



## THE SOCIO-POLITICAL IMPLICATIONS OF WASTEWATER IRRIGATION IN FAISALABAD, PAKISTAN

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### **Abstract**

Wastewater irrigation is becoming a common practice in water scarce regions to fulfill the need of water through easy and cheap source of irrigation water for agricultural in peripheries of the most populous cities of Pakistan. This study investigates the socio-political impact of wastewater irrigation. It highlights the complex relationship that exists between social justice, governance, and water management. The study uses qualitative research methods like focus group discussions to show how wastewater irrigation can both alleviate and worsen contemporary sociopolitical issues, such as environmental sustainability like soil or land, public health issues, and water resource availability. The study investigates stakeholders' opinions, policy bases, and community responses to start wastewater irrigation, shedding light on challenges faced by government that arise in handling this multifaceted problem. Finally, the paper discusses that effective and reasonable wastewater irrigation requires not only technical advancement but also comprehensive political discourse and community participation to address the safe use of wastewater and its adverse health impacts. The findings claim the need for multidisciplinary methods to achieve the safe use of wastewater in such areas to fulfill the desire of water for irrigation.

### **1. Introduction**

Wastewater irrigation has emerged as a critical strategy to address water scarcity in agriculture, especially in rapidly urbanizing and water-stressed regions. The role of socio-political and government institutions in this context is pivotal, as they shape the regulatory frameworks, financing mechanisms, and stakeholder engagement essential for sustainable wastewater reuse (Saldias et al., 2015). Across many cultures and geographical areas, the use of wastewater for irrigation has a long history. Societies have understood wastewater's potential as a resource for agricultural output since ancient times, especially in regions with limited water supplies. This introduction looks at how wastewater irrigation has been used historically, looking at farming methods and cultural customs that have developed in response to environmental issues.

Effective wastewater management practices are essential to make best use of wastewater while decreasing the possible health risks related to pathogens and contaminants (Ingrao et al., 2023). Agriculture practices are affected due to water scarcity (Jimenez, 2004). Wastewater has become a desirable alternative for irrigation due to the combination of high water demand and scarce



freshwater supplies. Using treated wastewater solves the problems brought on by growing agricultural demands while simultaneously conserving valuable freshwater supplies (Ungureanu et al., 2020).

### **1.1 Health Risks Associated with Wastewater Irrigation**

Wastewater contains pathogens and heavy metals. These illnesses brought on by new pathogenic organisms are quite concerning; the World Health Organization noted that since the 1970s, more than 1500 new pathogens and about 40 new infectious diseases have been detected (WHO, 2024). Wastewater contains several pathogens, including as parasites, viruses, and bacteria. Workers in agriculture and their families worked with wastewater and they affected easily with its use. Epidemiological studies have shown that such individuals are more likely to suffer by diarrhea and parasitic infections (Adegoke, et al., 2018). These pathogens transferred through direct contact with wastewater and its irrigated soil, and crops. In case of foodborne diseases, the wastewater grown vegetables are considered a source of transmission of pathogens and contaminants from food chain to human body (Drechsel et al., 2002). In raw vegetables and crops, the viruses and fecal coliforms stay alive for many days and they pose serious health risks to consumers (Jimenez, 2008). Low-income communities mostly affected by health risks, because They lack access to sanitary facilities and clean water (Jimenez, 2004). Small landholdings were owned by farmers at Paharang Drain, who were sustained by agricultural and labor labor. Salmonellosis, shigellosis, cholera, giardiasis, amoebiasis, hepatitis A, viral enteritis, and other diarrheal illnesses have all been connected to wastewater exposure (Dickin et al., 2016).

### **1.2 wastewater irrigation and institutional bodies**

Enforcement of wastewater regulations is the responsibility of irrigation and drainage departments; but, due to a lack of resources and qualified staff, implementation is still inefficient. National policies of sustainable wastewater use are existing but there is no proper implementation of it that's why untreated wastewater is released into irrigation canals. Only 8% of municipal wastewater is treated before disposal (Murtaza and Zia, 2012).

