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Soiled Agriculture and spoiled environment: Socio-economic impact of groundwater pollution in Tamilnadu

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SOILED AGRICULTURE AND SPOILED ENVIRONMENT: SOCIO-ECONOMIC IMPACT OF GROUNDWATER POLLUTION IN TAMILNADU*

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Abstract

The problem of water pollution poses a great threat to basic human living. The ramification of pollution is indeed more severe in the less developed countries that are afflicted with chronic problems of political instability, lack of political will, high level of illiteracy, unceasing poverty, increasing degree of urbanization, lack of basic needs and basic infrastructure and women subordination. The subject matter of groundwater and surface water pollution gains further significance due to economic liberalization policy, to which most underdeveloped countries have been subjected. In other words, the phrase, "sustainable development" emphasized in many international fora, has seemingly no meaning in many underdeveloped countries. Most river basins, in particular India, are heavily polluted. In addition, the river basins are stressed due to competing demand for water across different uses and users; there is an intense competition in tapping the good quality water among the sectors such as agriculture, industry and domestic. In the process, millions of gallons of ***good*** quality water is transported from rural to urban areas everyday; the net result is the flourishing water trade and the depletion of groundwater potential. It causes more anxiety not only because a huge quantity of water is transported from rural to urban areas, but also because of the release of comparable quantity of water as effluent. This contributes significantly to water pollution and ecological degradation. In addition, it poses a great threat to future generations. The present paper discusses the problem groundwater pollution in the particular context of the Palar river basin in Tamilnadu, where the tanneries have contributed to the environmental degradation in a large measure. The paper also discusses how the dependence upon the official agencies has in no way helped the society. Even when judiciary intervenes actively, things do not change radically because of the feckless and corrupt governance and the complete lack of monitoring mechanism. When everything fails, social dialogue process seems to be the key for problems associated with water management and environment. This is the key message of this paper.

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1 The Core argument and context

The 1972 Stockholm Declaration on Human Environment has proclaimed, "man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being" (Ayesha Dias, Human Development Report, 2000, Background Paper). The problem of pollution, however, poses a great threat to basic human living and results in gross human rights violations. The ramification of pollution is indeed more severe in the less developed countries that are afflicted with chronic problems such as political instability, lack of political will, high level of illiteracy, unceasing poverty, increasing degree of urbanization, lack of basic needs and basic infrastructure and women subordination. This subject matter in fact, gains further significance due to economic liberalization policy, to which most developed countries have been subjected. There has been a great concern over the issue of food security; availability of food for all has become a big question mark both in rural and urban areas. In other words, the phrase 'sustainable human development', emphasized in many international forums, has seemingly no meaning in many under developed countries. The problem of water pollution is thus set in this context in the river basins under study in India and in Nepal. In many river basins, one witnesses competing demand for water across different uses and users or between sectors such as agriculture, industry and domestic / municipal uses. This causes a tremendous stress on the limited available water resource, not only because groundwater is transported from rural to urban area, but also because of the release of almost comparable quantity of water as effluent. This contributes significantly to water pollution, causing permanent damage to environment and ecology. And further, the ability of the future generations to sustain on the available natural resource base is deeply disturbed.

The economic liberalization policy initiated by the Government of India since 1991 has provided an impetus to trade and the industrial sectors of India. This was indeed a crucial macro decision of the Government of India, initiated due to the international pressure and World Trade Organization. Yet, the government was

totally under-prepared to face the consequences. Even otherwise, the Government was unprepared to tackle problems such as water pollution. The severity of impacts of trade effluent generation on local water resources, agriculture, livelihood and on health of local people is going to become worse in the years to come.

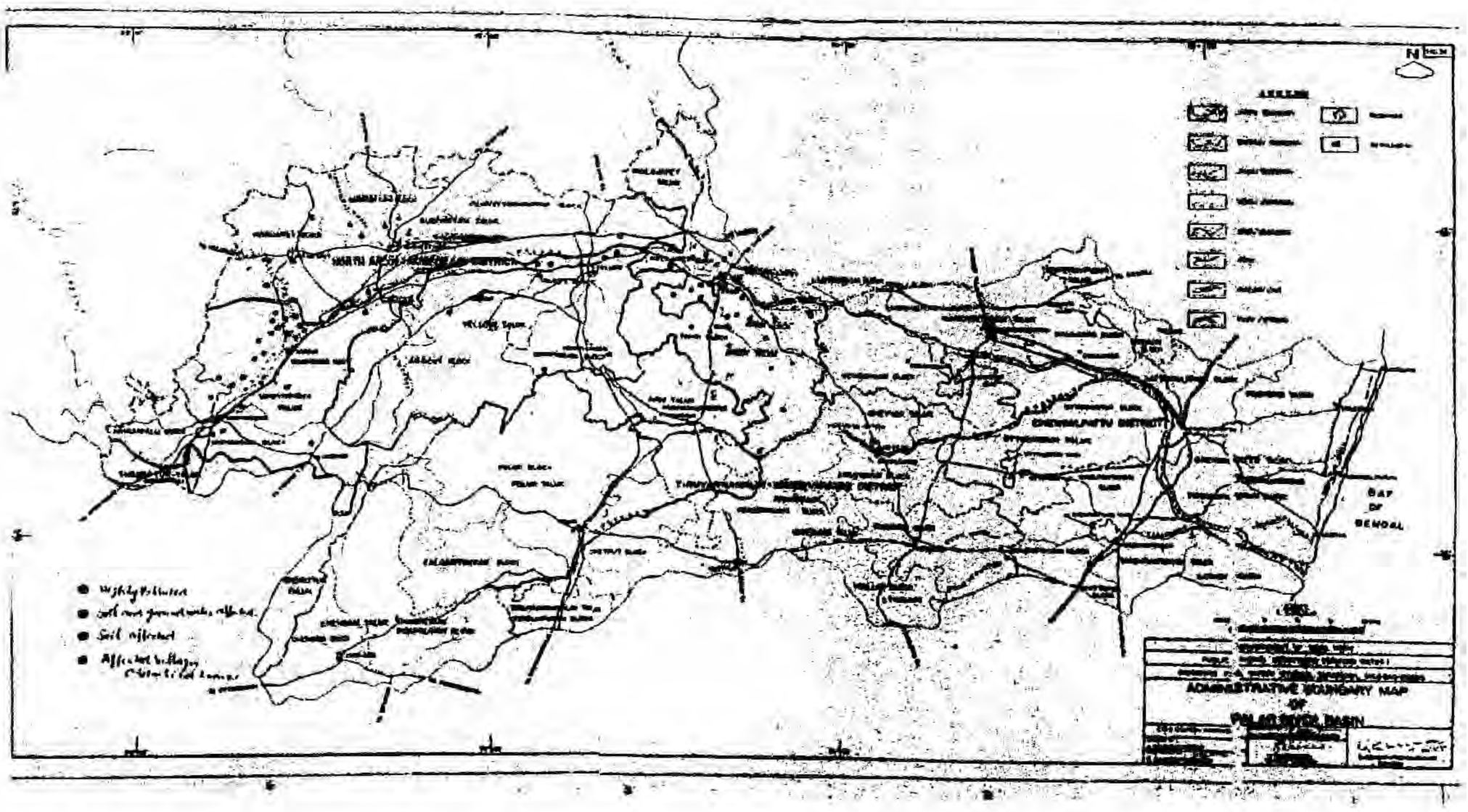
This paper explores socio-economic impacts of water pollution in the particular context of the Palar river basin and makes an attempt to document the ongoing social responses and social dialogue to the gravity of pollution. The analyses and discussions presented in this paper are based upon the secondary sources as well as the primary survey conducted in the selected river basin.

The paper is divided into seven sections including introduction. Following introduction, Section-2 provides the background information for the river basin; Section-3 discusses the intensity of water pollution caused due to the effluent discharge; Socio-economic impact of pollution is discussed in Section-4 followed by a dialogue on mitigation and regulatory measures adopted in the next section. While Section–6 deals with social responses and coping strategies, the final section provides an analytical summing up.

2.1 Background Information concerning the local water supply options and the industrial development in the Palar river basin

The Palar, one of the major rivers in the northern Tamilnadu, originates in Nandhi Durg hills of the eastern part of Karnataka State. This river passes through hilly stretches of Andhra Pradesh before it enters Tamilnadu near Vaniyambadi town. The Palar river basin covers an area of about 18,300 sq.km., of which approximately 11,000 sq.km. lie within the (Tamilnadu) State's borders. The basin covers the districts of Vellore, Tiruvannamalai and Kancheepuram. The major tributaries of this river are Poini, Kaundinya nadhi, Malattaru (joining this river in the western plateau region), Cheyyar, Agaram aru, Kamandalaru and Naganadhi (joining the main river in the central hilly and valley complex region) and Killiyar joining this river in the eastern plain region. This river finally joins the Bay Bengal near Mahapalipuram (see Palar basin drainage map).

Palar river basin map: Black dots in the map indicate location of tanneries



Average annual rainfall ranges from 800 mm to 1200 mm, most of it is contributed by the south-west and north-east monsoons. The climate is tropical and highly humid. Evapo-transpiration rate is as high as 2000 mm per year, which is much higher than the annual rainfall. Flash floods are common only during the north-east monsoon months. Water balance studies undertaken in the Institute of Water studies, Government of Tamilnadu, indicate that the Palar basin is a water deficit area (Institute of Water Studies, 1992). Major irrigated crops in this basin are paddy, sugarcane, groundnut and to some extent banana. Major unirrigated crops are coarse cereals besides groundnut in water scarce areas.

Tanks have historically been the most important surface irrigation source in the basin. There are no storage reservoirs in this basin but one finds a series of seven anicuts (diversion weirs) which fill a large number of irrigation tanks. The total number of tanks filled by these anicuts are little less than 700 and the total area irrigated by these tanks is about 61,000 hectares. These are called system tanks. Besides system tanks, a large number of non-system tanks also exist in this basin, exact number of which is not known. Concentration of system tanks is quite high in the lower Palar basin compared to the upper reaches of the basin. In other words, groundwater is the primary source of irrigation in the upper reaches of the basin compared to the lower reaches.

Besides tanks, there were numerous spring channels which had their origin in the Palar river or its tributaries, which irrigated thousands of hectares along the villages located on both sides of the river. According to the Institute of Water studies, there are about 606 spring channels in the basin area (IWS, 2000). In many villages, even now, the spring channels remain but in a dissipated and silted condition. While in many of these channels river water stopped flowing long ago, in some of them untreated effluent is discharged by the tanning industries. Therefore, these two sources, namely, tanks and spring channels constituted the main traditional local water supply options in this basin area.

However, as tanks and springs (as the major surface irrigation sources) are becoming more and more undependable or defunct, wells have emerged as the major

source of irrigation in the basin area. Net irrigated by wells in the basin works out to about 75% (Rajagopal and Vaidyanathan, 1998). This was in particular made possible because of the overall transformation that the village societies have experienced over a period of time: a large scale transfer of land from the upper castes / traditional landlords to the hitherto cultivating tenants has given way to the emergence of owner cultivation; In addition, the traditional landlords, who had a greater stake in land and tank water, performed the crucial role of an enforcing authority quite effectively with the help of tenants' labour. Most of those traditional landlords have already migrated to towns and cities in the last three or four decades. As a consequence land control institution have undergone a tremendous transformation and so also the traditional irrigation institutions have got disintegrated. (Janakarajan, 1993).

The study carried out by the Institute of Water Studies indicates that in the late 1980s there were around 132,000 irrigation wells in the basin area and the density of wells varies from 0.74 to 2.82 per hectare. Groundwater utilization is as high as 92 percent in this basin. Groundwater evaluation study in this basin has been carried out by the State Groundwater Board with the help of the data collected from 148 observation wells spread over different segments of the basin, over a period of 18 years (1971-1988) (UNDP study, IWS, Madras). This study indicates that the surplus groundwater potential is available to an extent of 269 mcm in the entire Palar basin (barring the hilly areas of the basin) (IWS, 1992).

Groundwater has also been a major source for drinking and industrial water needs. Quality, however, varies a great deal across the basin. This issue of water quality has not been addressed while assessing the groundwater potential in the river basin. This is in particular important because of a long history of leather tanning industry in this river basin, which has contributed quite significantly to the groundwater contamination.

In the Palar river basin, paddy is the traditional crop. However, due to changes in the local water supply conditions, crop pattern in this basin have undergone a radical transformation. Farmers have started growing non-food crops such as coconut which is less water intensive and pollution tolerant.

In the Palar river basin, the concentration of leather tanneries have the history of over a century. At present, the leather industries have turned out to be not only

highly profitable but have also been a substantial foreign exchange earner for the country. These industries have also generated large employment opportunities for the local population. See the Palar basin map where the concentration of the leather industries is indicated with black dots.

At the all India level, leather industry accounts for more than 7% of the country's export earnings and contributes employment opportunities to over two million people. Until the early 1980s, the country was exporting only semi-finished leather. However, when it was banned, export of finished leather began on a large scale. This was also the time when the number of tanneries multiplied rapidly. The technology of tanning also has changed from the conventional – eco-friendly -- vegetable tanning to the chrome tanning. Nevertheless, the export earnings of leather industry have been quite significant: From a mere Rs.320 million in 1965, it went up to Rs.59 billion in the year 1997 (or $1.7 billion), constituting 7% of total export from the country. This industry provides employment to about 2 million people. The Southern States in India, in particular Tamilnadu have been the major exporters of leather. About 51% India's leather exports originate from the Southern States and about 70 % tanning industries are concentrated in this region alone. Of the total exports from the South, Tamilnadu state alone contributes to 90%. And within the State, the Vellore district's share (Palar basin) alone is 90%. This works out to 30% of the country's total exports (Interview given by M.Rafeeque Ahmed Mecca, Chairman, Council for leather exports, Frontline, S4ptember 19, 1997). As per the independent consultancy organisation appointed by the Asian Development Bank (ADB), the number of 'red industries', which discharge huge quantity of untreated effluent in the Palar basin are, 460 tanneries (of which 3 large, 38 medium and 460 small), 63 chemical industries (3 large, 19 medium and 41 small) and 116 other industries (13 large, 39 medium and 64 small) (Asian Development Bank, 1994). Since then, the number of tanneries has reported to have gone up to over 700 in the Palar basin.

