GRASSROOTS JOURNALS

ISSN 2564-016X

JOURNAL OF ENVIRONMENTAL LAW AND POLICY | 001 (MAY 2021)
Published by The Grassroots Institute, in partnership with Yaroslav Mudriy National Law University of Ukraine, and in collaboration with Northern Institute of Minority & Environmental Law, University of Lapland. Website: http://grassrootsjournals.org/jelp

OPEN ACCESS Freely available online

M – 00210 | Research Article

ASSESSMENT OF ENVIRONMENTAL DAMAGE AND POLICY ACTIONS BY USING CONTINGENT VALUATION METHOD: AN EMPIRICAL ANALYSIS OF SAGO INDUSTRIAL POLLUTION IN TAMIL NADU, INDIA

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Received: 29 April 2021 | **Accepted:** 07 May 2021 | **Published:** 15 May 2021

ABSTRACT

The objective of the study focusses on water quality, health impact, loss of agriculture production and livestock population. Primary data was collected from 413 households in the study villages of Kaveripuram, Ammampalayam, Kattukkottai and Mallur by adopting the stratified random sampling technique. The information was also gathered on the sago industrial pollution to estimate the households' willingness to pay for improved water quality, and the human health impacts, loss of agriculture production, livestock populations and loss of environmental resources in the study area. The outcome of this study will be helpful to determining the sustainable environmental upgradation and policy reform.

Keywords: Water quality; Health impact; Agriculture production; Sago industry; Willingness to pay; Environmental pollution; Policy

How to cite this paper: Palani Periyasamy and Rajendran Sagar, 'Assessment of Environmental Damage and Policy Actions by Using Contingent Valuation Method: An Empirical Analysis of Sago Industrial Pollution in Tamil Nadu, India' (2021) 001 Journal of Environmental Law and Policy 86-104. <https://doi.org/10.33002/jelp001.04>

Assessment of Environmental Damage and Policy Actions by Using Contingent Valuation Method: An Empirical Analysis of Sago Industrial Pollution in Tamil Nadu, India

1. INTRODUCTION

The environmental problems will occur when the market system fails to establish an effective price mechanism in relation to environmental resources, according to economists. These services are free to use and are referred to as public or common goods, despite the fact that their use incurs external costs such as waste, dust, air pollution, noise, water pollution, and other negative environmental consequences.[1] The environment belongs to everyone, but no one owns it, and a common property cannot be valued for its use, so there is competitive overuse. As a result of the market's inability to identify and enforce property rights, environmental destruction has resulted in large part.[2] The costs of making any product or service are made up of a combination of expensive inputs like labour, capital, and technology, as well as mispriced inputs like natural resources. As a result, retail prices for products and services do not represent the true value of the overall capital used to manufacture them.[3] Here as consequence, from the perspective of an environmental economic approach, there is a difference between private and social costs of goods and services. As a result, the private costs of environmental products are usually covered by the retail price of goods and services, but not the external costs.

Because of that, producers and consumers are more likely to use them excessively in comparison to higher-priced alternatives. In addition, under-pricing creates inadequate incentives for the development of new technology to combat emissions.[4] Manufacturers aim to maximize profit in the Growth Economic Model, and consumers are able to fulfil their desires at the lowest possible cost to themselves. Market prices of products and factors do not represent their costs to society due to firms' private cost-cutting behaviour, resulting into economic inefficiency and decreased social welfare if markets are absent. Excessive pollution and environmental degradation are the end results of this process. Better environmental quality can be considered an economic good, whereas environmental degradation caused by other economic activities can be considered a cost item.

[1] Neli Bruce, and Gregory M Ellis, 'Environmental Taxes and Policies for Developing Countries' (Working Paper, Public Economics Division, Policy Research Department, World Bank 1993) <http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1993/09/01/000009265_3961005091708/Rendered/PDF/multi_page.pdf> accessed 13 May 2021.

[2] Harun Tanrivermis, 'Willingness to Pay (WTP) and Willingness to Accept (WTA) Measures in Turkey: May WTP and WTA be Indicators to Share the Environmental Damage Burdens: A Case Study' (1998) 19 Journal of Economic Cooperation Among Islamic Countries <https://www.sesric.org/files/article/79.pdf> accessed 13 May 2021.

[3] David Pearce, Anil Markandya and Edward B Barbier, *Blueprint for a Green Economy* (Earthscan 1989).

[4] Glen P Jenkins and Ranjit Lamech, *Green Taxes and Incentive Policies: An International Perspective* (Institute for Contemporary Studies Press 1994). <https://cri-world.com/publications/qed_dp_114.pdf> accessed 13 May 2021.

Environmental quality may be lowered as a result of the manufacture and/or use of other commercial products. This has a negative impact on each economic agent's output and/or cost functions. To boost or preserve environmental quality, a range of steps and procedures may be used. These include legal legislation governing goods, procedures, pollutants, and wastes, as well as economic instruments such as taxes, fines, state assistance, tradable pollution permits, and other agreements with polluters. The most appropriate instrument (or instruments) to use in any given situation will be determined by the legal and administrative structure as well as the existence of the pollution problems. For a long time, economists have been arguing that emissions should be taxed. These taxes are intended to eliminate market failures or missing markets. On the other hand, its were unable to find enough political support for this idea.

