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Journal Of Environmental And Healthcare Law

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ABSTRACT

Judiciary in India plays a vital role to fill the vacuums of environmental law. Judiciary in this effort tries to bridge between the Constitution and environmental laws introducing certain principles and doctrines. These principles and doctrines are important to achieve the ends of jurisprudence. Further, judiciary introduces them as many are recognized in international convention. In addition to the above, judiciary made a right observation with the case US District Court in Union of India v. Union Carbine Corporation. Wherein Indian judiciary got an opportunity to develop an indigenous jurisprudence and new strategies. For the first time absolute liability was introduced in the very judgment. Later on other liability principles are introduced such as precautionary principle, polluter's pay principle, public trust doctrine, doctrine of sustainable development and intergenerational equity principle are brought through judiciary from international law as it is implicit power given to under article 51 (c) of the Constitution. The said article directs the state to ' foster respect for international law and treaty obligations in the dealings of organized people with one another. As result of persistent effort of Indian judiciary, the National Green Tribunal Act, 2010 working exclusively on environmental matters.

Theprinciples Of Liability Evovled By Supreme Court Of India In Regulation Of Glboal Warming: An Assessment

The environmental law and the laws related thereto left some vacuums in the control and prevention of pollution and the preservation of environment. The judiciary in this situation tries to fill the gapes in the existing constitution and environmental laws, in this attempt judiciary evolved certain principles and doctrines to give a new vision to the said legal provisions.[1]The principles are a significant contribution to the environment jurisprudence.[2] Some of these principles are self-explanatory and applied as a preventive mechanism, while others are evolved as a compensatory one. None of these principles are comprehensive enough to account for every sort of environmental pollution and degradation. However, these principles are important to achieve the ends of environmental jurisprudence.[3] According to the court, the power is implicit in Article 51 (c), which directs the state 'to foster respect for international law and treaty obligations in the dealings of organized people with one another'.[4] Because whatever the principles and doctrine brought and applied are generally recognized in international conventions and the judiciary introduced them into Indian legal system.

[1]Jariwala, C.M(2004), Environment and Justice, New Delhi:APH Publishing, pp. 179, 180.
[2] Leelakrishnan, P(2006), Environmental Law: Case Book, New Delhi:Lexis Nexis Butterworths, p.345.
[3] Dube, Indrajit(2007), Environmental Jurisprudence: polluter's Liability, LexisNexis Butterworths, p.62.
[4] Leelakrishnan, note 2.

Whatever the observation made by judge Keenan of the US District Court in Union of India v. Union Carbine Corporation[5], when Union of India in the capacity of parens patriae[6] approached the US District Court of Southern District of New York, that "deprive the Indian Judiciary of this opportunity to stand tall before the world and to pass judgment on behalf of its own people would be to revive a history of subservience and subjugation from which India has emerged. India and its people can and must vindicate their claims before the independent and legitimate judiciary…" It is proved the Indian Judiciary to develop an indigenous jurisprudence and formulate new remedies.[7]This observation has raised doubt about the capability of Indian Judiciary in handling the case. This observation provoked the Indian Judiciary to develop an indigenous environmental jurisprudence with new strategies. It is appropriate now to remember chief Justice Bhagawati's declaration (including Ranganath Mishra, G.L. Oza, M.M. Dutta and K.N. Singh,JJ.) in M.C. Mehta v. Union of India[8] that "we have to evolve new principles and lay down new norms, which would adequately deal with the new problems which arise in a highly industrialized economy. We cannot allow our judicial thinking to be constricted by reference to the law as it prevails in England or for matter of that in any other foreign country. We no longer need the crutches of a foreign legal order". [9]Then, Indian judiciary propounded certain principles to protect environment from various sources of environment such as air pollution, land pollution, water pollution. These pollutions will lead to many problems, as pollution is a cause of environmental degradation or ecological imbalance which will result in global warming, acid rain, ozone depletion, and totally it affects ecosystem.

