

## An Assessment of Health Issues Present in Kathikkudam: A Green Criminological Perspective

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### ARTICLE INFO

Received: December 14, 2019  
Accepted: January 12, 2020  
Published: January 31, 2020  
Volume: 2  
Issue: 1

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### KEYWORDS

*Green Criminology,  
Environmental Crime,  
Hazardous Waste Disposal,  
Pollution, Diseases*

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### ABSTRACT

Improper disposal of hazardous waste may negatively affect human beings and other living organisms and the whole environment itself; hence it is considered as an offence against environment. A school of criminology known as 'green criminology' studies crimes and harms committing against environment which adversely affect ecology, living and non-living organisms. Illegal and improper hazardous waste disposal poses severe threats to humans which may appear in the form of health issues such as various diseases may be caused to the people living in surroundings. But most of the time it may not be appeared or come into lime light till an epidemic is outburst. In Kathikkudam there are chemical factories which manufacture pharmaceutical products like Gelatin, Collagen Peptide, Ossein, Di Calcium, etc. situated in the banks of Chalakkudy River, Thrissur. By using animal bones and chemicals to produce Ossein – a precursor to gelatin, the factories take 20-million-liter water per day from the river and as a byproduct huge quantity of hazardous waste is generated. This toxic waste is disposed to the Chalakkudy River and water canals running nearby those factories. It violates environmental protection rules like Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, the Environment (Protection) Act, 1986, and anti-pollution laws of air and water. This illegal waste disposal may cause to permanent degradation of soil and water sources and also creates air pollution due to the stench present. One of the main impacts of such disposal is that several people living in neighborhood may be affected with various health issues. The present study tried to analyze various diseases present in Kathikkudam by using quantitative research techniques. Primary data was collected using a structured questionnaire and the collected data was processed statistically and the results were derived. The pollution of air and water is tangible. Various types of long-term diseases and several health issues were detected.

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### INTRODUCTION

The studies of crimes against environment is a new school in criminology known as 'Green Criminology' which deals crimes and harms committed against environment, affecting the ecology, human and non-human organisms and the environment itself. As elsewhere in criminology, green criminology means thinking about offences (what crimes or harms are inflicted on the environment, and how), offenders (who commits crime against the environment, and why) and victims (who suffers as a result of environmental damage, and how), and also about responses to environmental crimes: policing, punishment and crime prevention (Potter, 2010). This field of criminology "explores green crimes and harms from an ecological vantage point, where harms and crimes committed against ecological units and the species living in those units are studied" (Lynch et al. 2013, p. 997).

Environmental crimes can be any –unauthorized act or omission that violates the law and is therefore subject to criminal prosecution and criminal sanction (Situ and Emmons, 2000);criminal conduct that may have negative consequences for the environment (United Nations Office on Drugs and Crime, 2011); act of violations of criminal laws designed to protect the health and safety of people, the environment or both (Gibbs, et al, 2010 cited in Hall, 2013); act committed with the intent to harm or with a potential to cause harm to ecological and/or biological systems and for the purpose of securing business or personal advantage (Clifford and Edwards, 2012). These crimes include a wide range of illegal activities such as illegal dumping of wastes – including hazardous and chemical wastes, the destruction of natural flora and fauna, pollution, illicit trade of hazardous waste, illegal logging of trees, trade of endangered wildlife species, smuggling of ozone-depleting substances and nuclear wastes, landscape degradation and radiation hazards; negative impacts on arable land, economic crops and trees, illegal extraction and trade in minerals, etc. (Nellemann et al. 2016; United Nations Interregional Crime and Justice Research Institute – UNICRI,n.d.). These offences can cause permanent and extensive harm to ecosystems with associated economic and human health impacts (Blindell, 2006). In environmental crime the first victim of a criminal act is the environment itself, which afterward threatens humans, for example, poisoned water sources, toxic gas release or polluted soil, etc. (Eman et al, 2011).