Traditional command and control instruments, tradable emission permits, and various inspections for pollutant criteria are preferred by decision-makers and public authorities over charges and taxes. Furthermore, a few experimental studies have shown that command and control policy instruments are more costly than market based incentives and unsuccessful in designing environmental policies.[5] The economic consequences of pollution control and prevention, especially end-of-pipe approaches, result in higher costs due to internalization of the cost of environmental harm, as well as lower productivity and investment in productive assets.[6] In recent years, there has been a renewed interest in taxation in both developed and developing countries. The main goal of environmental charges or taxes is to internalize the external costs that manufacturers and or customers incur as a result of their output and/or consumption activities.

Some taxation systems, such as emission, product, wastewater, solid waste, and noise charges, as well as tax differentiation and others, are used by governments in the EU and OECD countries. In India, The Environment (Protection) Act, 1986 enforces the "polluter pays principle" and solid waste and wastewater charges have been applied since 1986 at the local level.[7]

Environmental policy prescriptions and environmental, economic assessments are based on the empirical indicators that the Willingness to Pay (WTP) and Willingness to Accept (WTA) of each economic instrument will

[5] Wallace E Oates, 'Taxing Pollution: An Idea Whose Time Has Come?' *The RFF reader in environmental and resource management* (Resources for the Future 2006). <https://books.google.de/books?id=u2PqUlHZC_IC&pg=PA63&lpg=PA63&dq=Taxing+Pollution:+An+Idea+Whose+Time+Has+Come?&source=bl&ots=6WgU6XASL6&sig=ACfU3U2o_3IsoSwVc1mdw96RddoY56Zmeg&hl=en&sa=X&ved=2ahUKEwj8pIjaqMfwAhWT_rsIHeWfAeEQ6AEwAnoECAQQAw#v=onepage&q=Taxing%20Pollution%3A%20An%20Idea%20Whose%20Time%20Has%20Come%3F&f=false> accessed 14 May 2021.

[6] Mostafa K Tolba and others, The World Environment 1972-1992, Two Decades of Challenges' (Chapman and Hall 1993) <http://ciesin.columbia.edu/docs/001-009/001-009.html> accessed 13 May 2021.

[7] The Environment (Protection) Act, 1986 Chapter III.

yield equivalent measures of sacrifice.[8] So, economic instruments of environmental conservation policies may be commenced with the use of individual WTP and WTA measures.

The primary objective of this study is to estimate the individual consumer's Willingness to Pay (WTP) for improving environmental quality and to compare these estimates with the actual amount payment of environmental charges. Furthermore, using the Contingent Valuation Method (CVM) and analysing data obtained via the household questionnaire, the behaviour of economic agents relating to the relationship between charges, payment, and Willingness to Pay (WTP) and Willingness to Accept (WTA) measures have been observed. This study can be used to prepare pollution charges or taxes in order to achieve long-term environmental improvements in the Salem district, as well as developing countries in general.

2. METHODOLOGY AND SAMPLING DESIGN

In order to determine the taxation attitudes of individual consumers, the Salem district was selected as the study area. According to the Salem Starch and Sago Manufacturers Service Industrial Co-operative Society Ltd. (popularly called as SAGOSERVE), the district was chosen due to the large number of sago processing industries in Tamil Nadu.

In terms of human settlement and lifestyle, the district is a model for other districts considering economic and social development indicators. The villages of Salem district were stratified into two strata: control village and experimental villages. Salem is divided into 4 revenue administrative divisions by the local government. Out of four divisions, three revenue divisions were selected. Kaveripuram is a controlled village located in Mattur Revenue Division, and Mallur, Kattukottai and Ammampalayam villages are experimental villages falling in Salem Revenue Division and Attur Revenue Division.

The sampling unit is a household, living in the village. To determine the sample size, a number of households was arrived at from 8304 total households in the study area. Using stratified sampling technique, is a 5 per cent of the total households were selected. Thus, 413 households became the sample size. Of these 413 households, interviewed household were determined using random sampling method.

Between January and October of 2013, data was collected from individual households using a household questionnaire. Individuals aged 34 or older who belonged to selected households completed the household questionnaire. The pilot study used a total of 100 pre-test questionnaires to

[8] Jack L Knetsch, 'Environmental Policy Implications of Disparities Between Willingness to Pay and Compensation Demanded Measures of Values' (1990) 18 Journal of Environmental Economics and Management <https://doi.org/10.1016/0095-0696(90)90003-H> accessed 14 May 2021.

better understand the different socioeconomic conditions and their impacts. The questions in the household survey were divided into two categories: open-ended and close-ended. The survey included questions about a household's monthly income and expenditure, water purifier, refrigerator, type of house, the use of cooking and drinking water nearby sago industry, and so on.