The formulation and application of these principles/doctrines are remarkable milestones in the judicial process in protecting the environment from pollution. Because it led the people to be alert as all such cases arose through PIL which blocked the undue influence of political bigwigs and invalidated illegal contracts with adverse impact on ecology. The year 1986 onwards uninterruptedly may be labeled as period of court's care and innovations in the field of Environmental law. The concern of the courts for prevention and control of water and air pollution is reflected from the judicial decisions. It shows that the Supreme Court took up the cases involving different issues and delivered judgments with far reaching consequences[10] one of such consequences is global warming.

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[5] (1986)2 Comp LJ 169

[6] Right of a person, to sue or to be sued on behalf of another who is incapacitated to take up the case before a judicial forum as effectively as the former can.

[7] Shanthakumar, S(2007), Introduction to Environmental Law, Nagpur: Wadhwa and Company, p. 101.

[8] AIR 1987 SC 1086 at p 1089.

[9] Shanthakumar, note 7.

[10] Mehdi, Ali(2007),Water Pollution Laws and Their enforcement in India,Kolkata: R. Cambray & Co. Private Ltd., p.168.

The application of the principles/doctrines evolved by the Supreme Court to the phenomenon of global warming is appropriate for three reasons: the United Nations General Assembly has recognized that climate change is "a common concern of mankind"[11] and that the global climate must be protected for present and future generations of human kind;[12]environmental concerns have heretofore been treated primarily as raising issues of national sovereignty in appropriating natural resources and controlling transfrontier pollution. To protect effectively the global atmosphere, standards of "good neighbourliness" must transcend notions of global proximity (spatial dimension) and of obligations owed merely notions of global states or areas beyond national jurisdiction (temporal dimension). A global solution is required, based on legal principles which transcend traditional international legal notions of national sovereignty and the spatial dimensions upon which these notions are based; global warming satisfies all the criteria in application of these principles/doctrines namely- seriousness and urgency of the problem, potential for irreversible damage, need for new ways of thinking about the issues, possibility for developing acceptable measures of accountability, degree to which the problem serves as a useful prototype for analysis that occur in other contexts.[13]

Principle Of Absolute Liability[14]

The rule of strict liability[15] replaced with the absolute liability in Indian system. The Strict liability rule holds a person strictly liable when he brings or accumulates on his land something likely to cause harm if it escapes, and damage arises as a natural consequence of its escape. The strict liability principle was applied with certain exceptions which considerably reduced the scope of its operations. Exceptions are; act of God, act of third party, plaintiff's own fault, plaintiff's consent, statutory authority. With the expansion of chemical based industries in India, increasing number of enterprises store and use hazardous substances.[16] For the harm caused by in hazardous and inherently dangerous activities a new doctrine of absolute liability is formulated which is free from the exceptions to the strict liability rule [17] and with a standard stricter than strict liability. The absolute liability was first articulated by the Supreme Court and has since been adopted by Parliament i.e. this principle has got statutory status with

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[11] UNGA Res. 43/53 of 6 December 1988. And also see Redgwell, Catherine(1991), International Equity and Global Warming, in Churchill, Robin(eds.), International Law and Global Climate Change, London: Graham and Trotman Ltd, pp. 240 -242.

[12] UNGA Res. 44/207 of 22 December 1989. And also see ibid, pp. 245-248.

[13] Weiss, Edith Brown (1989), In Fairness to Future Generations: International Law, Common Patrimony and Intergenerational Equity, Tokyo: United Nations University Press, p. 168.

[14] We can say it as an improved version of Strict liability followed with certain exceptions: Plaintiff's Own Default, Act of God, Natural use of land, Consent of the Plaintiff, Act of Stranger, Statutory Authority, Common benefit.

[15] The principle of strict liability evolved in England in 1868 which is older than a century in Rylands v. Fletcher(1868) LR 3 (HL) 330.

[16] Divan Shyam , Rosencranz Armin(2002), Environmental Law and Policy in India, New Delhi:Oxford University Press, p. 105.

[17] Leelakrishnan, P(2005), Environmental Law in India, New Delhi:Lexis Nexis, Butterworths, p.228.