2.2 High degree of urbanization and rural-urban water trade in Tamilnadu and in the Palar basin

Though agricultural sector is still the single largest user of groundwater, there have been growing demands for this resource from other sectors or users. From this point of view, the proportion of water used / demanded by other sectors may appear small and insignificant. But, the fact of the matter is that since only good quality

water is demanded by other sectors, what is demanded by domestic and industrial sectors may be high when we calculate it as a proportion of total stock of good quality water. Further, since the good quality of groundwater is not available everywhere, there is lot of pressure wherever one strikes it. For instance, a large majority of Indian villages and towns are still dependent upon groundwater for their drinking and other domestic purposes. The urbanization process, the increasing demographic pressure and expansion of industrial activity have all generated competing demands for groundwater. This is more acute in a State such as Tamilnadu, where, almost all the available surface water sources have been utilized. Of the 1261 TMC (thousand million cubic feet) of surface water annually available, about 1155 TMC or 92% has been utilized for irrigation, municipal and industrial purposes (1050 for irrigation and 150 for drinking and industrial purposes. The competing demands between different users and uses have added enormous pressure to groundwater resource. As competing demands for groundwater has increased over time, conflicts or conflicting interests have also emerged among various user groups. ***The word `conflict' in our present context need not be understood as the one, which refers to physical violence. It should be rather seen as a potential force for competition and change.*** In particular, the conflicts should be set in a context in which most of the developing countries have been subject to a tremendous pressure due to combination of many factors such as economic liberalization and growing economic dependence upon dollar earning exports, introduction of new bio-chemical technologies, eroding common property resources (like traditional surface water resources, common land, forest etc.), demographic pressure, urban expansion and burgeoning consumerism.

In the particular context of groundwater resource, conflicts take place due to one critical factor, namely, scarcity. The scarcity in turn is caused due to imbalance between supply and demand. To put it differently, groundwater, as a crucial productive and natural resource base, is under great threat for two fundamental reasons: One, due to excessive unregulated pumping, resulting in secular lowering of water table (in some cases, the damage due to depletion is irreversible) and two, due to groundwater pollution caused as a result of discharge of industrial effluent, the use of chemical inputs in agriculture which seeps into the ground as a natural process of return flow of used water and due to domestic and municipal sewage. In both these cases, scarcity occurs: While in the case of the former, scarcity occurs due to over-

extraction, in the latter, it is due to contamination. Yet, aquifers are damaged in both the cases and in some areas, the damages are permanent.

The trading in groundwater occurs for non-agricultural uses also. The primary non-agricultural users are urban industrial owners and Municipalities (to meet drinking water needs). In other words, the dreadful story of water crisis that is imminent in the countryside is not only due to the use or over-use of good quality groundwater for agricultural purpose but enormous stress is added due to diversion of a large extent to urban industrial and domestic purposes. A high degree of urbanization, coupled with rapid industrialization has increased the demand for water for industrial purposes by many folds. Whatever quantity of water that is consumed for industrial processing is discharged as effluent in the open surface, streams, lakes/tanks and rivers, contributing thereby significantly to pollution load of surface and groundwater bodies. Therefore, the transportation of potable groundwater from villages to urban industrial uses not only aggravates the already depleting groundwater table, but also contributes to permanent damage to groundwater due to the discharge of industrial effluent. All these in turn pitch into drinking water scarcity, health hazards, decline in soil quality, reduction in agricultural yield, rise in the cost of living and in a overall sense contributes to persisting poverty conditions.

In addition, there has been a great deal of encroachments by the industrial owners into the villages as more and more agricultural lands are sold for industrial purposes. The irony of the fact is that the land, which are interior and which are still used as agricultural land are least demanded and fetches very low price because of declined soil and groundwater quality, thanks to the damage consummated by industries. On the other hand, those plot, which are closer to the main roads and, which have better quality of groundwater fetches a disproportionately high price. These are the plots of land, which have been demanded and bought by the industrial owners. In many cases, the industrial owners have bought plots of land specifically with a motivation of installing deep bore wells -- beating every other well owner in the vicinity by pitching the marginal cost of well digging or deepening disproportionately high -- with a view to transporting water (this is the case in which conflicts occur between rural and urban intruding users). Furthermore, the indiscriminate pumping of groundwater from the rivers for industrial and drinking water needs (in particular Palar river) have resulted in the drying up of several hundred spring channels, which originated from the river and which were yielding

water till the last couple of decades (this is again a case in which conflict occurs between different natural resource base).

Tamilnadu ranks second in terms of the degree of urbanization in India (34.2% in 1991), but stands first as per the composite index, calculated by including both the important features of urbanization such as town density and the degree of urbanization. While looking across the districts in the state, it turns out that in many districts, the degree of urbanization is much greater than what is reported for India, which is 25.7% in 1991. The rapid urbanization process, coupled with the speedy industrialization, added enormous pressure on the basic needs of the towns, most important of which is water.

In the last one decade or so, many industrial and commercial establishments in the urban areas of Tamilnadu have been drawing huge amount of groundwater either through their own deep bore wells or by purchasing water. Notable among the cities and towns in the state which depend upon the pumping of water from their rural neighbourhood are Chennai and Coimbatore - Tiruppur - Erode corridor (constituting erstwhile undivided Coimbatore district) and Karur (Karur district) and Didigul (in Didigul district). The sale of groundwater has been quite extensive in this area. Perhaps, the largest consuming town is Tiruppur in Coimbatore district, which has earned a place in the industrial map of the sub-continent, as one of the large foreign exchange earners due to heavy concentration of knit-wear industry in the town. In the absence of any other source, these units have been transporting groundwater from the rural areas by truck-tankers. Out of over 100 million liters of water used per day (mld) in this town, private water supply alone contributes to over 60%. The water is transported by the tanker-trucks from several villages of up to 30 KM radius from the Tiruppur town. A rough estimate puts the number of truck-tankers, which transport water to the town at 900 to 1000 of which about 90% is owned by the industry owners (stated by an Union Leader at Tiruppur). While it is not a news to learn that in several villages, a large number of farmers have resorted to sell water to the Industries at Tiruppur, it is but astounding that the Tamilnadu Electricity Board has authorized 230 agricultural wells around Tiruppur, Palladam and Avinashi for selling of water by issuing them a separate service connection.

In the Palar basin also, although tanks still supply water for agricultural needs in some villages, most prominent source has been groundwater. And, it is indeed the only source for drinking and industrial needs in the basin. The river although remains dry except for a few weeks during the monsoon months, serves as a very good sub-surface reservoir. The riverbed aquifer is quite rich that almost year long pumping appears possible until recent times. Over 200 mld of water is transported every day for industrial and drinking purposes. Even a part of Chennai city's drinking water requirement is met by pumping from this river. Besides, hundreds of villages and small towns located near the river get water supply from the Palar riverbed aquifer only. In the recent times, amusement parks, government sponsored atomic power station, many large industries (like Ford) and townships; zoo and so forth draw a large extent of groundwater from the Palar riverbed aquifer.

3 Intensity of pollution

Water pollution is a widespread phenomenon in an industrialized State like Tamilnadu. This is also a State, where surface water resource has been utilized almost fully with groundwater meeting more than 60% of the needs of all sectors. Water pollution in this context, enhances colossal stress on the existing resource base. Almost all river basins in the State are polluted (see Appendix-1 Estimated total pollutant load discharged into major rivers in Tamilnadu). The entire Cauvery basin is affected but due to the continuous water flow during most parts of a year, pollution load is not felt much. However, the tributaries of the river Cauvery such as Noyyal, Bhavani, Amaravathi, Kodaganaru and an age old canal called Kalingarayan have all been polluted quite badly. The worst affected however is Palar, in the Northern Tamilnadu where a large number of tanneries are located. Let us see briefly the intensity of pollution in the Palar basin, which constitutes our study region.

3.1 Intensity of pollution in the Palar river basin

The massive growth of leather industry in the last three or four decades have on the one hand contributed to substantial foreign exchange and employment, and on the other, contributed a permanent damage to groundwater and land. A study undertaken by Teekaram and Ahamed, as early as in 1980, as a part of the Soil Survey and land Survey Organization, Government of Tamilnadu, reveals some shocking information.

The number of tanneries as on around 1980 in the Vellore district (which covers major parts of the river basin), were only 249, of which only 51 tanneries engaged in chrome tanning, and the rest involved in vegetable tanning. Even though the number appears small, compared to what exists today, the damage to environment, even at that time was very high. In the first instant, the disposal pattern of effluent looked extremely dubious. The normal method was to store effluent in unlined lagoons and allow it evaporate in the solar power. But this study found that, first of all, not all tanneries had lagoons, secondly, lagoons were unlined and there fore a good deal of effluent was allowed to seep, thirdly, the conditions were extremely bad that effluent stored was always overflowing and finally, the capacity of lagoons did not commensurate with the effluent that they turn out. For instance, there were 855 lagoons in the district, of which only 62 were found to be matching with the capacity, and the rest were found to be disproportionately small compared to effluent they generated. Indeed, 696 of them were seen to be overflowing at the time of this Survey and further, the authors indicate that 415 lagoons were found to be in eroded and broken condition. In addition, 93 tanneries were seen to be discharging directly into the Palar river and agricultural lands and the rest into irrigation tanks and spring channels. The study found very high contamination of groundwater in the basin. The electrical conductivity recorded a high range of 5.0 to 6.6 millimhos/cm in the sample areas (anything above 2.25 was recommended as unsuitable for agriculture in this region); In addition chloride content was in the range of 38 to 46 mg/l, when normal limit was only 2.5 to 5.0. And very high levels of TDS and salinity have rendered groundwater unfit for irrigation and drinking (Teekaram and Ahamed, 1990).

If this was what found in 1980, the pollution level must have really escalated quite steeply, for, the number of tanneries have more than tripled since then. Further, the use of many new chemicals, shift from semi-finished to finished leather processing and large scale shift from vegetable to chrome tanning have all added massively to pollution loads in the basin.

As per the survey organized by the Central Leather Research Institute (CLRI) there were 577 tanneries in Tamilnadu, of which 344 were located in the Palar river basin. As on November 1996, the number tanneries have gone up to more than 1000, of which over three fourths were located in the Palar basin. Leather industry in India has experienced stagnation in the late 1970s and early 1980s but the growth of this industry

since then has been quite impressive in particular after the liberalization policy of Government of India. From a mere Rs.167 million, export of leather from the country has gone up to Rs.1608 million in 1989 and to Rs.57,000 million in 1996. The steep increase in the leather industry in the 1990s could be related to the India's economic liberalization policy.

In 1992, India's share of global market in leather was only 3.7% and it was urged to increase it to 10% in 2000. This means the tanning capacity will have to be augmented by 75% above the current production of about 1.5 billion feet (V.V.Eswaran, Leather Age, February, 1997). This also means a much higher order of pollution load into our eco-system.

The central minister for Environment Mr.Kamalnath has announced that Vellore district is one of the 19 most acutely affected districts in the country in terms environmental damages. About 50% of the total number of tanneries in the country is located in this district (Dinamalar, 10-2-1995).

The intensity of pollution in the basin could be understood from the extent to which surface and groundwater bodies are polluted in the region. To get this fact right, let us see in the first instant, extent of wastewater discharged from tanneries and the extent of chemicals used in the tanning process. On an average, 35 to 45 liters of wastewater is discharged per kilogram of raw skin / hide processed. Total quantity of water used by the tanneries in the basin works out to a minimum of 45 to 50 million liters per day; The quantity of effluent discharged from the tanneries (numbering 847), which are supposed to be connected to one of the 22 CETPs installed in the Palar basin, works out to 37,458 kld or or 37.5 mld. It works out to 1125 mld per month and 13,500 mld per year or 13.5 mcm per year (Tamilnadu Pollution Control Board). The extent of effluent generated by processing one kilogram of raw hides and skins to finished leather is around 34 liters. Therefore, the total weight of the raw hides and skins processed works out to 1.1 million kilograms per day. Further, for each 100 kgs of raw hides and skins processed, solid waste generation works out to 38.5 to 62 kgs; And, the 100 kgs of raw hides and skins is reduced to 20 to 32 kgs of finished leather after processing.

Vaniyambadi and Ranipet, the two major leather towns located in the Palar basin, generate quite a large quantity of effluent. The extent of chemicals used in the

tanning process, typical effluent characteristics and pollution load generated from tanneries in the two major towns are presented in Tables 1, 2 and 3.

Table-1 Extent of chemicals used in tanning process

Name of the chemicals	Measured per 100 kilogram of raw hides / skins processed (units in Kilogram)
1 Sodium Sulphide	3.0
2 Calcium hydroxide	4.5
3 Hydrochloric acid	0.3
4 Ammonium sulphate	2.0
5 Sodium bisulphate	1.5
6 sodium chloride	10.0
7 calcium formate	2.0
8 Sulphuric acid con. 96%	4.0
9 sodium carbanate	2.0
10 Sodium Sulphite	2.0
11 Chrome salts	10.0
12 Bates	0.8
13 Bactericides	0.3
14 Syntans	3.0
15 Fat liquors	4.0
16 Dyeing auxiliaries	3.8
17 Dyes	0.6
18 Finishes	4.0

Source: Dheenadayalan, M.S. 1996

Table –2 Typical Effluent Characteristics from Tanneries

(Unit – mg/l, unless indicated)

Parameter	Quality of effluent	
	Chrome tanning	Vegetable tanning
Total suspended solids (TSS)	2,004	11,184
Total dissolved solids (TDS)	15,152	17,254
Total volatile solids (TVS)	1,660	Nil
Chloride (Cl)	2,470	9,335
Sulphate	339	1,606
Oil and Grease	11	12
Biochemical Oxygen Demand (BOD)	930	1,262
Chemical Oxygen Demand (COD)	8,000	3,800
Ammonia-Nitrogen	Nil	70
Sulphide	288	Nil
% Sodium	98	74
Chromium	11.2	Nil

Source: Asian Development Bank, Tamilnadu Environmental Monitoring and Pollution Control, Final Report, Volume-II, June 1994

Table- 3 Extent of pollutants generation in two major tannery centers of the Palar basin

Parameter	Total pollution in Ranipet (KG/D)	Total pollution load in Vaniyambadi (KG/D)
TSS	26,635 – 51,980	17,707 – 27,135
TDS	92,465 – 198,246	82,409 – 121,103
BODS	13,734 – 30,292	7,293 – 15,565
COD	37,054 – 78,479	17,474 – 34,433
SULPHIDE	175 – 771	125 – 269
TOTAL CHROMIUM	859 - 3163	1,085 – 2,321

(Source: Madras School of Economics, 1998)

It is estimated that about 32,000 tonnes of basic chromium salts are used annually in Indian tanneries; it amounts to 2000-3200 tonnes of chromium as effluent from the tanneries. "If all the chromium used in the tanning industry is treated in the conventional way as much as 75000-100,000 tonnes of chrome sludge will be generated every year. A viable and safe disposal of chrome sludge has not yet been identified anywhere in the world." (G.Thyagarajan, 1992, 'Leather industry: In pursuit of better image', *The Hindu survey of Environment*, 1992). Easily three-fourths and one-third of this quantity is found in the Tamilnadu state and in the Palar basin respectively. As a solution to chrome sludge disposal, `chrome recovery and re-use process' technology has been evolved and is put into use in Kanpur tanneries. This technique seems to be easy and economically viable but yet to become popular. The adoption of such technique will reduce the chrome content in the wastewater to less than 0.3 ppm

As a part of meso-level survey of 51 villages in the basin, we gathered some simple and straightforward information regarding number of tanneries located within the village boundary, within a radius of 10 KM from the village boundary, location of Common Effluent Treatment Plants in the village and peoples' perception about the concentration tanneries in their villages. This information has been presented in Table-4. It may be noted that the Cluster-2 has the maximum number of tanneries – as many as 2.5 and 13.3 tanneries per sample village – within the village and within 10 KM radius from the village. Peoples' perception clearly indicates the way the villages are getting poisoned over a period of time and the kind of recklessness with which the tannery owners have contributed to the environmental degradation.

