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HOUSEHOLD WILLINGNESS TO PAY FOR THE ABATEMENT OF ENVIRONMENTAL POLLUTION: A CASE EXPERIENCE FROM SAGO INDUSTRY

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ABSTRACT

This study focuses on households' ability to pay for the reduction of environmental pollution caused by the sago industry in the Salem district of Tamil Nadu. The study collected primary data from 413 households, including Kaveripuram, Ammampalayam, Mallur, and Kattukkottai, using a stratified random sampling technique. Household data were consistent with the sago industrial pollution to estimate the willingness to pay for improved water quality, health impact, loss of agriculture production, and livestock populations in the region under study. From these findings, it is clear that household income concerning health impact, agricultural production, and livestock population in Rs. 142, Rs. 261 and Rs. 87 has increased by 1000 rupees. The study indicates that sago effluents can be developed and monitored much more quickly to enhance environmental quality by treatment plants.

Keywords: sago industry; abatement of environmental pollution; willingness to pay; treatment plants; environmental quality.

INTRODUCTION

Environmental issues may arise if the market system fails to establish an appropriate price mechanism for natural resources. These resources have been freely used and have been called public or common goods. However, their use imposes external costs, such as waste, soil, air, noise, odour pollution and other negative environmental impacts. Bruce and Ellis (1993) argued that everyone owns the environment and, therefore, that no one and a shared property cannot afford to use it, so there is a competitive overuse. As a result, environmental degradation has occurred, mainly due to a lack of market definition and property rights enforcement. The cost of producing any goods or services consists of a mixture of priced inputs, such as labour, capital, technology and invaluable inputs, such as environmental resources. Thus, the market price for goods and services does not reflect the real value of the total resources used to produce them (Pearce et al., 1990). Therefore, the divergence between the private and social costs of goods and services arises from an environmental, economic approach. As a result, the market price of goods and services generally covers the private expenses of ecological inputs, but not the external costs. As a result, producers and consumers are likely to use these products more than other higher-priced ones. Underpricing also provides insufficient incentives to improve new environmental pollution control technologies (Jenkins and Lamech, 1993; Harun Tanrivermis, 1998).

Firms are looking to maximize their profits, and consumers are willing to fulfil their wishes at the least cost to themselves. As a result of private cost-reducing behaviour, market prices of goods and factors do not reflect their costs to society, resulting in economic inefficiency and reduced social welfare and externality. This process results in excessive pollution and degradation of the environment. Non-marketed goods have not considered being economically sensible, and the environmental degradation caused by other economic activities has been seeing as a cost item in those activities. Production, consumption or other commercial activities may reduce the quality of the environment. Effluents produced by many industries, such as the paper industry, the dyeing industry, the leather industry, the tanning industry and the food processing industry, have adverse effects on soil properties and the germination of seeds reduce the production of seedlings. Negative externalities of industries or factories have resulted in crop loss, crop production, crop pattern changes, health problems and socio-economic inequalities in all countries (Sivasakthi Devi et al., 2010). Each economic agent's production and cost functions have affected negatively, including legislation on products, production processes, emissions, and waste. They also have various monetary instruments, such as taxes, charges, State aids, tradeable pollution permits, etc., and competition with polluters. The choice of the most appropriate tools to be used in any specific case will depend on the legal and administrative framework and the nature of the environmental pollution problems.

Economists have been arguing for taxing pollution for the last five decades. From their point of view, these taxes have used to remove market failures or misplaced markets. In these circumstances, economists have not been able to find sufficient political support for this idea. However, environmental economist and policy makers would like to suggest traditional control and control tools, tradeable pollution permits and various inspections of pollutant parameters instead of charges or taxes (Oates, 1984 and Oates and McGartland, 1984). Oates (1988) argued that a few scientific studies found that control and control policy instruments cost more than market-based incentives. Command and control policies have not been successful in the development of environmental policies. The consequences of pollution control and prevention, particularly the adoption of an end-of-pipe approach, resulting in higher costs due to internalization of damage costs, lead to reduced productivity and reduced productive investment (Tolba et al., 1993). In recent years, there has been a new interest in taxes in both developed and developing countries.