Recent studies highlight that while wastewater irrigation provides significant economic and social benefits to farmers and society at large, its governance remains complex and often unregulated, leading to health and environmental risks. Storkal, et al. (2023) stated that wastewater irrigation occurs widely, it is mostly informal and unsupported by formal policies, with government stakeholders recognizing the need for public funding and treatment infrastructure to mitigate risks without penalizing farmers unfairly. Qadir et al. (2010) identified the neglecting behavior of implementation of wastewater regulatory guidelines. Hoek et al. (2002) highlight the farmers have no information of harmful impacts of wastewater irrigation.

Numerous researches has examined the effects of wastewater irrigation on the environment and human health in Pakistan and other nations where vegetables are grown by using wastewater (Amoah et al., 2007; Keraita et al., 2008; jan et al., 2010; Abedullah et al., 2011; Chaoua et al., 2019; Sanaei et al., 2021; Ullah, 2022). However, thorough practical research on the function of institutions in wastewater irrigation for vegetable production has not yet been conducted.

However, additional research on farmers' attitudes and perceptions of wastewater reuse in other sectors has been conducted (Knudsen et al., 2008; Mojid et al., 2010; Carr et al., 2011; Khanpae et al., 2020; Sohail et al., 2021). Knudsen et al. (2008) point out that it is necessary to disseminate the awareness in stakeholders on how to promote health programs and activities aimed



at educating farmers and consumers about the use of untreated wastewater irrigation, it is imperative that more information be obtained regarding farmers' perceptions of risks and risk awareness when using human excreta and wastewater for agricultural production. A study by Mojid et al. (2010) find out the farmers' knowledge and perceptions about wastewater irrigation. Carr et al. (2011) examined the factors affecting on perception of community about treated water. Khanpae et al. (2020) examined the farmers' perspectives on wastewater-irrigated farms' sustainability from an economic, social, environmental, and health standpoint. Sohail et al. (2021) examined farmers' behavior about wastewater reusing affects in agriculture and necessity of government involvement to raise awareness among farmers in adoption of interventions or practices awareness of possible health risks of wastewater irrigation. Thus, the study's theme is pertinent.

Section 2, consist on overview of wastewater irrigation and its health risks. It is combination of previous and current researches about institutions and wastewater irrigation in the study area (Faisalabad, Punjab Pakistan). Section 3, explains the sources and techniques used in this work. Section 4, presents our main research findings, starting with an analysis of the farmers' view points on wastewater use in vegetables production and challenges during its use. It is followed by role of government institutions with clear attention at wastewater using sites and their visible and hidden rules implementations for safety of persons. Finally, we present a discussion followed by concluding remarks and policy recommendation (Section 5).

### **3 Material and Methods**

#### **3.1. Study area**

The Madhuana drain in Faisalabad is a major wastewater carrier that collects untreated sewage, domestic waste and industrial effluents from the city and nearby industrial areas that make it highly polluted. It ultimately discharges into the Ravi River via the Summandri Drain. Heavy metals such as lead (1.5 mg/L) and cadmium (0.13 mg/L) have been detected in the drain, indicating industrial contamination. While the Paharang Drain carries more industrial pollutants but Madhuana mostly receives sewage water and still has a high pollution load (Sheer, 2019; Mahfooz et al., 2020; Almas et al., 2025). Paharang drain, once used for carrying storm water but now it has become worsed polluted drain that carries industrial wastes (Rashid et al., 2018). The information was collected from wastewater using farmers of wastewater irrigating farmers nearby these drains (Figure 1.1). Vegetables production has becoming the key livelihood source for farmers at wastewater areas (Abedullah et al., 2011). It's a best location to investigate the problem. Insights developed in this article are based on secondary data and fieldwork conducted. Information was collected from April, 2023 to February, 2024.