Table-4 Number of tanneries located in and around the villages selected for the first round survey in the Palar basin, 1999-2000

Clusters	No. of Villages	Number of tanneries located		People's perception regarding tannery concentration in their villages and about the discharge of effluent
		Inside the village	Around 10 KM radius from the village	
Cluster1	2	Nil	Nil	Both the villages in this cluster are not affected. There is a CETP located at a distance of 15 KM but since the villages are in an elevated position, effluent does not pass through these villages. Farmers feel that their villages reasonably safe compared to those located downstream.
Cluster2	21	52	280	This is one of the big clusters where tannery concentration is very high. The untreated effluent pass through many villages in this cluster before reaching the river. There are 4 CETPs located in this cluster but according to farmers, the treatment plants very rarely work; but the effluent from the tanneries pass through the CETPs before reaching the river. The area is stinking very badly. Not only that water is polluted but also the air is severely polluted due to spraying of chemicals on leather. In many villages in this cluster effluent is discharged into tanks, streams and springs. In some villages, effluent is discharged into the open fields. In most of these villages, mosquitoes menace results in health problems. Tanneries have contaminated the sweet groundwater that was available even until 1980. Agricultural activities have stagnated: Due to poor yield and high incidence of crop failure, farmers do not show any interest in cultivation. More than 50 spring channels in these villages have been in disuse primarily due to effluent discharge.
Cluster3	5	2	11	One of the villages in this cluster is very badly affected due to continuous discharge of effluent in the agricultural fields for the past 30 years. The tanneries have lagoons but storing effluent in them has badly contaminated the groundwater. Two tanneries have their own effluent treatment plants but they never worked.
Cluster4	8	10	51	Tanneries have discharged the effluent in the supply channels and springs until recent times. At present, all the effluent is routed through the CETPs to join the Palar river. The standard strategy is to discharge more untreated effluent during rainy days.
Cluster5	13	6	320	This is one of the very big clusters, where a large number of tanneries are concentrated. Since the tannery effluent passed the fields and spring channels for over a couple of decades, groundwater contamination and salinity in the soil are quite severe. Only for the past three or four years, effluent is collected in the CETPs and let into the river. During summer months, effluent is under treated and untreated but during the rainy days, almost entire effluent is let into the river untreated. During the rainy days, effluent overflows and spoils the agricultural fields. Vannivedu, one of the worst affected villages in this cluster, looks like a desert surrounded by tanneries. Farmers have expressed their anger and anguish. Literally agriculture is dead in this village. But in many other villages, farmers still struggle to carry on with the agricultural activities. In another village called Chennasamudram, farmers stopped the effluent passing through the spring channel. The effluent then has taken a diversion to another village, which has resulted in a big inter-village dispute. In Poondi village in this cluster, effluent water is collected in the village tanks even now. The entire agricultural lands are affected in this village.
Cluster6	2	Nil	Nil	So far tannery effluent has not affected these villages. But farmers feel that the spring channels carry effluent water. But it has not affected their agriculture.

Source: Meso-level survey, 1997-99

Section-4 Socio-economic impact of pollution

The impact of water pollution caused due to discharge of industrial wastes is quite adverse. It affects the aesthetics of the region, wild life including birds and fish in the water bodies such as tanks and ponds, flora (a good number of habitats are destroyed due to water pollution), accumulation of pollution load in the top soil due to colour and toxic effluent discharged on land, Pollution of surface and groundwater bodies, decline in the quantity and quality of water available for drinking and agriculture, decline in agricultural employment and production and above all, deteriorating health conditions of human and animal population due to the use of contaminated water for drinking and other domestic purposes. According to the study carried out Stanley Associates for the TNPCB, the Palar basin is one of the worst affected due to industrial pollution, where groundwater is quite heavily contaminated. The study team, which visited a few tanneries in the Palar basin, concluded that the tannery effluent contains chrome to the extent of 10-15 mg/l, high BOD, TSS, oil and grase. To quote, "Judging by the amount and strength of the effluents, it is likely that the aggregate tannery effluent will have an adverse effect on the groundwater quality in the entire area and also on the Palar river, where the effluents are finally getting mixed" (P.1.30 Volume III).

4.1 Impact on area, crop pattern and yield

Paddy used to be the main crop in this region even until 1980. The good quality of tank and spring water supplemented by groundwater helped immensely paddy cultivation. Yield of paddy used to be 4500 to 5500 kilograms per hectare. But the pollution caused by tanneries in the region has damaged soil and water quality. As per the survey carried out by the Soil Survey and Land Use Organization, 1990, (Government of Tamilnadu), 3911 hectares of agricultural land is severely affected in the Palar basin and 11,851 hectares is moderately affected. Our own survey of 51 villages in the basin shows a reduced area under paddy cultivation, which includes both affected and unaffected villages (see Table-5). In the unaffected villages (numbering 4 villages), area under paddy in 1980 was 583 hectares. In 1996-97, it was 653 hectares. In the affected villages (numbering 47), area under paddy in 1980 was 2413 hectares. In 1996-97, it was almost reduced to half. On the other hand, area

under coconut in the affected villages, which resists to some extent salts used in the tanning process, has gone up to 287 hectares in 1980 to 730 hectares. On the whole, total cropped area in the affected villages is reduced from 4650 hectares to 3934 hectares, whereas, in the unaffected villages, it has actually gone up from 859 hectares to 1094 hectares.

Table-5 Area under paddy and other crops in the affected and unaffected villages

Villages	Area under paddy (hectares)		Area under coconut (hectares)		All Crops (hectares)	
	1980	1996-97	1980	1996-97	1980	1996-97
Unaffected Villages (4)	583	653	64	131	859	1094
Affected Villages (47)	2413	1242	287	730	4650	3934

Note: Figures in parentheses indicate number of villages.
(Source: First round survey, 1997-99)

Further, a mere reporting of area under various crops does not convey much, since in many of these villages yield levels have been dropped quite significantly and incidence of crop failure is quite high. The Soil Survey and Land Use Organization working in this region has studied the impacts on various crops reported as follows:

Paddy: Poor germination, stunted vegetative growth, poor grain formation, reduced grain weight, more of chaffy grains resulting in very poor yield.
Sugarcane: Normal length of internodes is reduced, girth become very thin and the weight of cane is reduced. Jaggery with poor consistency and black colour is obtained.
Coconut: Vegetative growth of the trees is good. Tender coconut water is saline. Size of the nuts is reduced. Falling buttons are common and in large number.
Groundnut: Leaf drying, poor root formation coupled with poor pod formation. And, for all crops, tolerance level for pest attack reported to be reduced significantly.

The detailed sample of survey of 8 villages in the Palar basin gives more evidence on cropped area, area irrigated and on yield. Clearly, water yielding characteristics and area irrigated by the wells vary between those villages, which are affected by industrial effluent and those, which are not. For instance, average net

irrigated area (NIA) and gross irrigated area (GIA) per well in the non-affected villages are 4.16 acres and 5.94 acres per well respectively; whereas, in the affected villages, this average works out to 2.72 and 5.50 acres per acre (See Table-6). It is more striking when we compare area irrigated under paddy in both sets of the villages: Total area irrigated by all crops by the sample wells in the selected villages works out to 903 acres of which 505 acres (56%) contributes to paddy. Over 90% (456 out of 595 acres) of it is grown only in the unaffected villages. It works out to 2.9 acres of area irrigated per sample well under paddy in the unaffected villages in contrast to only 0.50 acre per sample well in the affected villages. As may be seen from the table, the area under sugarcane and coconut (which tolerate reasonably the polluted water) are more compared to paddy in the affected villages.

The pollution impact comes our more clearly from Table-7. For instance, area irrigated per well is nil in about one-third of the sample wells (80 out of 253) in the Palar basin. The difference is quite sharp between affected and unaffected villages - 26% (41 out of 159 sample wells) in the unaffected and 41% (39 out of 94) in the affected villages. In most of the area coconut crop is cultivated but with very poor yield. For instance, in about one-third of the sample wells crop yield (in Rupees) is nil (Table-8). Again this difference is quite high between the affected and unaffected villages. While in the unaffected villages, 41 out of 259 sample well farmers (or 26% of sample wells) reported zero yield, in the case of affected villages, it is 39 out of 93 sample well farmers (or 41% of sample wells), which reported zero yield. On the other extreme, while 79 out of 159 sample well farmers (or 50% of sample wells) reported more Rs.5000 as the value of crop yield per acre of GIA by well, it is only in 5 out of 94 wells (or 5% of sample wells) in the affected villages. What is worse is that small operators of land who own wells, operate their wells with either poor water yields or pump a bad quality of water; whereas, the large farmers manage to sustain better by digging new wells or deepening the existing wells or both.

TABLE 6 AREA IRRIGATED BY SAMPLE WELLS BY CROPS IN THE PALAR BASIN

Village	No of sample wells Wet + Dry	Net area irrigated by the sample wells by crops (acres)							
		Paddy	Sugar cane	Coco-nut	Oil seeds	Others	Total	NIA / well	GIA/ well
Kathiavadi	40	86	8	12	14	12	131	3.28	4.50
Damal	49	324	14	0	13	2	353	7.20	7.78
Ramanai Kenpatti	42	5	1	48	0	2	56	1.33	3.71
Nariam-pattu	26	41	1	43	0	28	113	4.35	8.27
Sub-total	**157**	**456**	**24**	**103**	**27**	**44**	**653**	**4.16**	**5.94**
Peria-varigam	30	4	7	54	0	10	75	2.5	6.67
Solur	21	2	0	23	0	15	40	1.9	5.14
Poondi	22	37	22	0	7	0	66	3.0	4.91
Gudimallur	19	7	45	8	4	5	69	3.63	4.74
Sub-total	**92**	**49**	**74**	**85**	**11**	**30**	**250**	**2.72**	**5.50**
Grand total	**249**	**505**	**98**	**188**	**38**	**74**	**903**	**3.63**	**5.78**

Source: main Survey, 1999.

TABLE 7 GROSS IRRIGATED AREA BY THE SAMPLE WELLS IN THE SELECTED VILLAGES OF THE PALAR BASIN

GIA by the sample wells (acres) Frequency	Number of wells reporting in various frequencies of GIA in various villages										
	KYD	DML	RNP	NMP	Sub Total	PVG	SLR	PND	GDR	Sub total	TOTAL
Nil	8	13	17	3	41 (25.8)	17	13	2	7	39 (41.4)	80 (31.6)
0.01-1.00	2	0	2	0	4 (2.5)	0	0	1	0	1 (1.1)	5 (2.0)
1.01-5.00	17	9	12	8	46 (28.9)	4	2	11	7	24 (25.5)	70 (27.7)
5.01-10.00	11	13	8	8	40 (25.2)	2	0	5	3	10 (10.6)	50 (19.8)
10.01-20.00	2	11	4	4	21 (13.2)	5	4	3	2	14 (14.9)	35 (13.8)
20.00+	1	3	0	3	7 (4.4)	4	2	0	0	6 (6.4)	13 (5.1)
Total	**41**	**49**	**43**	**26**	**159 (100)**	**32**	**21**	**22**	**19**	**94 (100)**	**253 (100)**

Notes: Un-affected villages: KYD - Kathiyavadi; DML - Damal ; RNP - Ramanaickenpatti; NMP - Nariampattu
Affected villages: PVG - Periavarigam; SLR - Solur; PND - Poondi; GDR - Gudimallur;
(Source : Main survey, 1999)

TABLE 8 CROP YIELDS PER ACRE OF AREA IRRIGATED BY THE SAMPLE WELLS IN THE SELECTED VILLAGES OF THE PALAR BASIN

Yield per acre of GIA (Rs) Frequency	Number of wells reporting in various frequencies of crop yields in the selected villages										
	KYD	DML	RNP	NMP	Sub Total	PVG	SLR	PND	GDR	Sub total	TOTAL
Nil	8	13	19	4	44 (27.7)	18	13	2	7	40 (42.6)	84 (33.2)
<500	0	0	0	0	0 (0.0)	0	0	6	0	6 (6.4)	0 (0.0)
501-1000	1	0	0	0	1 (0.05)	2	0	5	1	8 (8.5)	4 (1.6)
1001-2500	2	0	3	0	5 (3.1)	5	5	0	2	12 (12.8)	17 (6.7)
2501-5000	5	0	14	11	30 (18.9)	6	3	5	4	18 (19.1)	53 (20.9)
5001-10000	21	15	6	11	53 (33.3)	1	0	4	5	10 (10.6)	68 (26.9)
10000+	4	21	1	0	26 (16.4)	0	0	0	0	0 (0	27 (10.70)
Total	**41**	**49**	**43**	**26**	**159 (100)**	**32**	**21**	**22**	**19**	**94 (100.0)**	**253 (100)**

Notes:Un-affected villages: KYD - Kathiyavadi; PND - Poondi; GDR - Gudimallur; DML - Damal
Affected villages: PVG - Periavarigam; SLR - Solur; RNP - Ramanaickenpatti;
NMP - Nariampattu
(Source : Main survey, 1999)

Paddy was the main crop in this basin until the last couple of decades. Indeed, the Vellore district was considered the rice bowl of Tamilnadu next to Thnjavur district. But unfortunately, that situation has changed completely, thanks to the water pollution contributed by the tanneries in this basin. In our detailed survey, we compared the yield of paddy alone between affected and unaffected villages. The result we have got is quite stunning (see Table-9). In many sample wells, although area irrigated has been reported, the yield was very low. Further, it was reported that quality of paddy and coconut output was inferior in the areas irrigated by contaminated wells. The price offered in the market for such output was reported to be at least one-third lower than what is offered to normal quality output.

