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IMPACTS OF WASTEWATER USE IN AGRICULTURE ON HEALTH AND ENVIRONMENT

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ABSTRACT

Urbanization, a promoter of economic development also produces large quantity of wastewater, which has become a major source of irrigation in several countries. Indeed, use of wastewater in agriculture is increasing particularly in water scarce rural areas adjacent to urban areas. Wastewater flow in natural drains and application in agriculture cause health and environmental impacts, besides economic returns to farmers. Present study examined health and environmental impacts of wastewater use in agriculture in rural areas adjacent Bangalore City in Karnataka. The study observed that urban wastewater application caused health and environmental impacts.

KEYWORDS: *Urban Wastewater, Health Impacts, Environmental Impacts, Bangalore, Crop Loss.*

1. INTRODUCTION

Urbanization, an important feature in economic development process has resulted in generation of large quantity of wastewater. Urban wastewater is a negative externality of urbanization but it is becoming an important source of water in rural areas around cities and towns for agriculture. Application of urban wastewater in agriculture is an age-old practice; however it is gaining importance in recent years owing to increased demand for agricultural outputs in urban areas and also because of increased wastewater production, throughout the year. Wastewater application in agriculture provides a source of irrigation to farmers, which forms the basis of livelihood, particularly in water scarce areas around urban areas. The same wastewater causes several health and environmental problems as it is polluted water, and farmers use it ignoring health and environmental problems of wastewater due to application in agriculture. According to Scott C. A., ET al. (2007) farmers have been using wastewater in an unregulated manner particularly in low-income countries, without understanding associated costs and benefits, which calls for detailed analysis of urban wastewater use in

agriculture covering impacts on health and environment. Jeroen H.J. et al (2004) observed that wastewater use presents health hazards, which is difficult to ignore. Further, the study stated that vegetables grown using wastewater are generally eaten after cooking, therefore, might not pose serious health problems on consumers, but these observations have not been tested. Alebel B. et al (2009) found that public health is under dangerous situation due to use of wastewater for irrigation and environment is also under serious issues in Addis Ababa, Ethiopia. Their study used contingent valuation method to estimate level of safe use of wastewater while using for crop production. The study focused on possible dangers of method of non-market valuation techniques in order to measure public health and environmental concerns. The study concluded that wastewater was used for survival, as 62 per cent of household total income originated from wastewater farming.

Abegunrin, T. P., et al (2015) focused on the effects of usage of wastewater irrigation on soil properties and parameters of growth of cucumber in the southwestern Nigeria. It was found that use of kitchen wastewater not affected adversely on fertility of soil as compared to groundwater with normal level of soil salinity and sodium. Matthew McCartney, et.al (2009) suggested adopting suitable water resource management and planning for reuse of wastewater after disposal of heavy metals and other ingredients. They found that in Musi river catchment there were poor ecological conditions due to more salinity and farmers shifted from rice crop to para grass crop.

Ursula J, Blumenthal, et al (2000) summarizes the impacts of wastewater use in agriculture as observed by other studies. Application of untreated wastewater in irrigating crops resulted in excess infection of intestinal nematodes among farm workers. For example, in India workers in sewage farms experienced more cases of Ascaris and Hookworm infections, compared to farm workers in clean water irrigating land. Workers in sewage farms suffered more from problems like anemia, as compared to workers in clean water farm. Further, it was observed that cholera can be transmitted to farm workers, particularly those working with wastewater coming urban areas, as observed in Jerusalem in 1970. Further, stated that irrigating edible crops with untreated water can cause intestinal nematode infections and bacterial infections. Evidences in Italy and Jerusalem showed occurrence of Ascaris and Trichuris infections because of eating wastewater cultivated salad crops, and the infections stopped when wastewater application was also stopped. Transmission of cholera in Jerusalem in 1970, typhoid fever in Santiago, Chile were seen as the result of consuming vegetable grown using untreated wastewater. Livestock consuming grass grown applying wastewater have also shown infections, particularly in Australia, where cattle got infected after grazing in pastures irrigated with wastewater. This might lead to infection among people who consumes meat from those cattle.

