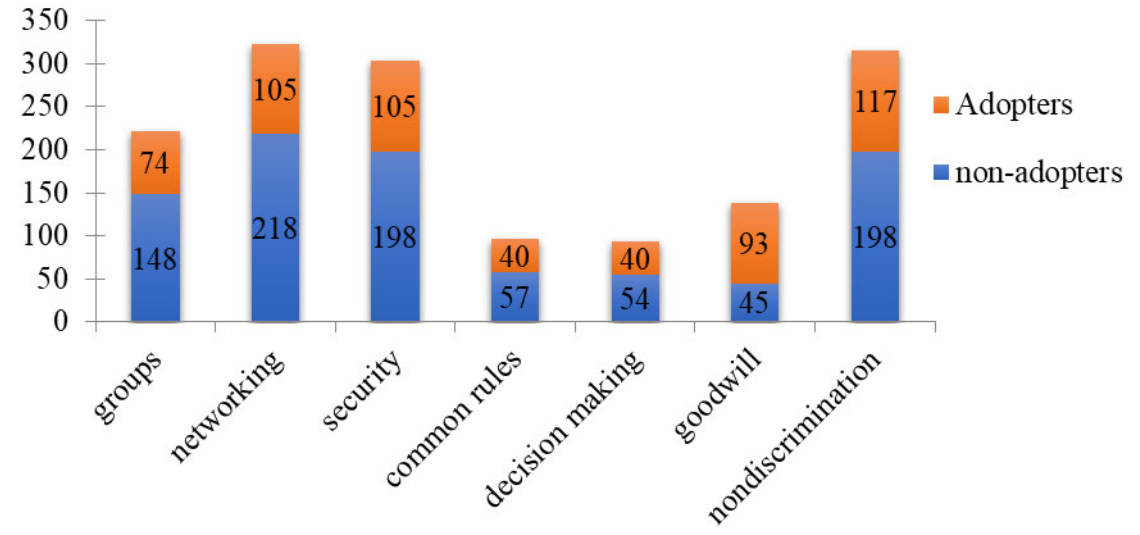

Figure 6: Social Capitals and Adoption of TWW Use

Table 7: Association between Social Capitals and Adoption of TWW Use in Ruai

Social asset	**χ2**	**df**	***p* value**	**Cramer's V**	**Qualitative interpretation [c]**
Group	1.33	1	.249	.06	very weak
Social networks	15.32	1	.000	.21	moderate
Security	.81	1	.368	.05	very weak
Common rules	1.86	1	.173	.07	very weak
Decision making	2.70	1	1.000	.09	very weak
Goodwill	3.0	1	.084	.09	very weak
Non-discrimination	99.75	1	.000	.53	very weak

Note. [c] Marchant- Shapiro (2015). Significant at $p \leq .05$

3.7 Association between the Respondents' Financial Capitals and Adoption of TWW

Figure 7 presents the financial capitals in the study among the households in relation to the adoption of TWW use. Most of the respondents (n=250) indicated as obtaining income from non-farm activities such as business, and formal employment inter alia. Other notable income comes from crops production (n=155 responses) most of which is associated with adoption of TWW use.