1.1 Contingent Valuation Method: Empirical Specification

Contingent Valuation (CV) was first used by Davis (1963) to estimate the value of big game hunting in Maine. Contingent valuation has become an important analytical method in economic welfare analysis by providing a mean to estimate values when markets do not exist and revealed preference methods are not applicable. Stated preference methodologies aim to provide an economic assessment of environmental impacts using data on hypothetical choices made by individuals responding to a survey and stating their preferences. These methodologies have been used to estimate direct use, indirect use and non-use values. The contingent valuation method (CVM) is a stated preference method that is implemented by means of surveys and aims to assess how individuals would hypothetically react to changes in environmental quality. In particular, it finds out how much respondents would be willing to pay for improved environmental quality or to avoid a hypothetical reduction in environmental quality.[9]

The contingent valuation method (CVM), one of the direct valuation methods, is a survey method used to elicit willingness to pay (WTP) and/or willingness to accept (WTA) values of the individuals by way of creating 'realistic' hypothetical markets. For instance, the individuals/households in the polluted areas were asked to either state their maximum WTP value for avoiding pollution in the future or to state their minimum level of compensation for the loss experienced from pollution damage. Though this method is simple and used widely in the area of water quality, this method needed to be administered very carefully, a failure of which would have led to the generation of invalid and unreliable results. In circumstances such as this, the cross-section data for production from both pollution in affected and the non-affected areas (i.e., with and without) were collected.

Using regression analysis to assess the impact of pollution, along with the influence for other factors, the outputs were estimated. The net change caused by pollution alone on outputs was monetized with the help of the market price, and this amount was treated as damage cost.[10] The main goal

[9] Craig Meisner, Hua Wang and Benoit Laplante, *Welfare Measurement Bias in Household and on-Site Surveying of Water-Based Recreation: An Application to Lake Sevan, Armenia* (The World Bank 2006). <https://openknowledge.worldbank.org/bitstream/handle/10986/8458/wps3932.pdf?sequence=1&isAllowed=y> accessed 14 May 2021.

[10] L Venkatachalam, 'Damage Assessment and Compensation to Farmers: Lessons from Verdict of Loss of Ecology Authority in Tamil Nadu' (2005) 40 Economic and Political Weekly <https://www.jstor.org/stable/4416473> accessed 14 May 2021.

of this analysis is to estimate the willingness to pay (WTP) by incorporating socioeconomic variables into the contingent valuation (CV) model, which assists the researcher in gaining information on the validity and reliability of the CV results and increasing confidence in the implications of this results obtained from the CV empirical analysis suggested.[11] Willingness to pay may not necessarily mean the actual price, which an individual (or a society with some special characteristics) will be willing to pay at the current rate of its purchase. It all depends upon the shape of the demand curve (or the preferences). Contingent valuation is well suited for the estimation of a change in the status of the environment. The theoretical basis indicates that an individual seeks to maximize a utility function, or equivalently minimize an expenditure function subject to a utility constraint, which includes a vector of services depending on the environmental status.[12] According to the model specifications suggested from Israel and Levinson (2004)[13], Benno Torgler et al. (2007)[14], Han et al. (2011)[15], Andrea Kollmann et al. (2012)[16], Salvator Ercolano et al. (2014)[17], Jones et al. (2015)[18] and Cicatiello et al. (2020)[19], the current investigation stresses on how the community is approaching the issues of environmental quality and how is their attitude towards the willingness to pay for tackling the existing constraints.

[11] L Venkatachalam, 'The Contingent Valuation Method: a Review' (2004) 24 Environmental Impact Assessment Review <https://doi.org/10.1016/S0195-9255(03)00138-0> accessed 14 May 2021.

[12] Timothy C Haab, and Kenneth E McConnell, 'Valuing Environmental and Natural Resources the Econometrics of Non-Market Valuation' (Edward Elgar 2002).

[13] Debra Israel and Arik Levinson, 'Willingness to Pay for Environmental Quality: Testable Empirical Implications of the Growth and Environment Literature' (2004) 3 Contributions to Economic Analysis & Policy.

[14] Benno Torgler, María A. García-Valiñas, 'The Determinants of Individuals' Attitudes Towards Preventing Environmental Damage (2007) 63 Ecological Economics <https://doi.org/10.1016/j.ecolecon.2006.12.013> accessed 14 May 2021.

[15] Fang Han, Zhaoping Yang, Hui Wang and Xiaoliang Xu, 'Estimating Willingness to pay for Environmental Conservation: A Contingent Valuation Study of Kanas Nature Reserve, Xinjiang, China' (2011) 180 Environmental Monitoring and Assessment <https://doi.org/10.1007/s10661-010-1798-4> accessed 14 May 2021.

[16] Andrea Kollmann, Johannes Reichl and Friedric Schneider, 'Who is Willing to pay for the Environment in the EU – An Empirical Analysis' (2012) 5 EuroEconomica.

[17] Salvator Ercolano, Giuseppe Lucio Gaeta, and Oriana Romano, 'Environmental Tax Reform and Individual Preferences: An Empirical Analysis on European Micro Data' (2014) 51 Journal of Behavioral and Experimental Economics.

[18] Nikoleta Jones, Julian RA Clark and Chrisovaladis Malesios, 'Social Capital and Willingness-to-pay for Coastal Defences in South-east England' (2015) 119 Ecological Economics.

[19] Lorenzo Cicatiello, Salvatore Ercolano, Giuseppe Lucio Gaeta and Mauro Pinto, 'Willingness to Pay for Environmental Protection and the Importance of Pollutant Industries in the Regional Economy. Evidence from Italy' (2020) 177 Ecological Economics.