Urban wastewater has become a non-conventional source of water for agriculture particularly in freshwater scarce zones. As observed above farmers in large numbers of countries depend on urban wastewater for their livelihood through agriculture. In this regard an analysis of impacts of wastewater use in agriculture on health and environment is required for better understanding of the effects. Review of literature revealed that factors like easy access to wastewater, etc. have motivated farmers to adopt for wastewater agriculture. Therefore, considering the need for using urban wastewater for agriculture in peri-urban areas and dearth of recent studies covering health and environmental impacts of wastewater application, there is a need for detailed analysis focusing above issues related to wastewater and its use in agriculture. These factors necessitated this study in order to fill the gap of recent studies covering impacts of wastewater agriculture in rural areas around urban areas. Urbanization is an indicator of economic development and increased urbanization along with increased provision of drinking water supply leads to increased generation of wastewater, usually which flows out of urban areas and becomes a source of water for irrigation in peri – urban and rural areas adjacent to urban areas. Urban wastewater is being used in agriculture, which

has both positive and negative impacts. Assured source of water, reduced expenditure and increased returns are the positive impacts while adverse impacts are on health of people working in farms using wastewater, those consumers consuming products produced by using wastewater, and environmental impacts of applying wastewater in agriculture like soil quality, ground water contamination, foul smell around the area and others. All these issues related to wastewater application in agriculture need to be probed at the field level. The present study attempted to address few of the above issues.

Health and environmental impacts of urban wastewater use in agriculture have been examined by collecting primary data in rural area adjacent to Bangalore City in Karnataka, India. Bangalore City generates large quantity of wastewater, which flows down in Vrishabavathi Valley passing through Bangalore Rural and Ramanagara districts, where farmers use wastewater for irrigating their crops. Hence, rural area around Bangalore City, falling in Bangalore Rural and Ramanagara districts was appropriate to examine objectives of the study. The setting of the study for primary data collection was villages across river Vrishabavathi. Data collection units were households using wastewater for agriculture in villages in Vrishabavathi irrigated area. A preliminary survey was conducted along Vrishabavathi river where wastewater is used for agriculture for identifying villages and four villages namely Gopahalli, Agara, Byramangala, Byramangala colony. These villages were selected purposively as field area for data collection. Households using wastewater for irrigating their fields in these three villages were identified for canvassing schedules. Totally 150 households selected, covering 70 small, 50 medium and 30 large farmers. Data were collected during the year 2019. In order to analyze the data descriptive statistics were used. This study attempted to examine health and environmental impacts of using wastewater in agriculture in the study area, by collecting information on experience and opinion of farmers on health and environmental impacts. However, it is to be noted that this study is limited to the extent of eliciting farmers' opinion and has not carried out any medical examination or laboratory tests to verify the experience and opinion of farmers to identify causes of disease. Results presented are as expressed by farmers. Health and environmental impacts of wastewater use as observed in the study area are discussed in the following sections.

2. Health impacts of wastewater use in agriculture

Farmers stated that they work in agricultural fields using wastewater often based on cultivated crop. Water is required once in three days for few crops and for few once in four or five days, while few other crops need water once in a week determining how frequently farmers interact with wastewater. This study attempted to collect information on health effects of working in agriculture activities using wastewater. Farmers, in focused group discussion, mentioned about different types of diseases in general rather than the one by which they suffered or suffering, mentioned in Table 1. Major health problems reported by the farmers are body itching after working in the field using wastewater, skin allergy, general weakness, etc. However, farmers had not consulted any medical doctor or facility; instead waited for the problem to heal down, with some amount of self-medication and if disease aggravates consult the health facility. This illustrates that though farmers have been experiencing health problems, which they ascribe for wastewater, they have not taken it seriously. Farmers reported that they have been consuming food products grown by using urban wastewater and have not experienced any ill-health. Therefore, the behavior of farmers shows that farmers are unaware about adverse health impacts of working with wastewater.

TABLE 1: VILLAGE –WISE HEALTH PROBLEMS DUE TO WASTEWATER AGRICULTURE

Name of the village	Health problem
Agara	Heat in the body, skin allergy, dengue, itching, body pain, stomach pain

Byramangala	Fever, burning sensation in eyes and body, itching, skin allergy, tiredness, stiffness in legs
Byramangala Colony	Malaria, skin allergy, itching, heat, weakness (tiredness), stiffness in legs
Gopahalli	Skin allergy, cough, typhoid, malaria, weakness (tiredness), stiffness in legs

Source: Survey data

The household survey collected information on adverse effects on health of farmers due to use of wastewater and presented in Table 2. Taking all farmers together 78 per cent reported adverse effects on health by use of wastewater, while 22 per cent of farmers expressed not having any ill health due to wastewater use. It can be noted that all categories of farmers reported negative effects on health due to wastewater use. Importantly the study observed that use of wastewater in agriculture is not good from the point of health considerations of farmers.