#### **3.2 Description of data**

Qualitative research method was used to collect the information. Data was gathered through key informant interviews and focus groups. To get more authentic and in-depth information of wastewater irrigations' health impacts and role of government and leading institutions. In the first phase, wastewater using villages were selected. The villages situated near to Madhuana drain were named as D1 and Paharang drain were named as D2. In the next, with the help of community leader, wastewater vegetables growers were identified and in prior meetings were conducted with them and in the meeting interview time was fixed. Total FGDs were sixteen and each discussion

was lasted between 45 to 60 minutes. Purposive sampling technique was used to select focus group participant. We asked native peoples in local language Punjabi, because it was more convenient for locals to understand the query and they can feel comfortable to response.



Fig 1.1 focus group discussion on left and key informant interviews on right

Focus groups were consisted on male participants because its culture that mostly males were involved in agriculture. The researcher asked the questions, but the facilitator took the notes. Prior to the interview, participants' agreement was obtained, and all conversations were captured on audio recorders. Field notes and audio recordings were transcribed and translated, themes were identified, and subthemes were generated by using Alas. ti. 8.4.15 software.

For key informant interviews, government departments specifically those dealing wastewater, were selected and prior consent was obtained from study participant. Interviews were lasted between 60 and 90 minutes. Questions focused on the reasons and impacts of wastewater irrigation on community and their role to handling and treating wastewater, and health risk reduction strategies that are common in agriculture community and hurdles in execution of these plans. The focus groups were created based on factors like age and education, they were homogeneous within but varied from one group to the next.

Feature	Paharang Drain (D1)	Madhuana Drain (D2)
<b>Farmers</b>	Small landholders (5-7 acres)	Medium landholders (up to 10 acres)
<b>Education</b>	Illiterate or less educated	8-12 years schooling (FA level)
<b>Water Sources</b>	Wastewater, Canal, Tubewell	Wastewater, Canal, Tubewell
<b>Pollution</b>	Industrial pollutants (High)	Sewage water (High)
<b>Designation</b>	D1	D2

Table 1.1. Characteristics of selected villages

#### 4. Results and Discussion

In this section, we discuss community's views about wastewater use in vegetables production. This is concluded by thematic analysis of focus group discussions. It is followed by the role of



institutions in wastewater irrigation. Thematic analysis was used for data analysis. The finding highlights specific initiatives and recommendations for wastewater using sites of Faisalabad, Pakistan.

#### 4.1 Wastewater in Faisalabad

The key informant interviews' insights and the FGDs' replies demonstrated that wastewater irrigation in Faisalabad has been going on for many decades. The alkaline pH of wastewater ranges from 6.8 to 7.9, however the Madhuana drain effluent has the highest alkaline pH of all. Wastewater had the highest readings (543 dS/m), followed by canal water (83.8 dS/m), suggesting a higher saline level (Almas et al., 2025).

#### 4.2. Farmers' views in wastewater

Most of the irrigation and underground water of Faisalabad is alkaline. The perspective of farmers about wastewater irrigation is attention seeking. The farmers termed wastewater as 'magical water'. There are various substances, solid wastes, fecal matter etc. in wastewater and find it affective for plants health. Farmers showed different perceptions behind selection of irrigation water. They view it as a "calcium drink" or having "magical properties" and "superpower." It acts as a resilient to drought conditions, particularly during the summer. An old age, less educated wastewater focus group respondent said;

*"If you mix animal dung in used water, it's just like calcium drink for soil and it is essential to fulfill the need of healthy material in soil. Wastewater sustains the health of the soil and its beneficial properties enhances the rate of production (FG\_ old age participant)."*

Majority of respondents showed positive views in wastewater irrigation. That is beneficial in food security, both at the household level (growing crops for consumption) and the community/market level (increased agricultural productivity). For poorer farmers who cannot afford tube well water, there wastewater is seen as a more accessible and affordable alternative, promoting social equity in access to resources. They thought, wastewater is easy source to earn profit. Community focused on the crops production rather than its properties.

