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Economic Assessment of Groundwater Pollution With Special Reference to Tirupur District

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Abstract- **The disposal of effluents on land has become a regular practice for some industries. Industries located in Tirupur district, Tamilnadu dispose their effluents on land and the farmers of adjacent farmland have complaint that their shallow open-well get polluted and also salt content of the soil started buildings slowly. This study attempts to capture the environmental and socio-economic impacts of an industrial effluent irrigation in different industrial location at Tirupur District, through primary surveys and secondary information. The continuous application of polluted groundwater for irrigation has also resulted in rising salinity in soil. To some extent, farmers are coping with the problem by cultivating salt-tolerant crops and/or by using other sources such as river water for irrigation. The study specifically focused on how groundwater affects irrigation and drinking water in Tirupur District. This study is descriptive and exploratory in nature. With the descriptive design, the researcher plans to gain more information about a phenomenon within a particular field of study by examining the characteristics of a specific single population. Exploratory study would provide an in-depth exploration of a single process. The finding of the study emphasized the need for assessing the water quality and make efforts to improve the water quality. It is recommended that farm households should be given opportunity to participate in mechanization of agriculture, and rural development programmers which would enhance their new livelihood activities and living standard is initiated and encouraged.**

Keywords- Discharge of effluents, land cultivation, Groundwater pollution, Water quality

I. INTRODUCTION

A large number of economic activities are affected by water pollution and it creates a serious problem to the development of the regions. The problem of water pollution acquires greater relevance in the context of an agrarian economy like India. The general debate is going on in the world and in India about the health of rivers and their positive and negative impact on farm activities, livestock and human health.

Many rivers lost their genuinty and natural characters and severely affected by the pollution from more number of unwanted pollutant sources from the environment. One such river in Tirupur district, Tamilnadu, which is polluted, is Noyyal River. This river water was affected because of millions of liters of untreated effluents released from the nearby bleaching, dyeing and printing units. Now the river Noyyal has become "Extinctive River" and it causes a huge loss to economic life of farm households.Industrial disposal of effluents on land and the subsequent pollution of groundwater and soil of surrounding farmlands is relatively new area of research. The environmental and socio-economic aspects of industrial effluents irrigation have not been studied as extensively as domestic sewage waste based on irrigation practice at least for a country like India. The disposal of effluents on land has become a regular practice for some industries. Industries located in Tirupur district, Tamilnadu dispose their effluents on land and the farmers of adjacent farmland have complaint that their shallow open-well get polluted and also salt content of the soil started buildings slowly.

The study attempts to capture the environmental and socio-economic impacts of an industrial effluent irrigation in different industrial location at Tirupur District, through primary surveys and secondary information. The negative externalities of industries have led to loss in cropland, soil, production and changes in cropping pattern, health problems and socio-economic imbalance in these regions. At present, the industrial pollution causes labour migration, unemployment or change in employment pattern, decrease in share of farm income to the total household income, deterioration of drinking water in wells and bore-wells *etc.*

II. ISSUES ASSOCIATED WITH INDUSTRIAL EFFLUENT IRRIGATION

Marginal-quality water contains one or more chemical constituents at levels higher than in freshwater. The continuous disposal of industrial effluents on land, has limited capacity to assimilate the pollution load, has led to groundwater pollution. The quality of groundwater in shallow open wells surrounding the industrial locations has deteriorated, and the application of polluted groundwater for irrigation has resulted in increased salt content of soils. In some locations, drinking water wells (deep bore wells) also have a high concentration of salts. Since the farmers had already shifted their cropping pattern to salt-tolerant crops and substituted their irrigation source from shallow open-wells to deep bore-wells and/or river water, the impact of pollution on livelihoods was maximizing.

Farmers in the adjoining areas have found the groundwater unsuitable for irrigation. In some cases, drinking water wells (deep bore-wells) have also been affected. Continuous application of polluted groundwater for irrigation has also resulted in rising salinity in soil. To some extent, farmers are coping with the problem by cultivating salt-tolerant crops and/or by using other sources such as river water for irrigation.