TABLE 2: FARMERS OPINION ON HEALTH IMPACTS OF WASTEWATER USE

Farmer's groups	Adversely affects		Does not affect		Total	
	No. of Farmers	%	No. of Farmers	%	No. of farmers	%
Small Farmers	55	78.57	15	21.43	70	100.00
Medium Farmers	39	78.00	11	22.00	50	100.00
Large Farmers	23	76.67	7	23.33	30	100.00
All	117	78.00	33	22.00	150	100.00

Source: Survey data

Information on number of farmers experienced health problems due to wastewater use in agriculture has been presented in Table 3. This study attempted to examine health problems by asking farmers to report on illness in last one year. It was found that taking all farmers together nearly 44 per cent of farmers reported to have suffered from fever, over 26 per cent from skin related problems, and 13 per cent each from cold and cough and other health problems like body ache. Across categories large farmers have reported relatively higher per cent of people being suffered from fever, followed by medium and small farmers. Farmers opined that cold and cough are very common health problems due to usage of wastewater in agricultural land. It was also reported that other problems such as stiffness in legs, excess of heat in body, body pain, stomach pain and tiredness were experienced by farmers. It can be mentioned that usage of wastewater in agriculture created different types of health problems. Among small, medium and large farmers the common types of health issues identified were fever and skin related issues as a result of wastewater usage in the agriculture.

TABLE 3: NATURE OF HEALTH IMPACTS IN THE LAST ONE YEAR

Nature	Category of Farmers							
	Small		Medium		Large		All Farmers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Skin Related	15	27.27	9	23.08	7	30.43	31	26.50
Fever	22	40.00	18	46.15	11	47.83	51	43.59
Cold and cough	8	14.55	5	12.82	3	13.04	16	13.68
Headache	2	3.64	1	2.56	0	0.00	3	2.56
Others	8	14.55	6	15.38	2	8.70	16	13.68
All	55	100.00	39	100.00	23	100.00	117	100.00

Source: Survey data

It is interesting to note that during group discussion farmers reported not to have availed health services, but in household survey they revealed to have consulted whenever they faced health issues. According to Table 4 more number of farmers (45 per cent) visited health care centers for treatment of fever and 26 per cent received treatment for skin related problems. About 15 per cent of farmers went to health care center to get cured other health issues such as stiffness in legs, excess of heat in body, body pain, stomach pain and tiredness which they suffered after working in wastewater agricultural field. 13 per cent of farmers have gone to health care centers to treat cold and cough. Overall, the study observed that farmers have received treatment from health care facilities for different types of health issues caused due to wastewater use in agriculture.

TABLE 4: NUMBER OF FARMERS VISITED HEALTH CARE CENTERS FOR TREATMENTS DURING LAST ONE YEAR

Type of Disease	Farmer's groups							
	Small		Medium		Large		All Farmers	
	No.	%	No.	%	No.	%	No.	%
Skin Related	9	25.00	5	22.73	5	33.33	19	26.03
Fever	16	44.44	10	45.45	7	46.67	33	45.21
Cold and cough	5	13.89	3	13.64	2	13.33	10	13.70
Headache	0	0.00	0	0.00	0	0.00	0	0.00
Others	6	16.67	4	18.18	1	6.67	11	15.07
All	36	100.00	22	100.00	15	100.00	73	100.00

Source: Survey data

The study attempted to collect information on expenditure incurred by farmers who had availed health care services for treatment of illness due to working in wastewater agricultural land, presented in Table 5, which shows on an average household have spent over Rs. 45 thousand in a year. But, one needs to be cautious on this amount of expenditure because farmers were not able to express that the disease was due to wastewater. Further, this study also not attempted to obtain medical validation on farmer's claim, which was beyond the scope of the study. With this limitation the study analyzed health expenditure as reported by farming households. It can be observed that higher health expenditure has been incurred to cure fever, which is Rs. 17 thousand per family for a year taking all farmers as a whole. Second highest amount of money spent by farmers was to treat skin related disease and it is over Rs. 11 thousand per family. Households incurred Rs. 7600 for treating cold and cough. Small farmers spent relatively less amount compared to other two groups, which might be due to not availing medication. However, the point to be noted is that use of wastewater resulted in health problems and compelled farmers to bear expenditure for treatment of illness, as opined by farmers in the study area.