#### 4.3 Difficulties in working with wastewater

The thematic analysis showed most of the farmer's faced the bad odor, skin infections mostly on lower legs. That were usually occurred in wastewater irrigation. They feel it really awful. The unpleasant smell of wastewater can lead to social discomfort and a reluctance to interact with others after irrigation. This highlights the social stigma associated with wastewater use. Focus group young age participants stated that;

*"Although wastewater has numerous benefits but it consists of harmful substances. Therefore, during irrigation with it most of us experienced skin irritation like itching and its bad smell is really very challenging. One of the farmer said, I have to cover the face with small piece of cloth or handkerchief. Breathing during irrigation is quite difficult".*

*"It's smell is very harsh and unbearable. After irrigation, we dislike to sit near to each other fellows but due to unavailability of clean water its use is mandatory".* This highlights the social stigma associated with wastewater use. Mostly farmers report becoming habituated to the dirtiness and bad odor of wastewater over time.

After analysis result showed that the farmers have both types of attitudes and awareness level with handling wastewater. Young age focus group respondents declared that they become now habitual to wastewater's smell and due to its numerous benefits respondents were happy to irrigate with it.



In the current research farmers are considering visible health risks of wastewater irrigation rather than invisible health risks of wastewater.

#### **4.4 Institutions' roles and wastewater irrigation**

Role of concerned institutions, in identifying the legal and illegal use of wastewater and its treatment policies and agendas formulation and implementation of strategies in the use of wastewater irrigation is essential.

##### **4.4.1 Wastewater and Organizations**

In order to maintain community health, the Punjab food administration in Pakistan has totally banned the use of wastewater in edible crops. However, the practice of growing vegetables using wastewater is still practiced in a number of locations, primarily in Faisalabad. The farming community is not happy with the approach that institutional and government organizations perform. The farming community acted rudely and uncooperatively towards the food department team. In key informant interviews with the food authority officer, despite their efforts to evade the regulations that prevent the use of wastewater in the growing of vegetables.

According to the environment protection officer, the Water and Sanitation Agency is responsible for wastewater management, indicating a complexity in jurisdiction and governance that might prevent effective environmental protection. Current measures or procedures to reduce the dangers of using wastewater and its negative effects on soil's health are insufficient. There may be gaps in reliable policies and practical procedures for environment health due to the division of labor in various institutions. The environment protection officer stated that;

*"Wastewater irrigation after mixing into rivers it caused dirtiness into it. Due to some reasons, we cannot deal the wastewater as it is not under our jurisdictions. Even though, wastewater has negative effects on soil and water. Every institution should work for protecting water and soil from harmful impacts of wastewater. Refined or clear policies should be formulated and implemented to minimize these risks(KII\_EPO)".*

They make efforts to create a sense of disliking towards wastewater use in agriculture among community members. Particularly at the school level, it is necessary to break down the stigma that divides the community members who support or use wastewater irrigation due to strong cultural views, lack of knowledge of health hazards, and traditions that emphasize particular farming methods over others. Active management is necessary for effective governance in the terms of environmental health, especially in regions where discrimination and misinformation are prominent. This may increase the risks to public health by contributing to poor management techniques and a lack of accountability. The agency's crucial resource allocation issue is brought to light by the recognition of workforce challenges. It reflects more general sociological concerns about unequal access to resources and the ways this affects the ability to bring about change. A community mobilizer OF Water and Sanitation Agency (WASA) expressed;

*"We work hard to explain the advantages of solid waste management, and we handle the social stigma associated with wastewater irrigation in the community. Although wastewater irrigation monitoring and supervision are not crucial components of our business, we are dedicated to continuous improvement and are confronted with a staffing shortage."*

In interview it is revealed that wastewater irrigation is common in those communities where education, lack of resources are common. These institutions are facing lack of multifaceted approaches in wastewater management. There is a gap in community's knowledge of wastewater

health risks and lack of information of handling contaminated produce like vegetables and crops. A cognitive dissonance about eating contaminated produce was observed, they believe that only washing is enough for to eat vegetables. The fact is this practice only removes dust. This happened due to lack of awareness and knowledge of hidden heavy metals and pathogenic attack in vegetables. Food authorities are responsible for evaluating the risks associated with wastewater irrigation and establishing guidelines or limits for contaminants in food crops. Food authority officer of Faisalabad expressed;