Table 9 Yield of paddy in the affected and unaffected villages of the Palar basin, 1999

Villages	No.of wells reporting	GIA under paddy by wells (acres)	GIA under paddy per well (acres)	Total Production of paddy in KGs	Yield per acre of GIA under well in KGs	Yield of paddy per well in KGs
Affected villages (aggregate information for four Villages)	56	57.34	1.02	35206	614	628
Unaffected villages (aggregate information for four Villages)	119	456.24	3.83	847,125	1857	7118

Source: Main Survey, 1998-2000

The information provided in the Table-9 indicates a clear difference in the yield of paddy per acre between affected and unaffected villages. Further, although many farmers have shifted from paddy to coconut in the polluted areas, yield of coconut is extremely low. For instance, in one of the unaffected sample villages, called Nariampattu, average yield of coconut per acre (for the year 1998-99) was worth Rs.15,400; whereas, in Periavarigam, one of the affected sample villages, yield of coconut per acre in the year 1998-99 was only Rs.6470.

An overall analysis of impact of pollution

The first round survey in 51 villages in various reaches of the Palar basin captured some important features, which enabled to analyze the severity and impact of pollution. The features covered include changes in crop pattern, number of polluting industries, evidence of decline in agricultural activities, evidence of decline in livestock population, number of villagers working in the polluting industries, number of polluting industries located in and around the vicinity of selected villages, decline in water quality, decline in crop yields and sale of land for industrial purposes. Each

one of these features was analyzed and scores were given in order to get a total picture for each one of the selected villages. For instance, if any of these features, say for instance, crop yield, is drastically reduced by more than half of what is reported to be normal, then it is referred as `bad'. If yield is reduced moderately, then it is referred as moderately affected or coded as 'moderate'. If yield reduction is marginal, it is then referred as `marginal'. If yield is unaffected it is indicated as `not affected'. Scores are also given to each one of these such as 1 if it is bad, 0.75 if it is moderately affected, 0.25 if marginally affected and 0 if not affected. Similar scores have been given to each one of other features. These scores were added finally to arrive at present conditions of the selected villages. If total score for a village exceeds 4, then villages are regarded as badly affected. If score is in the range of 2 to 4 then it is regarded as moderately affected village. Where the score is less than 2 the village will be called marginally affected village and of course when the score is zero, it is an unaffected village. While the summary results are presented in the Table-10, detailed information for each village is available with the author.

Table-10 Status of the sample villages in relation to pollution

Clusters	No of villages in each cluster	Badly affected	Moderately affected	Marginally affected	Unaffected
I	2	0	0	2	0
II	21	18	2	1	0
III	5	5	0	0	0
IV	8	8	0	0	0
V	13	11	1	1	0
VI	2	0	0	0	2

Source: First round survey, 1997-99

4.2 Impact on water quality

One of the major implications of water pollution in these basins is declining water quality and increasing scarcity for drinking water. There has been an increase in the dependence of the rural population on the public drinking water supply. This has been the case in hundreds villages in this basin. In the past, when water contamination was minimal or unknown, the local people used the local well water for all their domestic and drinking requirements. In the changing scenario, either

they depend upon the public water supply system or are forced purchased water. The worst hit are the poor and marginal farmers and landless agricultural labourers.

The data collected by the Central Pollution Control Board relating to water quality from its monitoring wells in the Palar basin shows very high water pollution. The value electrical conductivity (EC) ranged from 4100 to 17050 and in 6 out of 8 wells, it exceeded 10,000. The tolerance limit is 2250 and if it exceeds 3000, the germination and vegetative growth will be affected. The total dissolved solids (TDS) – mean value - was also much higher than the tolerance level of 2100 mg/l. It ranged from 2334 to 9782 and in 6 out of 8 wells the TDS exceeded 5800 g/l. There was not much of a difference between pre-monsoon and during monsoon values (see Table – 11).

Table-11 Water quality of groundwater in the selected areas of the Palar basin

Serial number of well stations	Name of the well stations	Average value during pre-monsoon (January-June)		Average value during monsoon (July-December)	
		EC	TDS	EC	TDS
1	Vaniyambadi	9740	5490	10978	6178
2	Valayampattu	13562	7471	12445	6762
3	Solur	15635	8712	13142	7387
4	Venkatasamudram	15650	8689	14357	7895
5	Periavarigam	17607	9867	17323	9698
6	Chinnavarigam	4807	2667	4933	2768
7	Ranipet	12825	7226	10140	5734
8	Vannivedu	4183	2372	3973	2297

Source: Central Pollution Control Board, 1991, Water quality data compiled from the monitoring wells in the Palar basin.

Lots of evidence on water pollution due to leather tanneries was presented in the Second International Water Tribunal (See Table -12), which gives details on physical and chemical parameters of groundwater samples in the sample wells located in different parts of the basin. It is quite evident from the table that contamination of groundwater is very high with far above the prescribed standards of BOD, COD, chloride, total hardness and heavy metals such as chromium.

The Tribunal discussed quite elaborately deteriorating water quality conditions in the Palar. The jurists stated, `As a result of the uncontrolled discharge of wastewater from the tanning industry both surface and groundwater have been seriously contaminated. The water is no longer suitable for drinking and has to be brought in from other areas at a price beyond the means of poor. In addition to the above, these practices, resulting in contamination with salt and chemicals, have rendered useless large areas of once fertile land' (p220, Second International Water Tribunal, 1992).

Table- 12 Physical and chemical parameters of groundwater samples in various segments of the Palar river basin 1991

Sl. No	Sampling area	pH	EC	BOD	COD	Chlorides mg/l	Total Hardness mg/l	Heavy metals concentration (in micro grams)			
								Chromi-um	Cadium	Copper	Zinc
1	Chrom Pet - 1	7.5	1,307	516	1,172	923	717	1.3	0	8.6	0
2	Ranipet-1	7.9	728	138	380	651	146	3.0	0	0	12
3	Ranipet -2	7.3	728	117	327	660	115	0	0.1	1.8	17
4	Ranipet -3	7.6	6700	773	1489	2896	843	3.0	0.45	2.3	28
5	Ranipet -4	7.3	1577	686	1017	1173	755	0.9	0	24.1	73
6	Ambur-1	7.4	4320	2216	3880	2481	643	2.5	6.5	11.1	12
7	Ambur-2	7.6	4380	318	673	2567	719	4.4	0	6.2	39
8	Ambur-3	7.2	2940	217	409	2940	420	0	0	12.4	14
9	Vaniyam Badi	7.2	2880	889	1940	1241	1079	0	0.12	0	132

Source: India Case: Water Pollution Due to Leather Industries in Tamilnadu, Second International Water Tribunal, 1992

The Tamilnadu Water Supply and Drainage Board (TWAD Board) has conducted a study in 1997 collecting random samples of water along the Palar river from Vaniyambadi to Palar Anicut a distance of about 60 KM. These results were compared with a study conducted by the Kings Institute in 1968. The latest study by the TWAD Board clearly indicates that TDS has increased by 79% in the Vaniyambadi

zone (upstream tannery cluster). The study also found that in the downstream the value of TDS value stood at 142%. This establishes the travel of pollutant, which is significant. The report also indicates that even if all the tannery effluent is stopped immediately, the extent of inorganic chemical constituents already dumped in the river could not be recovered even in the long run (A Report on the Palar Pollution studies, TWAD Board, Government of Tamilnadu, 1997).

Ambur, is one of the medium towns located along the Palar river, where a large number of tanneries are concentrated. This town until last two decades had absolutely no drinking water problem as water was directly pumped from the Palar riverbed. The water used to be sweet. Now the water is unusable. The drinking water is sold at Rs.2 per pot in this town. The people sent many memorandums to the Government for providing safe drinking water. An epidemic has spread in the Ambur town recently in which 8 people were killed. Consumption of Polluted drinking water alleged to be the reason for the outbreak of epidemic (The Indian Express, 8-4-1997).

The data collected from the field survey to ascertain water quality was not based upon any chemical tests. We depended upon some qualitative information collected from each every sample well owner in the selected villages for the second round survey. We asked some simple questions with respect to their sample wells: Can you or do you use your well water for drinking? Do you use your well water for irrigating all crops? Is your well water saline, coloured with odor and cane be used only for specific crops? Is your well abandoned / unused due to contamination? Even if a well is closed due to lack of water, we still sought answers about the quality of water. The collected information has been presented in the Table-13

Table-13 is self-evident. The difference in the water quality between affected and unaffected villages is striking. In the case of unaffected villages, there is hardly any well, which is abandoned due to contamination; And, more than three-fourths of the sample wells report that the water can be used for drinking. In contrast, in the affected villages, only 6 out of 110 sample wells reported that the water can be used for drinking. Further, 35% of the sample wells have been abandoned and closed due to contamination and water from another 30% of the sample wells is used for irrigating only specific crops such as coconut. Only less than one-third of the sample

wells in the affected villages reported that the water could be used for irrigating all crops.

Table: 13 Quality of water in the Palar basin as reported by the sample well owners

Villages: Affected and Not affected	Total number of sample wells reporting	Number of sample wells reporting			
		Used For drinking	Used for irrigating all crops	Saline, coloured with odor and used for irrigating specific crops only	Abandoned and unused due to contamination
Affected villages:					
Wetland:	34	0	10	8	16
Dry land	66	5	20	24	17
PSU	10	1	2	2	5
Total	110	6	32	34	38
Unaffected Villages					
Wetland:	67	49	18	0	0
Dry land:	84	60	24	0	0
PSU	20	15	5	0	0
Total	171	124	47	0	0

Note: PSU indicates purposive sampling units
Source: Main survey, 1998-2000

4.3 Impact on land and land value

A survey of 80 landowners conducted in three villages of the Palar river basin in 1997 revealed that as a consequence of tannery effluent their agriculture was very badly affected. About two-thirds of the respondents reported soil or water pollution as a reason for leaving their land fallow. Further, almost all the respondents reported that the yield and market value of land have been decreasing (Madras School of Economics, 1998).

A detailed survey of 8 villages conducted in this basin as a part of the current research programme clearly indicates that the value has come down drastically due to degradation of groundwater and land / soil salinity. Normally, value of land would depend upon factors such as access to irrigation sources, dependability of water

sources, soil quality, location of land from the head of an irrigation source and so forth. But in the affected zones of the Palar river basin, where land and water have been subject to a severe stress, the land value very much depends upon water quality and its proximity to main road and industries. Nearer the main road and cluster of industries, better the value of land. This is the type of land, which is favoured by industry owners for locating their units and for other related business activities. On the other hand, the plots, which are located far away from the main road, do not fetch a good price even though quality of water is reasonable. However, the plots of land, which have good quality groundwater do fetch a better price. What follows next are a series of tabular presentations of value of land in various sample villages of the Palar basin.

For instance, in **Kathiavadi village** (a partially affected village), there is a big difference between the value of land located below the Chitheri tank command and those located below the command of the big tank. The Chitheri tank water is polluted due to mixing of tannery effluent in for the past 20 years. The value of land as ascertained from sample farmers is presented in Table-14.

Table-14 Value of land according to various land-types in Kathiavadi village (partially affected and road side)

Sl. no	Type of land	No of observa-tions	Average value of land in Rs
1	Wet land under Chitheri tank command– in use well – tail end to tank -- poor yield of water	7	95,000
2	Wet land – in use well – irrigating all crops – good yield of water – big tank	4	200,000
3	Dry land well - In use – poor yield of water - moderate quality	1	100,000
4	Dry land – in use well – good water – good yield	12	150,000
5	Dry land – in use well – poor quality water	11	90,000
6	Wet - Interior – in use well – moderate quality	1	100,000
7	Dry land well – near industry and close to Chitheri foreshore area	3	300,000
8	Dry – abandoned well – near tannery	2	125,000

Source: Main Survey, 1998-2000

Table-15 Value of land according to various land-types in Periavarigam village (affected and road side)

Serial No.	Type of land	No of observations	Value of land per acre in Rupees
1	Wet land – in-use well- interior – moderate quality water - interior	5	75,000
2	Wet land – interior – poor quality water	1	50,000
3	Dry land well – in use – poor quality of water – closer to the village sites	15	97,000
4	In use - dry land well – poor quality – closer to the highway	3	150,000
5	Dry land abandoned well – poor quality - interior	2	50,000
6	Dry land abandoned well – just adjacent to tanneries – very poor quality groundwater	2	250,000
7	Closer to the highway – dry land abandoned well	4	110,000

Source: Main Survey, 1998-2000

Table-16 Value of land according to various land-types in Solur village (affected and road side)

Serial No.	Type of land	No of observations	Value of land per acre in Rupees
1	Wet land- Interior – abandoned well – severe contamination of groundwater	4	80,000
2	Wet land – in-use well – irrigating only coconut with low crop yield	1	100,000
3	Dry land – in-use well – irrigating coconut crop only with low crop yield	3	96,000
4	Dry land – severely contaminated groundwater – road side	1	250,000
5	Dry land – severely contaminated groundwater – house sites	2	137,000
6	Dry land- close to industries – contaminated groundwater – all abandoned wells	3	300,000
7	Dry land – severely contaminated groundwater – far away from industrial cluster	4	100,000
8	Dry land – severely contaminated – interior	1	50,000

Source: Main Survey, 1998-2000

It may be seen from this table, the land which have a better proximity to industries do command a price of Rs.300,000 per acre, even though these are dry lands which do not have access to tank water and further to that groundwater is contaminated in this segment. On the other hand, wet lands, which have access to tank water fetch a low price of Rs.95,000 per acre. It is mainly because of contamination of groundwater. Periavarigam and Solur villages are more or less similar to Kathiavadi village, except that groundwater is much more severely contaminated in these two villages. Otherwise, like Kathiavadi, both these villages are located close to the main road with developed industrial clusters. The value of land is determined on the basis of nearness to industrial cluster and road. It is quite obvious for instance in Periavarigam village (Table-15), dry land with contaminated groundwater but located close to tanneries fetches a price of Rs.250,000 per acre, whereas, even wet land, but interior fetches only Rs.50,000 per acre. Quite similar is the case of Solur village (Table-16).

On the other hand, **Gudimallur and Poondi**, severely affected and interior villages, and located far away from the industrial clusters fetch a very low price compared to those which are located on the main road and close to industries. Both these villages are located at a distance of less than 10 KM from Kathiavadi, but the value of land is far less. (see Tables 17 and 18). These villages do not only have 'disadvantageous location', but groundwater is also severely contaminated due to effluent discharge. In Gudimallur village for instance, the value of wetland (which is supposed to get tank water) fetches a much lower price compared to dry land, which is rain fed. This is because, while dry lands are uplands with lower degree of water contamination, the wetlands are located right below the tank, in which effluent water is stored. This is exactly the case in Poondi village (see Table-18).