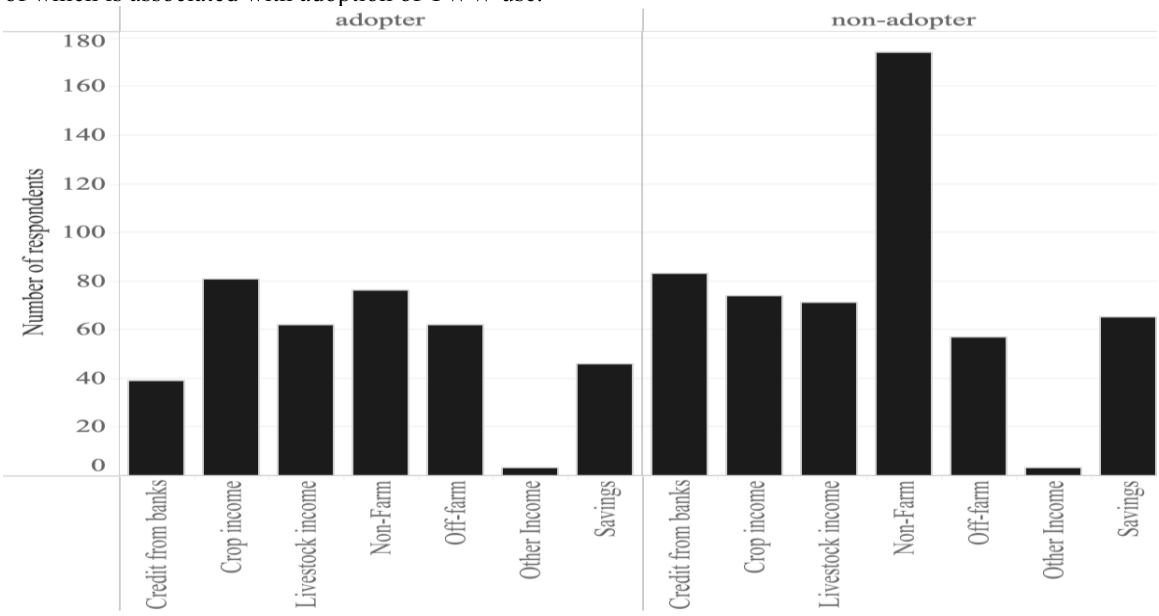

Figure 7: Financial Capitals and Adoption of TWW Use

Table 8: Association between Financial capitals and adoption of TWW use in Ruai

Financial capital	$\chi 2$	df	p-value	Cramer's V	Interpretation [c]
Credit from banks	1.07	1	.301	.06	very weak
Income from crop	33.40	1	.000	.31	strong
Income from livestock	11.29	1	.001	.18	weak
Off-farm	21.31	1	.000	.25	moderate
Non-farm	10.01	1	.002	.17	weak
Savings	2.41	1	.120	.08	very weak
Remittances	1.48	1	.224	.07	very weak
Pension	.37	1	.545	.03	very weak
Other income	.55	1	.456	.04	very weak

Note. [c] Marchant- Shapiro (2015). Significant at $p \leq .05$

Statistically, results in table 8 show a strong and moderate significant relationship ($p \leq .05$) between respondent's income from on-farm (crops and livestock), and off-farm (labour, transport storage in relation to agricultural activities) respectively one hand and a weak one with non-farm (done outside agriculture such as teaching, hospitality), and adoption of TWW in Ruai. On the other hand, there was no significant association ($p > .05$) between respondent's accessibility to credit facilities, savings, pension and the adoption of TWW in Ruai.

This could mean that, generally, the households in Ruai do not take or rarely consider taking financial credits from banks for helping in the adoption of TWW in their neighborhood. Hence, the income obtained from on-farm and off-farm activities as aforementioned could be the enabling financial asset for their continued use of the TWW in Ruai. There is also evidence of livelihood diversification, where some households adopting use of the TWW engage in both on-farm, off-farm and non-farm activities, ostensibly for generating additional income and spreading risk as noted in Sekumade and Osundare, (2014).

4.0 Conclusions and Recommendations

The study findings show remarkable evidence for statistically significant associations between some livelihood assets and adoption of the treated wastewater by the community members in Ruai. Wastewater as an asset, peoples' experience and skills its use, availability of reserve and other (communal, idle, squatter) lands adjacent the wastewater treatment plant as capitals have strong positive relationship with the adoption of the wastewater in Ruai. Group networking among friends, relatives and other users of wastewater in Ruai is also a significant social asset in the adoption of TWW use in Ruai. It's also notable that non-use or lack of access to assets such as agricultural land could have denied many willing respondents (n=288) an opportunity for reusing the treated wastewater to secure their livelihoods, as described (Ibrahim, *et.al*., 2017; Geiser, Bottazzi, Epprecht, Fokou, Fritschi, Ramakumar, Shahbaz, Steimann, and Strasser, 2011).

The study recommends the use of the findings to inform formulation of an appropriate policy on management of treated waste water ecosystem in Ruai that integrate possible re-use scheme by the community members by leveraging their livelihoods assets, particularly, the aforementioned assets/capitals. The findings can also be used as a reference in the creation of awareness to the community members among other audience on the potential of adoption of treated wastewater by use of their available livelihood assets for their enhanced and diversified livelihood outcomes. Additionally, the findings reveal a need for further study to find out why people with livelihood assets viable for deriving livelihoods have not been inspired to adopt the use of TWW in Ruai.

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