III. REVIEW OF LITERATURE

The following are the reviews related with objectives of the research study

1. Impact of water pollution

Sachinananda Mukerjee Sand Nelliyat (2007) stated in their study "Groundwater Pollution and Emerging Environmental Challenges of industrial Effluent Irrigation in Mettupalayam Taluk," the results indicate that the disposal of industrial effluents on land, which has limited capacity to assimilate the pollution load, has led to groundwater pollution. The study also showed that the environmental impacts of industrial effluent irrigation is different for different sites, so the farmers had shifted their cropping pattern to salt tolerant crops and substituted their irrigation sources from open wells to deep bore wells. Ninety four % of the respondents stated their drinking water is polluted.

Bhagirath Behra and Ratna Reddy (2000), study on "Environment and Accountability – Impact of Industrial Pollution on Rural Communities" has attempted to study the environmental impact of water pollution on rural communities in general and on agricultural production, human health and livestock in particular. To conduct this survey the authors have selected a village under the industrial belt in Metak district of Andhra Pradesh. The entire village has been suffering from various diseases arising out of water pollution. Livestock in the village were also facing serious health problems. It was identified by the authors that the other serious problems were infertility, low milk production, drastic declining in agricultural productivity due to high TDS, EC, etc., the authors have used CVM to estimate the economic losses, damages and willingness to pay the compensation.

2. Quality of drinking water

Balakrishnan et al. (2008) to assess "Impact of Dyeing Industrial Effluents on the Groundwater Quality in the Kancheepuram (India)" studied to investigate the effects of dyeing industrial effluents on the quality of groundwater in and around the Kancheepuram town with reference to drinking and irrigation purposes. Twenty groundwater samples were collected from various parts of the dyeing industrial regions and samples were analyzed with standard analytic methods.

The concentrations of TDS, Chloride Hardness, Sulphate, Nitrate, Iron and Lead were found to be higher and exceeded the permissible limits of BIS and WHO standard. The User Specific Water Quality Indices (USWQI) of each groundwater samples were evaluated for both purposes. The USWQI of the groundwater samples varied from 85 to 30 for drinking purpose and 89 to 50 for irrigation purpose. The results show that the groundwater quality in the present study area can be categorized under 'good' for irrigation and 'fair' for drinking water.

Rita Kant (2011) in her study on "Textile Dyeing Industry –An Environmental Hazards," assessed about the damage caused by synthetic dyes has an adverse effect on all forms of life. The organic materials show allergic reactions. The colloidal matter present with colors and oily scum increases the turbidity, bad foul smell in water. These effluents also reduce soil productivity and those who consume the water and agricultural products of affected areas harm the health problems to the human and livestock's.

3. Statement of the problem

The effluent released by textile industries causes adverse effect on soil properties, seed germination and also causes reduction in the growth of the seedlings. The negative externalities of industries have led to loss in cropland, soil, production and changes in cropping pattern, health problems and socio-economic imbalance in these regions. Now the industrial pollution causes labour migration, unemployment or change in employment pattern and decrease in share of farm income to the total household income *etc*.

In Tamil Nadu, four major districts - Coimbatore, Tirupur, Erode and Karur are noted for textile industries. Out of these four districts, Tirupur have many Dyeing and Bleaching industries, the effluents from these discharged into the Noyyal river have been affecting the water sources, land, human and livestock in Tirupur

district. Hence, the researcher has attempted a study on the economic assessment of groundwater pollution on agriculture, which specifically focuses on how groundwater affects irrigation and drinking water in Tirupur District.

IV. OBJECTIVE OF THE STUDY

The objectives of the study are

- To study the socio-economic characteristics of the farm households in selected villages in Tirupur District.
- To assess the external effects of groundwater pollution on the land quality, water resources, cropland, changes in water quality and perception of future challenges of farm activities.

V. METHOD OF DATA ANALYSIS

The research considers two types methods used to analyze the data; field investigations and questionnaire analysis. The field investigations concerns about the potential land holdings and the quality of irrigated water. Four villages were selected because those villages groundwater were polluted due to the release of effluents in the nearby lands and Noyyal River. Moreover, regulations and reuse criteria of similar circumstances were cited.

The questionnaire was designed to address the following: Socioeconomic information on farming households, Land ownership, Irrigation quantities, cost, quality, irrigation methods and irrigation schedule and perception of farmers facing challenges.The questionnaire was discussed with local farm households to understand the local conditions and all possible answers were captured. A pre-test was carried out with a sample of 15 farmers and some adjustments were included in the final version of the questionnaire. SPSS 16 software was used to analysis the questionnaire and finds the results for the study.