Table-17 Value of land according to various land-types in Gudimallur village (affected and interior)

Sl. No	Type of land	No. of observations	Value per acre in Rs.
1	Wet – In use wells – poor yield and poor quality water	5	51,000
2	Wet – abandoned and polluted wells	2	50,000
3	Dry – In use wells – poor yield and poor quality of water	6	64,000
4	Dry – in use wells – near main road	1	90,000
5	Dry – in use- good yield but poor quality of water	1	70,000
6	Dry – abandoned wells – poor quality of water – close to house sites	1	75,000
7	Dry abandoned and contaminated wells	3	40,000

Source: Main Survey, 1998-2000

Table-18 Value of land according to various land-types in Poondi village (affected and interior)

Sl. No	Type of land	Number of sample wells	Average value of land (in Rs)
1	Wet land – In use wells – reduced yield – poor quality of water	13	83,400
2	Wet land – In use wells – poor yield and poor quality of water	1	50,000
3	Wet land – abandoned well – poor quality and poor yield	1	50,000
4	Dry land – in use wells – reduced yield and poor quality water	5	103,000
5	Dry land – abandoned well – poor quality water	2	75,000

Source: Main Survey, 1998-2000

In Contrast, in the unaffected villages - Ramanaicken Pettai, Nariampattu and Damal - the value of land is determined entirely due to conventional factors such as access to tank and groundwaters and land quality. But, still the plots of land, which have better access to main road fetches a higher price. (see Table 19, 20 and 21). These are the villages where the conventional sources of irrigation such as tanks and

springs are still in reasonable in use. In fact, the plots, which have both surface and groundwater command maximum price in these villages.

Table-19 Value of land according to various land-types in Ramanaicken Pettai village (unaffected and interior)

Sl. No	Type of land	Number of sample wells	Average value of land (in Rs)
1	Wet land – in use wells- good quality groundwater	4	150,000
2	Wet land – not in use well – lack groundwater	2	100,000
3	Wet land – irrigated by spring channel water with good groundwater	2	200,000
4	Dry land - in-use well –good quality groundwater	21	145,000
5	Dry land – in-use well – good quality groundwater – road side	1	200,000
6	Dry land – not in use well due to lack of groundwater	12	82,500
7	Dry land – not in use well due to lack of groundwater but road side	1	125,000

Source: Main Survey, 1998-2000

Table-20 Value of land according to various land-types in Nariampattu village (interior unaffected)

Sl. No	Type of land	Number of sample wells	Average value of land (in Rs)
1	Wet land – in-use wells – good quality groundwater	7	107,000
2	Wet land – not-in-use well – good quality groundwater	2	100,000
3	Dry land – in-use well – good water potential and good quality	6	117,000
4	Dry land – in-use well – poor water potential and good quality	8	72,000

Source: Main Survey, 1998-2000

Table-21 Value of land according to various land-types in Damal village (unaffected Road side)

Sl. No	Type of land	Number of sample wells	Average value of land (in Rs)
1	Wet land with tank water – good groundwater potential	18	250,000
2	Wet land with tank water – moderate groundwater yield	5	150,000
3	Wet land with tank water – poor groundwater yield	5	88,000
4	Wet land with good tank water – not in use well due to lack of groundwater – roadside	7	189,000
5	Wet land with good tank water – not in use well due to lack of groundwater – interior	3	100,000
6	Dry land – moderate yield of groundwater	4	161,000
7	Dry land – poor yield of groundwater	3	77,000
8	Dry land – moderate yield of groundwater – road side	2	188,000
9	Dry land – moderate yield of groundwater – river side	2	150,000

Source: Main Survey, 1998-2000

On balance, we learn three main points from our analysis of value of land (Tables 13 to 20):

(a) The land value in the villages, which are affected by tannery effluent, is much less compared to those, which are not affected; exceptions are those plots of land, which are located close to industrial clusters.

(b) The road side plots, irrespective of whether affected or unaffected, get better price.

(c) In the case of unaffected villages, the value of land is determined on the basis of access to water sources; the value is seemingly the highest which have both surface and groundwater.

From this, can we conclude that even though tannery effluent has contributed to severe water pollution, farmers in these villages are still better-off since their lands get a better price? The answer is no because, such hike in the value of land benefits only a small fraction of the village population; Further, even those who sold their lands have gained only in the short run; Our interviews confirm that most of those who sold their plots of land have instead of re-investing, have spent their money. Most of them are seeking odd jobs and are in debt trap. In a few exceptional cases, property (land) was purchased elsewhere or are living on bank interest earnings. Therefore, from the larger of perspective of environmental damages that have occurred in the village and in the region, the gains that appear to have surfaced due to hike in the land price is nothing but delusion.

4.4 Impact on Employment

There are about 750 tanneries and leather related units in the Palar basin, which generates a good deal of employment in this area in particular, among the Scheduled castes population. It has affected the local agricultural activities, which is already in great distress due to land and water pollution. It is true that the employment potential in agriculture has declined drastically due to shrunk agricultural activities in the region but during peak seasons, when there is a need for employment of labourers in bulk, they have to be brought from distant villages. This is primarily because of gain of employment opportunities for the landless Scheduled Caste population in the tanneries.

Nevertheless, the argument that the tanneries have created a huge employment potential is not quite true. The number of persons employed in the tanneries (see Table-22) as a proportion of total population is low. The percentage of total population employed in the tanneries works out to 0.20 (of the total population of 14,595), 4.33 (81,486), 0.53 (11,720), 3.55 (31,264), 1.95 (34,136) and 0 (6,952) in various clusters respectively. Further, a bulk of the work force employed in the tanneries is brought from southern parts of the State, a part in particular from among the Muslim population. This is an important reason why we have observed a good deal of immigration in this area, including our study villages. For instance, Solur, one of the villages selected for the second round survey for detailed investigation, has witnessed more than 300 families (majority Muslims) as permanent new settlers; Bulk in-migration (new settlers) have occurred in number of other villages also such as in Periavarigam (150

families), Chinnavarigam (200 families), Masigam (100 families), Vannivedu (275 families), Kathiavadi (100 families), and Gudimallur (175 families). For all the 51 villages put together (selected for the first round survey), the number of new settlers works out to 2025 families. In Damal and Ramanaicken patti, which are located in the downstream and unaffected villages, do not have new settlers, who have sought employment in the tanneries. But in all other villages, we found new settlers who sought work either in the leather tanneries or in the shoe-upper manufacturing companies.

Table-22 Number of persons employed in the tanneries from the various clusters of villages selected for the first round survey

Clusters	No. of villages in each cluster	Number of persons employed in tanneries and other related units								
		Scheduled castes			Others			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
1	2	27	0	27	2	0	2	29	0	29
2	21	1571	920	2491	532	505	1037	2103	1425	3528
3	5	42	20	62	0	0	0	42	20	62
4	8	290	390	680	84	345	429	374	735	1109
5	13	283	340	623	35	7	42	318	347	665
6	2	0	0	0	0	0	0	0	0	0
Total	51	2213	1670	3883	653	857	1510	2866	2527	5393

Source: First Round Survey, 1997-99

Further, due to extensive employment opportunities in the leather related activities, there has been a drastic decline in the landless agricultural labour force even in the unaffected villages. See Table-22, which indicates that it is the landless Scheduled Caste population, which have gained reasonable degree of employment opportunities in the tanneries compared to others. Moreover, since agricultural wage rates are far less compared to the wage rates in the leather units, many, in particular landless people, prefer to work in them. The prevailing agricultural wages range from Rs.35 to 50 per day for men, and for women, it ranges from Rs.25 to Rs.35 per day. Where as in the tanneries and shoe-upper companies, the minimum wage works out to Rs.50 for an unskilled casual labourer and Rs.100 and upwards for a skilled labourer. The women in the shoe-upper companies get a monthly remuneration of Rs.1000 and upwards with free transport facility from their places of residence.

Do we call it a distress induced non-farm employment or prosperity induced non-farm employment? There seems to be prosperity if we look at it from the angle of foreign exchange earning and employment generation. But when we go deep into what is in stock for us, it is alarming and would find it very difficult to call it prosperity induced non-farm employment. The short run prosperity that the society has gained is only at the cost of severe environmental degradation, distress in agriculture, health hazards and total loss of good environment and ecology for the future generation. In other words, there is a great deal of distress involved in the so-called prosperity that has been witnessed. Further, it is distress for one and `prosperity' for another (at least in so far as getting access to employment, leaving aside the health hazards involved for the tannery workers) Millie (1998).

Furthermore, many kinds of non-farm employment have emerged in the villages studied in the Palar basin primarily because of stagnation in agriculture. All these are offshoots of distress in agriculture. While some of these non-farm employments (such as beedi rolling, road laying, coconut leaves weaving for house roofing etc.,) have existed even in the past, in the last 10 to 15 years, many people have entered into these works. The most recent non-farm employments to which people have shifted on a large scale are handloom weaving, building construction, road laying, quarries, lorry cleaners and drivers, working in brick kilns, petty business and sand mining in the river. All these are in addition to employment generated by the tanneries and other associated units. Altogether, in the 51 villages studied for the first round survey, number persons employed in the leather related units are 5,383; but the number persons engaged in the other non-farm activities are as high as 25,855 (see Appendix-2 for details on each village).

4.5 Forced migration

In many villages we surveyed, we found both in-migration as well as out-migration. It is distress for those who have lost their land and groundwater due to pollution, it is distress for those who have lost agricultural income due to pollution, it is distress for those who have developed heath problems due to water contamination and more so it is distress for those who have left their villages due to pollution. Therefore, one of the major impacts of environmental degradation in the region is the out-migration of people from their villages who traditionally engaged in agriculture.

People have migrated to nearby towns or moved to cities after selling or leaving behind their properties. Incidence of migration due to environmental degradation has been reported from majority of the 51 villages selected for the first round survey but the number varies according to intensity of pollution. But in two villages (namely, Gudimallur and Vannivedu), there was a bulk out-migration of 150 and 125 families respectively. These two are very badly affected villages due tannery pollution. Cultivation in these two villages is almost ceased for the past 15 years and further people of these villages have to deal with acute drinking problem. In Vannivedu village, four streets representing four major cultivating castes remain totally empty. Some of them have sold their properties at a throw away price and others have left behind their properties since there was no buyer. The people who have left their villages look like refugees for, their livelihood is threatened, lost their homes, have got to take refuge into a place where there are lots of uncertainties. In other words, since the water resources in this basin are either heavily over-used or are loaded with industrial effluents and since the traditional irrigation systems and environmental values have collapsed, the vulnerability of the bottom layer population viz. resource-poor is quite acute. They are left with the options of fleeing to become homeless or stay and suffer.

The United Nations High Commissioner for Refugees (UNHCR), in the 1993 State of the World's Refugees, identified four root causes of refugee flows. These were political instability, economic tensions, ethnic conflict and environmental degradation' (p.1 Steve Lonergan, undated). Another study indicates that Environmental refugees have become the single largest class of displaced people in the world (Jacobson, J., quoted in Lenegan, 1998, p.1).

The conventional – neo-classical approach suggests that the population migration is only a natural response to interregional imbalances (either due to uneven development of or uneven endowment of natural resources leading to more economic opportunities). The population movement is generally from areas where labour is plenty and capital is poor to a region where labour is less and capital is plenty. A number of push factors have been identified, the principal among them is population pressure. Other push factors are political instability, environmental degradation and lack of economic opportunities. The other approach criticizes the neo-classical

paradigms. According to this approach, the macro power structure and macro structural forces, which lie at the bottom should be the explanation for population movements rather than placing too much emphasis on the free choice of individuals. "The neo-classical approach, arguing that population displacement are natural occurrences, suggests that they are positive events and that policy development should reflect and reinforce the beneficial aspects of these movements. The structuralist approach, however, emphasizes that population movements are a response to unnatural imbalances in power and opportunities. Consequently, the negative aspects of population displacements are a function of inequities in government, and policy should be developed to address these imbalances and attempt to stem what must be viewed as a consequence of the inequitable distribution of resources in society" (Lonergan, undated, p.8). Further, imbalances in power get accentuated due to lack of government's will (for instance, in the strict enforcement of pollution abatement laws), feckless and corrupt governance. The government's insensitivity or lack of motivation on the one hand and the irresponsibility of the polluters (mainly industrialists) on the other or the nexus between them causes enormous environmental degradation. This has a direct to consequence to displacement of human population. They are reduced to the status of refugees in their own homelands, since they have to leave their homelands in search of employment elsewhere to make a living. Or even if they continue to stay in their own villages, migrate everyday for jobs to nearby towns, walk for miles to get drinking water, succumb to health problems and so forth. This kind of forced movement or displacement of population from their traditional habitat either permanently or temporarily (due to environmental degradation), causes enormous stress and distress, uncertainties and most of all affects their socio-economic and health conditions and quality of life. Thus the UNEP has started using the phrase 'environmental refugees'. If these kinds of deterioration of environment are unchecked, it will directly lead to political instability, extreme poverty and economic stagnation.

5 Farmers' perception on how village economy has been affected due to tannery effluent and water pollution (could be in boxes)

In order to ascertain farmers' perception on social impact of pollution, some qualitative information was collected from the sample well owners and through several group

interviews. We gathered information on many aspects, which clearly indicate that pollution impact on the village society and the dreadful state of the economy. We have collected information for all 51 villages covered in the meso-level survey, but present below only a few cases with a view to highlight the problem.

5.1 Village – Kathiavadi: (partially affected village)

There are two tanks in this village, namely, Sitheri (small tank) and Peria-eri (Big tank). Since tannery effluent directly enters into the Sitheri, all the wells located below this tank are completely polluted and those located adjacent to the command area of the small tank are also affected. Altogether about 100 wells are contaminated in this village. In fact, the Sitheri is reported to be a polluted tank for the past 25 years due to the discharge of effluent from five tanneries located just above this tank. Since this tank is a feeder tank to two other tanks downstream namely, Mottur and Ramanathapuram, these tanks are also polluted. There existed a spring channel, which irrigated more than 100 acres of land but that spring source is dried before 25 years primarily due to the mixing of effluent water into the springs and therefore farmers have decided to stop using this source. While in the big tank, fish culture is still alive, in the small tank, community fish culture was stopped about 15 years ago. A Common Effluent Treatment Plant (CETP) is located near this village for treating effluent gathered from all other adjacent tanneries, but farmers complain the CETP works only when an officer visits the spot and otherwise, (a) waste water is let out of the CETP after some initial treatment and (b) whenever rainfall occurs, the entire waste water is let out untreated. Sample well owners gathered traces of water contamination or change in the water quality in their wells even before 25 years. At that time they were using their own well water for drinking, but slowly for the past 15 years the well water became unsuitable for drinking due to salinity and chemical smell. The well water is reported to be better during rainy months but in summer the water is dreadful. On the whole, out of a sample of 41 wells, 20 wells reported low level of contamination (cannot drink) and the rest have reported to be severely polluted. The well water in the Sitheri command and at least in 25% of the wells in the big tank, are not usable for cultivation: The nurseries do not grow well, yield is reduced by half, prone for pest attacks, the paddy germination is delayed and unhealthy and groundnut plants turn yellow within 45 days of sowing. The land below the Sitheri command and those located adjacent to this tank but receiving

irrigation from the Big tank have all turned saline and white in colour. Although, there have not been any drastic change in the crop pattern, farmers are slowly shifting to coconut and sunflower as suggested by the department of agriculture. These two crops are reported to be resisting salinity better than paddy. But a majority still cultivate paddy primarily for the reasons of meeting their domestic grain requirements. But almost all the sample farmers located in the Sitheri command and many of those located in the big tank command reported a drastic reduction in the paddy, groundnut and sugarcane yields. Normal paddy yield of about 30 bags per acre (2250 kgs) has been reduced to 10 bags (750 kgs) per acre in the past 20 years. The sugarcane used to yield about 50 to 60 tons per acre, now reduced to 25 to 35 tons per acre. The groundnut crop is the worst affected. The yield of this crop is reduced by more than half to hardly 10 bags (500 kgs of pods) at the moment. The drinking water was never a problem in this village since farmers used to consume the well water for all purposes. Now that practice is ceased due to water contamination. People rely on pipe water supply, which is available for a couple of hours every day.

