Utilization and Effects of Sewerage Water for Vegetable Production among Vegetable Growers in Peri-Urban Areas of Lahore, Punjab, Pakistan

Shafiq Ur Rehman Zia[1*], Ijaz Ashraf[2], Gulfam Hassan[3], Salman Asghar[4], Muhammad Raza Ejaz[4] and Amer Habib[5]

1. Adjunct Lecturer, Sub-campus Burewala, University of Agriculture, Faisalabad.
2. Associate Professor, Insti. of Agri. Ext., Edu. & Rural Development, University of Agriculture, Faisalabad.
3. Assistant Professor, Insti. of Agri. Ext., Edu. & Rural Development, University of Agriculture, Faisalabad.
4. Ph.D. Scholar, Insti. of Agri. Ext., Edu. & Rural Development, University of Agriculture, Faisalabad.
5. Assistant Professor, Department of Plant Pathology, University of Agriculture, Faisalabad.

Abstract

We found the perception of vegetable growers regarding usage of sewerage water to meet irrigation application. The study was quantitative in nature. It was conducted in peri-urban areas of Lahore, Punjab, Pakistan. A sample of 360 vegetable growers (180 registered vegetable growers and 180 non-registered vegetable growers) were interviewed. Data were analyzed by Statistical Package for Social Sciences (SPSS). The obtained results were categorized into two sections. In the first section, the demographic characteristics were stated. Second section consist of perception of respondents regarding usage and harmful effects of sewerage water. The descriptive statistical analysis was used to find age, education, land size and income sources of vegetable growers. The ranking of respondents was done based on mean value and score to meet the objective of study. The findings show that only 17.2% of non-registered and 14.4% of registered growers were coming from age group of 61-70 years respectively. The registered vegetable growers are more in knowledge instead of non-registered growers. At the end, the study stated recommendations for the research, extension, and vegetable growers to enhance training needs assessment of vegetable growers and persuade to neglect perception of sewerage water usage as for irrigation application.

Key Words: Sewerage water, Training needs assessment, Descriptive Statistics,

Introduction:

The livelihoods of the population directly or indirectly based on agriculture which is the largest sector of Pakistan's economy (Govt. of Pakistan, 2019).

In densely populated countries, human health has long been a key concern. Ground water resources are depleted because of heavy industrialization. As a result, wastewater is the most cost-effective way to irrigate land. Electric power generation is a challenge in developing countries, and Pakistan is like other developing countries also experiencing high electricity prices, forcing agriculture farmers to use wastewater for irrigation. There are certain typical irrigation practices that are utilized individually and in some locations in collaboration to meet

the need for irrigation water. The use of sewage water for irrigation is causing concern among human's health (Alturiqi *et al*., 2020).

Hussain *et al.* (2021) conducted a study to determine the quality of meals delivered to humans. It is vital to analyze the quality of the irrigation system to obtain the desired results. All of Lahore's vegetables were seen being carried to local marketplaces from nearby cities and villages. The irrigation system for various vegetables varies, for example, some vegetables were irrigated with ground water via tubewells, while others were irrigated with surface water. River Ravi water is used to irrigate a significant portion of Lahore and Sheikhupura, and fields adjacent to villages and other housing complexes are watered with residential wastewater. Hudiara drain wastewater, on the other hand, is a source of irrigation that absorbs a large volume of industrial effluents. As, Cd, and Pb were found in these vegetables.

Vegetable crops may be either annuals, biennials, or perennials (Egyptian onions, garlic and horseradish). From a production standpoint, a vegetable crop may be defined as a high-value crop that is intensively managed and requires special care after harvest (Welbum, 2015). It is known that an intake of 400 g per day to prevent chronic diseases (especially heart diseases, cancers and diabetes) and supply needed micronutrients (especially calcium, iron, iodine, vitamin A and zinc) (WHO, 2015). Qadir *et al.* (2000) reported that peri-urban and urban area's land is got contaminated with dangerous substances of municipal and industrial sewerage water. It is opinion found that wastewater irrigation is done to enhance the production of food crops (vegetables) is considered it polluted in urban agricultural lands. Jarup (2003) found that the growing of vegetables on polluted land contain poisonous metallic element. The liver and kidney of human beings got effected by continuous intake of these type of vegetables. Milacic and Krali (2003) revealed that health risk associated with the consumption of vegetables accumulation of heavy metals in developing countries. Ensink *et al.* (2004) reported that usage of wastewater impends population health and is a major hazard to farmers and their families from intestinal parasites – most often worms. Farmers in Pakistan using wastewater are five times more likely to be infected by hookworms than canal water which causes anaemia and retardation in children. Mapanda *et al.* (2005) concluded that horticulture in urban and peri-urban areas is fully dependent on the wastewater irrigation and enriched soil with the accumulation of heavy metals that may pose potential health and environmental risks in the long term. Qadir *et al.* (2010) reported that as millions of small-scale farmers used the wastewater to irrigate edible crops which generated by different sources i.e. commercial, industrial, and domestic etc. The use of wastewater in peri-urban and urban areas is also recommend as productive use often