The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 Section 3(l) defines hazardous waste as “any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances”. Improper hazardous waste disposal or dumping is a form environmental crime and poses serious threat to the environment and all the living organisms. In human beings, the harmful effects of this crime may appear as in the form of health issues like various diseases and may be in a very slow process and may take much time to get to know. But most the times it may not be appeared or come into lime light till an epidemic is outburst.

There are few chemical factories situated in the banks of Chalakkudi River, Kathikudam, Thrissur whom manufacturing Gelatin, Collagen Peptide, Di Calcium, Phosphate Chitosan, NutriGold, Seedaaid, CartiPep and Ossein ([www.gelatin.in](http://www.gelatin.in)). These chemical factories produce Ossein by using animal bones and chemicals – Ossein is a precursor to gelatin – and the Ossein is further processed in Kakkanad, Cochin to produce gelatin for products that range from transparent capsule covers to blood, skin and bone enhancement commodities (Parvathy, 2013).

Per day, these chemical factories use 130 tons of crushed animal bones, 1,20,000 liters of hydrochloric acid, and 20 tons of lime, ferric chloride, alum, caustic soda and other unknown chemicals – having the storage capacity of 960 tons of hydrochloric acid and stored the same in the compound without any precautionary measures for disaster management (Jananeethi Report, 2010). These companies produce 8.77 Metric Tonne (MT) of Ossein, 4.30 MT Limed Ossein, and 41.84 MT Di Calcium Phosphate per day. Process recovery generates dry bone meal 2.4 MT, sinews 2.5 MT, wet bone meal 2.25 MT and animal fat 1000 kg per day (Jananeethi Report, 2010). These companies consume large volumes of water from Chalakkudy River without permission from any authentic source (Jananeethi Report, 2010).

#### **POLLUTION BY THE CHEMICAL FACTORIES**

The toxic waste, which is the by-product of Ossein production, is disposed and allowed to circulate in the Chalakkudy River, across rice fields, water canals, irrigation channels and wells. As per studies and reports, NGIL extracts 20 million liters of water per day, far in excess of the sanctioned limit, and disposing massive amounts of waste into the Chalakkudy River, and across prime agricultural areas, public lands and irrigation canals. This has led to the permanent degradation of more than 40% of drinking water wells in Kathikudam. These reports also claim that this waste has also caused severe health concerns including cancer, asthma and other respiratory ailments in the area (Jananeethi Report on Pollution of Nitta Gelatin India Ltd., 2010 &Nishad & Nimmy, 2014). At the monsoon of 2013, the Chalakkudy River swelled with putrid, dead bodies of fish on its banks, especially at two spots near to company effluent outlet. The air contained the stench of toxic waste due to the improper disposal of hazardous waste by the factory. The Kadukutty Panchayat, that oversees Kathikudam, has not given its consent to NGIL in the last 5 years. Despite the fact that the Panchayat holds legally recognized powers in India, each year, NGIL is given the state’s consent to continue the manufacturing. This sanction is a direct violation of the Environment Protection Act and the Clean Water Actand also violates the Panchayat Raj Act 1994 (Parvathy, 2013).

In an environmental impact assessment study conducted by Dr. V. M. Nishadand NimmyP. Pallan (2014) in Kathikkudam shows that NGIL consumes 20 million liters of water from the river per day and discharges almost same volume of effluent into the river. Water flowing through local streams has turned totally unusable for drinking, washing, or agricultural purposes. The Supreme Court Monitoring Committee in 2006 had included the effluent plant

sludge generated in NGIL in hazardous category. The sludge accumulated in the factory premises and the continuous release of effluents to river may cause long term environmental impacts (Nishad & Nimmy, 2014). According to Jananeethi Report on Pollution of Nitta Gelatin India Ltd. (2010), in the initial stage of the plant, there was no waste water management system effectively implemented. NGIL premises were fully dumped with solid waste, as it was started depositing within factory compound by digging large 15 feet deep trenches, over the years, due to area saturation, the company started depositing the waste in the adjacent paddy fields and other agricultural land. The effluent discharging area at the river center showed deposit of sludge beneath running water.

