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Impact of Sewage on Health, Economic and Social Life of Rural People in Al-Hair - Kingdom of Saudi Arabia

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ABSTRACT

This paper aimed to evaluate the health, social and economic effects of sewage on rural people's life in Al-Hair, Saudi Arabia. A total of 90 rural people, representing about 1% of the population of the study area, were interviewed using a questionnaire. Percentages, arithmetic means, and standard deviations were calculated. The study revealed that 26.7% of the respondents had expressed a high degree of health impact from sewage and high social and economic effect with the percentages of 85.6% and 84.4% respectively. The interrelation between the perception of the diverse effects of sewage and people's personal characteristics indicate that age, gender, household size and education level, are key determinants of rural people' perception on health, social and economic-related risks due to sewage. Therefore, there is need to sensitize rural people about risk-reduction measures of sewage. Additional research is required to suggest intervention framework for dealing with sewage in the study area with collaboration from different stakeholders. This will provide additional information to decision-makers for policy formulation in sewage treatment by considering the adverse effects on people's life and different potential roles from all partners.

1. Introduction

The Kingdom of Saudi Arabia (KSA) is situated in the southernmost part of western Asia. The area of the Kingdom is about 2,250,000 km^2 which occupies 80% of the Arabian Peninsula (Al-Rushaid, 2010). The Kingdom's economy is one of the largest in the Middle East and North Africa, indicating 25% of the region's Gross Domestic products (GDP) and ranking among the top 20 largest economies of the world. The mean real GDP growth of the Kingdom averaged 4% per annum over the past decade. During this period, the government invested US$454 billion in capital projects including infrastructure, education, and healthcare (Public Statement Copy, 2017).

Water is an important natural resource for the survival of all the living things comprising human, production of food and economic development. Globally, there are many cities that are faced with the severe shortage of water. Environmental and economic growth and all other developments are highly affected by water availability and the quality of surface and ground-water. The quality of water is influenced by human activities, and hence water pollution is a major threat to the welfare of both the world and its population (Halder and Islam, 2015).

Sewage is running waste water that is discharged from houses, shops, and factories which are generally transported in small liquid form with some small solid in big pipes known as sewers. The sewage waste water (SWW) might also be directed to a particular pace for recycling or be disposed-of far away from humans as it can cause diseases (FAO, 1992). Sewage is a mixture of nutrients, suspended solids, pathogens and different pollutants that have a dissimilar effect on the environment and human health (Ladan, 2014). Disposal of sewage is considered as the main issue of the urban world because of increase in human populace, urbanization, and industrialization. According to United Nations Educational, Scientific and Cultural Organization (UNESCO), waste water generation is enhancing with a rapid speed globally due to increase in population and urbanization. A large portion of Asian and African people have no access to waste water management and treatment services. A large volume of sewage waste water is put openly into the water resources that threaten the human health, environment, food security and sustainability of water resources (Zandarya, 2011).

Due to the increase in water demand, there are focusing on water quality because 95% of the water comes from inland rivers. The sufficient sewage system played a vital role in the reduction of water pollution.

Therefore, they are not focusing only water quality, but also on economic development through industries (Muyibi et al., 2008). The cohesion of sewage issues in coastal areas of the globe is important because 60% human population has occupied these areas. As a result, home and industrial sewages are major threats to the coastal areas globally (Manzoor et al., 2011). Leakage of untreated sewage moreover has a negative impact on the environment e.g. in 2008; media reported that in KwaZulu-Natal South Africa, a lot of sewage wastes were being discharged into the Durban harbor killing a large population of fish and threatening marine ecosystem (The Mercury, 2008).

Recycling of sewage sludge treatment showed an environmental and economic impact by dewatering, sludge melting, composting, drying, landfilling and application in agriculture (Hong et al., 2009). The assessment of water and waste-water is very important to protect the health of the public and the surroundings. Data on fresh and marine water quality in the Kingdom are still inadequate and uncoordinated. Thus, checking these constraints is crucial for the safeness judgment of the surroundings/environment and human-health. Environment and water polluted by sewage cause some diseases in human, and this can also affect the present shorter life of the humans in developing countries as matched with the developed countries (WHO, 2002; Al-Sefry, 2006).

The industry of sewage sludge is evolving, and some developments that extract more energy from sludge are either being implemented or are nearing full-scale demonstration (Mills, 2014). The Anaerobic Digestion (AD) method is used for sludge treatment, by which pathogen killed for the recycling of soil promoted by the European Union though Sewage Sludge Directive 86/274/EEC". The method has also played a significant role in the production of methane by sewage sludge which could be used as a fuel (Appels et al., 2008). The production of bio-oil from sewage sludge by Pyrolysis process contributed economic values, but also eliminates the pollutants from sewage sludge. The Pyrolysis process is limited in a full-scale implementation of the technology (Kim and Parker, 2008).