TABLE 5: EXPENDITURE INCURRED TOWARDS TREATMENT OF ILL HEALTH DUE TO WASTEWATER USE IN AGRICULTURE IN LAST ONE YEAR (EXPENDITURE PER FAMILY PER YEAR IN RS.)

Type of illness	Farmers groups			
	Small	Medium	Large	All Farmers
Skin Related	8000	12000	14000	11333
Fever	12000	18000	22000	17333
Cold and cough	5000	8000	10000	7666
Others	6500	9500	12500	9500
Total	31500	47500	58500	45833

Source: Survey data

Farmers in the area have been facing the problem of mosquitoes and flies, which is attributed for presence of wastewater. It is known that mosquitoes and flies are causes for vector based diseases. Information presented in Table 6 reveals that 82 per cent of farmers reported the problem of mosquitoes and flies. Problem of mosquitoes alone has been reported by over 86 per cent of farmers in their villages due to wastewater utilization in agriculture. Therefore, wastewater use in agriculture has caused growth and spread of mosquitoes and flies in the study area.

TABLE 6: PROBLEM OF MOSQUITOES AND OTHER INSECTS DUE TO WASTE WATER

Vectors	Yes		No	
	No. of farmers	Per cent	No. of farmers	Per cent
1. Mosquitoes	76	86.36	12	13.64
2. Fly	47	75.81	15	24.19
Total	123	82.00	27	18.00

Source: Survey data

Farmers reported that different measures have been initiated by government for controlling problem of insects like mosquitoes and flies. Therefore, the study tried to collect information on whether any such programs were conducted or not. Table 7 illustrates that 54 per cent of farmers said that mosquitoes and flies controlling programs were conducted in the area. However, 46 per cent of farmers reported that no such programs were conducted. It means that all farmers are not aware about these programs and the conducted programs need to be effective for controlling mosquitoes, otherwise people will not come to know about the programs and gain benefits of such programs.

TABLE 7: INSECT CONTROLLING PROGRAMS BY GOVERNMENT

Nature of Health programs	Yes		No	
	No. of farmers	Per cent	No. of farmers	Per cent
1. Mosquitoes controlling	48	52.75	43	47.25
2. Fly controlling	33	55.93	26	44.07
Total	81	54.00	69	46.00

Source: Survey data

Farmers, during discussion, had reported about bad or foul smell because of wastewater flow near villages and farmland. Hence, this study collected opinion of farmers at household level on odor of wastewater while applying in agriculture land. Information presented in Table 7 shows that 68 per cent of farmers said about bad smell in farmland and 32 per cent of farmers around residence. It indicates that bad smell or odor is a problem in the study area due to wastewater use.

Table 7: Farmers opinion on bad smell (odor) from waste water applied in farm land

Farmers groups	Experienced bad smell due to waste water			
	At Farm Land	per cent	Around Residence	per cent
Small	46	65.71	24	34.29
Medium	32	64.00	18	36.00
Large	24	80.00	6	20.00
All	102	68.00	48	32.00

Source: Survey data

The study observed that people in the area have been suffering from illness which might be due to application of wastewater in cultivation. However, farmers reported that health related

programs have not been conducted in the area both to treat and create awareness among people. In this regard, this study attempted to elicit farmers' opinion for conducting health camps, regular health checkups and awareness creation activities and the obtained information has been presented in Table 8. Large number of farmers (76 per cent) expressed the need for conducting some type of health programs to create awareness about the effects of wastewater use and remedial measures to be undertaken. It can be seen that 78 per cent of farmers asked for regular health checkups by health authorities. This indicates the need for conducting health camps, regular health checkup for maintaining health of people in the area.

Table 8: Need of health programs to address impacts of wastewater use

Nature of health programs	Yes		No	
	No. of farmers	%	No. of farmers	%
1. Health Camps	48	76.19	15	23.81
2. Regular Health Checkup	39	78.00	11	22.00
3. Awareness Creation	27	72.97	10	27.03
Total	114	76.00	36	24.00

Source: Survey data

3. Environmental impacts of using wastewater in agriculture

Urban wastewater, pollution, creates adverse effects on environment particularly in rural areas using wastewater. During the field survey, through focused group discussion, this study tried to collect information and experience of farmers on environmental impacts of using wastewater in agriculture. Farmers opinion elicited in course of discussion, presented in Table 9, reveal different types of environmental problems due to wastewater application in agriculture. It was noticed that environmental problems reported by farmers were common in all villages. People said about bad smell, mosquito problem, plastic waste and acid content in water which are environmental impacts caused by wastewater. Around agricultural fields and wherever wastewater flows bad smell emanates and pollute environment. Bad smell problem increases during summer, when water flow from urban area recedes due to no rainfall, instead wastewater released from factories and other commercial establishments flow in the drain causing more smell. Besides, people also face problems in agriculture listed in the table.