*“In Pakistan, wastewater irrigation is ban to grow edible crops like vegetables but community is stubborn and most of the time they break the law. There is a myth in wastewater using community that washing is enough to clean the vegetables (KII-FAD).”*

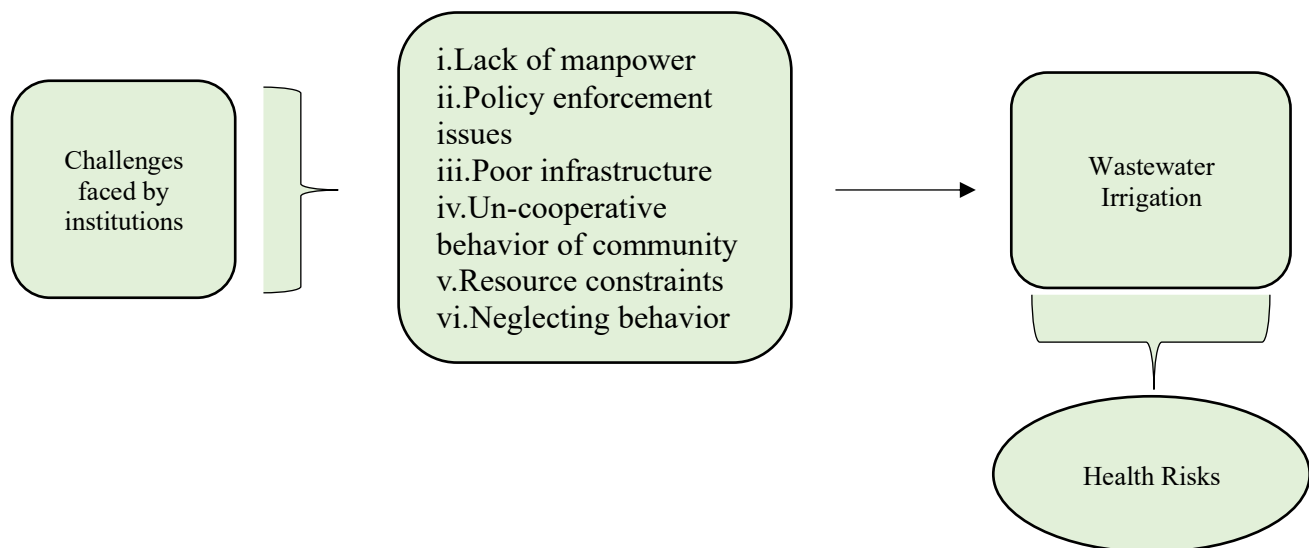


Fig.1.2 wastewater irrigation and institutions

The addition of floating wetlands to wastewater treatment ponds represents a forward-thinking and environmentally friendly method of wastewater management. As chief scientist of NIBGE stated that; *“We launch floating plants in wastewater ponds at Uchkera, Faisalabad to treat all collected wastewater. and it move through all ponds. Afterwards, it become clean and can be used in crops production (NIBGE-Chief Scientist)”*. Various reasons were identified by key informant interviews and focus group discussions that wastewater irrigation is still common in communities due to farmers’ un cooperative behavior. The institutions are facing challenges to stop wastewater irrigation like lack of manpower for regular monitoring at sites and impartial implementation of rules.

#### 4.3.2 Farming community and institutions

The small land holding farmers often face crisis like limited resources, low budget and lack of canal water. Due to inflation various farmer forced to opt different alternative sources of irrigation water like wastewater. In FGDs, it was concluded that regulatory bodies may not support the small

farmers. This injustice and uncooperative behavior may target the farmer psychologically. Farming groups stated that; *“Food authority department always destroy our vegetable. Despite the fact that they disregard our efforts and whole season struggle. We face major loss of our crops as we can’t afford tubewell water in this inflation. Its quite painful and insensitive attitude of the government towards our occupation.”*