Environmental charges or taxes internalize the external costs that caused the activities of producers or consumers. Some taxing mechanisms in the EU and OECD countries include emission, product, wastewater, solid waste, noise charges, tax differentiation, and others applied by governments. In India, the Environmental Protection Act of 1986 enforces the polluter pays principle that solid waste and wastewater charges have used at the local level since 1986. Environmental policy and economic assessments based on empirical indicators that each WTP and WTA monetary instruments will provide equivalent sacrifice measures (Knetsch, 1990). As a result, financial instruments, environmental policy instruments and regulations have begun to apply individual WTP and WTA measures.

The primary objective is to estimate the individual consumer WTP's environmental quality and compare these estimates with the actual amount of environmental charges paid. Besides, economic agents' behaviour concerning the relationship between controls and WTP/WTA measures' price has been inspected through the CVM by analyzing data through the household questionnaire. Such research may be useful for further arrangements on pollution charges or taxes to achieve sustainable environmental improvement in the district of Salem and developing countries.

METHODOLOGY

Sampling Process and Data Collection

In order to determine the taxation attitudes of individual consumers, the Salem District was selected as the research area. The reason for selecting the district is based on the high number of sago industries that its basic socioeconomic uniqueness is an ambassador of the Salem region. It is accepted by the Salem Starch and Sago Manufactures Service Industrial Co-operative Society Ltd (popularly called as SAGOSERVE) that the district is a prototype of Salem with respect to human settlement and life style. According to both the economic and social development levels, the Salem district was stratified into two strata as Control village and Experimental villages. Salem is divided into 4 revenue administrative divisions by the Local Government. Out of four divisions, there are three revenue divisions have selected as sample area, Kaveripuram is controlled village have located in Mattur Revenue Division, Mallur, Kattukottai and Ammampalayam are experimental villages followed by Salem Revenue Division and Attur Revenue Division.

The sampling unit is the relevant household, which is living in the defined areas on the stage of the sampling process. To determine the numbers of households that live in selected areas, the Government Administrators of each village conducted a survey. By that survey, current household numbers are defined as 8304 which constitute the population of the study. Using stratified sampling the desired proportion of the sample is a 5 per cent of current household numbers in each village.

In this case, 413 household were selected out of the total population. The numbers of households were decided by stratified sampling, but interviewed households were determined at random. The sampling unit is the relevant firms which are registered with the SAGOSERVE and 478s sago industrial units at present in Salem district where is the high numbers of firms were decided by sampling area determined by stratified sampling method. The data were collected from individual households between January, 2013 and October, 2013 with the help of household questionnaire in different seasons. The household questionnaires were asked by dichotomous choices; open-ended and close-ended questions are included in household's monthly income and expenditure, water purifier, refrigerator, type of house, the use of cooking and drinking water nearby sago industry, etc., In their study, Mitchell and Carson (1994) also found that the most often used can water, such as taxes, purifier utility bills and medical expenditure are likely to be familiar to most respondents.

Theoretical Framework

The environmental policy debate has evolved over the past few decades to recognize the importance of market-based incentives as instruments to encourage pollution abatement. A market-based incentive concerns the estimates of costs and benefits of alternative actions, thereby affecting the decisions and behavior of individuals, firms, and governments, in order to choose the environmentally superior alternatives. The use of market-based instruments saves economic resources because decision makers are made aware, through prices, of the environmental implications of their choices. Despite their appeal, most market-based instruments are difficult to administer and are sometimes politically unacceptable. Therefore, it is imperative that the fiscal instruments designed for pollution control are appropriate to the existing situation.

Why market based incentives?

Market-oriented pollution control strategies have emerged due to a realization that traditional regulatory approaches are inefficient for most pollution abatement (Ackerman and Stewart, 1988). First, the spending required in order to comply with increasingly stringent environmental laws and regulation is becoming a major cost of production. The US Environmental Protection Agency, for example, estimates that over $100 billion is spent annually to comply with federal regulations (Alm, 1989). Governments are, therefore, investigating control options and mechanisms that would maximize the pollution abatement per dollar spent.

Second, it is increasingly clear that the costs of installing and operating the necessary control equipment very greatly both within and between industries. To get the most efficient (least-cost) reduction in pollution, industries with the lowest abatement costs should reduce their level of pollution with due compensation from industries with higher abatement costs. To provide a sense of the cost variability, we refer to a 1982 study that estimated the investment in pollution abatement equipment and operating costs of pollution-control activities by manufacturing industries (Anderson, 1992; Anderson, 2002 and UNEP, 2004).