Kingdom of Saudi Arabia gathers and treats about 672 million cubic meters of waste-water daily and re-uses less than 20% of this volume (Al-Musallam, 2006). Even though some 30 main sewage amenities in the year 1999 with the secondary, tertiary and modern level of treatment and overall design capability of 1,426,000 m^3/day, a substantial encounter starts to happen in the low total sewerage rate of 37% (Qadir et al., 2010). The National Water Company (NWC) mentioned that it would spend $23 billion on the Kingdom's sewage gathering and treatment frame/infrastructure for the afterward years and targets to enhance waste-water network treatment up-to 100% through the Public Private Partnerships (PPP). As a result, the Kingdom is expected to grow into third largest water re-use market globally after America and China (Saudi Gazette, 2010).

In Hail area of Saudi Arabia, the microbial groups were detected in the drinking water, caused by the mixing of ground and sewage water (Suliman, 2015). In the Gulf countries, the coastal pollution is a major problem. It has been concluded that the insufficient sewerage system is one of the major causes, deteriorating the coastal and marine environment (Sheppard et al., 2010). The domestic water discharge contains high suspended solids, heavy metals, ammonia, nitrates, phosphates (Naser, 2011), resulting serious impacts on the environment and ultimately affecting human food and health (Singh et al., 2004).

A huge volume of literature on sewage treatment indicates that improper management of sewage poses adverse effects on social, health, economic life, and causes environmental protection issues like air, river, and stream pollution. No significant study on the negatives impacts caused by the sewage has made in the remote areas like Al-Hair. Hence, this study is an effort to assess the impact of sewage on the social, economic and social life of rural people in Al-Hair town, Saudi Arabia.

2. Materials and Methods

The present study was undertaken in Al-Hair area, located in the south of Riyadh city with the distance of 45 km, Riyadh region, Saudi Arabia. As of the 2010 census, it had a population of 13,473 people (General Authority of Statistics, 2012). The location of the study area is presented in the Fig 1.

The data analysis process included reviewing and coding, and data tabulation processes. Some statistical methods were employed by using SPSS 22 to analyze results. Frequency, percentages, arithmetic means, and standard deviations were used to describe the different variables. Moreover, spearman correlation was measured to estimate the significance of relationship between personal characteristics of the respondents, and their perception to different impacts resulted from sewage.

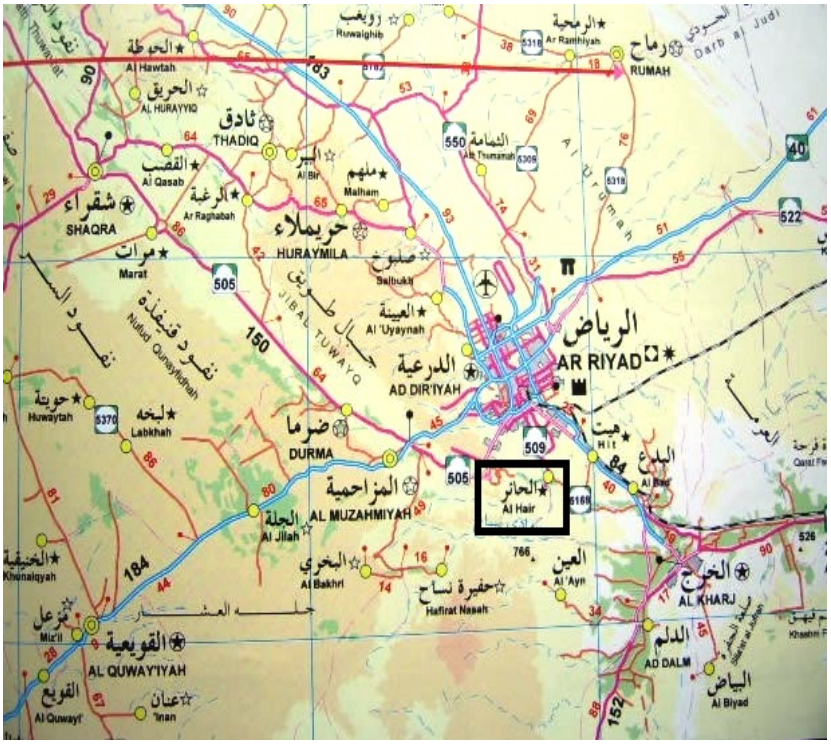

Fig. 1- Location of the study area (Ar-Riyadh Capital of Saudi Arabia)

3. Results and Discussion

3.1. Demographic Characteristics

Respondents' demographic characteristics are presented in Table 1. Slightly more than half of the respondents (51.1%) aged from 30 to 50 years. More than one-fifth (21.1%) were more than 50 years of age. The study referred that 61.1% of the sample were male, while the rest were female. The overwhelming majority of the respondents (88.9%) were Saudi citizens. More than one-half (54.4%) had Bachelor degrees, 15.6% had completed secondary school, and 12.2% of respondents were found to be illiterate. More than one-half (58.9%) had large families (>8 members), while more than one-quarter (28.9%) had small families (3-5 members).