Hazardous Substances Rules 1989, Public Liability Insurance Act 1991, and National Environment Tribunal Act 1995.[18]

This Principle as propounded by the Supreme Court in Shriram Food and Fertilizer Industries and another v. Union of India and others[19](M.C. Mehta v. Union of India) in determining the liability of large enterprises engaged in manufacture and sale of hazardous products.[20] The Supreme Court directed to relocate in order to restart the industry some other place, with fulfilling certain conditions with new principle of absolute liability in respect of hazardous or inherently dangerous industry. Later the Supreme Court reiterated this principle in many cases. In Indian Council for Enviro Legal Action v. Union of India[21] case, the Supreme Court held that "the Industries are absolutely responsible not only for the remedial action of safely disposing of the sludge, but also for the loss and sufferings sustained by the villages."

Precautionary Principle

This principle underlines the idea that prevention is better than cure and suggests a technique different from the traditional reactive methods The "precautionary Principle" is more a policy than a law, which should be applied by the Government as well as the industries at the time of consent and proposal to establish the plants respectively. The principle obligates that the precautionary measures should be integrated into the development plan. The industry must earmark some capital for the purpose of installation of treatment devices at the time of establishment of the plant.[22]Before the precautionary principle there was concept at international level 'assimilative capacity'[23], it was permitted to pollute to a

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[18] Public Liability Insurance Act 1991: The Parliament of India enacted this Act with the object to provide immediate relief to the persons affected by accident occurring while handling any hazardous substance. This Act provides relief to the claimant without pleading that death or injury was cased due to negligence of the owner. Under this Act, it is mandatory on the part of the owner to buy insurance policies to protect his employees and also liable to the surrounding residents and their property.
National Environment Tribunal Act 1995: The Parliament of India enacted this Act with few important objects: to provide for strict liability for damages arising out of any accident occurring while handling any hazardous substances along with effective and expeditious disposal such of cases, and to implement the decision taken at the Rio conference 1992 by developing national laws regarding liability and compensation for the victims of pollution and other environmental damages.[18]

[19] AIR 1987 SC 965.

[20] Shriram Foods and Fertilizer Industries, was situated in a single complex in Delhi, in a thickly polluted area. It had several units engaged in the manufacture of caustic soda, chlorine, hydrochloric acid, stable bleaching powder, superphosphate, Vanaspati, soap, sulphuric acid, aluminium anyhrons, sodium sulphate, high test hydrochloride and active earth etc. There was a major leakage of oluem gas on December 4, 1985 and affected a large number of persons, both workmen and public with one death. Again within two days one minor leakage also took place.

[21] AIR 1996 SC 1466.

[22] Mehdi, note 10, p. 191.

[23] Principle 6, The Stockholm Declaration, 1972 and also see Singh, C.P (2010), "The Precautionary Principle and Environment Protection", in Special Issue on Climate Change and Environmental, Journal of the Indian Law Institute, 52: 467-483, p.472.

certain limit, law will be enforceable when the limit is crossed. According this principle, enforcement was delaying as enquiry/investigation of concentration and boundaries of pollution were postponing it to do so. Hence, the 'precautionary principle' was replaced with 'assimilative capacity'.[24]

The precautionary principle implies, that even where there is no scientific evidence available to support a particular theory, precaution should be taken.[25]The precautionary principle has been invoked to justify a policy of aggressive greenhouse gas (GHG) emission controls that would go beyond "no regrets" actions to reduce global warming. However, this justification is based upon selectively applying the principle to the potential public health and environmental consequences of global warming but not to the adverse consequences of such a policy.[26] In Vellore Citizens Welfare Forum v. Union of India[27]case, the Supreme Court has declared the 'precautionary principle' is an essential feature of sustainable development relying on the Principle 15 of Rio Declaration which proclaims that "in order to protect the environment the precautionary approach shall be widely applied by States according to their capabilities and it is accepted as part of the law of the land. Where there are threats of serious or irreversible damage, effective measures to prevent environmental degradation" and developments from Stockholm Declaration to Rio Declaration the document prepared jointly by the World Conservation Union, United Nations Environment Programme and World Wide Fund for Nature called, "Caring for the Earth, 1991.The Court also suggested that where there is an identifiable risk of serious and irreversible harm like extinction of species, wide spread toxic pollution, major threats to essential ecological processes, it may be appropriate to place the burden of proof on the person or entity proposing the activity that is potentially harmful to the environment. The Court considered that Precautionary principle is one of the essential features of the sustainable development.[28]

