

# Social, Economic and Health Impact of Industrial Pollution in Dindigul District, Tamil Nadu: Protocol for an Explanatory Study

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## ABSTRACT

**Background:** Pollution of air, water and soil poisons the environment and cause diseases. The illness in a social context needs further exploration in this particular context. That also led to a reduction in agricultural production, drinking water contamination, and cause illness to both human and animal. That is how it is contributing to alterations in social structure specifically the social institutions. By studying the problem of pollution, we address the impact of pollution on health, society and the environment as a whole.

**Methods/Design:** For the mentioned objectives, the explanatory design was adapted. The study will have three components. A quantitative survey using an interview schedule conducted among the members of the selected villages of Dindigul, district. Specific questions on Social, Economic and Health impacts of industrial pollution will be administered. There will be two different locations, one closer to the Tanneries and villages located 10 Kilometers away from the Tanneries. Even the later villages there are other industries such as handlooms. This will help to understand the difference in the impact of industrial pollution with specific reference to tanneries. Qualitative data aims to conduct in-depth interviews among the village leaders and Focus Group Discussions among the community members. The basic water and soil tests form the villages near tanneries will give additional evidence to understand the physical effects of pollution on the rural environment. The study has received ethical approval from the Institutional Ethics committee.

**Discussion:** Due to the industrialization in the city of Dindigul and the surrounding area, the pollution from industrial outlets not only affect the environment, but it also affects the social structure, interactions, and employment.

**Keywords:** industrial pollution, social impact, economic, Tamil Nadu, Tanneries

## 1. Background

Meier WL in Climate, Climatic Change, and Water Supply (National Research Council (U.S.), 1977) discussed the reduction in available water results in effects ranging from

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inconvenience to serious economic loss. Water shortages can be generated by causes such as catastrophic damage to facilities, the deficit in water supply, inadequate distribution system, improper management, demand increase, and pricing of water. Mallick and Roldan-Rojas (Mallick & Roldan-Rojas, 2015) from Bangladesh found, conflicts during the water collection between the inhabitants and also within the households. It also impacted on the social connectedness and responsibilities among the members of the community Turton and Ohlsson (Turton & Ohlsson, 1999) paper attempted to a deeper understanding of the social dimension of water scarcity and social stability by developing some key concepts further in the lines of Ohlsson second-order scarcity. Lukasiewicz et al.(Lukasiewicz et al., 2013) studied Aboriginal elders on people's reactions to water policy using the social construction approach on the environment affects, found, personal experience of the respondents play a vital role and the policy rarely acknowledge them and results in conflict. Lund JR, (Lund, 2015) years review suggested the problems could be solved by the focus on longer duration studies to develop and integrate ideas across disciplines. Kähkönen (Kahkonen, 1999) reviewed the role of social capital in community-based rural water and urban sanitation delivery on irrigation management, rural drinking water delivery and urban sanitation. Walker et al. (Walker et al., 2015) paper suggest those involved with environmental and water resources planning and management need to consider the social responses as well as the economic and environmental impacts of our decisions.

## 1.1 Rationale

Due to the industrialization in Dindigul, drinking water contamination in the surrounding villages, and migration of the population that contributes to the re-emergence of some of the infectious diseases. Use of Chromium in the tannery industry causes different problems. This affects the environment the social structure and interactions. To achieve sustainable development one need to look into all aspects of society.

The present study aims at studying, social and environmental impacts of industrial pollution on the population of Dindigul district, Tamil Nadu. During 1989-90, principal investigator of this study has done a study on Environmental impact of Tannery pollution on rural areas of Dindigul district for his Master's thesis.

The present study would like to answer the following questions:

- What are the effects of water contamination through with pollutants on health, environment and society as a whole?
- What are the effects of pollution on livestock and agriculture in the surrounding villages of tanneries through the usage of polluted water and soil in the surroundings?
- What are the long-term consequences of industrial pollution on the rural environment in terms of social structure, the landowning and another economic wellbeing in the surrounding areas of tanneries?
- What are specific consequences such as illnesses, deaths and other untoward events in the affected villages compared to the non-affected villages?

Besides, the researcher also would like to document, the distribution and determinants of health and diseases morbidity, injuries, disability and mortality in population due to water pollution in addition to the social impacts. The researcher would also like to study the exposure of individuals to the industrial and occupational environment. The study will look into the degradation of air, water and food and study toxicity of chemicals such as Chromium and their forms as perceived by the population. Is there a reemergence of infectious diseases due to water contamination, skin and breathing disorders and their effect on social interactions, exclusion and so on?