It is found that the surrounded environment of the factory is severely harmed with chloride pollution where the concentration of chloride ion is very high. The protein concentration is observed beyond the allowable level of concentration. The concentration of ammonia is high in factory premises and the samples collected from river shows the presence of ammonia where in upstream of the river (based on the factory outlet) the level of concentration is low where in downstream it is high. It confirms the presence of ammonia in river is due to the release of effluent from factory outlet. Enumeration of coliform bacteria shows significant count indicates that the samples were contaminated. Whether less or dominant, the presence of pathogens may be harmful to the population living in the surroundings of such a contaminated environment (Nishad & Nimmy, 2014). The studies that have been conducted as yet have shown that the presence of heavy metals, phosphate, sulphate, ammonia, chloride, etc. are high in concentration.

#### **VIOLATIONS OF RULES BY THE CHEMICAL FACTORIES**

The factories consume approximately 20 million liters of water per day from the Chalakkudy River without any sanction from the local self-government (i.e., the panchayat authority) and it has been continuously going on for last 31 years (Jananeethi Report on Pollution of Nitta Gelatin India Ltd., 2010). This huge exploitation of natural resources by the company is a continuous violation of rules since the company has not yet approached the statutory bodies for formal sanction of using such quantity of water. The company has no permission to draw water from Chalakkudy River and discharge treated water with highly polluted effluents to the river, or permission to lay underground concrete pipeline to the river. It is a clear violation of Kerala Panchayat Raj Act, 1994. The Water (Prevention & Control of Pollution) Act, 1974, Section 25 says that “no person shall establish an industry which is likely to discharge sewage or trade effluent into a stream or well or sewer or on land”. With reference to Section 25 of the Act, the Supreme Court said: “No one has a right to carry on a business so as to cause nuisance to the society. One cannot carry on business in the manner by which the business activity becomes a health hazard to the entire society” (AIR 1988, Guj 57). Also the company lacks mandatory papers like certification by Kerala Agricultural University to the manure, the sources of crushed animal bones and the names of its suppliers, copy of directions given by Pollution Control Board for improving the treatment plant, copy of the Environment Impact Assessment (EIA) report etc. Section 9(1) of Hazardous Wastes (Management and Handling) Rules, 1989 directs that the occupier generating hazardous waste and operator of a facility for collection, reception, treatment, transport, storage and disposal of hazardous waste shall maintain records of such operations. There was no such kind of records present in the factory (Jananeethi Report on Pollution of Nitta Gelatin India Ltd., 2010).

The Industrial and Occupational safety standards are not complied effectively. The laborers in the plant do not have sufficient devices which assure protection which is to be viewed as a gross violation of human rights. It is the violation of the law, the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, in which Sec. 4 (5-ii) states that the company should provide persons working on the site with the training, equipment and the information necessary to ensure their safety.

The company (occupier) generating hazardous wastes shall take all practical steps to ensure that such wastes are properly handled and disposed of without any adverse effects which may result from such wastes and the occupier shall also be responsible for proper collection, reception, treatment, storage and disposal of these wastes either itself or through the operator of facility [Hazardous Wastes (Management and Handling) Rules, 1989 Sec.4(1)]. NGIL has walled around the compound, and filled the compound with sludge. The wall is more than 8 feet high and therefore operation inside the wall cannot be seen from the outside. During the monsoon, there is leakage of effluents through the wall contaminating water and soil in the adjoining lands.

Pressing on the Article 21 of Constitution of India, the Supreme Court has declared in several cases that the right to safe environment and clean water is part of Right to Life. Every citizen has a right to fresh air (The Supreme Court of India verdicts on: Subhash Kumar v. State of Bihar; Virender Gaur vs. State of Haryana; M.C. Mehta vs. Union of India; T.N. Godavarman Thirumulpad v. Union of India). The Air (Prevention and Control of Pollution) Act, 1981, Section 22 states that “no person operating any industrial plant, in any air pollution control area shall discharge or cause or permit to be discharged the emission of any air pollutant in excess of the standards laid down by the State

Board.” Also, the Section 31A entitles the government or Board to close down, prohibit or regulate any industry that pollutes air. Jananeethi Report on Pollution of Nitta Gelatin India Ltd. (2010) says there is a high foul smell is present in the factory premises and the surroundings and the air pollution forcing people leave their homes and livelihood. This report also states that there is a kind of social exclusion is present as relatives and friends avoid visiting families in this area because of the air and water pollution; marriages are difficult as parents do not wish to send their daughters to Kathikkudam for obvious reasons (Jananeethi Report on Pollution of Nitta Gelatin India Ltd., 2010).