The study indicated that pollution-control expenses form only a small part of the total costs of most industries. These expenses are concentrated in a relatively small number of activities, with three sectors like chemicals, petroleum refining, and primary metals accounting for 55 per cent of the total spending. Investment in pollution abatement consumes more than 20 per cent of the total investment for the pulp and paper, petroleum refining, and primary metals industries. The primary metals industry has the largest share, at slightly more than 2 per cent of the total expenditures on pollution abatement.

Third, concern over the impact of environmental regulation on the strength of the national economy and the nation's ability to compete in international markets is acute. Consequently, policy makers place an increasing emphasis on the degree and type of burdens placed on businesses and individuals.

Economic Instruments for Pollution Control

Efficiency arguments in favor of public intervention to mitigate pollution problems are well established. Fundamentally, it is recognized that market failures do occur, with the end result that the true social cost of a product or physical input is not reflected in its price. these failures are termed 'externalities'. An external effect occurs when the welfare of a household depends not only on its own actions, but also on the actions of others. If the activity imposes an adverse impact on others, it is termed a negative externality. Pollution activities are a prime example of negative externalities.

When there are pollution externalities, the market mechanism fails to induce the polluter to consider the costs to others of his or her activity. In other words, a free market without corrective intervention would result in pollution emissions in excess of the 'optimal' levels. More specifically, an industry would pollute until its private marginal benefits equaled its private marginal cost. Economic theory suggests that if the monetary value of the environmental damage caused by pollution can be determined, an environmental charge equal to the cost of damage could be established to serve as a disincentive for environmentally harmful behavior. By imposing this charge on polluters, the cost of pollution is internalized, automatically encouraging them to reduce pollution ot the optimal level.

Equivalence of Taxes and Subsidies

Environmental charges are commonly viewed as taxes imposed on the polluter. However, an established monetary value does not necessarily have to be a tax; the same optimal pollution level can be achieved by providing a subsidy to the polluter.

In that case, the polluter is paid to curtail pollutant discharges in accordance with the degree of willingness to pay for cleaner surroundings. The equivalence of an environmental tax and a subsidy is an important concept. Intuitively, if pollution has a social welfare cost, society should be willing to pay to stop the polluter from continuing the polluting activity. The net effect is the same as one obtained by imposing a tax on the polluter. The level of the subsidy or tax should be equal to the charge determined by the estimate of environmental damage. If we step back one level from the individual entities (that is, polluters and society), it is evident that, on balance, whether there is a tax imposed on polluters of a subsidy given to them, the economic resources expended to achieve a given optimal amount of pollution reduction are approximately the same (Ashworth and Papps, 1991). This equivalence is referred to as Coase's Law and has become of central importance in recent developments, applying economic reasoning to legal issues (Atkinson and Tietenberg, 1987).

The Polluter-pays Principle (PPP)

Another concept gaining credence among policy makers is the polluter-pays principle (PPP). The convergence of the principle and the use of market-based instruments leads to a critical policy stance the elimination of subsidies for pollution reduction. Economic theory leads us to understand that there is no net economic difference between an tax on pollution and a subsidy to reduce pollution. The PPP favors placing the entire burden of pollution abatement on the polluter. This distinction is only normative, since there will in reality be a partial or full transfer of the burden onto the consumer, depending on the relevant demand elasticities. Thus, a market-based incentive embracing the PPP only eliminates the subsidy option from consideration.

The PPP was accepted by Organization for Economic Cooperation and Development (OECD) member countries in the 1985 Declaration on Environment Resources for the Future, in which they undertook to introduce more flexibility, efficiency, and most-effectiveness in pollution control. In particular, they pledged to carry out a consistent application of the polluter-pays principle and a more effective use of economic instruments, in conjunction with their environmental regulations. The recommendation on the implementation of the polluter-pays principle specifies that member countries, as a general rule, should not assist polluters in bearing the cost of pollution control by granting subsidies or tax advantages. Exceptions to this rule were allowed only if all of the following conditions were met:

1. If they related to industries, areas, or plants where severe difficulties would occur.
2. If they were limited to well-defined transition periods adapted to the specific socioeconomic problems associated with the implementation of a country's environmental program.

3. If they were not likely to create significant distortions in international trade and investment.

Britain adheres most closely to the PPP in the area of industrial pollution control. It is a firm government policy to make industry responsible for the installation and operation of pollution control equipment capable of reducing emissions to the legally acceptable level. If a particular company cannot afford to buy the necessary antipollution equipment, the government does not offer subsidies (Bohm and Russell, 1985).