they have no alternative sources of irrigation water. However, the wastewater is composed of the undesirable constitutes which can harm human health and the environment. Jan *et al.* (2010) found vegetables got contaminate in Pakistan by using sewerage water and environmental abetment practice is almost missing due to the lack of environmental management and no specific law for environmental pollution under consideration. According to situation, changing perception of vegetable growers regarding usage of sewerage water is compulsory. It was observed during this research; (a) What are the perceptions of vegetable growers about sewerage usage (b) What are the responsible strategies to overcome this factor? (c) what are the factors that affected them in usage of sewerage water.

Materials and Methods:

The largest province of Pakistan in terms of agricultural production and the population is the Punjab. The southern, northern, and central are three zones of this province. The agricultural production of Pakistan is attributed Punjab province as top in comparison of other provinces. Keeping in view the resources and time, this research was conducted in peri-urban areas of Lahore, which is known as capital of this province. Simple random sampling technique was used to select the targeted sample size. The list of vegetable growers (Two categories= registered and non-registered) was got from the Office of Directorate of Agricultural Extension and Adoptive Research, Lahore. From each category, 180 respondents were selected purposively thereby making a sample of 360 respondents. A validated interview schedule containing close ended questions within usage of 5^{th} Linkert scale was prepared keeping in view the objectives of study. The reliability and validity of research tool was checked before the data collection. The interview schedule was pretested on 30 respondents, which were not of the selected sample size of this study. Furthermore, the content validity and face validity of research tool was also checked in consultation with faculty members and post graduate students of Institute of Agri. Extension, Education and Rural Development, University of Agriculture, Faisalabad. Reliability of interview schedule was checked by Cronbach's alpha which was 0.089. Statistical Package for Social Sciences was used for data analysis. Descriptive statistic was used for socio-economic factors. The "t-test" was used in comparison of knowledge level of these two categories.

Results and Discussion:

Results and discussion are consisted of two sections. First section is composed of an explanation of demographic attributes and perception of vegetable growers about usage of sewerage water and responsible factors are describes in second section.

Table No. 1 Distribution of respondents according to their age

Age (in years)	Non-Registered vegetable grower		Registered vegetable grower	
	f	*%*	*f*	*%*
30-40	35	19.4	78	43.3
41-50	75	41.7	57	31.7
51-60	39	21.7	19	10.6
61-70	31	17.2	26	14.4
Total	180	100.0	180	100.0

Table 1 reveals that less than one fifth (19.4%) of the respondents belonged to age group ranges from 30-40 years in non-registered vegetable growers while a good number (43.3%) of registered vegetable growers were of the same age group. The findings show that young age group of registered growers are more interested in vegetable cultivation. While 41.7 and 31.7% of the respondents were of the age group ranging from 41-50 years of non-registered and registered growers respectively. Only 17.2% of non-registered and 14.4% of registered growers were coming from age group of 61-70 years respectively. Similarly, our findings are in line with Hassan et al. (2017) indicate that a simple majority (52.4%) of farmers fell in age category of 36-50 years followed by 27.4% farmers who belonged to old age category (above 50 years).

Table No. 2 Distribution of respondents according to their education

Education	Non-Registered vegetable grower		Registered vegetable grower	
	F	*%*	*f*	*%*
Illiterate	56	31.1	30	16.7
Primary	29	16.1	36	20.0
Middle	47	26.1	31	17.2
Matric	34	18.9	50	27.8
Above Matric	14	7.8	33	18.3
Total	180	100.0	180	100.0

Table 2 indicates that among those who did not get education were 31.1% of non-registered while only 16.1% of belonged to registered vegetable growers. Data indicated that only 16.1% of non-registered and one-fifth (20.0%) of registered growers had primary education, whereas more than one-fourth 27.8% of registered growers were having matric education. It is found that registered vegetable growers were more educated than non-registered vegetable growers. Education is generally considered as important variable that could enhance farmers' attitude towards the adoption of new technologies (Agwu, 2004).