Lynch et al. (2013) quotes Schnaiberg’s theory of treadmill of production which states that capitalism causes ecological disorganization through the process of ecological additions and ecological withdrawals. Ecological additions are discharging chemical wastes or pollutants to the nature and ecological withdrawals are the collection of raw materials from the nature which often exploit natural resources and create damages to the ecosystem, for example, logging and mining. Lynch et al. (2013) says ecological disorganization is a crime against environment since it causes unnecessary ecological harm/destruction through the process of ecological withdrawals and ecological additions. We can see those chemical factories are highly involved in ecological disorganization process in the study area by taking huge amount of water from the river (ecological withdrawal) and disposing highly toxic wastes to the river (ecological addition).

### SIGNIFICANCE OF THE STUDY

There are several types of environmental harms/crimes present in India and not much studies are there in the Indian criminological realm on those issues; especially on the health issues caused by improper hazardous waste disposal. Thus, the present study tries to analyze various diseases present in Kathikkudam where hazardous waste dumping has been taken place by chemical factories situated in the area.

### RESEARCH DESIGN AND METHODOLOGY

The present research study aimed at analyzing the socio-demographic details of the people living at Kathikkudam and to examine the major health issues present among the people living at Kathikkudam where hazardous waste dumping is going on. Area of the study is Kathikkudam in Kadukutty Panchayath of Chalakkudy Municipality in Thrissur district. The households situated near by the NGIL factory in Kathikkudam are the sample of the present study. Around 46 residential houses are situated within a distance of 100 metres radius from the factory. Thirty households were cooperated with the study in which the total number of inmates were 139. A structured questionnaire with open and close ended questions was used to collect the primary data. Data obtained from the questionnaire were quantitatively analyzed by using the Statistical Package for Social Science (IBM SPSS).

### RESULTS AND DISCUSSION

#### A. Socio-Demographic Profile

##### 1. Age

**Table 1. Age**

Age (Years)	Frequency	Percent
16 – 25	2	6.7
26 – 35	6	20.0
36 – 45	10	33.3
46 – 55	5	16.7
56 – 65	4	13.3
66 – 75	3	10.0
<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 2 shows age of respondents with six groups. Group 1 is for the age group 16-25 and number of respondents is 2 (6.7%). Group 2 is for the age group 26-35 and number of respondents is 6 (20.0%). Group 3 is for the age group 36-45 and number of respondents is 10 (33.3%). Group 4 is for the age group 46-55 and number of respondents is 5 (16.7%). Group 5 is for the age group 56-65 and number of respondents is 4 (13.3%). Group 6 is for the age group of 66-75 and number of respondents is 3 (10.0%). Most respondents belong to the age group of 36-45 (33.3%).

## 2. Gender

**Table 2. Gender**

Gender	Frequency	Percent
Male	11	36.7
Female	19	63.3
<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 1 shows the frequency of gender of respondents. Number of Female respondents is 19 (63.3%) and number of male respondents is 11 (36.7%). Majority of respondents are females.

## 3. Religion

**Table 3. Religion**

Religion	Frequency	Percent
Hinduism	18	60.0
Christianity	12	40.0
<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 3 shows the frequency of religion. Eighteen (60.0%) respondents belong to the religion Hindu and 12 (40%) belongs to Christianity.

## 4. Community

**Table 4. Community**

Community	Frequency	Percent
General	13	43.3
Other Backward Communities	10	33.3
Scheduled Caste	6	20.0
Other Eligible Caste	1	3.3
<b>Total</b>	<b>30</b>	<b>100.0</b>

The community wise details of the respondents are; a) General – 13 (43.3%); b) Other Backward Communities – 10 (33.3%); c) Scheduled Caste – 6 (20%); and d) Other Eligible Caste – 1 (3.3%).