3. WILLINGNESS TO PAY BID FUNCTION ANALYSIS

Analysis of bid function underlying the WTP responses was undertaken; and with a range of explanatory variables being investigated linear functional form was tested. The former seemed to perform better in terms of the statistical significance of regression coefficients. Hence, the linear functional form was reported here since this provides ease in the interpretation. Bid function can be written as follows:

$$Y = a + \beta_1 S_{class} + \beta_2 F_{size} + \beta_3 EDU_{head} + \beta_4 TY_{emp} + \beta_5 DIS_{w.collection} + \beta_6 AL_{drinking\ water} + \beta_7 WTP_{HR} + \beta_8 WTP_{agri.loss} + \beta_9 WTP_{livestock\ damage} + \mu$$

$$Y = -594.162 + 2.704 S_{class} + 4.721 F_{size} + 6.199 EDU_{head} + 4.542 TY_{emp} + 8.093 DIS_{w.collection} + 2.343 AL_{drinking\ water} + 142.697 WTP_{HR} + 261.638 WTP_{agri.loss} + 87.596 WTP_{livestock\ damage} + \mu$$

Where,

Y = Dependent Variable

Y is the willingness to pay for the abatement of environmental pollution.

α is Constant.

β_1-β_9 is coefficients to be estimated.

μ is an error term.

The equation represents the determinants of willing to pay as a function of avoiding environmental risk factors:

S_{class}	=	Social Classification
F_{size}	=	Family Size
EDU_{head}	=	Education of the Family Head
TY_{emp}	=	Type of Employment
$DIS_{w.collection}$	=	Distance for Water Collection
$AL_{drinking\ water}$	=	Alternate Drinking Water
WTP_{HR}	=	Willingness to Pay for Health Risk
$WTP_{agri.loss}$	=	Willingness to Pay for Agricultural Loss
$WTP_{livestock\ damage}$	=	Willingness to Pay for Livestock Damage

4. RESULTS AND DISCUSSIONS

An appropriate environmental tax system may be proposed according to the socioeconomic characteristics of households and firms by using the direct valuation instruments such as willingness to pay related to consumer and producer preferences about the environmental taxes or charges. To determine the suitable approach to share the environmental damages, costs between economic agents in this case, the amount of money that an individual is willing to pay for improving the environmental quality is obtained by the following question: How much would consumers and producers be willing to pay (WTP) as environmental taxes or charges for improving mankind's environmental quality? Or, what would they be willing to accept (WTA) to compensate for the environmental damage in the

case of sago effluents? The data provided by individual consumers are analysed and the relationship between individuals' fulfilment with currently applied environmental tax payment in selected cases and their willingness to pay is learned. A general WTP and/or WTA function for individual consumers is defined as the following: WTP_i or $WTA_i = f(Q_i, Y_i, T_i, S_i)$, where Q_i is quality or quantity of the attribute, Y_i is the income level, T_i is the index of tastes and S_i is a vector of relevant socioeconomic factors explained by Whitehead (1994).[20]

In this study, WTP functions of households and firms are estimated. There is no theoretical correct form of these functions (Pearce et al., 1989[21]; Bateman and Turner, 1993[22]; Pearce and Turner, 1994[23]; Kula, 1994[24]). In these cases, economic theory does not clearly define a certain mathematical form of economic relationship. One of the main points of criticism raised in this debate refers to the choice of the correct elicitation format. In these circumstances, there are two possibilities: one can ask for people's willingness to pay (WTP) for an improvement of environmental quality, or one can ask for their willingness to accept (WTP) compensation for renouncing this improvement. Critics of the CVM hold that both measures should lead to nearly the same amount of money which can be interpreted as the value. The fact that most practical CVM surveys exhibit a rather substantial divergence between WTP, and WTA is taken as evidence that the CVM is a "flawed measuring instrument", as followed:

[20] Alfred N Whitehead, 'Valuation Methods for Environmental Costs and Benefits' in E. Kula (ed), *Economics of natural resources, the environment and policies* (Chapman & Hall 1994).

[21] David Pearce, Anil Markandya and Edward B Barbier, *Blueprint for a Green Economy* (Earthscan 1989).

[22] Ian J Bateman, and Kerry Turner, 'Valuation of Environment, Methods and Techniques: The Contingent Valuation Method' in R Kerry Turner (ed), *Sustainable environmental economics and management: principles and practice* (Belhaven Press 1993).

[23] Kerry Turner, David Pearce and Ian J Bateman, *Environmental Economics an Elementary Introduction* (The Johns Hopkins University Press 1994).

[24] Erhun Kula, *Economics of Natural Resources, the Environment and Policies* (Kluwer Academic Publishers 1994).

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Table 1
Household Survey

Name of the village		Environmental Pollution		
		No	Yes	Total
Control Village	Kaveripuram	20 (4.8)	62 (15.0)	82 (19.9)
Experimental Villages	Ammampalayam	0 (0.0)	86 (20.8)	86 (20.8)
	Kattukkottai	0 (0.0)	123 (29.8)	123 (29.8)
	Mallur	0 (0.0)	122 (29.5)	122 (29.5)
Total		20 (4.8)	393 (95.2)	413 (100.0)

Note: Figures in parentheses denote the percentage of the column total.

For analysing the willingness to pay of households in both control and experimental villages, a percentage analysis has been worked out. In the experimental villages, 393 (95.2 per cent) of the surveyed households were ready to pay the compensation for the loss in terms of environmental amenities. 20 (4.8 per cent) households were not at all ready to pay the compensation from control villages due to a better environment.