The Court succeeded in bringing the principle under the purview of Article 21, 48A, and 51A (g) of the Constitution and the environmental laws. Therefore, the Court directed to appoint an authority to

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[24] Principle 11, UN General Assembly Resolution on World Charter on Nature, 1982, and Principle 15 of Rio Declaration 1992 emphasis to shift from „assimilative principle to precautionary principle".
[25]Dube, note 3, p.63.
[27]Indur M. Goklany, "Applying the Precautionary Principle to Global Warming" Weidenbaum Center Working Paper No. PS 158 November 2000 available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=250380
[27] It was case related to industrial pollution caused by large number of tanneries discharging untreated trade effluents in the agricultural fields, open lands and water ways. AIR 1996 SC 2715 at 2721.
[28]According to the Court, in the context of municipal law, the principle includes three things: environmental measures, to be taken by the State or other authorities, must be such that it „anticipate, prevent and attack the causes of environmental degradation"; where there are threats of serious and irreversible damage then any lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation; the onus of proof shall be on the actor or the developer/industrialist to show that his action is environment benign.

implement this principle under section 3 (3)[29] of the Environment (Protection) Act, 1986.The principle makes state to take immediate action as it cannot delay the matters on the ground of scientific precision and as the burden of proof lies on the polluters such incidents could be minimized.

The principle directly applied in M.C. Mehta v. Union of India[30] case, for protecting the Taj Mahal from air pollution. The Court held that the industries, identified as potential polluters by the PCB, had to change over to natural gas as an industrial fuel and those who were not in a position to obtain gas connections should stop function in Taj Trapezium Zone (TTZ). The Court observed that the atmospheric pollution in TTZ has to be eliminated at any cost and not even 1% change can be taken when human life apart from the preservation of a prestigious monument.

Again the principle applied directly in A.P. Pollution Control Board v. M.V. Nayudu[31]case, the Supreme Court directly applied the principle stating that "it involves the anticipation of environmental harm and taking measures to avoid it or to choose the least environmentally harmful activity, wherever scientific uncertainty is there. Environmental protection should not only aim at protecting health, property and economic interest but also to protect the environment. Precautionary duties must not be triggered by the suspicion of concrete danger but also by concern or risk potential." Principles11 and 15 of the Rio Declaration embody the position that in the protection of environment from pollution, a precautionary approach was best suited and it should be widely applied so that uncertainty in scientific results would not deter action to prevent environment from further degradation. It conveys 'act now and soon' irrespective of some error. Thus the concept of precision in justice is not rigidly adhered to under this principle. This is what the Supreme Court did in Bhopal Mass Disaster.[32]Prof. Charmian Barto suggests regarding this principle that an immediate action may be taken with some error which could be corrected at the time of informed decision taken with additional available data or further research.[33]

Legal provision also brought by the MOEF, introducing EIA, in order to give effect to the principle. Another important factor in precautionary principle is that the "burden of proof" lies on the industrialist to show that ecological balance is maintained. It is said by the Supreme Court in Narmada Bachao

[29] According to this section 3 (3) the Central Government may, if it considers it necessary or expedient so to do for the purpose of this Act, by order, published in the Official Gazette, constitute an authority or authorities by such name or names as may be specified in the order for the purpose of exercising and performing such of the powers and functions of this Act.
[30] AIR 1997 SC 734.
[31] AIR 1999 Sc 912.
[32] Union Carbide v. Union of India, AIR 1992 SC 248 at 262 and also see Jariwala, note 1, p. 183.
[33] Barto, Charmian (2000), "The Status of the Precautionary Principle in Australia", Harvard Environment Law Review , 22: 509-542,p. 547.