Use of Chromium in the tannery industry causes different problems. Chromium is one of the hazardous substances. It is also a major toxic metal with multiple effects. Even though the Chromium a natural element in earth's crust, the Chromium (0) and Chromium (VI) which are discharged as an effluent from the pollutant industry are hazardous. Chromium (VI) caused health problems such as liver, heart, respiratory illnesses, reproductive health failure, cancer of brain, kidney, breast, uterus and Gastro-intestinal. The researcher would like to look into how it affects the family structure and effects of reproduction on family and community as a whole.

### **1.3. Objectives**

I aim to study the social, economic and health impacts of industrial pollution caused by the tanneries among the members of the selected villages of Dindigul district, Tamil Nadu.

#### *Specific Objectives*

1. To study the Economic impact of industrial pollution with specific reference to Tannery pollution in Dindigul district.
2. To study the Social impact of industrial pollution with specific reference to Tannery pollution in Dindigul district.
3. To study the health impact of industrial pollution with specific reference to Tannery pollution in Dindigul district.

#### *Secondary Objectives*

1. to study the effect of industrial pollution on agricultural production in the selected villages of Dindigul district
2. To study the effect of industrial pollution on the displacement of people in the selected villages of Dindigul district
3. To study the effect of industrial pollution on the drinking water among the members of the selected villages of Dindigul district

## **2. Methods/Design**

### **2.1 Study type/design**

For the mentioned objectives, the explanatory design was adapted. The study will have three components. A quantitative survey using an interview schedule conducted among the members of the selected villages of Dindigul, district. Specific questions on Social, Economic and Health impacts of industrial pollution will be administered. There will be two different locations, one closer to the Tanneries and villages located 10 Kilometers away from the Tanneries. Even the later villages there are other industries such as handlooms. This will help to understand the difference in the impact of industrial pollution with specific reference to tanneries. Qualitative data aims to conduct in-depth interviews among the village leaders and Focus Group Discussions among the community members. The basic water and soil tests form the villages near tanneries will give additional pieces of evidence to understand the physical effects of pollution on the rural environment.

This study has three components.

1. Primary data collection using an interview schedule
2. Qualitative data collection
3. Water and Soil testing from the samples collected from the affected villages.

## **2.2. Study setting**

Dindigul district, Tamil Nadu.

## **2.3 Participants and sample size**

All men and women above 18 years in selected villages in Dindigul district will be included in the study. It is proposed to study the two sets of 10 villages, a. Located near the tanneries and b. Located away from the tanneries. It is proposed to collect data from each of the selected 400 households. Basic information about the respondents and all the member of the households will be collected. Besides, the social, economic and health impacts of industrial pollution will be collected from the respondents.

## **2.4 Sampling**

In total there will be 400 respondents for the quantitative study. Sample size calculated using OpenEpi, Version 3, open-source calculator with an assumption that the proportion of the population in the villages located near tanneries having the intention to displace themselves from those villages is 65% and the same for the villages located farther from the tanneries as 40%, with the 95% confidence interval, with 90% power, with the ratio of controls to cases as 1 estimated 90 each for both the set of villages. Double the size for design effect due to multistage sampling of clusters and it was rounded to 200 each to account for refusals or ending up with incomplete interviews. This will lead to 400 respondents studied using a structured tool for a quantitative study. It is proposed to have 50% of the respondents to be women. Respondent selection for the quantitative study will be randomly drawn from the Electoral list from the selected 20 villages of Dindigul district.

For qualitative component of the study, 10 Focus Group discussions (FGD) in affected villages and 10 FGDs in non-affected villages will be conducted to discuss on the importance of water on social and economic aspects of the population. There will also be 10 in-depth interviews among the village leaders of the affected villages and 10 in-depth interviews from the non-affected villages on the topic. There are 10 cases studies, which are based on the relevant cases, and interest to the researcher that will make the researcher understand the subject better. Besides, the investigators will be engaged in observation and documentation some of the physical characteristics of the villages. Outlines of the villages will be drawn using members of the community on water and agricultural sources. For objective 3, water and soil samples will be collected from the villages located near the tanneries in Dindigul. All men and women above 18 years of age are included in the study. However, those who are not having good health and unable to participate will be excluded.

## **2.5 Variables and data sources**

The dependent variables for the study are the change in social structure, interaction and control over the resources, the opportunity cost of pollution, and illnesses associated with industrial pollution. The independent variables identified through the preliminary literature review are as follows. Household characteristics such as, gender, age, marital status, literacy, live and work outside the village, monthly income, occupation, poverty status, caste status, migration, expenditure and savings, land use and agriculture, housing and infrastructure, drinking water quality, sanitation facility, environmental factors, health and illness, perceptions and expectations on pollution, social integration and cohesion, natural increase, physical environment, and problem and suggestions on industry pollution.