Table 2
Difference in WTP for Abatement of Environmental Pollution between Polluted and Controlled Villages

WTP for Abatement of Environ-mental Pollution	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Differe-nce	Std. Error Differe-nce
Equal variances not assumed	11.598	0.001	-10.965	191.611	0.000	-157.880	14.399

An independent sample "t" test was used to interpret the difference in the level of willingness to pay between the control and experimental villages. A "t" test assuming homogeneity of equal variances was calculated. The results of the test indicated that there is a significant difference in the level of willingness to pay to avoid the environmental pollution in control and experimental villages between two groups t (191.611) = -10.965 p = 0.001. The

results suggest that willingness to pay for improving the environment in the control village is lower than the experimental villages. The sig. (2-tailed) value in our example is 0.000. This value is less than 0.05. Hence, we can conclude that there is a statistically significant difference between the willingness to pay between control villages and experimental villages. Since our group statistics box revealed that the mean for the control villages is INR 100.55, it was lower than the mean for the experimental villages i.e., INR 258.43. It is possible to conclude that willingness to pay for the abatement of environmental pollution is high in experimental villages because they are physically and mentally disturbed by sago effluents.

4.1 Determinants of Willingness to Pay

The economic and social costs of environmental damage are usually divided into three broad categories: health cost, productivity cost and the loss of environmental quality. The economic value of these costs can be estimated by using valuation methods. Environmental economics is concerned with the impact of the economy on the environment, the significance of the environment to the economy, and appropriate way of regulating economic activity. Currently, this field is given an attention in most of the countries. For valuing the improvement in environment, different methods are available.

In this study, "stated preferences" contingent valuation method (CVM) is used. Much research was found on CVM in different countries, but only a few studies have been carried out in India applying the CVM.

Table 3
Regression Result for Willingness to Pay

Sl.No.	Independent Variables	Regression Coefficients	Std. Error	t	Sig.
1	*a* (Constant)	-594.162	52.948	-11.222	0.000***
2	S_{class}	2.704	3.875	.698	0.486
3	F_{size}	4.721	5.584	.845	0.398
4	EDU_{head}	6.199	3.044	2.037	0.042**
5	TY_{emp}	4.542	6.524	0.696	0.487
6	$DIS_{w.collection}$	8.093	8.471	0.955	0.340
7	$AL_{drinking\ water}$	2.343	11.561	0.203	0.839
8	WTP_{HR}	142.697	16.172	8.824	0.000***
9	$WTP_{agri.loss}$	261.638	13.430	19.482	0.000***
10	$WTP_{livestock\ damage}$	87.596	14.748	5.939	0.000***
N = 413, R^2 = 0.664, F = 79.359					

Note: **5 level significant, ***1% level significant.

The estimated coefficients for the model specification found to have the 'best' fit of the self-explanatory variables with the most statistically significant outcomes. As table dependent variables: WTP, number of observations = 413, F = 79.359. The dependent variable used is WTP (per month per family) for the quality of drinking water. All samples were included in the WTP amounts. While the overall model is found to be statistically significant (F = 79.359), its explanatory power is low i.e., 66 per cent of the variation in WTP, being explained by the explanatory variables.

The overall model's R2 value of 0.664 indicates a 66.4 per cent level of variation in the explanatory variables. The coefficient of S_{class} is 2.704, which means that various social groups are more willing to pay for the good environment as compared to both control and experimental areas. The present populations are more educated and knowledgeable about the effects of sago industrial pollution. Compared to educated, uneducated peoples are experiencing more vulnerable effects of sago industrial pollution, and since the water resources are polluted, the people are willing to pay for good quality drinking water. The control village respondents are not ready to compromise their health and environment and they are valuing these resources over the money.

The coefficient of $DIS_{w.collection}$ variable is a + 8.093 at 5 per cent level of significance. This means that distance to the drinking water collection have an increasing ratio of cost. In this situation, people are more willing to pay on the basis of distance of drinking water being collected. The result shows that people are bothered for the distance for quality drinking water. So, it means that if good quality of drinking water is available at far distance from the residence, people are willing to pay.

In general, the operations of the sago industries and its untreated discharged effluents get clogged beneath the land surface and ultimately mixed with the ground water sources. In this way, the quality of the groundwater becomes questionable, and this particular hidden dimension of damage is expressed through the inferences of the study. That is the reason the people are going to collect portable drinking water from faraway places. These are the circumstances that specifically indicate that the operations of the mentioned industries are deteriorating the nearby water sources; therefore, the community has to be dependent on quality water sources from distant means of water for drinking as well as for other purposes.

$AL_{drinking.water}$ variable is + 2.343 with the 10 per cent level of significance. This means that alternative drinking water collections have an increasing cost. The distance has included price, time and income. In these circumstances peoples are unable to pay for that, but many of the households are willing to pay for quality drinking water.

WTP_{HR}, $WTP_{agri.loss}$, $WTP_{livestockdamage}$variables are +142.697, +261.638, and +87.596 with 1 per cent level of significance. This means that health loss, agricultural loss and livestock damages are very close to our day-to-day life, because these three impacts are more expensive. It is explained that these

peoples depend on agriculture, agro-industry labourers. Holding livestock is determines social status and economic well-being of the households. The regression results show that if a person or household's income increases by INR 1000, they are willing to pay INR 142 for health risk, INR 261 for agriculture loss, and INR 87 for livestock damage, respectively.