Empirical Model

Barbier et al., (2017) assume that there are N individuals in an economy, who may be willing to pay for a specific improvement in environmental quality, such as reducing the water pollution associated with sago industrial pollution in Salem district. Salem district is also called 'sago land' of Tamil Nadu because it accelerates growth of modern industries, extracted ground water diminishes and disrupts aquatic ecosystems. The water pollution causing sago effluents consists of environmental degradation which are directly linked to the total levels of production and consumption in the controlled and experimental villages. Assuming a feasible technology for abating these emissions, individuals may be willing to forego some of their income that should otherwise be spent on consumption in order to contribute to overall pollution abatement.

Thus, the utility function of a representative agent in the experimental villages is

$$U = U(c, P), U_c > 0, U_{cc} < 0, U_p < 0, U_{pp} < 0 \quad (1)$$

Where c is per capita consumption and P is the overall water pollution level associated with sago effluents.

Let y denote the individual's given level of per capita income. The choice is to allocate a share $\omega \in [0, \bar{\omega}]$. Of this income to pollution control, with the remainder spent on consumption. However, there is a minimal level of consumption that ensures an upper limit $\bar{\omega}$ on the individual's allocation of income to pollution abatement, i.e., $c = (1 - \bar{\omega})\ y = \bar{c}$. If $\alpha\ (N\omega y)$ is the reduction in pollution through all individual's expenditures on pollution control, then overall emissions generated with the economy is

$$P = [cN - \alpha\ (\omega y N)] = (1 - \omega)\ y - \alpha\ (\omega y),\ N = 1, \quad (2)$$

Where normalizing the number of individuals maintains the focus on the representative agent's decision (e.g., P can now be thought of as per capita pollution levels). The abatement technology is governed by

$$\alpha'\ (\omega y) > 0, \alpha(0) = 0, \alpha'(0) = 0, \alpha(\bar{\omega} y) = \bar{\alpha},\ \alpha'\ (\bar{\omega} y) = \beta < \infty \quad (3)$$

For a given income level, pollution abatement is an increasing function of expenditure allocated to pollution control. Abatement cannot occur if no money is allocated to reducing pollution, abatement is finite if the maximum amount is allocated to control, and the rate of increase in pollution abatement at the upper limit on control is bounded above by β.

The representative agent's problem is

$$\max_{\omega\epsilon[0,\overline{\omega}]} U\left((1-\ \omega)\,y,\ (1-\ \omega)\,y-\ \alpha\,(\omega y)\right). \tag{4}$$

For the given level of income y, the optimal allocation share for reducing pollution ω^* satisfies

$$-U_C - U_P(1+\alpha') \le 0, \omega \ge 0 \qquad -U_C - U_P(1+\alpha') \ \ge 0, \omega \le \ \varpi \tag{5}$$

For the corner solution $\omega = 0$, the marginal benefit of pollution abatement $-U_P(1+\alpha')$ is less than the cost $U_C y$, and thus the individual will not contribute any income to emission reduction. All of the agent's income will be devoted to consumption, and thus pollution will be at its maximum $P = c = y$. For the other corner solution $\omega = \overline{\omega}$, the marginal benefit of pollution abatement exceeds the marginal cost, and the individual will allocate the maximum amount of income to pollution reduction. As this corner solution is not important for what follows, for simplicity it will be assumed that $\omega > \overline{\omega}$.

The marginal WTP for pollution reduction W_p is therefore defined by the marginal rate of substitution between less pollution and more consumption $-U_p/U_c$ and is governed by the following condition

$$W_P = -\frac{U_P}{U_c} \le \frac{1}{1+\alpha'}, \omega \ge 0 \tag{6}$$

In the case of the corner solution, the WTP is equal only to the marginal rate of substitution between less pollution and consumption. In the case of the interior solution, the marginal rate of substitution must also equal $1/1+\alpha'$, the opportunity cost of less pollution in terms of foregone consumption. For the corner solution case, when the representative agent allocates no income to pollution reduction, $\omega = 0$. It follows from (2) and (6) that $P = c = y$ and $W_p = -U_P(y)/U_C(y)$. Consequently,

$$\frac{\partial W_p}{\partial y} = \frac{U_{cc}U_P - U_{PP}U_c}{[U_c]^2} > 0, \varepsilon p \equiv \frac{\partial W_p}{\partial y}.\frac{y}{W_P} = \frac{U_{cc}U_P - U_{PP}U_c}{-U_c U_P}\ y\ > 0 \tag{7}$$

The marginal WTP for pollution control increases with income, and the elasticity of W_n with respect to income is also positive. Because the terms in the denominator of εp in (7) are a function of per capita income, this elasticity is not constant.