TABLE 9: ENVIRONMENTAL IMPACTS OF WASTEWATER USE IN AGRICULTURE

Name of the village	Environmental Impacts
Agara	Bad smell Mosquito problem Plastic waste Chemicals in water (acid etc.) Low crop yield Weed problem Crop loss
Byramangala	Bad smell Low agricultural yield Paddy cultivation difficult Flower cultivation difficult because of insects and other diseases Weed problem Livestock rearing is difficult

Byramangala Colony	Increase in soil productivity due to nutrients in wastewater Bad smell, Water pollution Livestock rearing is difficult Plastic and glass pieces create problems Crop failure Yield reduction
Gopahalli	Bad smell, mosquito Crop loss Disease to coconut plants Livestock rearing difficult Paddy cultivation not possible

Source: Survey data

Farmers opined that irrigating with wastewater helps crops to grow well, but, yield level decline and sometimes the crop dries, particularly when acid level in wastewater is high, during summer period. Growth of weed is another major problem which reduces crop yield, besides increasing total cost of cultivation. It has been observed that number of labourers used in wastewater cultivation is higher than that in freshwater agriculture in the study area. Paddy cultivation is difficult using wastewater, because, as reported by farmers, paddy crop grows well but its yield is very low and sometimes no yield at all, only grass. Hence, large number of farmers switched to cultivate other crops like mulberry or baby corn. It is observed that nowadays cultivation of vegetables is also turning out to be difficult and non-viable, as opined by farmers during survey.

Wastewater use in agriculture has negative impacts on the environment as discussed earlier. Information presented in Table 10 illustrates large number of farmers reporting adverse impacts of use of wastewater on environment. All categories of farmers, in large number, agreed to the above opinion stating negative environmental impacts of wastewater cultivation.

TABLE 10: FARMERS OPINION ON IMPACT OF WASTE WATER USE IN AGRICULTURE ON ENVIRONMENT

Farmers 'groups	Wastewater use adversely affects environment			
	Yes	Per cent	No	Per cent
Small Farmers	61	87.14	9	12.86
Medium Farmers	45	90.00	5	10.00
Large Farmers	28	93.33	2	6.67
All	134	89.33	16	10.67

Source: Survey data

A negative impact of wastewater use in agriculture is on crop as expressed by farmers during interaction. Information presented in Table 11 illustrates that 78 per cent of farmers reported that wastewater use in agriculture adversely affects crop. However, it is interesting to observe that 22 per cent of farmers opined that wastewater use has no negative impacts. These divergent opinions need to be explored in detail about wastewater use in agriculture.

TABLE 11: IMPACTS OF WASTEWATER USE ON CROP

Farmers' groups	Crop loss			
	Yes	Per cent	No	Per cent
Small Farmers	54	77.14	16	22.86

Medium Farmers	40	80.00	10	20.00
Large Farmers	23	76.67	7	23.33
All	117	78.00	33	22.00

Source: Survey data

As observed above farmers reported about crop loss due to wastewater use in agriculture In order to explore nature of crop loss the study collected information from farmers According to Table 12 large number of farmers said that there is loss in growth of crop (43 per cent), loss in soil fertility (nearly 30 per cent) and yield loss was also experienced by 27 per cent. It can be seen that loss in growth of crop has been reported by more per cent of large farmers (50 per cent). Therefore, study observed that there is loss of yield, soil fertility and growth of the crop because of wastewater use in agriculture.

TABLE 12: TYPE OF CROP LOSS DUE TO WASTE WATER USE IN AGRICULTURE (IN PER CENT)

Type of Loss	Farmers' groups			
	Small	Medium	Large	All
1. Loss in growth of crop	38.57	42.00	50.00	43.52
2. Loss in yield	31.43	26.00	23.33	26.92
3. Loss in soil fertility	30.00	32.00	26.67	29.56

Wastewater in Vrisha bhavathi river is a perennial source in the study area and farmers have been using for agricultural purpose

es. In this background the present study asked farmers to report whether they have observed any impact on groundwater level due to regular wastewater flow. Information provided by farmers has been presented in Table 13, which illustrates that groundwater level in the study area has increased as more than 86 per cent of farmers reported. Farmers in all categories also have agreed on this point, confirming increase in groundwater level. Further, farmers informed that the water quality has been deteriorated because of wastewater. More than 86 per cent of farmers reported about poor groundwater quality in the study area and mentioned that it is because of wastewater flow in the area.