Table No. 3 Distribution of respondents according to their Landholding size

Land holdings	**Non-Registered vegetable grower**		**Registered vegetable grower**	
	f	***%***	***f***	***%***
1-10 acres	83	46.1	100	55.6
11-20 acres	60	33.3	57	31.7
21-30 acres	20	11.1	11	6.1
Above 30 acres	17	9.4	12	6.7
Total	180	100.0	180	100.0

Data in **Table 3** indicates that less than half (46.1%) of the non-registered respondents had land of (1-10acres) while a simple majority (55.6%) of registered respondents had same landholding size. A good number (31.7%) of registered vegetable growers and 33.3% of non-registered vegetable growers had land of 11-20 acres. Only 11.1% of non-registered vegetable growers and only few (6.1%) of registered vegetable growers had land of 21-30acres. It is found that non-registered vegetable growers have above 30 acres landholding size instead of registered vegetable growers.

. **Table No. 4 Distribution of the respondents according to their income source**

Income source	**Non-Registered vegetable grower**		**Registered vegetable grower**	
	f	***%***	***F***	***%***
Farming	168	93.3	142	78.9
Non-farming	12	6.7	38	21.1
Total	180	100.0	180	100.0

Data in **Table No. 4** depicted that farming was the major source of income for the registered and non-registered farmers followed by the other than farming professions as income sources as revealed by only few (6.7%) of non-registered and slightly greater than (21.1%) of registered respondents.

Table No. 5 Weighted score, mean, standard deviation and rank order of factors responsible for usage of sewerage water for vegetables production

Factor	Non-Registered vegetable grower				Registered vegetable grower				T-value	P-value
	WS	Mean	S.D.	Rank Order	WS	Mean	S.D.	Rank Order		
Unavailability of canal water	572	3.18	1.492	1	688	3.82	0.763	2	5.160	.000**
Highly cost of tube well water	564	3.13	1.451	3	687	3.82	0.758	4	5.600	.000**
Load Shedding	564	3.13	1.566	4	831	4.62	1.043	1	10.58	.000**
Cheap source of irrigation	556	3.09	1.576	5	686	3.81	0.817	5	5.458	.000**
Availability of this water at easy access	572	3.18	1.593	2	688	3.82	0.820	3	4.826	.000**
Use as compost source for soil	540	3.00	1.528	6	540	3.00	0.693	6	.000	1.000*

P > 0.05 = NS, P < 0.05 = Significant and P < 0.01 = Highly significant. NS = Non-significant
*** = Significant ** = Highly-Significant**

The data in **Table 5** depict the factors responsible for respondents (registered and non-registered) regarding usage of sewerage waster for vegetables production. The unavailability of canal water was ranked 1st among non-registered growers with weighted score of 572 and mean value of 3.18 tended towards medium category. Scot *et al.*, (2004) found that farmers in urban and peri-urban areas of all developing countries who need water for irrigation often have no other choice than to use of wastewater. Similarly, Huibers *et al*., (2004) found that urban areas of many developing countries, urban and peri urban agriculture depends, at least to some extent, on wastewater as a source of irrigation water. Whereas load shedding was highest ranked 1st factor with weighted score of 831 among registered vegetable growers and mean value of 4.62 slightly towards high but tended towards very high category. Another responsible factor for usage of sewerage water is most prominent is the unavailability of canal water among registered vegetable growers was ranked 2nd with mean value of 3.82 slightly heading towards medium but tending to high category with weighted score of 688. The following responsible factors i.e. unavailability of canal water, high cost of tube well water, load-shedding, cheap source of irrigation and availability of water at easy access of both vegetable categories showed

the highly signified value .000. The least ranked factor of both categories was use sewerage water as compost for soil with weighted score of 540 respectively. These findings reveal that rapid urbanization and growing wastewater volumes, wastewater is widely used as a low-cost alternative to conventional irrigation water and supports livelihoods and generates considerable value in urban and peri-urban agriculture despite the health and environmental risks associated with this practice (Qadir *et al.*, 2010). The use of sewerage-contaminated municipal water for irrigation of crops is an old practice in many big cities of Pakistan (Ullah *et al.*, 2011).