5.2 Village – Gudimallur

This village used to be very rich with spring channel from flowing the Palar river and irrigating over 100 acres of land. At the moment the age-old spring channel looks extremely pathetic with full of coloured and stinking effluent water. Groundwater contaminated is reported to be in existence for the past 20 years in this village. All the 19 sample wells have reported contamination in their wells. There are two tanks in this village, and both of them are affected due to tannery effluent discharge. There is an age-old spring channel in this village, which provided direct irrigation to an extent of 120 acres. For the past 10 years, a cluster of tanneries to let off effluent uses this spring channel. The seepage water from this spring channel has also affected a large number of wells as well as tank water because spring channel also feeds the tank. All the wells located in this village are affected due to pollution. All the sample well owners reported of the soil salinity and soil receiving white colour like salt powder. While more than 50% of the hitherto cultivated land remains fallow, in other lands hardly one crop is cultivated that too during monsoon months when the effect of pollution id reported to be less. But the yield of paddy is not more than 10 bags (750 kgs) per acre in this village. Whereas, about 20 years ago, this village used to be very rich with yield ranging from a minimum of 25 bags (1875 kg)

to 35 bags (2625 kgs). As in the case of all other villages in this region, the groundwater at source is more a source for drinking. People depend upon tap water supplied by the local Panchayat for all their domestic uses including drinking. Extensive complaint of various kinds of skin ailments and allergies were reported to be prevalent in this village. Apparently, chemical sprays used for leather finishes results in extensive air-pollution, which also causes respiratory problems in this village. Almost all the villagers complained about the mosquitoes menace due to the year long flow of effluent water in the spring channel that flows through the village and eventually gets stagnated in the Palar river. Since this village is located on the Palar river side, the problems of bad smell from waste water and mosquitoes make one's living extremely miserable in this village. The value of land used to be Rs.1000 per cent about 10 years ago. It has come down to Rs.750 per cent in the partially affected land and to Rs.400 per cent to fully affected land.

5.3 Village – Poondi

There are three tanks in this village. The effluent from nearby tanneries directly enters into the big tank and then to other two tanks. There is a spring channel, which originates from the Palar river, is also used for letting off effluent. In particular, the head of the spring in the Palar river is stagnated with effluent. Groundwater contamination was reported in all the wells located below the commands of all three tanks as well as those in the dry lands. Indeed all the sample wells (22) reported water contamination in their wells. While in some water contamination reported to have occurred in the past 10 years, in many others it has occurred before 20 years. The effect of tannery effluent is seen more during summer months, beginning from April to July. Only during the rainy months when the effect of the pollution is less, tank water is used for raising one paddy crop. In the other two seasons, all the lands in the village remain fallow. Soil has turned saline and white in colour. The plant growth is stunted and nurseries turn yellowish even before 20 days after sowing. Further, about 40kgs of paddy seeds were used for nursery sowing in the past, but at present farmers use nearly 60 kgs. Many paddy growing farmers have shifted to sugarcane because of extremely poor yield and due to the high incidence of complete crop failure. Even in the case of sugarcane yield is about 30 tons per acre. The use of chemical fertilizers is reported to have gone up due to water pollution, in particular the use of NPK mixtures. Land value remains stagnant in this village for the past 15

years. There are extensive complaints of skin ailments and diarrhea in this village. Drinking water is supplied by the Panchayat but not adequately. The value of land is in the range of Rs.500 to Rs.800 per cent.

5.4 Village – Periavarigam

There is a tank in this village, which does not receive any effluent. The entire effluent from tanneries is discharged into a stream called Kanaru, which eventually joins the river Palar. The river bed adjacent to this village to a length of two kilometers is spread with stinking and coloured effluent. The Kanaru stream, which carries effluent at the moment, used to flow with sweet water during monsoon months even until the early 1980s. A CETP has started functioning since 1995 in this village, which also has started letting the treated, semi-treated and untreated effluent into this stream. All the 32 sample well farmers have reported saline and coloured groundwater with odor in their wells for over 15 years. The paddy yield was reported to be around 2500 kgs and sugarcane yield was up to 60 tons per acre before 20 years. At the moment there is a big shift in the crop pattern from paddy, groundnut and sugarcane to coconut. The groundwater is used in a limited area for coconut crop only. The yield is very low and considered even less than 25% of what one normally got before 20 years. There are at least 6 tanneries located within the boundary of this village, which has contributed to the severe groundwater contamination in this village. There is an acute drinking water problem in this village and women folks at times are walking for miles to get potable water. The water supplied by the local Panchayat is unreliable and of poor quality. There is an extensive reporting of skin ailments and respiratory illness. The residents of this village feel that the employment generated in the tanneries does not help the local people since only outsiders are employed in the tanneries. In the last 15 years, over 200 outside families have settled in this village. It is reported that due to the in-migrants, the cost of living has gone up tremendously in this village.

5.5 Village – Solur

This village is located on the national highway, at a distance of 53 KM west of Vellore town. This is one of the worst affected villages in this cluster. The land and water became unsuitable for cultivation in this village even before 35 years.

There are 12 tanneries located within the boundary of this village. More than half of the village land have been sold to tannery owners in the last 25 years. But the land transactions have not been recorded properly. This village has got a spring channel, which used to irrigate 28 hectares of land. At present, this channel is stinking with full of effluent water. All the tanneries let out their effluent into the agricultural lands, government lands and in irrigation channels. Further, the tannery owners make use of many streams that used to carry fresh water from the nearby mountains to let out effluent. During rainy days it was reported that the entire village would be surrounded by effluent and rainwater. In fact, many outer walls and floors in the houses were eroded due to heavy salts. There is a treatment plant in this village but it never works. Several memoranda were sent to the State and district administration, but all in vain. At present agriculture is completely dead and all the 129 irrigation wells are severely contaminated. Due to chemicals, the masonry works of wells have got eroded and some wells are posing real threat to village population. In about 30% of agricultural lands standing coconut crops could be seen but they do not yield anything. Only in rainy season, some farmers cultivate paddy and even then yield never goes beyond 400 kilograms per acre. The straw turns into black colour and there is acute shortage for animal feed. Therefore, farmers have sold their cattle before 10 years. At present there is hardly any one who owns a cow or a bullock in this village. The agricultural traders are even refusing to buy from this village because of bad quality. It was reported that even bricks made from this village soil have no market. But this was reported to be a rich and fertile village, which had a name for very good quality paddy and vegetables.

One Mr.Krishnamurthy had to resign from his post of Panchayat President because of compulsions that he had to face from the tannery owners. He was asked to be a party for all the malpractices of tannery owners. Later, when he became a village munsif. At that he prompted a school teacher (Mr.Rathinam) to file a case against the tannery owners of this village. The school teacher agreed to do so. The tannery owners came to know this plan while the preparations were on to file a case. On the same night, with the help of workers working in their factories, they severely assaulted the teacher and Munsif and their properties were damage. This happened in the year 1992. After this episode, Mr.Rathnam got shocked and fell sick. He gave up the idea of filing the case. Finally he died in the year 1995.

At present there is acute drinking water problem in this village. The use of contaminated water, for even washing, results in severe dermatological problems. Many have complained chronic intestinal and respiratory illness. While a good number of, once rich farmers, have sold their lands and settled in the urban areas, the poor and landless agricultural labourers have sought employment in the tanneries. Many others, who have lost in agriculture but do not seek jobs in tanneries (due to taboo attached to leather works) are undertaking all kinds of odd jobs like construction, petty-business etc. Many of them are heavily indebted. There are about 300 migrant Muslim families (brought by the tannery owners), who have taken jobs in the tanneries.

6 Mitigation and regulatory measures (ETPs and CETPs) adopted so far

Although the dire need for effluent treatment always existed ever since the industry shifted from vegetable tanning to chrome tanning, it was only after the intervention of the judiciary in the mid 1990s that effluent treatment became mandatory for running a tanning unit. Indeed, the Water (Prevention and Control of Pollution) Act was passed in 1974 by the Government of India; this Act was adopted in Tamilnadu in 1981and the State Government has constituted the Tamilnadu Pollution Control Board in 1982; and the Board has prescribed the pollution standards and tolerance limits for various pollutants present in effluent water that may be let into inland surface water, public sewers, marine coastal areas or inland. But this Act and all other subsequent prescriptions remained only in paper. In fact, the whole episode got blown up only after the Vellore Citizens Welfare Forum (a non-governmental organization) filed a public interest petition before the Supreme Court in 1991. In a historic judgment on 1st May 1995, the Supreme Court ordered to close all the tanning units, which do not have the facility of treating effluent water. Then the Court directed the NEERI to examine the feasibility of erecting Common Effiuent Treatment Plants (CETP). It was after the recommendation of the NEERI in 1996, the idea of CETP came into existence in Tamilnadu.

The concept of CETP has emerged prominent basically due to non-viability of smaller units to have their own individual treatment plants. The smaller units constitute about 90% in the industry. Further, for an individual unit it may help in reducing the pollution abatement costs due to operation of economies of scale in wastewater

treatment. The Tamilnadu Pollution Control Board has initiated a project of CETP to enable treatment of effluent water released by clusters of tanneries, and dyeing and bleaching units located in various parts of the State. A total 56 CETPs have been proposed to be erected all over the State, of which 27 would treat tannery effluent, another 27 would treat the effluent falling out of dyeing and bleaching industries and of the remaining 2, one each for treating wastewater from hotels and hospitals. Of the 27 CETPs proposed to be erected (many of which have been reported to be functioning) for treating tannery effluent, 22 are located in the Palar basin. Similarly, 8 out of 27 CETPs (proposed to be erected for treating effluent of dyeing bleaching units) are located in the Noyyal basin. Details of CETPs are provided in the Table-23.

Table-23 Details regarding CETPs located in various parts of the State

Name of the river basin	Type of industries	Number of CETPs	Number of beneficiary units	Quantity of Effluent (in kld)	Cost of the Project (Rs.in million)
Palar	Tannery	22	847	37,458	614
Noyyal	Dyeing and bleaching	8	300	42,350	279
Bhavani	Dyeing and bleaching	4	545	2839	70
Amaravathi	Dyeing and bleaching	8	548	14,100	166
Others	Dyeing, bleaching, tannery, hotels and hospitals	14	576	14,368	201

Source: Tamilnadu Pollution Control Board

But, the State has promoted the CETPs by way of providing subsidies. While the Government of India provided 25% of the cost, the State Government extended a matching grant. The rest is met through the beneficiary contribution and by way of borrowing from financial institutions. The tanners in Tamilnadu claimed that they have pumped in Rs.500 million for pollution control measure'. (M.M.Hashim, 1996).

The CETPs are designed to maintain the prescribed standards with respect to only a few chemical parameters such as BOD, COD, pH and TSS. These CETPs will do nothing about removing salts, chromium, colour, odor etc. from the effluent. Before analyzing the performance of the CETPs, let us have an idea on the characteristics of

untreated effluent in two types of tanning process, namely, vegetable tanning and chrome tanning (see Table-24)

Table-24 Characteristics of effluent generated before treatment

Sl. No	Parameters	Characteristics of effluent before treatment under (average)		Tolerance limits prescribed to discharge into inland surface waters
		Chrome tanning process	Vegetable tanning process	
1	PH	8.0	9.1	7.25
2	Total Suspended solids (TSS) mg/l	3750	4300	100
3	TDS (mg/l)	17250	14090	2100
4	BOD (mg/l)	1850	2475	30
5	COD (mg/l)	4500	6240	250
6	Sulphide (mg/l)	30	83	2
7	Total Chromium (mg/l)	165	15	0.1

Source: Derived from Madras School of Economics, 1998

6.1 Performance of the CETPs in the Palar basin

Most of the CETPs seem to comply with some specific parameters such as pH, TSS, BOD and COD but it varies from one CETP to another. But invariably, TDS is quite high in all the outlet points of the CETP after treatment. The tolerance level of TDS is 2100 mg/l but at the outlet point of the CETP, the values stood at 15326 (Ranitec), 16300 (Visharam), 3690 (SIDCO Phase-1), 8006 (Vanitec 1) and 5674 (Vanitec 2). The tolerance limit for sulphides after treatment should be 2 mg/l before letting into the inland water. But what is seen in the wastewater after treatment is 16-21 mg/l. The common salt is never removed from the effluent. Therefore, parameters such as TDS is almost untouched even after the so-called treatment. The National Environmental Engineering Research Institute (NEERI) undertook a spot study of CETPs in the Ranipet cluster (of the Palar basin). It concluded that the TDS and chlorides were very high even after the treatment (NEERI, Waste Management in

Cluster of Tanneries in Tamilnadu – TALCO – RANITEC CETP, Ranipet, 1997). Therefore, it was suggested to adopt what is called high rate transpiration system, in which effluent water is applied in land designed specially and plant trees, which have higher transpiration capacity. But this was never done.

6.2 Economic costs of effluent treatment

The costs of effluent treatment in the five major CETPs in the Palar basin are Rs.16.3, 23.2, 26.7, 32.3 and 43.6 per KLD. This excludes the cost of reverse osmosis treatment and sludge treatment costs / storage costs. Total pollution abatement cost per kilogram of raw material processed works out to a minimum of Rs.0.65 in Ranitec CETP to Rs.1.66 in Udayendram CETP, which includes the costs of reverse osmosis. Since the Government meets a part of the costs of erection of the CETP by way of subsidy, the private costs per Kg of raw material processed works out to Rs.0.46 to Rs.1.19 (MSE, 1998).