## 5. Marital Status

**Table 5. Marital Status**

Sl. No.	Marital Status	Frequency	Percent
1.	Married	25	83.3
2.	Unmarried	5	16.7
	<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 5 shows the marital status of the respondents where: married persons are 25 (83.3%), and unmarried are 5 (16.7%). The group married persons has the highest frequency 21 (70%).

## 6. Occupation

**Table 6. Occupation**

Sl. No.	Occupation	Frequency	Percent
1.	Government Sector	1	3.3
2.	Private Sector	7	23.3
3.	Self-employment	4	13.3
4.	Retired - Government Sector	2	6.7
5.	Home maker	14	46.7
6.	Unemployed	2	6.7
	<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 6 illustrates occupation of respondents) Government Sector – 1 (3.3%); ii) Private Sector – 7 (23.3%); iii) Self-employment – 4 (13.3%); iv) Retired - Government Sector – 2 (6.7%); v) Home Maker – 14 (46.7%); and vi) Unemployed – 2 (6.7%).

## B. Drinking Water Details

### 1. Source of Drinking Water

**Table 8. Source of Drinking Water**

Sl. No.	Source of Drinking Water	Frequency	Percent
1.	Well Water	27	90.0
2.	Well Water and Other Source of Water	3	10.0
	<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 8 shows the sources of drinking water. The main source of drinking water is open well water – 27 families out of 30 (90%) are using open well as the source of drinking water. Open well with other source of drinking water is using by 3 families (10%) where ‘other source of water’ means water supplied by Kerala State Water Authority.

### 2. Distance between Open Well and Septic Tank

**Table 9. Distance between Well and Septic Tank**

Sl. No.	Distance between Well and Septic Tank (Meter)	Frequency	Percent
1.	5-10	19	63.3
2.	11-15	8	26.7
3.	16-20	1	3.3
4.	21-25	1	3.3
5.	26-30	1	3.3
	<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 9 shows the distance between open Well and Septic Tank in each family. the details are i) 19 houses (63.3%) have a distance of 5-10 meters, ii) 11-15 meters: 8 houses (26.7%), iii) 16-20 meters: 1 house (3.3%), iv) 21-25 meters: 1 house (3.3%), and v) 26-30 meters: 1 house (3.3%). The group of 5-10 meters is the most frequent one in this category where 19 households has this distance from open well to septic tank.

**C. Air & Water Pollution Details**

**1. Pollution of Air**

**i) Presence of Ash Color Residue in Surroundings & Stench in Atmosphere**

**Table 10. Presence of Ash Color Residue in Surroundings & Stench in Atmosphere**

	<b>Presence of Ash Color Residue</b>	<b>Presence of Stench</b>
Yes	12 (40%)	27 (90%)
No	18 (60%)	3 (10%)
<b>Total</b>	<b>30 (100%)</b>	<b>30 (100%)</b>

Table 10 illustrates the presence of ash color residue in surroundings of 30 households in which the residue is seen in 12 houses (40%) while majority of the houses, 18 (60%) are not seen with the residue. The residue is Calcium Phosphate, a byproduct of Ossein production coming out from the factories. This table also shows that majority of households, i.e., 27 (90%) have the presence of stench in atmosphere in their compound while remaining 3 households (10%) have not the stench present in their compounds. Presence of ash color residue and stench in atmosphere show the presence of air pollution in the area. During the data collection, the researcher noticed a foul smell from a distance while traveling to the location and it is in the atmosphere in most locations, especially near to the factory fencing, paddy fields, households, etc. and experienced headache during the data collection.