5. CONCLUSION AND POLICY RECOMMENDATIONS

Most economic studies, including environmental assessments and policy prescriptions, are focused on the empirical assumption that willingness to pay and willingness to accept compensation would yield equal measures of sacrifice. Price and benefit signals are used in a market economy to direct capital to high-valued uses. Firms seeking to increase profit and customers seeking material well-being are both allowed to pursue their goals at the lowest possible expense. When commodities and variables are priced to represent their costs to society, such private cost-cutting activity is a social virtue; however, when markets are absent and externalities exist, it results in economic inefficiency and decreased social welfare. It causes unnecessary emissions and environmental destruction.

Environmental quality can be thought of as an economic good, and environmental destruction caused by other economic activities can be thought of as an expense or input into those activities. Environmental content, unlike most consumer products, is bestowed rather than manufactured. However, the production and/or consumption of other commercial goods can degrade environmental quality, so it, like other goods, is in variable supply. For example, manufacturing processes that dump waste products into the atmosphere deplete the supply of clean water and air, which are priced for their own sake. People who want to breath and drink clean and healthy air and water are driving the demand for environmental quality. The desire to pay more for a good decreases as the amount available increases, and increases as the capacity to pay for it (household income) increases. Environmental quality is supplied by polluting activity producers and customers, who have more of it when they minimize the level of polluting activities or buy equipment that decreases the amount of pollution induced at given level of output. The extra costs of pollution abatement equipment or the net value of foregone production (that is, the value of output less the value of the capital released) are the costs of providing better environmental quality. Normally, we will expect the marginal cost of 'supplying' an additional unit of environmental quality to increase as the quantity supplied increases (i.e., as the amount of pollution abatement increases). The 'optimal' level of pollution is achieved when the marginal ability to pay for improved environmental quality is exactly equal to the marginal cost of providing it.

Because of a market 'failure' or a 'missing' market, environmental degradation becomes an economic policy problem. Demanders and

suppliers have no means of expressing their relative willingness to pay for, or marginal willingness to accept, a decrease in quantity of environmental quality. Firms and consumers who degrade environmental quality by their practices, on the other hand, pay no charge. Polluters consider the degradation of environmental quality to be almost free to them, thus ignoring the costs they place on other. Particularly, sago factories have discharged wastewater near public lands such as streams and ponds. As a result, the Tamil Nadu government imposed a tax and banned some highly polluting industries, as well as providing waste management techniques. In order for companies to install or follow government regulations, they must incur significant costs. Since sago industries do not want to spend so much money in these conditions, the wastewater is eventually drained into their soil. At the same time, the wastes dumped in this manner can mix with the groundwater below the surface, polluting the natural groundwater. Same time, both the government and the public are unable to interfere and exert influence. Such activities result in further abuses of land rights between polluters and consumers. As a result, they escape other costs such as the installation of a Common Effluent Treatment Plant (CEPT).

When an input is free, a cost-cutting manufacturer needs to use as much of it as possible, resulting in unnecessary environmental degradation. However, environmental pollution does not come without a cost to the economy as a whole. Rather, high social costs are levied on the economy in the form of less leisure opportunities, health risks, decreased worker productivity, general unhappiness, and so on. Why isn't there a demand for environmental quality as there is for other goods? The lack of private property rights and the fact that environmental quality is a public (i.e., non-rival) good. It is important to have legal right to regulate the use of something in order for it to be valued by the consumer. Everyone owns the world, but no one owns it. There is economic overuse since a 'common property' cannot be valued for its use.

5.1 Coase and Piguvian Ideology for Policy Recommendations

Coase (1960)[25] pointed out that overuse is not a foregone conclusion. In theory, those who want better environmental quality should be willing to find a way to 'bribe' polluters to reduce emissions to an acceptable level. Since environmental quality is a non-rival or public good, this does not occur. Everyone benefits from clean air bought for himself, but the seller cannot bill for the benefits he offers to others. Furthermore, even if charging a premium were feasible, it would not be ideal since the marginal cost of an additional buyer of environmental

[25] Ronald Coase, 'The Problem of Social Cost' (2013) 56 The Journal of Law and Economics <https://www.jstor.org/stable/10.1086/674872> accessed 13 May 2021.

quality is zero. As a result, no one has a strong financial incentive to pay polluters to curb emissions. Finally, he suggests that in order to stop free riding, everyone must cooperate. Pollution levels are unsustainable because polluters do not bear the full social cost of their acts, as previously stated. Almost seventy years ago, A.C. Pigou[26] suggested that the government impose taxes on activities with external social costs and provide subsidies for activities with external social benefits. The term "external" refers to costs and benefits that are not factored into the market prices that private economic decision-makers face.

Consider the external expense of buying a gallon of fuel. The buyer pays the entire marginal cost of output in the sales price if the gasoline market is well-functioning in other ways. However, when a customer burns fuel in a car engine, another social expense is borne that the consumer is not responsible for. The combustion of gasoline contributes to the degree of air pollution in the region, albeit in a minor way. Wince air pollution is a 'public' bad that affects many people in the city, a small increase in air pollution in a region with a large population can have a finite marginal cost. When determining whether or not to buy an additional gallon of fuel, the user of gasoline lacks this aspect of the marginal social cost. The practice claims to be cheaper than it is because the user does not pay the full social expense of burning fuel. The Pigouvian tax concept is to levy a tax on gasoline equal to that portion of the marginal social cost that is not accounted for in the production price – the external marginal cost. The tax-inclusive price that the buyer pays is then proportional to the product's marginal social cost. The marginal social cost of a gallon of fuel, for example, is US $1.10 if the manufacturing cost of gasoline is a dollar per gallon and its combustion raises the social cost of emissions by 10 cents. In the absence of government policy, the consumer pays just a dollar per gallon, but with a 10 cent Pigovian levy, the consumer perceives the socially correct price of US $1.10.