VI. RESULTS AND DISCUSSION RESULT ANALYSIS

The social and economic characteristics considered relevant for the study are selected based on the exploration of the available literature. Agriculture provides the principal means of livelihood for over 58.4 per cent of India's population. It contributes approximately about one-fifth of total gross domestic product. Agriculture provides significant support for economic growth and social transformation of the country. As one of the world's largest agrarian countries, India has a monsoon-dependent farming system, with large areas receiving inadequate rainfall. Moreover, much of this rainfall is restricted temporarily to few months while the rest of the years predominantly remain dry. In such circumstances, it is only with well-irrigation that cultivation on an annual basis is possible. Moreover, irrigation has acquired additional importance since the green revolution in India. Agriculture in this area is mainly affected because of water contamination. The results presented in this chapter were derived from the data collected from the sample respondents.

1. Socio-Demographic Characteristics of the Respondents

The general information about the respondents relating to their age, social group and marital status is tabulated and interpreted in Table.

Table 1 Socio-Demographic Profile of the Respondents.

Indicators		Kodumanal	Kathanganni	Nallur	Anaipalayam	Total
Age (in years)	25-35	4 (13)	4 (11)	2 (6)	3 (9)	13(10)
	35-45	12 (37)	17 (45)	12 (38)	11 (35)	52 (39)
	45-55	11 (34)	12 (31)	10 (31)	15 (47)	48 (36)
	55-65	5 (16)	5 (13)	8 (25)	3 (9)	21 (15)
Religion	Hindu	29 (91)	36 (94)	30 (94)	29 (91)	124 (92)
	Christian	1 (3)	1 (3)	1(3)	2 (6)	5 (4)
	Muslim	2 (6)	1 (3)	1 (3)	1 (3)	5 (4)
Social Group	OC	3 (9)	2 (6)	0	3 (9)	8 (6)
	BC	23 (72)	29 (76)	21(66)	19 (60)	92 (69)
	SC/ST	6 (19)	7 (18)	11 (34)	10 (31)	34 (25)
Marital Status	Married	24 (75)	34 (89)	26 (81)	27(84)	111 (83)
	Unmarried	8 (25)	4 (11)	6 (19)	5 (16)	23 (17)
Family Type	Joint Family	12 (38)	13 (34)	15 (47)	11 (34)	51 (38)
	Nuclear Family	20 (62)	25(66)	17 (53)	21 (66)	83 (62)
Educational Qualification	Illiterate	5 (16)	17 (45)	15 (47)	10 (31)	47 (35)
	High School	10 (31)	11 (29)	9 (28)	12 (38)	42 (31)
	Secondary	8 (25)	4 (10)	6 (19)	5 (16)	23 (17)
	Graduate	4 (13)	5 (13)	1 (3)	3 (9)	13 (10)
	Others	5 (15)	1 (3)	1 (3)	2 (6)	9 (7)
Total		32 (24)	38 (28)	32(24)	32 (24)	134 (100)

Source: Computed from field survey (2018)

1. Age

Nearly one-fifth (15 per cent) of the respondents are fall in the age group of 55-65 years. Thirteen per cent of the respondents fall under the age group of 25-35 years. In total, 75 per cent respondents are between the ages of 35 and 55 years which compares fairly well with the productive age range.

2.Religion

It was found that, from the total, 124 respondents were Hindu; of the respondents fall under the religion of Christian and Muslim are four per cent each. Majority of the respondents belong to Hindu religion.

3. Social Group

Highest number of respondents belonging to the Backward Caste in the sample villages was 72 per cent in Kodumanal, 76 per cent in Kathanganni, 66 per cent in Nallur and 60 per cent in Anaipalayam. In

Kodumanal, Kathanganni, and Nallur, Scheduled Caste constituted 19, 18 and 34 per cent and Other Caste (OC) formed 9 and 6 per cent in Kodumanal and Kathanganni respectively. In Anaipalayam, 9 per cent belonged to Other Caste and 31 per cent were from Scheduled Caste. Overall, 69 per cent respondents were from backward communities, 25 per cent from Scheduled Caste and 6 per cent from Other Castes.