For the interior optimum, changes in $W_n = -U_p/U_c$ correspond to changes in the opportunity cost of reduced pollution $1/1+\alpha'$. By examining how changes in y affect the right hand side of (6), we can infer how marginal WTP for pollution reduction also responds to changes in income. It follows that

$$\frac{\partial W_p}{\partial y} = \frac{-\alpha''\omega}{[1+\alpha']^2}, \varepsilon p \equiv \frac{\partial W_p}{\partial y} \cdot \frac{y}{W_P} = \frac{-\alpha''}{1+\alpha'}\,\omega y \quad (8)$$

As Eq. (8) indicates, how the marginal WTP for reduced pollution changes with income depends on the curvature of the abatement technology function $\alpha\ (\omega y)$ as governed by (3). If this technology is increasing and convex, and thus $\alpha'' > 0$, then as income increases W_p falls. However, if abatement technology is increasing and concave so that $\alpha'' < 0$, then rises as income increases. There is no change in if abatement increases linearly with pollution reduction expenditure . Similarly, the income elasticity of the marginal WTP for pollution reduction also varies with abatement technology, i.e., if . Unless abatement technology is linear so that , for different per capita income levels, the income elasticity of WTP is not constant.

Finally, as (7) indicates, even if the individual allocates no income to pollution control, the agent's marginal WTP for pollution reduction rises with per capita income. If income arises above some threshold level *w*, the interior solution is reached. It follows that the conditions for optimal abatement, pollution levels and marginal WTP for pollution reduction can be restated as

$$\alpha\ (W^*y) = 0, \quad P = c = y, \quad W_P = \frac{-U_P}{U_c}, \quad y \le \hat{y} \quad (9)$$

$$\alpha\ (W^*y)\ > 0,\ P = (1 - W^*)\ y - \alpha\ (W^*y),\ W_P = \frac{1}{1+\alpha'(W^*y)},\ y > \hat{y} \quad (10)$$

As per capita income rises to w, pollution increases by the same amount. It must reach its maximum at *w*, because for income beyond this threshold, emissions declines at the rate $\partial P/\partial y = -\omega^*\ (1 + \alpha') < 0$.

RESULTS AND DISCUSSION

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 to (WTA) compensate for the environmental trouble in the case of sago effluents?. The data provided by individual consumers are analyzed and the relationship between individuals' fulfillment 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 (Whitehead, 1994). In this study, WTP functions of households and firms are estimated. There is no theoretical correct form of these functions (Pearce et al., 1990; Pearce and Turner, 1990; Bateman and Turner, 1993; Kula, 1994). 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:

Table 1 Distribution of WTP to avoid Environmental Pollution in Sample Villages

Area	Name of the village	WTP to Avoid Environmental Pollution		
		No	Yes	Total
Controlled 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)**	

Source: Field Survey (2013).
Note: figures in parentheses denote the percentage of the column total.

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

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

WTP	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances not assumed	11.598	.001	-10.965	191.611	.000	-157.880	14.399

Source: Field Survey (2013)

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 level of willingness to pay to avoid the environmental pollution from control and experimental between two groups t (191.611) = -10.965 p = .001.

The results suggest that willing 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 .05. Because of this, we can conclude that there is a statistically significant difference between the willingness to pay between control and experimental villages. Since our group statistics box revealed that the mean for the control village is Rs. 100.55 it was lower than the mean for the experimental villages is Rs.258.43, it is possible to conclude that willingness to pay for the abatement of environmental pollution is high in experimental villages due to they are facing huge of physically and mentally disturbed by sago effluents.