Andolan v.Union of India[34].However, this principle criticized from US industry and trade interests that it is not based on science and raises unfounded fears based on tentative evidence and it can be applied only to major threats of harm involving large uncertainties and does not apply to small or known risks. [35] But it never prevents environmentalists to approach the court for environmental justice.

Polluter's Pay Principle

The principle basically means that the producer of goods or other items should be responsible for pollution caused in the process of production and they should bear the cost of the damages done due to such pollution. This includes environmental costs and direct costs to the people or property.[36] The polluter pays principle has been invoked as the guiding force behind the public policy remedies to the problem. For example, tradable permits to curb greenhouse gases were advocated as a practical application of the Polluter Pays Principle by Mandate for Change.[37] That the polluter must pay for the damage caused by him is a salutary principle evolved very early in Europe when that continent was haunted by a new specter- that of unprecedented pollution.[38] Development activities of a country have to face the serious problems of giving adequate compensation to the victims of pollution and environmental hazards.[39] When prevention of pollution is found as a waste talk and inefficiency in industrial activities, it was necessary to device different kinds of measures to prevent and minimize industrial pollution.

The principle is originated in this attempt as an economic and administrative measure to restrain and control the pollution problem under the Organization for Economic Cooperation and Development (OECD) as its brainchild. During the time there were demands on Governments and other institutions to introduce policies and mechanisms for protection of the environment and public from the threat posed by pollution in a modern industrialized society. This is, however, only a principle and its exact scope, especially over the limits on payment for damages caused has not been satisfactorily agreed even in the European community or British environmental legislation.[40] Despite the difficulties inherent in defining

[34](2000) 10 SCC 664.
[35] Singh, C.P (2010), "The Precautionary Principle and Environment Protection", in Special Issue on Climate Change and Environmental, Journal of the Indian Law Institute, 52: 467-483, pp.481, 482.
[36] Mehdi, note 10, p.188.
[37] which was widely seen as the policy guide for Mr. Clinton during his 1992 campaign and indeed, in signing the Kyoto Protocol, the Clinton Administration endorsed the use of a tradable permits program. (The United Nation‟s agreement known as the Kyoto Protocol, if ratified by the Senate, would commit the United States to drastic reductions in CO2emissions.) Robert, Stavins and Thomas Grumbley(1993), "The Greening of the Market: Making the Polluter Pay," in Mandate for Change ,Washington, D.C.: The Progressive Policy Institute , pp. 203-206.
[38] Leelakrishnan, note 2, p. 354.
[39] Ibid.
[40] Ball, Simon and Bell, Stuart (1996), Environmental Law and Policy relating to the protection of the environment, London: Black Press Ltd. p. 98.

the principle, the European community accepted it as a fundamental part of its strategy on environmental matters by underlying principles of the Four Community Action Programmes on the Environment.[41] Principle 16 of the Rio Declaration also lays down that national authorities should endeavour to promote the internationalization of environmental cost and use of economic instruments, taking into the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.[42] Today it has been recognized as a powerful legal tool to combat environmental pollution and associated problems.

However, it is introduced to the Indian environmental law through the Supreme Court only, in the case of Indian Council for Enviro-legal Action v. Union of India[43] , the Court said that for whatever the damage or loss happened by the hazardous substances of an industry, it is responsible to make good the loss caused. The Court observed that Sections 3 and 5 of the Environment Protection Act empowered the Central Government to give directions and take measures for giving effect to this principle. Further in M.C. Mehta v. Kamal Nath[44] case, the Court said that the polluter is responsible for compensating and repairing the damage caused by his act. Despite its deterrent impact on potential polluters, the doctrine is limited in the sense that it can be applied as remedial stage, after pollution has taken place.