TABLE 13: IMPACT OF WASTEWATER USE IN AGRICULTURE ON GROUND WATER LEVEL

Farmers 'groups	Ground water level			
	Increased	Per cent	No change	Per cent
Small Farmers	58	82.86	12	17.14
Medium Farmers	44	88.00	6	12.00
Large Farmers	28	93.33	2	6.67
All	130	86.67	20	13.33

Source: Survey data

This study attempted to examine whether there was any conflict between neighbour farmers due to wastewater use in agricultural field and its negative impacts discussed above. Table 14 reports that nearly 85 per cent of farmers reported that there was no conflict or quarrel between farmers as majority of them are using wastewater and everybody has been experiencing the same problem. It shows that large number of farmers have accepted the situation, but over 15 per cent of farmers reported that there were some minor arguments

whenever crop loss incurred, particularly in case of vegetable cultivation. However, none of them have taken it seriously as reported by farmers.

TABLE 14: CONFLICTS BETWEEN NEIGHBORING FARMERS DUE TO WASTE WATER USE		
Farmers' groups	Quarreled with neighboring farmers	
	Yes	No
Small Farmers	18.57	81.43
Medium Farmers	14.00	86.00
Large Farmers	10.00	90.00
All	15.33	84.67

Source: Survey data

Overall impact of wastewater use in agriculture was observed in the value of land as opined by farmers, because during survey farmers said that application of wastewater reduced soil quality along with other health and environmentally adverse effects. As a result, purchasers of land do not come to that place and value of land has not increased in these areas for agricultural purposes. Information presented in Table 15 shows that nearly 83 per cent of farmers stated that land value has decreased in the area. Farmers mentioned that land adjacent to roads fetch some high value for its commercial use otherwise buyers hesitate to purchase these lands. It shows that use of wastewater for agricultural activities has reduced agricultural land value though the area is close to Bengaluru city.

TABLE 15: IMPACT OF WASTEWATER APPLICATION IN AGRICULTURE ON LAND VALUE		
Farmers' groups	Land Value	
	Increased	Decreased
Small Farmers	20.00	80.00
Medium Farmers	18.00	82.00
Large Farmers	10.00	90.00
All	17.33	82.67

Source: Survey data

Considering the adverse impacts of wastewater use an attempt was made to elicit opinion of farmers whether they would like to change method of irrigation from wastewater to freshwater. The answer was positive stating that more than 81 per cent of farmers (Table 16) would like to change irrigation to freshwater provided a freshwater source. Due to negative factors like decreased value and contaminated water, pollution, health and environmental problems farmers feel to adopt fresh water agriculture than wastewater. This opinion of farmers indicates that owing to freshwater scarcity and easy availability of wastewater they have adopted wastewater agriculture.

TABLE 16: FARMERS OPINION CHANGING SOURCE OF IRRIGATION FROM WASTEWATER TO FRESHWATER		
Farmers' groups	Would like to Change	Would not like to change
Small Farmers	75.71	24.29
Medium Farmers	86.00	14.00
Large Farmers	86.67	13.33
All	81.33	18.67

Source: Survey data

CONCLUSION

Urban wastewater, a pollution, is increasing with urbanization across countries and has become a source of livelihood for farmers in rural areas adjacent to urban areas. Widespread use of wastewater in agriculture poses health and environmental problems. An attempt was done to understand health and environmental impacts, which revealed that both health and environmental impacts are experienced by farmers. The major health problems are skin allergy, weakness or anemia, body itching, etc. People working in wastewater based agricultural field were compelled to spend on treatment, thus putting more burden. Presence of wastewater also led to problem of mosquito and flies, thus becoming source of vector based diseases. Wastewater application has also created several environmental problems like bad smell in the region, plastic waste, acid content in water, mosquito problem, reduction in crop yield, weed problem on agricultural fields, etc. Deteriorated soil and water quality compelled farmers to change cropping pattern towards crops sustaining wastewater, thus affecting diversity in cultivation. All this calls for measures to reduce adverse health and environmental impacts of using wastewater. Indeed, affected people look for medical help such as health camps, treatment and awareness creation, which need to be taken up on priority basis. Besides, action is also required to arrest environmental impacts of wastewater on soil and other resources.

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