6.3 The performance of the Individual Effluent Treatment Plants (IETPS)

There were 65 IETPs in the Palar basin as on 1996 and MSE (1998) studied 13 of them to assess their performance. Like in the case of the CETPs, the IETPs also comply with certain standard parameters but the TDS remains very high even after treatment. The TDS level in the treated water varies from 2144 to 12516, while the tolerance level prescribed by the TNPCB is 2100 mg/l. In fact, in 8 out of 13 IETPs, the TDS level has exceeded 6800 mg/l. Chromium never seems to be removed from the effluent. And 4 IETPs let the so called treated water into river and the rest (9) let it go into the open land (which also eventually reaches river). The total pollution abatement costs for IETPs is more for the IETPs compared to the CETPs. In the case of the IETPs it varies from Rs.1.07 to Rs.4.22 per kg of raw material processed, whereas, in the case of the CETPs, it works out to Rs.0.54 to Rs.1.13. After deducting the subsidy elements given by the Government, the private costs for treatment works out to Rs.0.41 to Rs.1.48in the case of the IETPs, whereas, cost varies from Rs.0.41 to rs.0.81 per kg of raw material processed in the case of the CETPs.

The office of Public Affairs, Chennai issued a press release on November 24, 2000, indicating a project to explore industrial wastewater recycling for the tanneries in Tamilnadu. The U.S. Trade and Development Agency (USTDA) funded the project to the extent of $180,000 and TNPCB was supposed to implement it. The primary goal of this project was to evaluate the technical and institutional alternatives available to develop industrial wastewater recycling for the numerous tanneries in the Vellore region of Tamilnadu. The current status of this project is not known.

6.4 Sludge disposal

No efforts have been made so far for the disposal or treatment of sludge, which contains a very high level of chromium and other heavy metals and chemicals. The sludge generated is stored in various open sites very close to the village sites or near the river beds. During the rainy days, sludge deposit gets washed away slowly and spread to the agricultural fields causing enormous problems to the village community. There was a news item in The Hindu, dated April 16th, 2000, with a title, 'Residents up in arms against tannery pollution' since sludge was dumped in the burial meant for Scheduled Castes of three villages near Ambur town for many years. The Vellore Citizens Forum sent letters to all the State authorities and the Tamilnadu Pollution Control Board (TNPCB), urging them to take immediate steps with a view to protect the lives of the people. But no action has been taken so far by the TNPCB.

6.5 State subsidy on CETPs

After the High Court's Green Bench verdict on 29-4-1998 making the CETPs mandatory, the Government of Tamilnadu has sanctioned a subsidy 25% of the project cost without any ceiling to Tiruppur's and Karur's dyeing and bleaching units in order to get over the crisis. The Government has thus released Rs.195 million towards subsidy for 38 CETPs and further Rs.67.7 million to another 9 CETPs through Tamilnadu Pollution Control Board. The Board releases the money to the CETPs depending upon their progress.

On the whole, the effluent treatment is still a far cry. The CETPs and IETPs first of all, do not their plants all the time; even if they do, the effluent water is only under treated; and, farmers confirm that during the days of rainfall or during night hours, the effluent is let out of the plants untreated.

7 Social Responses and Coping Strategies

7.1 Social Responses and Effect

Organized peoples' response against the severity of pollution has been witnessed only in the recent times. A small organization called Community Action for Development was the first organized effort to condemn the environmental degradation caused due to tanneries. It was formed in one of the badly affected towns, namely Ambur in the late 1980s. Its sustainability was uncertain primarily due to threats posed by the tannery owners. The organizer of this movement therefore started writing in a national news paper and generated some public awareness. Later a movement called Vellore Palar Protection Movement was started in the year 1991 and has been reasonably active in the basin. They have organized many demonstrations and protests marches in the region. Each year, when the Tannery owners organize International Leather Trade Fair in Chennai, the volunteers of this movement distribute pamphlets to the foreign buyers, describing the extent to which the environment is damaged due to leather tanning. An organization called Pasumai Thayagam (an outfit of one of the leading political parties in Tamilnadu) organized many protest meetings and demonstrations in the basin with a view to organize people. Another organization called Trust Help has made a video film and a case against the tanneries and presented them to the International Water Tribunal in the year 1992. Peace Trust, yet another organization, has organized a public debate on tannery pollution issue in Chennai on 29th June 1996.

One of the most important responses to the acute pollution problems caused by the tanneries came from the Vellore Citizens Welfare Forum. It filed a petition (W.P (c) 914 of 1991 before the Supreme Court of India under Article 32 of the Constitution. The Supreme Court Bench in their judgment clearly upheld the Precautionary Principle and the Polluter pays Principle as the most fundamental and essential features of sustainable development. Excerpt from what is regarded as a far reaching judgment

delivered by the Supreme Court Bench, constituting, Justices Kuldip Singh, Faizan Uddin and K.Venkataswami: "It is no doubt correct that the leather industry in India has become a major foreign exchange earner and at present Tamilnadu is the leading exporter of finished leather accounting for approximately 80% of the country's export. Though the leather industry is of vital importance to the country as it generates foreign exchange and provides employment avenues, has no right to destroy the ecology, degrade environment and pose as a health-hazard. It cannot be permitted to expand or even to continue with the present production unless it tackles by itself the problem of pollution created by the said industry". With a view to compensate the affected farmers in the region, the judges in their judgment has ordered and directed the Government of India to constitute an authority under Section 3 (3) of the Environment (Protection) Act, 1986 with all the powers necessary to deal with the situation created by the tanneries before September, 1996. This authority constituted by the Government of India shall implement the `precautionary principle' and the `polluters pays' principle: "The authority shall, with the help of expert opinion and after giving opportunity to the concerned polluters assess the loss to the ecology / environment in the affected areas and shall also identify the individuals/ families who have suffered because of the pollution and shall assess the compensation to be paid to the said individuals / families. The authority shall further determine the compensation to be recovered from the polluters as cost of reversing the damaged environment". The judgment also indicated that the said Authority should compute the compensation under two heads, namely, for reversal of ecology and for payment to individuals. And, the Court directed all the tanneries to install effluent treatment plants within a stipulated time period (November 30, 1996). Further, the Supreme Court of India imposed a fine of Rs,10,000 on each tannery located in the State of Tamilnadu. This money along with compensation to be recovered from the tanneries should form what the Court called 'Environment Protection Fund', which should be used for restoring the damaged environment. The Court also ordered that the tanneries, which fail to pay the fine, should be closed.

Thus, as per the directions given by the Supreme Court of India, **The Loss of Ecology Authority (Prevention and Payment of Compensation)** was constituted. While the Authority was carrying on its work, tannery owners filed a case in April 2000, alleging that the Authority was investigating into the matter beyond its scope. Therefore they pleaded that the Court should intervene to stop the entire proceedings of the Authority. But the Court has dismissed this petition.

Nevertheless, the Authority completed its work and submitted its report to the Government of India in January 2001. The Authority identified 15165 hectares belonging to 29193 farmers spread over the entire district of Vellore in the basin as affected land area and recommended a total compensation of Rs.26.82 crores (Rs.268 million). This amount will be recovered from 546 tanneries identified by the Authority in the basin on the basis of the extent of effluent discharge.

The Vellore Citizens' Forum – the original petitioner who filed the case in the Supreme Court – felt that what has been recommended is only peanuts and in reality, the Forum felt that the compensation should have been recommended from the year of starting of the tanneries. The Forum also felt that the compensation payable to farmers should be on account of loss of land value and bio-diversity and on the basis of damages done to human and animal health; neither did the authority take into account the loss of income to farmers over a period of time due to land and water pollution.

Anomalies associated with the findings and recommendations of the Authority

- Although the pollution caused by tanneries started affecting the basin area many decades ago, the compensation recommended by the Authority covers only the period from August 1991 to December 1998.
- Further, as per the original ruling of the Supreme Court, the authority was to receive petitions from the affected farmers, but the authority instead has identified them by their own mechanism. (Down to Earth, Vol.9, No.23, April 30, 2001).
- Compensation was computed on the basis of TDS level in the irrigation wells; If TDS is in the range of 1000 to 2100 mg/l, then compensation payable is Rs.1000 per hectare per year. If TDS level is 2100 to 3500 mg/l, then compensation payable is Rs.2000 per hectare per year. Rs.6500 is paid as compensation if TDS is in the range of 3500 to 4900. And, if it exceeds, Rs.14000 is paid as compensation per hectare per year. It is easy to identify the irrigation wells with TDS levels, but how could one arrive at land area affected using the TDS level in the irrigation wells? They adopted a simple method in which all the land area irrigated by that well has been taken to be affected land. This fine and logical. But what is the method of identifying the land area

irrigated by an affected well? This is where the anomaly crops up. Instead of asking the farmers themselves, the land area, which is located in the same survey number in which an affected well is also located, has been taken as the land area affected. But in reality, area irrigated by a well cuts the survey numbers. Further, in many cases, only well is located in a particular survey number. In which case, should one conclude that no land has been affected? Therefore, land area affected has been grossly understated. The actual area affected and deserves compensation must be several folds more.

- Compensation towards investment lost in the contaminated wells is not considered; Each farmer has spent a considerable money in well digging and deepening (see Appendix 3 for details on farmers' investments on wells).
- Loss of agricultural income and employment; Until the last two or three decades, this basin was considered the second rice bowl of Tamilnadu. Paddy yield used to be at least 25 bags or 1875 kgs per acre. At present, in many of the affected villages, the land is kept fallow or coconut crop is raised without much yield (give data).
- Compensation towards heath hazards posed due to water contamination;

7.2 Responses From the tannery owners

A survey of 74 tanneries in the Palar basin conducted by the MSE (1998) gives perception of tannery owners with regard to pollution standards maintained by them. Their complaints are the following: One, they switched from vegetable tanning to chrome tanning due to Government's policy to boost exports of finished leather and leather goods rather than exporting semi-finished leather; two, tolerance level of BOD is too stringent compared to what is prescribed by many other exporting nations; three, TDS standards (2100 mg/l) was fixed without calculating the cost involved in it. Further, existing CETPs are not designed to attain such level of prescribed standards.

On Supreme Court's direction that polluters should pay for the restoration of the ecology and compensation for the victims, 'about four-fifth of the tanners said that the Government and society should bear most of the burden. Many of them asked why the tanners alone be penalized for the past environmental degradation' (MSE, 1998). They have even gone to the extent of saying that the notification of the Government of India

conferring power to Loss of Ecology Authority is ultra vires of the Environment (Protection) Act 1996 and the provision of the Constitution. They also add that the Authority has no jurisdiction to assess or demand compensation in law. They also indicate that the Authority claiming compensation is violative of principles of natural justice.

7.3 Some suggested policy measures to get over tannery pollution

One view is that the polluters should pay for the damages: 'Every effort should be made to apply the principle in manner which will enable the polluters to internalize the environmental costs in their production and pricing decisions' P.185, MSE, (1998). What is the practical mechanism with which one can ensure that the industries do internalize environmental costs. This is difficult, in particular in a situation where there exists a nexus between bureaucrats and polluters? The norms are prescribed by the TNPCB and even the Supreme Court orders for the closure of the units, which do not comply with the order of having either IETP of be a part of a CETP. But beyond that so far, even the judiciary did not go. Under these circumstances, how to make sure that the polluters follow the TNPCB's regulations in following the standards prescribed by them.

The Supreme Court gave three options to the tanners: one, joining a CETP, erecting one's own IETP or relocating a tannery. But none of these decisions are going to help or make sure that the environmental damages made so far will be set right. Nor do these decisions ensure that the tanneries will follow the standards prescribed by the TBPCB. Our study. A mere erection or being a part of a CETP or dislocating a unit will never solve the past and present problem. Nor any punitive measures such as imprisonment etc will help.

It is suggested that for effective operation of the CETPs, metering of the volume of effluent generated and the pollutants present in the effluent at outlet points of each member tannery of a CETP should be measured and monitored so that each individual unit could be charged proportionately. This will give incentive to the individual units to reduce waste-water generation and in the extent of pollutants used. The existing cost sharing system in the CETP does not provide such incentives.

Creation of separate industrial estates for tanneries with adequate support system for pollution prevention, abatement and for the use of recycled water. The industrial estate meant for tanneries should be located quite far from the rivers, streams and tanks so that the existing water bodies are not polluted.

CETP should be made an effective low cost institutional mechanism to treat wastewater; this needs technological up-gradation for treatment of wastewater. And also encourage the use of recycled water for some initial processes so that a good deal of water could be saved.

To build pubic knowledge and awareness, government should make sure a free information flow from tanneries about all aspects of industries including export potential, employment generated by this industry, pollution and environmental degradation cause due to this industry, health hazards involved and so forth. This will help to generate public opinion and some viable solutions may emerge.

Yet another measures, which the tanneries have been asked to adopt is the chrome recovery technology, which is reported to be a somewhat better and cleaner technology.

8 ANALYTICAL SUMMINGP AND THE WAY FORWARD

That unpolluted groundwater can be a buffer against drought conditions in particular tropical countries needs no further emphasis. As mentioned earlier, it is now widely recognized that massive expansion of groundwater irrigation has contributed quite substantially to India's food security and overall economic growth despite increasing demographic pressure. But unfortunately, a vital natural resource such as water (both surface and groundwater) is in a state of decay posing a big threat to the sustenance of mankind. This issue is going to become quite serious and alarming, even at the current rate of urbanization and industrialization. The direct users may be internalizing or paying the price for such degradation of this resource such as by way of paying a higher cost of digging and deepening, higher cost of extraction, loss of futile investment on wells due to drying up of wells and groundwater contamination, paying a higher price for drinking water (which hitherto was free as was available from local wells), loss of agricultural income and

employment contributing to poverty, decline in nutritional levels and hunger, groundwater contamination leading to health hazards and so on. If these are not assessed and managed without further delay, the cost that the future generation would have to pay will be terrific and irreversible

Competition arising out of physical limits in a given rural area or due to demographic pressure and the consequent over-use of groundwater may be kept under control through some institutional mechanism. But urbanization and industrial expansion or in short modernization processes sharing the natural resource that is already under stress in the rural areas may cause disastrous impact to the local economy, society, ecology and environment. In the particular context of the Palar basin, the so-called modernization process, not only shares with the local resource base, but also contributed quite heavily to the degradation of environment. It directly affects farmers in particular those of marginalized and defenseless section.