Table No.6 Weighted score, mean, standard deviation and rank order of health hazards of sewerage water

Health hazards	Non-Registered vegetable grower				Registered vegetable grower				T-value	P-value
	WS	Mean	S.D.	Rank Order	WS	Mean	S.D.	Rank Order		
Headache	458	2.54	1.388	5	523	2.91	0.649	5	-3.163	.002**
Fever	474	2.63	1.437	1	669	3.72	0.867	1	-8.659	.000**
Vomiting	466	2.59	1.578	2	524	2.91	0.742	2	-2.479	.014*
Malnutrition	442	2.46	1.435	8	521	2.89	0.705	7	-3.683	.000**
Gastrointestinal	458	2.54	1.380	6	523	2.91	0.666	6	-3.163	.002*
Kidney disease	450	2.50	1.384	7	378	2.10	0.661	8	3.498	.001**
Diarrhea	466	2.59	1.445	3	524	2.91	0.671	3	-2.714	.007*
Skin itching	466	2.59	1.490	4	524	2.91	0.719	4	-2.612	.009*
stomach ailments	415	2.31	1.278	9	368	2.04	0.577	10	2.499	.013**
heart problems	413	2.29	1.276	10	370	2.06	0.586	9	2.283	.023*

P > 0.05 = NS, P < 0.05 = Significant and P < 0.01 = Highly significant. NS = Non-significant
*** = Significant ** = Highly-Significant**

Data in **Table 6** show that different health hazards are determined by usage of sewerage water for irrigation in vegetable fields. The both categories i.e. registered and non-registered vegetable growers ranked fever 1st as most prominent health hazards for them within weighted score of 669 and 474 respectively. It is evident from the previous studies that vegetables grown by using sewerage water contain many heavy metals causing serious health hazards to the

community as well (Murtaza *et al.,* 2003). Another health hazards i.e. vomiting was ranked 2nd with the weighted score of of 466 by non-registered and mean value of 2.59 while registered vegetable growers ranked 2nd with weighted score of 524 and mean value of 2.91 tended to medium category. Health hazards regrading other features involved in using of sewerage water i.e. diarrhea, skin itching, headache, malnutrition and gastro-intestinal seemed with mean value ranging from 2.29 to 2.63 indicating effectiveness of low to medium levels by non-registered vegetable growers while mean value of registered vegetable growers about theses aspects ranging 2.06-2.89. Cholan *et al.,* (2013) depicted disabilities regarding usage of sewerage water associated with malnutrition and a high prevalence of upper gastro-intestinal cancer. Dunlop and Wang (1961) argued that the contaminated vegetables with sewerage water are consumed, they produce diarrhea and other health risks. The other related aspects like kidney damages, stomach ailments and heart problems were ranked 8th, 9th and 10th by non-registered vegetable growers. Gupta *et al.,* (2011) and Sharma *et al.,* (2006) concluded that the use of treated and untreated wastewater for irrigation had increased the contamination of Cd, Pb, and Ni in edible portion of vegetables causing potential health risk in the long term.

Conclusion and Recommendations: We examined the factors responsible for usage of sewerage water to irrigate the vegetables by vegetable growers. We concluded that vegetable growers had miserly demographic profile having low level of education, moderate farming experience and identification of low diversification in agriculture sector. The most abundant income source was found is farming by vegetable growers. Furthermore, vegetable growers were not in good position to compete with factors and harmful effects of sewerage water.

Vegetable growers were known to harmful effects being caused by sewerage water i.e. fever, stomach ailments, diarrhea, skin problems and kidney issues. They had a limited range to cope with them. They were deficient in access to suitable measurements to cope with factors due to many reasons. Unavailability of canal water, load shedding, availability of this water at easy access and use as compost for soil were the key factors to compel the growers for use of sewerage water.

Findings from this study show that there is need to train vegetable growers and also improve their adoptive capacity to use up innovative techniques and site-specific technologies under the impact of usage of sewerage water. In this regard, adult education program would be started by public sector (agricultural extension) and to recruit educational activities for growers to enhance their educational abilities. The government should be focused on introducing harmful

effects of sewerage water being used for vegetables irrigation. It is evident for many studies which were conducted in developed countries that government should ban on using of municipal water in peri-urban areas. Unfortunately, this law abducting found in Pakistan, it should be resolve. Secondly, government should give subsidies on electricity that farmers fulfill their irrigation needs. This research urges a key role from the extension department to boost up the vegetable growers to adopt alternative sources of irrigation rather than sewerage water to overcome this paradigm.

Acknowledgement: This manuscript is not submitted to any journal for publication. All authors contributed equally in preparing of this article. The presented data were not copied from any written report or thesis.

Conflict of interest: The presented literature in this manuscript is not against the norms and value of society and would not create any type of conflict.

References:

Agwu, A. E. (2004). Factors influencing the adoption of improved cowpea technology in Nigeria. J. Inter. Agri. Ext. Edu. 11(1): 81-84. 1173-1179.