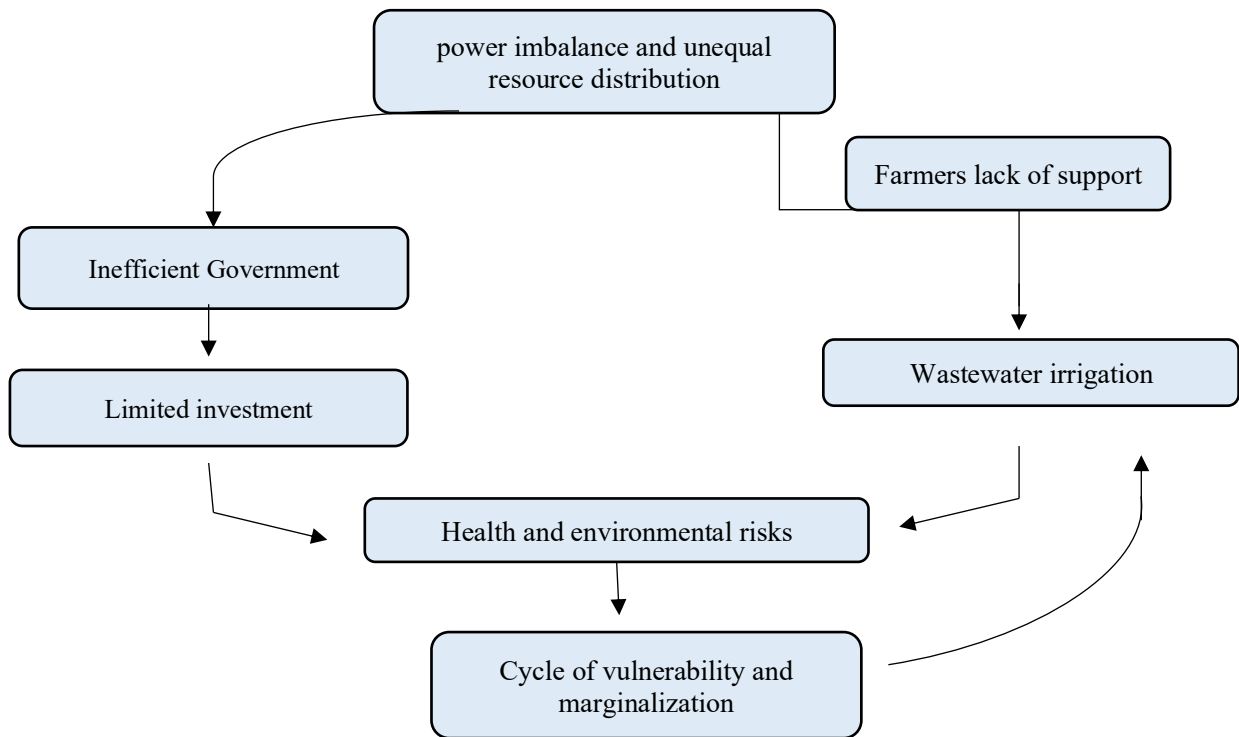


Fig 1.3 Conflict theory and vulnerable communities and government institutions

Conflict theory, originally derived from the works of Karl Marx, posits that power disparities and struggles over scarce resources drive social dynamics. It is conflict dynamic where farmers are facing economic loss due to poor role of institutions and most of them were small land holding farmers. Government neglect them and never inform them the actual side affects of using wastewater. They feel helpless because their rules implementation is not transparent.

## 5. Discussion

This study emphasizes how the perceptions of farmers and the institutions in Faisalabad, Pakistan, contribute in wastewater irrigation. By concentrating on it, we have demonstrated how different organizations performing their role in wastewater irrigation and why it’s still in use in Faisalabad. Perception is farmers’ opinion about wastewater in favor to use it or not (Singh et al., 2021). The majority of farmers are generally aware of irrigation water contamination. Young and mostly educated formers actually had less supportive behavior towards wastewater irrigation. In selection of irrigation water, the poor small landholding farmers believed that it had no adverse effect on vegetables quality. Farmers have an unfavorable opinion about function of institutions and policymakers. Instead of enforcing stringent regulations, training and the supply of alternative