4. Marital Status

Marriage is an important institution in most societies. It brings an important and major change in the lives of men and women irrespective of their economic position. The analysis shows that in table 4.2.2, from the total respondents, 83 per cent were married and 17 per cent were unmarried. Majority of the respondents were married.

5. Family Type

From the analysis, it is observed that, nuclear family constitutes the highest per cent age of 62, 66, 53 and 66 in Kodumanal, Kathanganni, Nallur and Anaipalayam villages respectively. The respondents of 38, 34, 47 and 34 per cent in all four villages were living in joint families respectively. Thus, it is observed that, majority (62 per cent) of the respondents prefer only nuclear family system.

6. Educational Qualification

It was further observed from the table 4.2.2 that, among the respondents 47 (35 per cent) are illiterate. Among the group, 47 per cent in Nallur, 45 per cent in Kathanganni, 31 per cent in Anaipalayam and 16 per cent in Kodumanal. 38 per cent of respondents qualified high school level in Anaipalayam was highest and lowest per cent of 31, 29 and 38 per cent of respondents in Kodumanal, Kathanganni and Nallur. Highest percentage 25 per cent in Kodumanal completed their HSC and lowest of 10 per cent in Kathanganni. Further it was observed that 16 per cent of respondents studied up to college level. 9 per cent of respondents studied other courses like diploma, certificate courses to lead their livelihood.

7. Acres of Land Cultivated

Table 2 The table shows about the water availability in open wells and bore wells.

Land Cultivation	Kodumanal	Kathanganni	Nallur	Anaipalayam	Total
Below 2 Acres	07(22)	17(45)	18(56)	12(37)	54(40)
2-4 Acres	10(31)	08(21)	07(21)	11(34)	36(27)
4-6 Acres	03(9)	05(13)	02(6)	01(3)	11(8)
Above 6 Acres	12(37)	08(25)	5(15)	08(25)	33(25)
Total	32(24)	38(28)	32(24)	32(24)	134 (100)

8. Availability of Water for Agriculture

The table shows about the water availability in open wells and bore wells.

Table 3 Availability of Water for Agriculture.

Water Availability	Kodumanal	Kathanganni	Nallur	Anaipalayam	Total
Good	3 (9)	4 (10)	1 (3)	10 (31)	18(13)
Fair	11(34)	16 (42)	17 (53)	9 (28)	53(40)
Bad	18 (56)	18 (47)	14(44)	13 (41)	63(47)
Total	32(24)	38(28)	32(24)	32(24)	134(100)

It is observed from the table and chart that,56 per cent in Kodumanal, 47 per cent in Kathanganni, 44 per cent in Nallur and 41 per cent in Anaipalayam said that availability of water is not suitable for cultivation. On an average, 40 per cent of the respondents said availability of water is fair and 13 per cent said it is good. Nearly one-half of the respondents stated that the water available for cultivation was not enough.

9. Water Quality for Agriculture

The table shows the water quality for agricultural purpose.

Table 4 Water Quality for Agriculture.

Water quality	Kodumanal	Kathanganni	Nallur	Anaipalayam	Total
Good	7 (22)	5(15)	2 (6)	5(15)	19(14)
Fair	12(37)	16 (42)	14 (44)	11(34)	53(40)
Bad	13 (41)	17 (45)	16 (50)	16(50)	62(46)
Total	32(24)	38(28)	32(24)	32(24)	134 (100)

Source: Computed from field survey (2018)

In the table it is shown that, 50 per cent of the respondents in Nallur and Anaipalayam, 45 per cent in Kathanganni and 41 per cent in Kodumanal said that the water quality is very bad. On an average 40 per cent of the respondents' felt that water quality is fair and remaining 14 per cent said their quality of water for agriculture is good.

10. Characteristics of Changes in Water Quality

The changes in water quality were explained in the table below.

Table 5 Characteristics of Changes in Water Quality.

Kind of changes	Kodumanal	Kathanganni	Nallur	Anaipalayam	Total
Turbidity	15(47)	18 (47)	13(41)	7 (22)	53(39)
Taste and Odour	3(9)	9(24)	5(16)	9(28)	17(13)
Colour	2(6)	2 (5)	1(3)	10 (31)	15(11)
Salinity	12(37)	9(24)	13(41)	6(19)	50(37)
Total	32(24)	38(28)	32(24)	32(24)	134 (100)

Source: Computed from field survey (2018)

11. Result of Water Quality in Selected Villages

Water samples collected from the selected villages and the analysis was conducted by using only nine parameters. A total number of nine samples, three samples from each village have been analysed. The table below brings out the characteristics of parameters and its specific values identified from testing the samples.