5.2 Role of Government Actions

The above suggestions provide a basis for government action. One option is to make people who benefit from improved environmental quality pay for it. In this situation, a tax is imposed on everybody in the economy, with the proceeds going to polluters to help them reduce the amount of pollution they produce. This is a 'consumers pay' policy. Another option is suggested by Coase's proposal. It makes no difference to Coase whether property rights are granted to polluters or to users of environmental quality. In the above case, consumers have the right to seek compensation from potential polluters. When environmental quality is very good, the amount polluters are willing to pay to degrade

[26] Arthur C Pigou, 'Some Aspects of Welfare Economics' (1951) 41 The American Economic Review.

the environment by a certain amount is greater than the amount people need to earn (their marginal willingness to accept) to tolerate any degradation. As a result, polluters are willing to pay for environmental destruction, and households are willing to tolerate any amount of it. This is the 'polluters pay' principle.

This result can be reached if the government imposes a pollution tax on polluters. Alternatively, it may impose limits on the quantity of emissions that firms would emit. Both of these measures are based on the principle of 'polluters pay'. Either a 'consumers pay' or a 'consumers pay' policies will achieve the most economically effective level of emissions through lump-sum taxation (environmental quality). But in terms of distributional effect, administrative comfort, and revenue implications for the public sector, the two types of policies differ.

As a result of the partially treated and untreated sago effluent discharges, the operations of the listed industries in and around the study area have been dramatically affected in ground water, human health, loss of agricultural production, and livestock population. Depending on the extent of pollution, the government will collect the money from the polluters and distribute it to the victims. This is an example of a recommendation that can be derived from the study's findings and would undoubtedly benefit the social welfare. Instead of imposing mandatory requirements, the government might consider taxing polluters to pay for both a lump-sum payment to victims and the restoration of the environment of affected villages. Furthermore, the study discovered that sago contamination causes increased health risks, agricultural production losses, livestock health disorders, and increased defensive expenditures for their socioeconomic consequences of land cultivation, mandays loss, and migration to other occupations, as well as increased defensive expenditures by the affected areas. There is a need to concentrate on sago effluent discharge and treatment benchmarks in order to monitor health risks and improve green resources in order to ensure long-term environmental sustainability.

6. ACKNOWLEDGEMENTS

The authors express sincere gratitude to Indian Council of Social Science Research (ICSSR) for granting research project and financial assistance under IMPRESS scheme without which this research would have been impossible.

REFERENCES

Kollmann A, J Reichl and F Schneider, 'Who is Willing to pay for the Environment in the EU – An Empirical Analysis' (2012) 5 EuroEconomica

Torgler B, M García-Valiñas, 'The Determinants of Individuals' Attitudes Towards Preventing Environmental Damage (2007) 63 Ecological Economics

Bruce N, and G M Ellis, 'Environmental Taxes and Policies for Developing Countries' (Working Paper, Public Economics Division, Policy Research Department, World Bank 1993) <http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1993/09/01/000009265_3961005091708/Rendered/PDF/multi_page.pdf> accessed 13 may 2021

Ciriacy-Wantrup SV, 'Capital Returns from Soil-Conservation Practices' (1947) 29 Journal of Farm Economics <https://doi.org/10.2307/1232747> accessed 13 May 2021

Coase RH, 'The Problem of Social Cost' (2013) 56 The Journal of Law and Economics <https://www.jstor.org/stable/10.1086/674872> accessed 13 May 2021

Davis R, 'The Value of Outdoor Recreation: An Economic Study of the Marine Woods' (dissertation1963)

Israel D and A Levinson, 'Willingness to Pay for Environmental Quality: Testable Empirical Implications of the Growth and Environment Literature' (2004) 3 Contributions to Economic Analysis & Policy

Han F, Z Yang, H Wang and X Xu, 'Estimating Willingness to pay for Environmental Conservation: A Contingent Valuation Study of Kanas Nature Reserve, Xinjiang, China' (2011) 180 Environmental Monitoring and Assessment https://doi.org/10.1007/s10661-010-1798-4 accessed 14 May 2021

Gaterell MR, and others, 'A Valuation of Rutland Water Using Environmental Economics' (1995) 16 Environmental Technology

Hanemann WM, 'Willingness to Pay and Willingness to Accept: How Much Can They Differ?' in WF Oates (ed), *The Economics of The Environment* (Cambridge University Press 1994)

Bateman I, and R K Turner, 'Valuation of Environment, Methods and Techniques: The Contingent Valuation Method' in R Kerry Turner (ed), *Sustainable environmental economics and management: principles and practice* (Belhaven Press 1993)

Jenkins G and R Lamech, *Green Taxes and Incentive Policies: An International Perspective* (Institute for Contemporary Studies Press 1994). <https://cri-world.com/publications/qed_dp_114.pdf> accessed 13 May 2021