Contingent Valuation Method: Empirical Specification

The main objective of estimating econometric (or parametric) model in WTP survey and calculating mean WTP and to allow presence of respondents' socioeconomic factors into WTP functions. Such incorporation of individuals 'socioeconomic variables into the CV model, helps the researcher to gain information on the validity and reliability of the CV results and increase confidence implication of the results obtained from the CV empirical analysis (Habb and McConnell, 2002; Venkatachalam, 2004). 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 is that an individual seeks to maximize a utility function, or equivalently minimize an expenditure function subject to a utility constraint, that includes a vector of services depending on the environmental status. The contingent valuation method (CVM), one of the direct valuation methods, is a survey method used to elicit WTP/WTA values of the individuals by way of creating 'realistic' hypothetical markets. For instance, the individuals/households in the polluted areas may be 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 needs to be administered very carefully, a failure of which would lead to the generation of invalid and unreliable results. In circumstances such as this, the cross-section data for production from both pollutions affected and the non-affected areas (i.e., with and without) are collected and using regression analysis the impact of pollution, along with the influence for other factors, on output is estimated. The net change caused by pollution alone on output is monetized with the help of the market price, and this amount is treated as damage cost (Venkatachalam, 2005).

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 gives attention in most of the countries. For valuing the improvement in environment different methods are available.

Relevant factors in environmental quality management are economic assessment of emissions abatement benefits and the scot of such a reduction. The characteristic of environmental sustainability, a public good, demands to be followed by those customarily engaged in studies of consumer goods. Two ways of valuing environmental quality have been used. The first includes indirect approaches which compare private goods' observable prices to an implied value for a public good. For example, the relationship between a public good, water quality and two private goods, agricultural production and harm to health, have presented in this paper. Water quality affects the agriculture production as well as the spending on preventive and medical expenses associated with the health impact of pollution. Changes in the level of water quality are likely to adjust the demand schedules for certain consumer products. The size of those changes can be extracted from implied prices (or marginal willingness to pay valuations) of the public benefit in question. The use of household data when measuring environmental goods has been explained by (Maler, 1974; Freeman, 1979), and more recently and exhaustively by (Bockstael et al., 1984 and Johansson, 1987). Nevertheless, the indirect approach examined in this paper has rarely been applied to valuing public goods in general and environmental goods in particular.

The second approach is a Contingent Valuation Method (CVM). It specifically elicits from the respondents their assessments of presented changes in the quantity of a public good within a hypothetical contingent demand for it. The researcher utilized "stated preferences" contingent valuation method (CVM). After reviewing all the methods, CVM was chosen for the present study. Much CVM research was found in different countries, but only a few studies have been carried out in India applying CVM. As far as the application of CVM for river pollution is concerned, the researchers found only one study on the Ganga River. No such study was available in respect of any other river. As far as the study of rivers is concerned, the rivers like the Gangas and smaller rivers like Noyyal River need different approach, while applying the CV method. Likewise, for the practical explanation that morbidity differs widely, there is much less work on willingness to pay to reduce the risk of morbidity. Carrying out the large number of studies needed for all related morbidity outcomes would cost a great deal. As a consequence, WTP calculations are commonly used to measure the probability of death or decrease in the number of deaths within a population. But other methods are being used to measure the importance of reducing the risk of non-fatal diseases to members of society. (Robinson, 2007; Hoffmann and Scallan, 2017). The key determinant is whether the average people will spend some money on pollution reduction expenditures or not. And our theoretical outcome is preference based. If the representative people is unable to spend any money on enforcement, instead income raises the emissions. When allocating some money to curb emissions, the abatement technology affects not just how money pollution declines but also the sign of income elasticity and magnitude of the WTP to regulate pollution. This role of reduction technology in affecting any pollution to income relationship is consistent with the fact that pollution control returns to scale are important for an environmental pollution (Barbier et al., 2017).

Contingent Valuation (CV) was first used by Davis (1963) to estimate the value of big game hunting in Maine. Hannack and Brown (1974) applied CV to value waterfowl hunting. 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 (Boyle, 1990). 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 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 (Laplante, 2006). It is hypothesized that WTP will vary depending on the gender and age of the person for reducing environmental pollution. Awareness is supposed to affect WTP, with more years of education contributing to greater WTP, because the knowledge and ability to use natural resources and access information may be greater. If any extension service is used, WTP may be larger due to a demonstrated interest in accessing multiple sources of information. With higher farm production, WTP can be higher, as the payment potential is greater. Larger cultivated land area may increase WTP, as the need for knowledge and resources may be greater. Market distance may increase WTP, as it may be more convenient for those further from a market to obtain information directly via bid functions (Akujuru and Ruddock, 2014; Suresh Chandra Babu and Claire J. Glendenning, 2019; Ukpong, 2019).

Willingness to Pay Bid Function Analysis

Analysis of bid function underlying the WTP responses was undertaken; 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 interpretation. Bid function can be written as follows:

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

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

Where,

Y = Dependent Variable

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

á is Constant

$â_1$-$â_9$ is coefficients to be estimated

ì is an error term.