Table 1- Demographic characteristics of respondents

Characteristics	***Frequency***	***Percentage***
Age		
< 30	25	27.8
30-50	46	51.1
> 50	19	21.1
Gender		
Male	55	61.1
Female	35	38.9
Nationality		
Saudis	80	88.9
Non-Saudis	10	11.1
Educational Status		
Illiterate	11	12.2
Read and write	10	11.1
Basic Education	6	6.7
Secondary School	14	15.6
University	49	54.4
Family size		
3-5	26	28.9
6-8	11	12.2
>8	53	58.9

3.2. Health, economic and social impact of sewage

Respondents expressed their opinions to the different aspects of sewage as shown in Table 2. Chest diseases were ranked first of health impacts had been suffered from sewage with an average mean of 2.51 and SD of 0.86. The statement "Trees around sewage became a place for criminals" was ranked first among the social impact statements with the mean of 2.87 and SD of 0.46. The economic impacts were ranged between minium for the statement of "Sewage made a real estate cheaper" (Mean 2.72; SD: 0.67) and maximum for the statement of "Flies from sewage transfer diseases to cattle" (Mean 2.98; SD: 0.1). Sewage has the moderate adverse effects on people's health (Mean 1.9; SD: 0.93), and on the other hand has a high effect on both of social life (Mean 2.7; SD: 0.6) and economic situation (Mean 2.8; SD: 0.43).

Table 2- Health, social and economic impact of sewage

Statements	***Mean****	***S.D.***
Health impact		
One of the family has Hepatitis B or C	1.72	0.96
One of the family has yellow eyes	1.5	0.85
One of the family has chest diseases	2.51	0.86
One of the family has chronic Diarrhea	2.02	0.99
One of the family has Leishmaniosis on skin	2.02	0.99
Overall average	1.9	0.93
Social impact		
Sewage contributes to immigration from Al-Hair	2.68	0.68
Trees around sewage became a place for criminals	2.87	0.46
I feel shame to live in Al-Hair	2.72	0.68
Overall average	2.7	0.6
Economic impact		
Sewage push investors to out of the city	2.82	0.53
Sewage made a real estate cheaper	2.72	0.67
Flies from sewage transfer diseases to cattle	2.98	0.1
Sewage contributed in decreasing Agri. Marketing	2.86	0.42
Overall average	2.8	0.43

Yes (3), Unsure (2), No (1)

The distribution of the respondents according to numeric values that represent the degree of which they have suffered from the different impacts of sewage is presented in Table3. The results showed that the levels of health impact ranged between 5 and 15 degrees, 3-9 for social impact and 5-15 for economic impact. The study revealed that about 26.7% of the respondents had expressed a high degree of health impact; 25.6% had a low degree of impact, and 24.4% didn't suffer health impacts from sewage. Moreover, the vast majority of respondents indicated the high impact of sewage on social and economic aspects with the percentages of 85.6% and 84.4% respectively. This result ensures on the importance of establishing plants for sewage treatment to overcome the adverse effects. The findings of the study are in agreement with those of Minh and Nguyen-Viet (2011), as they also mentioned that an improved sanitation had reflected to have great impacts on people’s health and economy. In a similar vein, Hutton et al. (2007) maintained that water and sanitation improvements are cost-beneficial in terms of time savings associated with better access to water and sanitation services, contributing at least 80% to overall economic benefits.

The preceding results address the importance of understanding rural people knowledge and perceptions of risk associated sewage and risk-reduction measures for the development of mutually acceptable risk-management strategies. In cases where people are aware of different risks, they assess their social capital to work with others and with different governmental agencies to find out appropriate solutions.

Table 3- Classification of respondents depending on the impact of sewage

Categories	*Range*	*N*	*%*
Health impact			
High impact	5-15	24	26.7
Moderate impact		21	23.3
Low impact		23	25.6
No impact		22	24.4
Social impact			
High impact	3-9	77	85.6
Moderate impact		2	2.2
Low impact		6	6.7
No impact		5	5.6
Economic impact			
High impact	4-12	76	84.4
Moderate impact		5	5.6
Low impact		8	8.9
No impact		1	1.1

3.3. Interrelation between health, social and economic impacts

The perceptions of the respondents toward health, social and economic impacts of sewage on Al-Hair area are illustrated in Table 4.