**2. Pollution of Water**

**i) Color and Odor of Water:**

**Table 11. Color & Odor of Water**

<b>Color of Water</b>	<b>Frequency</b>	<b>Odor of Water</b>	<b>Frequency</b>
Normal Color	14 (46.7%)	Neutral	20 (66.7%)
Discolored Water	16 (53.3%)	Foul Odor	10 (33.3%)
<b>Total</b>	<b>30</b>		<b>30</b>

Table 11 shows the pollution of water in the sturdy area where the color of water is a variable and majority of the households, i.e., 16 (53.3%) has open well with discolored water while 14 households (46.7%) have normal water. The main characteristics of discolored water are: they appeared as yellowish, ionic taste, and oily with increased hardness. Table 12 also shows the odor of water with the open well of 30 households. As per the odor of well water, 20 respondents (66.7%) state that the water is in neutral odor while 10 respondents (33.3%) state that the water has foul odor, especially some fleshy decayed smell with the water. Though they use this water for all living purposes since there is no other source of water they have. For drinking, the water is used after well boiled. In some households the respondents said that they feel itchy and burning sensation in their body for sometimes after taking bath.

During the field visit to collect data for the present study, the researcher observed that red colored leachate over the sides of the factory fencing wall and this flew to the adjacent canal. Some pools adjacent to factory fence were filled with this colored leachate. The same color water present in most of the nearby household wells confirms the active infiltration of the leachate. At present one of the factories is operating a pump house (motor house) in Chalakkudy River, more than 1 kilometer away from the factory to take water using large iron pipes. At the same time the factory discharges the hazardous waste to the river using other pipes which going underneath of paddy fields, private lands, and through water canals. During the data collection, the researcher observed that the pipes discharging waste effluents to the river have leakage in two or more places in water canals situated nearby. The effluent sludge was mixed with water and that area of canal become dark colored and oily with colored layers at the surface of water.

## D. Health Issues Details

This section discusses about various diseases present in the study area.

### 1. Presence of long-term disease(s) in family

The long-term diseases present in households are enquired and quoted here. 14 families (46.7%) have persons affected with long-term diseases and 16 families (53.3%) have no such issues in their family. 10 families (62.5%) have one person each affected with long-term diseases; 4 families (25%) have 2 persons; 1 family (6.25%) has 3 persons affected with; and 1 family (6.25%) has 4 persons affected with long-term diseases, in this case the number of family members is 4 and all have kidney stone. The long-term diseases are present in the study population are a) Kidney Stone (10 persons); b) Asthma (6 persons); c) Dyspnoea (4 persons); d) Cough, Gallbladder Stone, Headache, Osteomalacia, and Arthritis and Arthritic Pain (2 persons each); and e) Intestinal Cancer, Heart related disease, and Haemorrhoids (1 person each).

Most affected long-term diseases in the study population are Kidney Stone (10 persons); Asthma (6 persons); and Dyspnoea (4 persons). Asthma, Dyspnoea, and cough are respiratory diseases and the total number of persons affected with respiratory diseases are 12.

### 2. Details of Persons died in family

In the study population, 12 families (40%) have persons died and 18 families (60%) have not. In those 12 families, 7 families have one person died and 3 families have two persons died – total number of persons died is 15.

**Table 12. Reason for Death**

Sl. No.	Reason for death	No. of affected persons
1.	Chronic Obstructive Pulmonary Disease (COPD)	3
2.	Intestinal Cancer	2
3.	Brain Stroke	2
4.	Seizure	2
5.	Lung Cancer	1 Each
6.	Kidney & Liver failure	
7.	Heart Attack	
8.	Cirrhosis	
9.	Subdural Hematoma	
10.	Road Accident	
	<b>Total</b>	<b>15</b>

The above table shows the reasons for death and they are; Chronic Obstructive Pulmonary Disease (COPD) which has the highest frequency (3 cases), while Intestinal Cancer, Brain Stroke, and Seizure have the frequency of two each; Lung Cancer; Kidney & Liver failure, Heart Attack, Cirrhosis, Road Accident, and Subdural Hematoma have one cases each.

## E. Details of various diseases affected in family

### 1. Various Fevers

Fevers like viral fever, Typhoid, Dengue and other types of fevers are asked by the researcher. The cases of Typhoid, Dengue and other types of fevers are not reported from the study area. But viral fever occurred in 23 families (76.7%) out of the 30 families in study area and total number of persons affected by viral fever was 69.