Alturiqi, A.S., Albedair, L.A. and Ali, M.H. (2020). Health risk assessment of heavy metals in irrigation water, soil and vegetables from different farms in Riyadh district, Saudi Arabia. J. Elementol. 25 (4):1269–1279.

Cholan, Z., L. zhongyi, Y. Weiwei, P. Lipping, G. Minghua and L. Dokyoung. (2013). Assessment of metals pollution on agricultural soil surrounding a Lead-Zinc mining area in the Karst region of Guangxi, Chaina. Bull. Environ. Contam. Toxicol,90**:** 736-741.

Ensink, J. H. J., T. Mahmood, W. V. D. Hoek, L. Raschid-Sally and F. P. Amerasingle. (2004). A nation-wide assessment of wastewater uses in Pakistan: an obscure activity or a vitally important one. Water Policy 6:1–10.

Falola, A., O. E. Ayinde and V. E. T. Ojehomon. (2013). Economic analysis of rice production among the youths in Kwara State, Nigeria. Albanian. J. Agri. Sci. 12(3): 503-510.

Government of Pakistan. (2019). Economic survey of Pakistan. Economic Advisor's Wing, Finance Division, Islamabad.

Gupta, N., D.K. Khan and S.C. Santra. (2011). Heavy metal accumulation in vegetables grown in a long-term wastewater-irrigated agricultural land of tropical India. Environ. Monit. *Assess*., Epub. ahead of print. http://www.ncbi.nlm.nih.gov/pubmed/22131014.

Hassan, G. (2017). Training needs assessment of vegetable growers in peri-urban areas of District Faisalabad. Unpublished Ph D. dissertation. University of Agriculture, Faisalabad, Punjab-Pakistan

Huibers, F.P., O. Moscoso, A. Duran and J.B.V. Lier. (2004). The use of waste-water in Cochabamba, Bolivia: a degrading environment.

Jan, F. A., M. Ishaq, S. Khan, I. Ihsanullah, I. Ahmad and M. Shakirullah. (2010). A comparative study of human health risks via consumption of food crops grown on wastewater irrigated soil (Peshawar) and relatively clean water irrigated soil (lower Dir). J. Hazard. Mater. 179: 612–621.

Jarup, L. (2003). Hazards of heavy metal contamination. Br. Med. Bull. 68:167–182.

Mapanda, F., E. N. Mangwayana. J. Nyamamgara and K. E. Giller. (2005). The effect pf long-term irrigation using wastewater on heavy metal contents of soils under vegetables in Harare, Zimbabwe. J. Agri. Eco. Environ. 107. 151-165.

Milacic, R. And B. Kralj. (2003). Determination of Zn, Cu, Cd, Pb, Ni and Cr in some Slovenian foodstuffs. Eur. Food Res. Technol. 217: 211–214.

Murtaza, G., A. Ghafoor, M. Qadir and M.K. Rashid. (2003). Accumulation and Bioavailability of Cd, Co and Mn in soils and vegetables irrigated with city effluent. Pakistan J. Agric. Sci., 40: 18–24.

Qadir, M., A. Ghafoor and G. Murtaza. (2000). Cadmium concentration in vegetables grown on urban soils irrigated with untreated municipal sewerage. Environ. Dev. Sustainability 2, 13–21.

Qadir, M., D. Wichelns. L. R. Sally. P. G. Mccornick. P. Drechsel. A. Bahri and P. S. Minhas. (2010). The challenges of wastewater irrigation in developing countries. J. Agric. Water. Management. 97. 561-568.

Rajasree, R., C. K. Timbadia and F. L. Sharm. (2017). Constrains perceived by vegetable growers for the use of farm mechanization. J. C. Agri. Res. 5(2): 227-231.

Scott, C. A., N.I. Faruqui and L. Raschid-Sally. (2004). Wastewater use in irrigated agriculture: management challenges in developing countries.Wastewater Use in Irrigated Agriculture. CABI Publishing, UK.

Sharma, R.K., M. Agrawal and Fiona Marshall. (2006). Heavy metal contamination of soil and vegetables in suburban areas of Varanasi, India. Ecotoxicol. Environ. Safety. 66(2):258-266.

Ullah, H., I. Khan and I. Ullah. (2011). Impact of sewerage contaminated water on soil, vegetables and underground water of peri-urban Peshawar, Pakistan. Environ. Monit. http://www.ncbi.nlm.nih.gov/pubmed/22203410.

Welbum, G.E. (2015). Vegetable History, Nomenclature, and Classification. Vegetable Production and Practices.

World Health Organization. (2015). Promoting fruit and vegetable consumption around the world. World Health Organization, Geneva.