The equation represents the determinants of willing to pay as a function of avoid 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}	=	Willing to Pay for Health Risk
$WTP_{agri.loss}$	=	Willing to Pay for Agricultural Loss
$WTP_{livestock\ damage}$	=	Willing to Pay for Livestock Damage

Table 3 Regression Result for Willingness to Pay

Sl.No	Independent Variables	Regression Coefficients	Std. Error	t	Sig.
1	α (Constant)	-594.162	52.948	-11.222	.000***
2	S_{class}	2.704	3.875	.698	.486
3	F_{size}	4.721	5.584	.845	.398
4	EDU_{head}	6.199	3.044	2.037	.042**
5	TY_{emp}	4.542	6.524	0.696	.487
6	$DIS_{w.collection}$	8.093	8.471	0.955	.340
7	$AL_{drinking\ water}$	2.343	11.561	0.203	.839
8	WTP_{HR}	142.697	16.172	8.824	.000***
9	$WTP_{agri.loss}$	261.638	13.430	19.482	.000***
10	$WTP_{livestock\ damage}$	87.596	14.748	5.939	.000***

N = 413, R^2 = 0.664, F = 79.359

Source: Field Survey, 2013.

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 use 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 around 66 per cent of the variation in WTP, being explained by the explanatory variables.

While the R^2 value 0.664 overall model indicate that 66.4 per cent level of variation in the explanatory variables. The coefficient of S_{class} is 2.704, this means that various social groups are more willing to pay for the good environment as compared to both areas. The present populations are more educated and knowledgeable about the effects of sago industrial pollution. Compared with educated and uneducated peoples are experiencing more vulnerable effects of sago industrial pollution, and since lost 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 than money.

The coefficient of $DIS_{w.collection}$ variable is a positive signed by 8.093 at 5 per cent level of significance. This means that distance to the drinking water collection have an increasing ratio of cost, this situation that people are more willing to pay on the basis of distance of drinking water collections. The result shows that distance of water resources from residence is not near to the residence. People are bothered about the distance for quality of drinking water. So, it means that if good quality of drinking water is available in far distance from the residence, people are willing to pay till date.

$AL_{drinking.water}$ variable is a positive signed in 2.343 with the 10 per cent level of significance. This means that alternative drinking water collections to the market have an increasing cost, this distance has included price, time and income has spent on more. These circumstances peoples are unable to pay for that, but many of the households are willing to pay for quality of drinking water. WTP_{HR}, $WTP_{agri.loss}$, $WTP_{livestockdamage}$ variables is positive signed, such as 142.697, 261.638, and 87.596 which is the 1 per cent level of significance. This means more important for health, agricultural loss and livestock damages are very close to our day to day life, because these three impacts are more expensively. It is explained that these peoples depend on agriculture, agro industry laboures and holding livestock's is determine those social status and economic wellbeing of this area. In this result has found out that the one thousand of wage income will increase, willing to pay for the abatement of environmental pollution will increase due to huge of effluent waste water released from sago industry. In that portion of Rs.142, Rs.261 and Rs.87 respectively, so the alternative hypothesis will be accepted and null hypothesis will be rejected in the appearance of regression results.

CONCLUSIONS

The present study has estimated households' willingness to pay for the abatement of environmental pollution by sago industrial effluents in Salem District of Tamil Nadu. It is very clear from the results that groundwater, human health, loss of agriculture production, and livestock population of partly treated and untreated sago effluents have affected groundwater. Based on that result, the government can collect the polluters' amount and pay to the victims depending on the level of pollution incidence. In its place of mandatory standards, the government could think taxing the polluters to reflect for both lump sum transfer to the victims and the restoration of affected villages' ecology.

Sago pollution results in higher health risks, loss of agricultural production and animal health problems, leading to increased socio-economic consequences of land cultivation, failure of working days and migration to other jobs have had a significant impact on the affected areas. This study's findings will also help policymakers in central and local government agencies determine fair environmental fees to paid in affected villages for environmental management. Therefore, based on the overall possible expenditure of the household's ability to pay, the government agency will socialize the total investment from several sources, such as peoples in affected villages, investors and local government expenditure. As a result, the need to concentrate on sago effluents and monitor by treatments plants will be built and controlled much more rapidly to improve the environmental resources.

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