### 2. Diarrhea

Four types of Diarrhea are reported in the study area, namely, a) Diarrhea with fever (6 cases); b) Diarrhea with Stomach pain (7 cases); c) Diarrhea where blood stains are present in the stool (1 case); and d) severe Diarrhea with vomiting and body pain which lead to dehydration (4 cases). Total number of persons affected with all these four cases of Diarrhea is 18. Since the water sources are



### 3. Lung diseases

**Table 33. Whether any family member(s) affected by Lung disease(s)**

	Frequency	Percent
Yes	19	63.3
No	11	36.7
<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 33 shows the case of lung diseases. Majority of the families 19 (63.3%) are cases of lung diseases affected with the family inmates while 11 families (36.7%) have not. Total number of persons affected by Lung diseases is 33.

**Details of Lung diseases affected:** a) Dyspnoea: 27 cases, b) Cough with expectoration: 10 cases, c) Cough: 2 cases, d) Sneezing: 2 cases, e) Common cold: 2 cases (Table 34). Dyspnoea and Cough with expectoration are the two major lung diseases found in the study area.

**Table 34. Details of Details of Lung diseases affected**

Sl. No.	Details of Lung diseases affected	No. of cases
1.	Dyspnoea	27
2.	Cough with expectoration	10
3.	Cough	2
4.	Sneezing	2
5.	Common cold	2

### 4. Skin diseases

**Table 37. Whether any family member(s) affected by Skin diseases**

	Frequency	Percent
Yes	12	40.0
No	18	60.0
<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 37 shows that 12 families (40%) reported cases of skin disease while 18 families (60%) families did not. Total number of persons affected with skin diseases is 19.

**Table 38. Details of most affected Skin diseases**

Sl. No.	Skin Diseases	No. of persons
1.	Pigmentation due to itching	5
2.	Hyper pigmented patch	3
3.	Urticaria	3
4.	Itching	3
5.	Active skin ulcer	3
6.	Orchitis	3
7.	Tinea infection	2
8.	Skin Scaling	1
9.	Hypopigmented macule	1
10.	Plaque	1

This table shows the details of various skin disease affected in which the major skin diseases reported are:

- Pigmentation due to itching: 5 persons.
- Hyper pigmented patch, Urticaria, Itching, Active skin ulcer, and Orchitis: 3 persons each.
- Tinea infection: 2 persons
- Skin Scaling, Hypopigmented macule, and Plaque: 1 person each.
-

## 5. Urinary diseases

**Table 40. Whether any family member(s) affected by Urinary diseases**

	Frequency	Percent
Yes	10	33.3
No	20	66.7
<b>Total</b>	<b>30</b>	<b>100.0</b>

Table 40 shows that 10 families (33.3%) have persons affected with urinary diseases while 20 families (66.7%) did not have. Total number of persons affected with urinary diseases are 15.

**Table 41. Major Urinary diseases& number of affected persons**

Sl. No.	Major Urinary diseases	No. of affected persons
1.	Kidney Stone	10
2.	Burning sensation while discharging urine	4
3.	Urinary Tract Infection	1

The table 41 shows the major urinary diseases and number of affected persons affected. Kidney Stone (10 cases), Burning sensation while discharging urine (4 cases) and Urinary Tract Infection (1 cases) are the observed urinary diseases from the study area.

## 6. Any type of Asthma

**Table 46. Whether any family member(s) affected by any type of Asthma**

	Frequency	Percent
Yes	5	16.7
No	25	83.3
<b>Total</b>	<b>30</b>	<b>100.0</b>

The table 46 shows that 5 families (16.7%) reported persons affected with asthma while the other 25 families (83.3%) did not. Total number of persons affected with asthma is 6.

## 7. Any type of Allergy

**Table 47. Whether any family member(s) affected by any type of Allergy**

	Frequency	Percent
Yes	15	50.0
No	15	50.0
<b>Total</b>	<b>30</b>	<b>100.0</b>

The table 47 shows that 15 families (50%) have persons affected with allergies and 15 families (50%) have not. Total number of persons affected with allergy are 30.