## **2.6 Bias**

As study requires data on industrial pollution people may have different perspectives according to their occupational and income status. There would also be members of the community who work in the tanneries. Their perspectives will vary with the general population.

## **2.7 Limitations**

The assessment of the linkage between exposure (industrial pollution) and social, economic and health may not be directly answered as the study adapts Cross-sectional design.

## **2.8 Plan for data analysis**

Data will be analysed using SPSS for quantitative data and manual methods for qualitative data. The data will be analysed for all aspects associated with the problem of industrial pollution and its impacts on Social, Economic and Health. The impacts of social aspects will be analysed by studying how it is affecting the social structure, interaction and control over the resources. For economic impact, the opportunity cost of pollution on the livelihood will be studied. For health, the specific illnesses associated with industrial pollution will be studied.

For Water and Soil testing from the samples collected from the affected villages, the following test will be performed.

1. Biochemical oxygen demand (BOD) will be measured
2. Saline deposits over the soil make crop production unsuitable, thus, the following parameters will be measured for the collected water samples at School of Chemistry, Madurai Kamaraj University. Colour, Odour, Turbidity, Electrical conductivity, pH, Total Alkalinity, Total Hardness and softness, metal ions such as Ca, Mg, Fe, Mn and anions such as NO<sub>3</sub><sup>-</sup>, Cl<sup>-</sup>, F<sup>-</sup>, SO<sub>4</sub><sup>2-</sup> and phosphate. The soil samples will be dried. Atomic Absorption Spectroscopy (AAS) and Inductively coupled plasma mass spectrometry (ICP-MS) will be measured for metal content.

## **2.9 Ethical considerations**

The Principal Investigator obtained the Ethical clearance of the Institute Ethics Committee, Sree Chitra Tirunal Institute for Medical Science and Technology, Trivandrum. It is a community-based study. The study will be conducted in the Dindigul District of Tamil Nadu. The PI will directly contact the villagers for the study. For the water and soil testing, a chemistry expert from Madurai Kamaraj University will collaborate and support. Only patients voluntarily consent for the study will be included in the study. They will be advised about the voluntary nature of participation and their right to withdraw from the study whenever they feel so. The participant information sheet and informed consent form are prepared in lay language to make sure that each participant thoroughly comprehends the nature of the study and what is expected from them during the study. Data collection will be scheduled as convenient to the participants. Study is not directed at any particularly vulnerable population. No harms are involved in the study.

The researcher will ensure the confidentiality of participants and data security by undertaking certain measures as given below.

1. The communication details of the principal investigator are mentioned in the participant information sheet. Each participant can contact for further clarifications if needed.
2. Data will be collected at place and time convenient for the participants.

3. The researcher will ensure privacy.
4. The personal information of the participants masked during analysis.
5. The researcher will remove face sheets containing identifiers from survey instruments after the data entry.
6. Data will not be shared with anyone.
7. Principal Investigator will keep the data safely.
8. Computerized records will have codes for anonymity.

### 3. Discussion

This study will provide insight on the impact of industrial pollution on social and environment of the population of Dindigul district, Tamil Nadu. Mallick and Roldan-Rojas (Mallick & Roldan-Rojas, 2015) found, conflicts during the water collection within the households and also impacted on the social connectedness and responsibilities among the members of the community. Turton and Ohlsson (Turton & Ohlsson, 1999) understood the social dimension of water scarcity and social stability. Likewise, in this present study the social impact will be analysed in terms of the industrial pollution effect on the social structure, interaction and people's control over the resources. Meier, (National Research Council (U.S.), 1977) discussed the reduction in available water results in effects ranging from inconvenience to serious economic loss. Economic impact will be assessed based on the opportunity cost of pollution on the livelihood. The health impact will be assessed based on the specific illnesses associated with industrial pollution. The study will provide data that will help in enhancing the policies associated with industrial development that will address the needs of the community based on the findings on social, economic and health impacts of industrial pollution.

### List of Abbreviations

FGD	Focus Group discussions
BOD	Biochemical oxygen demand
AAS	Atomic Absorption Spectroscopy
ICP-MS	Inductively coupled plasma mass spectrometry
PI	Principal Investigator

### Declarations

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**Authors' contributions:** Srinivasan Kannan conceived the study. Srinivasan Kannan wrote the article.

**Ethics approval and consent to participate:** Sree Chitra Tirunal Institute for Medical Sciences and Technology Institutional Ethics Committee (SCT/IEC/1495/OCOTBER-2019) granted ethical approval. All participants will be provided with a written informed consent before the study.

**Consent for publication:** Not applicable.

**Competing interests:** The authors declare that they have no competing interests.

**Availability of data and materials:** Not applicable

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