Table 6 Water sample Test results.

S N	Parameters	Kodumanal			Kathanganni			Nallur			Anaipalayam		
		Site I	Site II	Site III	Site I	Site II	Site III	Site I	Site II	Site III	Site I	Site II	Site III
1.	pH	8.30	8.28	7.71	7.81	7.91	8.59	8.70	7.22	7.27	9.42	8.02	8.91
2.	EC(dS m-1)	6.09	7.15	4.13	4.11	4.12	1.35	5.60	5.99	5.79	9.08	6.3	5.6
3.	Colour	Co. less	Co. Less	Co. less	Co. les	Co. less	Co. Les	Co.le s	Co.le s	Co.le ss	Co.le ss	Co.l ess	Co.l ess
4.	Dissolved Oxygen(mg/l)	7.1	7.44	8.5	8.60	8.72	9.2	7.04	8.21	8.36	5.9	2.9	6.3
5.	BOD (mg/l)	128	123	102	93	91	74	131	119	116	130	141	152
6.	C OD (mg/l)	325	318	252	241	234	193	344	295	297	102	141	153
7.	TDS (mg/l)	3880	4560	2630	2612	2640	857	3246	3828	3720	3990	5730	3510
8.	TSS (mg/l)	400	428	140	120	160	86	380	386	320	320	316	360
9.	Chloride (mg/l)	40	60	30	34	38	13	50	56	50	62	59	65

Source: Department of Environmental Science, TNAU

Various Physical chemical and biological parameters were studied and given in the analysis were colour, Electrical Conductivity (EC), Total Dissolved Solids (TDS), pH, Total Suspended Solids, Chemical Oxygen Dissolved (COD), Biological Oxide Dissolved (BOD), and Chloride, Dissolved Oxygen. The values were compared with the WHO Standard values which are given in the same table. The result indicates that the quality of water considerably varies from one sample site to another. This wide variation is because of salinity and other dissolved materials from the nearby dyeing, bleaching and textile units in the study area.

12. Summary of Findings

A summary of the major findings from the analysis is recapitulated in the following section. Forty six per cent respondents water quality for irrigation was appalling; forty per cent of water is fair and remaining 14 per cent said their quality of water for agriculture is good. Thirty nine per cent of the respondents' water turbidity has been changed. Turbidity is highest in Anaipalayam (31per cent) and lowest in Nallur (3 per cent).Water salinity is more in Nallur (41 per cent), and least in Kathanganni (19 per cent). Overall taste and odour was 13 per cent in all the villages. Sixty three per cent of the respondents cropping pattern has been changed and remaining 37per cent no changes in cropping pattern, but yield from the land was reduced. The cropping pattern has changed in all the villages – from 53 per cent in Kathanganni to 78 per cent in Nallur.

VII. CONCLUSION

The assessment of variables related to social and economic perception of farmers is difficult because there is possibility of overestimating the findings. Moreover, the effects due to permanent discharge of effluents to the farm lands and Noyyal River are difficult to assess. Totally, 134 households were selected for the study from four villages that included farm households from different groups on the basis of their economic category i.e. landholdings, type of irrigation, water quality, and farm activities.The issues assume tremendous importance as groundwater pollution has become a major challenge in national resource management. Once upon a time, farmers' always depends on Noyyal River and open well for irrigation, but now-a-days depending on bore wells and rain water for their farm cultivations.

It is also deteriorated due to groundwater pollution. The dodge in the regulatory system assist this process. Despite all these actions, the farm households did not succeed in influencing either industries or regulatory authorities. The movement could not sustain because a majority of the population have shifted to jobs in the industry leaving agriculture. It is obvious that mere passing of laws and creating institutional structures are obligatory, however not adequate to tackle the environmental issues. Regulations must be implemented in their precise perception of the agriculturists. Institutions should be physically powerful, with more sovereignty and powers, to covenant with the problems and provide accurate solutions.

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