## 8. Eye infection

**Table 49. Whether any family member(s) affected by Eye infection**

	Frequency	Percent
Yes	11	36.7
No	19	63.3
<b>Total</b>	<b>30</b>	<b>100.0</b>

The above table shows the number of persons affected with Eye infection. 11 families (36.7%) are affected with eye infection while 19 families (63.3%) are not. Total number of persons affected with eye infection are 13. Two families have two persons each affected with this disease where total number of family members are four each.

**9. Nose infection**

**Table 50. Whether any family member(s) affected by Nose infection**

	Frequency	Percent
Yes	6	20
No	24	80
<b>Total</b>	<b>30</b>	<b>100.0</b>

The table 50 shows that 6 families (20%) have persons affected with this and 24 families (80%) have no persons affected. Total number of persons affected with nose infection are 9. Two families with the strength of six members have three and two persons affected with this disease respectively.

**10. Any type of Cancer**

**Table 51. Whether any family member(s) affected by any type of Cancer**

	Frequency	Percent
Yes	1	3.3
No	29	96.7
<b>Total</b>	<b>30</b>	<b>100.0</b>

The table 49 indicates majority of families, i.e. 29 (96.7%) reported that there is no cancer patients in their family inmates while one family (3.3%) reported that it has a person affected with cancer (Intestinal cancer). The affected person is a retired worker of NGIL. From the discussions with the people living in the area and environmental activists, they say there are many cancer patients but the family won't disclose it to outsiders or with people anonymous to them to avoid stigma which may lead to more social isolation, for example, getting good marital relations to the youngsters in the family.

**CONCLUSION AND SUGGESTIONS**

For a long time criminology focused only on humans' issues pertaining with safety, well-being, law and order, etc. .Nevertheless, after industrial revolution and watching it's consequences on environment and humans, some criminologists started to think about the state of humans in a world where everything is polluted and the earth's resources are all exploited in which no return or U-turn is possible and obviously the natural disasters, global warming, climate change and related menaces. These thoughts developed into considering not only humans but the whole environment and other living and non-living organisms present. Acts which may have negative consequences upon environment – its ecosystem, living and non-living organisms, etc. are considered as offences perpetrated against the environment, i.e. environmental crime. One of the major crimes against environment is pollution; of water, soil and air. Improper handling of hazardous waste or illegal dumping of hazardous waste into natural resources or anywhere in the space is a serious form of pollution and hence a heinous crime against environment. The chemical factories using 20 million of water per day from Chalakkudy River in Thrissur for their manufacturing requirements and also discharges more or less the same amount of effluent water to the river from the past 36 years. It is resulted in heavy contamination of water and soil – the scientific studies conducted in surroundings of those chemical factories at Kathikkudamshows the severity of pollution; the presence of heavy metals in water bodies and in soil; presence of stench in atmosphere; and presence of various pathogens in water bodies, etc.

The present study tried to analyze the health issues present in Kathikkudam and the results shown that in the sample population of thirty households various diseases are present. 40% of households are having instances of death and most of them are due to respiratory ailments, kidney and liver failure, intestinal cancer and lung cancer. Most families have cases of viral fever, lung diseases (especially Asthma, Dyspnoea and Cough with expectoration). The cases of Skin diseases, Urinary diseases, Allergies, Eye and Nose infections, etc. are detected. In this study one person is reported with intestinal cancer. Although the present study has a small sample size, it shows level of some diseases are high in the sample population situated within 100 meters of the chemical factories.

To get an in-depth data about health issues due to exposure of hazardous waste dumping, well-structured medical examinations by medical practitioners are required in the study area. For a social science researcher there are limitations in studying health issues pertained with hazardous waste exposure. The studies conducted in Kathikkudam regarding the pollution shows high level of pollution in the area in water bodies, and soil. But studies of air pollution could not be identified in review of literature. More studies are required to know what kind of changes happened to the environment – permanent/temporary, reversible/irreversible; how pollution affects living and non-living organisms

and so. In every environmental crime, one of the victims is humans and more studies are required to know the psychological and social impacts on the people living nearby such chemical factories. Hoping in coming years there would be effective movements towards this direction too.

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