Knetsch J L, 'Environmental Policy Implications of Disparities Between Willingness to Pay and Compensation Demanded Measures of Values' (1990) 18 Journal of Environmental Economics and Management

Knetsch J L, 'Environmental Policy Implications of Disparities between Willingness to Pay and Compensation Demanded Measures of Values' (1990) 18 Journal of Environmental Economics and Management

Koutsoyiannis A, *Theory of Econometrics: An Introductory Exposition of Econometric Methods* (Palgrave 2001)

Kula E, *Economics of Natural Resources, the Environment and Policies* (Kluwer Academic Publishers 1994)

Cicatiello L, S Ercolano, G L Gaeta and M Pinto, 'Willingness to Pay for Environmental Protection and the Importance of Pollutant Industries in the Regional Economy. Evidence from Italy' (2020) 177 Ecological Economics

Markandya A, 'The Economic Valuation of Environmental Impacts, Issues and Applications in the Indian Context' in SPWD (ed), *Valuing India's Natural Resources* (SPWD 1998)

Meisner C, H Wang and B Laplante, *Welfare Measurement Bias in Household and on-Site Surveying of Water-Based Recreation: an Application to Lake Sevan, Armenia* (The World Bank 2006) <https://openknowledge.worldbank.org/bitstream/handle/10986/8458/wps3932.pdf?sequence=1&isAllowed=y> accessed 14 May 2021

Mitchell RC and RT Carson, *Using Surveys to Value Public Goods the Contingent Valuation Method* (Resources for the Future 1990)

Nikoleta J, J Clark and C Malesios, 'Social Capital and Willingness-to-pay for Coastal Defences in South-east England' (2015) 119 Ecological Economics

Oates WE, 'Taxing Pollution: An Idea Whose Time Has Come?' *The RFF reader in environmental and resource management* (Resources for the Future 2006) <https://books.google.de/books?id=u2PqUlHZC_IC&pg=PA63&lpg=PA63&dq=Taxing+Pollution:+An+Idea+Whose+Time+Has+Come?&source=bl&ots=6WgU6XASL6&sig=ACfU3U2o_3IsoSwVc1mdw96RddoY56Zmeg&hl=en&sa=X&ved=2ahUKEwj8pIjaqMfwAhWT_rsIHeWfAeEQ6AEwAnoECAQQAw#v=onepage&q=Taxing%20Pollution%3A%20An%20Idea%20Whose%20Time%20Has%20Come%3F&f=false> accessed 14 May 2021

Pearce D, A Markandya and EB Barbier, *Blueprint for a Green Economy* (Earthscan 1989)

Pigou AC, 'Some Aspects of Welfare Economics' (1951) 41 The American Economic Review

Portney RP, 'The Contingent Valuation Debate: Why Economists Should Care' (1994) 8 Journal of Economic Perspectives

Ercolano S, GL Gaeta, and O Romano, 'Environmental Tax Reform and Individual Preferences: An Empirical Analysis on European Micro Data' (2014) 51 Journal of Behavioral and Experimental Economics

Haab T, and K McConnell, '*Valuing Environmental and Natural Resources the Econometrics of Non-Market* Valuation' (Edward Elgar 2002)

Tolba M K and others, The World Environment 1972-1992, Two Decades of Challenges' (Chapman and Hall 1993)

<http://ciesin.columbia.edu/docs/001-009/001-009.html> accessed 13 May 2021

Turner RK, D Pearce and I Bateman, *Environmental Economics an Elementary Introduction* (The Johns Hopkins University Press 1994)

Venkatachalam L, 'Damage Assessment and Compensation to Farmers: Lessons from Verdict of Loss of Ecology Authority in Tamil Nadu' (2005) 40 Economic and Political Weekly

Venkatachalam L, 'The Contingent Valuation Method: A Review' (2004) 24 Environmental Impact Assessment Review

Whitehead AN, 'Valuation Methods for Environmental Costs and Benefits' in E.Kula (ed), *Economics of natural resources, the environment and policies* (Chapman & Hall 1994)

Young T and PG Allen, 'Methods for Valuing Countryside Amenity: An Overview' (1986) 37 Journal of Agricultural Economics

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	Author 1	Author 2
Conceived and designed the research or analysis	Yes	Yes
Collected the data	Yes	Yes
Contributed to data analysis & interpretation	Yes	Yes
Wrote the article/paper	Yes	Yes
Critical revision of the article/paper	Yes	No
Editing of the article/paper	Yes	No
Supervision	Yes	No
Project Administration	Yes	No
Funding Acquisition	Yes	No
Overall Contribution Proportion (%)	60	40

Funding
A generous funding was granted by Indian Council of Social Science Research (ICSSR) under IMPRESS scheme.

Research involving human bodies (Helsinki Declaration)
Has this research used human subjects for experimentation? No

Research involving animals (ARRIVE Checklist)
Has this research involved animal subjects for experimentation? No

Research involving Plants
During the research, the authors followed the principles of the Convention on Biological Diversity and the Convention on the Trade in Endangered Species of Wild Fauna and Flora.

Research on Indigenous Peoples and/or Traditional Knowledge
Has this research involved Indigenous Peoples as participants or respondents? No

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)
Have authors complied with PRISMA standards? No

Competing Interests/Conflict of Interest
Authors have no competing financial, professional, or personal interests from other parties or in publishing this manuscript.