Development should serve as a key vehicle for promoting human rights, eradication of poverty and protection of environment. But unfortunately, in many parts of the developing world, the development and modernization processes are turning out to be seemingly unsustainable; what are called developmental processes are themselves proving to be a main source of human rights violations and for ecological and environmental degradation. The kind of developmental activity, which we have seen in the Palar basin, not only poses severe environmental tribulations, thereby making it utterly unsustainable, but also has been a key source contributing to human rights violations. Thousands of farmers have left their homes leaving behind their land houses and other properties, water contamination leading to scarcity for good drinking water which in turn have resulted in a serious health problems, thousands of farmers have given up their agriculture due to polluted land, soil and groundwater, many have lost their income and employment and so forth. See the following schematic representation, which provides the summary on the intensity of water pollution and its impact.

Hierarchies	Government, Central and State Pollution Boards, Government machineries and R & D Institutions : There exists a close nexus among these agents.
Market	Tannery owners, other polluting industries, exporters of leather and water companies which pump from river and sell water to tanneries
Individualistic	Trade unions, which organize workers working in the industries and fight for their wage rise; They neither fight against environmental degradation nor do they organize farmers whose land and groundwater have been subjected to severe contamination. NGOs do some uncoordinated action but extremely small in number. A few judicial activists / lawyers have been successful in creating awareness about this issue by filing public interest litigations; So far human rights activists have not taken up this issue in this region; Academic activists have done some work in this area to highlight the problem
Fatalists / Shock absorbers	Farmers who have lost their land and wells due to pollution; Farmers who have lost their agricultural income and employment; Farmers who have sold or left behind their properties and migrated to other parts of the district and State; Urban and rural People who suffer due to drinking contaminated water; This section is defenseless; Either they flee or stay and suffer.

The sustainable development as a phrase emerged for the first time in the Report of the World Commission on Environment and Development, *Our Common Future*, 1987. It defined sustainable development as, `development which meets the needs of the present generation without compromising the ability of future generations to meet their own needs' (p.2 Ayesha Dias, *2000,)*. Subsequently, the concept sustainable development has received much broader definition, which included promotion of human dignity and human rights, and advancement of economic, social, cultural, civil and political liberties, besides protection of ecology and environment for the future generation. All these have been grossly violated in the Palar basin, thereby making the `developmental activity' a blatant and outright unsustainable one.

All these raise an important question: Are we lacking effective environmental laws?

Until the 1972 UN Conference on the Human Environment held in Stochholm, the environmental in the country were very weak. However, after the UN Conference, where India expressed strong concerns for environmental protection, things have changed. The 42nd Amendment of the Indian Constitution passes in 1974 was a landmark. This enabled a series environmental protection laws, the most important of which is The Water (the prevention and control of pollution) Act. This Act enabled the constitution of Central Pollution Boards and subsequently a Board for each State. While the former functions directly under the control of the Government of India, the latter, under the control of the respective State Governments. Further, a separate ministry was created in the Central Government structure for environment and forests in 1980 as a specialized agency for planning, promoting and protecting environment. Therefore, we have enough environmental laws supported by the Courts. The best example is the verdict given by the Supreme Court of India against the tanneries of the Palar basin. The Bombay High Court has delivered a resounding judgment upholding the powers of the Central Government to issue directions or prosecute anybody who cause damage to environment. Further, the same judgment also broadened the locus standi of citizens to approach the Courts to prevent environment degradation of any part of the country www.goacom.com). In the recent years, the Precautionary Principle (which recommends pollution prevention rather than pollution clean-up) has become a key phrase in many verdicts of the Courts. The international environmental laws recommend several measures to combat the danger of pollution: The key measures among them are internalizing the economic costs of pollution and to adopt the 'polluter pays principle'. What is then wrong?

Dilip Biswas, the Chairman of the Central Pollution Control Board has confessed, 'Enforcement of such legislation is a challenging task because of various reasons including the inherent flaws in the laws and infirmity of enforcement machinery' (Environmental Legislation Challenges of Enforcement, Eastern Window E-mail, Visison 2001, p.1). He further adds that though environmental laws and specific empowered authorities have been set up for pollution prevention and

payment towards compensation, monitoring mechanism for implementation is undefined. This is quite true in the case of the pollution in the Palar basin: Leather tanneries, in the first instance, have been classified under `red industries' (heavily polluting industry). This warrants by law installation of treatment plants and treatment of effluent water to the prescribed standards before letting it out. This was never done until the intervention of the Supreme Court through a public interest litigation filed by the Vellore Citizens' Forum in 1991. At present, though many tanneries have treatment plants, the effluent water is either untreated or under-treated. In other words, the Supreme Court has delivered what is regarded as an historic verdict, but the country lacks, enforcement and monitoring mechanism, good governance and honest and committed bureaucratic and political set up, which would have indeed made the Supreme Court's intervention really effective and rewarding.

Serious statements in this regard were also made the Union Minister, Mr.N.T.Shanmugam in the Parliament, indicating the continuing danger caused due to the untreated wastewater entering the Palar river. To quote, `There are number of tanneries on the bank of Palar river.....The effluent of tanneries have contaminated the sub-soil water in that area....There is no safe drinking water in that area. Some organizations filed a case in the Supreme Court and also got ruling on it. Even then, the situation is continuing. The Government has to order the Pollution Control Board to watch the tanneries in Tamilnadu whether they are treating the effluent properly and to allow them to charge them according to norms laid by the Board' (Matters under rule 377, Lok Sabha debates, 6-8-1998).

The Supreme Court of India has made an unambiguous verdict that although the leather industry is vital to the country's economic development, it has no right to destroy the ecology, degrade the environment and pose a health hazard and further pointed out that the concept of sustainable development should be upheld to eradicate poverty and to improve the quality of human life. The Court has even ordered for the constitution of an Authority called Loss of Ecology Authority with a view to assess the damage caused due to tannery pollution and to pay compensation to the affected people and also to recover the cost of the damage from the tannery owners. The net benefit of this verdict is not anything, which is going to reverse or compensate the severe damage already committed to land and water resources as well as human beings. In order to implement the existing laws, what we need is an

effective, strong and corruption less governance. The international organizations such as WTO also does not ensure that these principles are followed. To quote Ayesha Dias, 'A new body of international economic law is emerging however, relating to trade and investment, whose impact on environment and human rights is highly questionable, to say the least. Much recent writing and analysis has focused on the human rights and environmental impacts of the Multilateral Agreement on Investment and the World Trade Organization. This body of international economic law, far from being a pillar of sustainable development, is resulting in the unregulated promotion of sustainable development' (p.3).

All these raise two important questions:

- *Do we face a deadlock situation?*
- *Do we have a way forward?*

Multi-stakeholder dialogue is an approach, which has immense utility in not only identifying various stakeholders but also helps to assess their varying interests, strengths, and weaknesses. This approach has emerged in response to the apparent deficiency of conventional socio-economic tools.

Multi-stakeholders' dialogue

In a conflicting and in a sort of deadlock situations over the use and abuse of natural resources, multi-stakeholders' dialogue approach provides an extremely useful framework and platform.

- To take stock of use and abuse of natural resource in question in a context of sustainable development;
- To review the use and abuse of natural resource in question in a overall context of urban and industrial expansion and in the context of poverty, food security and hunger;
- To assess and examine who are the defaulters of law, their positive and negative contributions to society and economy;
- To bring together various stakeholders for a fruitful dialogue with a view to hear, debate, document and make public their voices;

- To find ways for preventing further degradation of natural resource in question and to work towards sustainable development with a common agenda within a framework acceptable to all stakeholders;
- Most important of all is to find ways to turn situations of conflict and distrust into opportunities for mutual aid and cooperation (Grimble, Robin and Man-Kwun Chan, 1995)

Social dialogue approach would not yield instant results. It is a process in which all stakeholders, though initially fight and debate, settle down after a while. What is however crucial is to sustain the tempo and interest of stakeholders until some tangible outcome emerges. The dialogue process may yield definite results under conditions, where already some threshold level of disaster has been reached. For instance, social dialogue would be more fruitful in a river basin, which is heavily used, which is dumped with industrial and domestic wastes resulting in heavy contamination of surface and groundwater, where there is severe competing demand for water, where ambiguities exists in defining water rights, where water and environmental laws are ineffectively implemented, where official monitoring system either never exists or failed and where trade offs between competing water users are ill-conceived and ill-managed.

The social dialogue approach has a package of measures such as,

- Bringing all stakeholders into a common platform with a common agenda;
- Provide them with adequate knowledge and equip them with scientific data base;
- Training if necessary;
- Start a literacy program on water and on other natural resource management;
- Develop links and support with legal, political and government institutions;

Multi-stakeholders' social dialogue is of two kinds: They are, (a) Top-down approach and (b) bottom-up approach. These approaches are adopted according to kind of issues and problems that the society is confronted with. For instance, let us take the issue of 'free electricity supplied to farm pump-sets' in Tamilnadu and

Punjab states in India. This is an absolutely populist measure, which in the long run may go against people's interests and might also ruin the State finances as it has already happened in Tamilnadu. Whenever, the ruling party wanted to introduce electricity tariff, the opposition parties express a public outrage and vice-versa. Among the farming community, there is a mixed feeling: While some are against withdrawal of subsidy, others are for introducing tariff. There is also a discontentment among those of small and marginal farmers, that the biggest beneficiaries are large and multiple pump set owners, who not only use water for their own cultivation, but also sell water for others[3]. In which case, best course, would be to bring together all political parties along with farmers' representatives into a common platform to discuss and debate the issue of 'free electricity'. The bottom-up approach is the one in which all direct users of a natural resource are brought together: Example, water users in a river basin, which is heavily over-used and polluted.

But there are some open-ended questions even in this approach: They are,

- How to sustain a spirited dialogue process among the multi-stakeholders until one reaches a tangible solution?
- How to upscale success stories?
- What is the time frame involved for achieving a reasonable degree of success with tangible and innovative solutions?
- Should we wait until one reaches `the disaster / threshold level' to initiate a dialogue process?

[3] The interviews held with farmers in the Palar and Noyyal river basins in Tamilnadu reflect these sentiments (Janakarajan,2001).

Appendix-1 Estimated industrial pollutant loadings discharged into major rivers in Tamilnadu

Parameter	Madras	**Palar**	Pannier	Vellar	**Cauvery**	Vaigai	Vaippar	Tambra-parani
TSS	120446	29938	9339	32111	61402	15579	6382	20042
TDS	815245	400302	80059	130348	472357	126527	63813	145761
Chloride	192050	101434	18467	36712	116196	31173	14870	38255
Sulphide	15674	3818	1462	4636	9160	3033	1375	2018
Ammonia-Cal Nitrogen	15461	3034	1906	2593	8163	1953	1422	2167
Phenol	131	383	4	5	119	29	3	10
Oil & Grease	4059	670	527	737	2660	584	378	818
BOD	51496	23496	7525	13775	38574	12303	5380	7316
COD	182189	70990	23511	41667	127346	37293	16926	27908
Copper	32	4	1	Na	78	Na	Na	1
Zinc	5072	465	502	807	2623	481	354	682
Total Chromium	643	474	23	152	210	51	12	149
Nickel	102	93	24	5	116	7	Na	Na
Cyanide	19	22	4	2	15	3	Na	Na

Note: Na: Not available

Source: Asian Development Bank, Tamilnadu Environmental Monitoring and Pollution Control, Final Report, Volume-II, June 1994

Appendix-2 Growth of non-farm employment in the villages selected for the first round survey, 1997-99

Sl. No.	Name of the village	Type of non-farm activity	
		Leather	Others
1	Vadakkuppattu	28	300
2	Ramanaickenpettai	1	258
3	Sanankuppam	45	150
4	Alankuppam	450	60
5	Periankuppam	20	150
6	Karumbur	40	150
7	Parsanapalli	20	25
8	Veerankuppam	75	175
9	Solur	300	175
10	Vinnamangalam	400	120
11	Sathambakkam	32	80
12	Pavarthanpattarai	26	80
13	Komeswaram	60	220
14	Ayithampattu	305	51
15	Nariampattu	240	230
16	Periavarigam	130	295
17	Chinnavarigam	645	120
18	Kailasagiri	360	265
19	Masigam	60	285
20	Chinna damal cheruvu	50	240
21	Kothapalli	Nil	175
22	Erikuthi	25	285
23	Balur	250	120
24	Ammanankuppam	25	40
25	Katharikuppam	10	104
26	Kilpatti	20	128
27	Chinnathottalam	4	100

28	Mukkunram	3	217
29	Nandiyalam	165	325
30	Arappakam	100	340
31	Kathiavadi	35	110
32	Veppur	190	10
33	Kil visharam	100	340
34	Kilminnal	29	210
35	Kil monavur	170	220
36	Melmonavur	290	42
37	Vannivedu	225	230
38	Kilambadi	10	40
39	Pudupadi	55	45
40	Poongodu	Nil	10
41	Sakkaramallur	90	120
42	Thirumalaicheri	40	70
43	Sathambakkam	25	70
44	Manthangal	80	340
45	Ammananthangal	15	45
46	Chenna samudram	20	245
47	Poondi	10	300
48	Thenkadappanthangal	30	136
49	Gudimallur	90	80
50	Damal	0	87
51	Kilambi	0	82
Total		5383	25855

Note: 'Others' include beedi rolling, match industry, coconut leaves weaving for house roofing, handloom weaving, construction, road laying, quarries, lorry cleaners and drivers, brick kilns, petty business and sand mining in the river.

Source: First round survey, 1997-99

Appendix 3 Costs of well irrigation in the wet & dry land wells of the Palar basin

Village	No.of sample wells	Original cost per well (Rs)	Average current cost per well (Rs)	Original average cost per hectare of NIA (Rs)	Current average cost per hectare of NIA (Rs)
Kathiavadi	13	2615	91,000	1935	67,000
Poondi	15	8733	79,000	6488	58000
Gudimallur	7	857	86,,000	534	54000
Periavarigam	5	8800	58,000	9205	61000
Solur	5	1800	51,000	5556	159000
Damal	38	13289	75,000	4297	24000
RN Pettai	8	4875	65,000	7800	104000
NM Pattu	8	6250	87,000	2317	32000
Average		8242	72286	4767	69875
Costs of well irrigation in the dry land wells of the Palar basin					
Kathiavadi	27	11074	116,000	8413	88000
Poondi	7	16857	84000	19250	96000
Gudimallur	12	5583	79000	9293	131000
Periavarigam	25	5400	93000	6139	105000
Solur	16	7063	93000	7766	103000
Damal	11	16000	81000	6780	35000
RN Pettai	34	10471	76000	19734	143000
NM Pattu	18	10444	68000	8835	58000
Average		10362	86250	10776	94875

Note: Solur, Periavarigam, Gudimallur and Poondi are affected villages due to discharge tannery effluent, where groundwater is badly contaminated; Among other villages, while Kathiavadi is partially affected, Damal, NM Pattu and RN Pettai are not affected. Source: Main survey, 1998-00

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