Table 4- Status of respondents' perceptions regarding health, social and economic impacts and their characteristics

Situations	*Health Impact*				*Social impact*				*Economic impact*				*N*	*%*	*Main Characteristics*
	H	*M*	*L*	*N*	*H*	*M*	*L*	*N*	*H*	*M*	*L*	*N*			
1													6	6.7	- 83.3% < 30 years -100% male - 100% Saudis - 100% illiterate - 100% 3-5 family members
2													5	5.6	- 100% < 30 years -100% male - 100% Saudis - 100% illiterate - 100% 3-5 family member
3													2	2.2	- 100% < 30 years -100% male - 100% Saudis - 100% read and write - 100% 3-5 family members
4													9	10	- 100% < 30 years -100% male - 100% Saudis - 88.9% read and write - 100% 3-5 family members
5													21	23.3	- 85.7% 30-50 years -100% male - 100% Saudis - 66.7% secondary school - 52.4% 6-8 family members
6													14	15.5	- 100% 30- 50 years -85.7% male - 69.7% Saudis - 100% hold university degree - 100% > 8 family members
7													33	36.7	- 57.3% > 50 years -100% female - 69.7% Saudis - 100% hold university degree - 100% > 8 family members

N (No impact), L (Low), M (moderate), H (High)

Seven situations were developed regarding the different impacts of sewage from the view point of the respondents. The findings presented in Table 4 revealed that social and economic impacts remained dominant than health impacts in majority of the situations. It was noticed that people with higher education, large families, and females had greater awareness on the adverse effects of sewage rather than others. More than one-third (36.7%) respondents mentioned that the impacts of sewage on the health, social and economic aspects of life in Al-Hair area are high. The respondents with the perceptions of high influences of sewage could be described as females, holding the university degrees, family members > 8, older than 50 years (57.3%) and 69.7% are Saudis.

3.4. Respondents' perception of health, social and economic impacts and their characteristics

The relationship between respondents' perception of different hazards of sewage and their personal characteristics was measured using Spearman coefficient. As seen in the Table 5, there was a significant relationship at 0.01 level between respondents' perception to hazards of sewage and age, health, educational level, and family size. The findings of the study presented in Table 5 indicate when a person grows old ($r = 0.93^{**}$), he is more concerned about the impact of sewage on his health. The study shows the positive correlation with education ($r = 0.9^{**}$) that educated respondents are more health conscious. Similarly a person with the big family size is more concerned about the health of his off-springs (r = 0.95**) and the negative impact sewage can have on their health. It can be concluded that gender, family size, age and educational status are the key factors to influence on respondents' perception of health, social and economic impacts of sewage. The outcomes of our study are in line with the findings obtained by Ndunda and Mungatana (2013). They also indicated that age, gender, household size, education level, farming experience, credit access and income are key determinants of rural people perception of health-related risks due to sewage.

Table 5- Correlation between respondents' perception of health, social and economic impacts and their characteristics

Spearman's rho correlation	***Health***	***Social***	***Economic***
Age	0.93^{**}	0.66^{**}	0.61^{**}
Educational level	0.9^{**}	0.72^{**}	0.66^{**}
Family size	0.95^{**}	$.635^{**}$	0.57^{**}

** *Correlation is significant at the 0.01 level*

5. Conclusions and recommendations

This study was based on descriptive survey data. The data was collected from a randomly selected sample of 90 rural people in Al-Hair, Riyadh Province of Saudi Arabia in 2017. Sewage has direct and indirect effects in urban and peri-urban areas without treatment plants. However, inadequate sanitation infrastructure in the Al-Hair has resulted in extensive pollution, causing significant negative health, social and economic issues. Understanding the perceptions of the rural people about the adverse effects of sewage in both the urban and rural areas is vital in making policy recommendations to overcome the sewage risks. The preliminary analysis of survey data using means shows that people consider high social and economic effects from sewage on their lives. Some of the effects reported by rural people are: Sewage contributed to migration of locals from Al-Hair, trees around sewage provided a place to the criminals, flies from sewage transferred diseases to the cattle and the marketing of the agricultural products and commodities have significantly reduced. The interrelation between the perception of the diverse effects of sewage and people's personal characteristics indicate that age, gender, household size and education level, are key determinants of rural people' perception on health, social and economic-related risks due to sewage. Therefore, relevant policies are required to minimize the different hazards of sewage, keeping in view the socio-economic characteristics of the populations living near the sewage facilities. The study also establishes the need for the launching of the Extension and Education programs to create awareness on the adverse effects of sewage and strategies to reduce their harmful effects. Additional research is required to suggest intervention framework for dealing with sewage by involving all stakeholders in the management of sewage to ensure sustainable development.

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