water sources may reduce wastewater use. Small land holders and poor ones did not show supportive attitude towards institutions laws and rules. There was a gap of communication between local farmers and higher authorities. Economic benefits are more valued over quality of water and health of individuals. They find all of these beneficial properties in using wastewater and similar results were seen in previous literature like (Mojid et al., 2010; Carr et al., 2011). At study sites, farmers highlight the political issues like lack of fair allocation of resources, mismanagement of canal water distribution etc. all showed the conflicting behavior and complaining attitude of farmers towards concerned institutions. Along with a call for cooperative measures to address the issues brought on by inflation and the need for reliable water sources, it emphasizes the urgent need for supporting policies and recognition of farmers' struggles. Farmers have been affected by the general changes to their surroundings as well as the loss of infrastructure. Long-standing stigmas may be eliminated by educational programs aimed at schools, which may affect how the next generation understands and adopts wastewater treatment techniques.

Participatory governance approaches have the potential to increase safety measure conformity foster confidence, and increase the overall efficiency of wastewater management plans. This implies that in order to promote compliance with health rules, more accountability measures and community engagement are required. Increasing public knowledge needs changing societal standards about food safety. Campaigns for education must to be keen to cultural differences and customized the beliefs of the community. Effective implementation of behavioral and attitude changes requires cooperation with stakeholders and community leaders. From harvesting to post-harvest, numerous stakeholders must collaborate and provide input for effective management. In order to reduce potential health risks, it is essential to promote safe procedures regarding the use of wastewater in agriculture. Effective risk communication techniques that educate stakeholders on safe handling, treatment, and monitoring procedures are therefore required. Communities can improve food security, close nutrient loops, and advance sustainable farming methods by using treated wastewater for irrigation. In addition to boosting local economies, this integration promotes a feeling of collective resource ownership.

## **6. Conclusion**

The use of industrial and household wastewater for irrigation is a very crucial activity in Faisalabad, Pakistan. The consumption of wastewater irrigated vegetables is very common in the city. Farmers can be affected by helminth disease due to direct contact with wastewater and soil. Canals are heavily polluted and farmers are using that water on their fields. Farmers preferred to use it because it's free and easily accessible. However, old and young age farmers at both farming sites had different perception of wastewater irrigation and their perception about eating of unwashed vegetables was varies by age and education levels. The awareness of washing hands with same irrigation water was different in both age groups and it shows positive perception in old age groups but it varies on the base of education. Therefore, information dissemination through seminars and campaigns are very necessary to raise awareness among farmers about the presence of contaminates in wastewater and its bad health impacts.

Wastewater users mostly had negative attitude towards decisions of institutions' roles. They dislike their decisions and feel they law making authorities never priorities their opinions. Therefore, a stakeholder meeting with farmers is necessary, that will play a crucial role in effective law making



and its implementation. To make it smooth, farmers' associations head that must be a local man from farming community, should be the part of the committee.

Moreover, the farmers showed blaming behavior towards institutions roles. The farmers feel helpless like food authority departments mostly in a season's plough and destroy their vegetables field and they feel helpless. The poor drainage and infrastructure of the village forced the farmers to thrash their household human excreta directly into canal water. Ultimately, it's an irrigation and drainage departments as well as poor housing society's negligence. Thus, well designed incentives like more pay for organic and healthy vegetables in the market and tagging of vegetables based on irrigation water, push the farmers to use clean water in irrigation. This suggests a level of community acceptance and a recognition of its benefits for irrigation. Even with awareness of potential risks (the illiterate respondent acknowledging "harmful substances" but deeming it safe for agriculture), the perceived benefits outweigh the concerns.

#### **Acknowledgements**

The United Kingdom Research and Innovations (UKRI) and the Medical Research Council (MRC) provided funding for this study. We would like to thank the institutions and administrations of Faisalabad, Punjab, Pakistan, for their support. Additionally, we appreciate farmers sharing their expertise on wastewater irrigation.

#### **Competing Interests**

The writers affirm that they have no conflicting interests.

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