In Deepak Nitrite Limited v. State of Gujarat[45] case, the Supreme Court again made it clear that the compensation should have broad correlation with the harm caused by the polluting industry. It means the word 'compensation' is equivalent to what was lost. In Vellore Citizen's Welfare Forum v. Union of India case, the Supreme Court had declared that the polluter pays principle is an essential feature of sustainable development. It means that absolute liability for harm to the environment extents not only to compensate the victims of pollution but also the cost of restoring the environmental degradation. As customary International law has been accepted as part of the law of the land, polluter pays principle has become part of the law of the land. Hence, the court directed the Central government to constitute an authority, and accordingly 'Loss of Ecology Authority' was constituted to assess the damage caused by the tanneries. Whatever the fine collected from the tanneries had to be deposited under a separate head called “Environment Protection Fund” to utilize for the compensation purpose.

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[41] Article 130 (2) sets out: preventive action is to be preferred to remedial measures; environmental damage should be rectified at source; the polluter should pay for the cost of the measures taken to protect the environment; environmental policies should form a component of the EC's other policies. See Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, OFFICIAL JOURNAL NO. L 073 , 14/03/1997 P. 0005.
[42] Mehdi, note 10, p.189.
[43] AIR 1996 SC 1446
[44] (1997) 1 SCC 388.p.415.
[45] (2004) 6 SCC 402

In Ramji Patel v, Upbhokta Marg Darshak Manch[46] case, the Supreme Court held that awarding damages is in consonance wit the "Polluter Pays Principle" i.e. the polluter is under an obligation to make good the damage caused to the environment.

Apart from the judiciary, the Parliament enacted the Public Liability Insurance Act, 1991, under which all industries having a capital value of rupees two lakhs to get insured is mandatory and the National Environment Tribunal Act, 1995 enacted incorporates this principle.

Public Trust Doctrine

The Public Trust Doctrine was originally espoused by Emperor Justinian, during the Roman Empire.[47] It provided that 'certain common properties such as rivers, seashore, forests and the air were held by government in trusteeship for the free and unimpeded use of the general public. This is formed the basis for the English Common law Public Trust Doctrine. Under the English Law, the sovereign could own these resources but the ownership was limited in nature, the Crown could not grant these properties to private owners if the effect was to interfere with the public interests in navigation or fishing. Resources that were suitable for these uses were deemed to be held in trust by the Crown for the benefit of the public".[48]

As English Common Law extended this doctrine only to certain traditional uses such as navigation, commerce, and fishing, American Courts expanded the concept adopting the reasoning that protection of ecological values is among the purposes of public trust, may give rise to an argument that the ecology and environment protection is a relevant factor.[49] In Indian legal system this doctrine forms the crux on which Article 47 of the Constitution is based. In fact, the objectives enshrined in the Preamble and DPSP impose an obligation on the state as well as its citizens to preserve the environment and its use for the maximum benefit of people. Section 2 of the Forest (Conservation) Act, 1980 reflects the Public Trust Doctrine. And also as Indian legal system is essentially based on English Common Law includes this doctrine as part of its jurisprudence.

However, it is apt to quote the prophetic words of V. R. Krishna Iyer, judges are the trustees of the human estate, the world's great heritage' enunciated the Public Trust Doctrine implicitly through a plethora of cases.[50] According to Professor Joseph L Sax[51], there are certain restrictions on such

[46] (2000) 3 SCC 29.
[47] Sahasranaman, P.B(2009), Handbook of Environmental Law, New Delhi: Oxford University Press, , p.34.
[48] Shanthakumar, note 7, pp. 108, 109.
[49] See National Audubon Society v. Superior Court of Alpine County 33 CAL 3d 419., (1997) 1 SCC 388, p. 412., and Philips Petroleum Co. v. Mississippi 108 S ct 791 (1988).
[50] Sahasranaman, note 47, p.35.
[51] Shanthakumar, note 7, p. 109.

properties that the court identifies: the property subject to the trust must not only be used for a public purpose, but it must be available for use by the general public; the property may not be sold, even for a fair cash equivalent; the property must be maintained for particular types of uses.[52] Recognition of the public trust doctrine for the protection of natural resources is another judicial innovation. Even though, Indian court has not considered the protection of public trust resources for their favorable impacts on climate is a protected public use, the Supreme Court has manifested a clear concern for the ecological value of public trust resources, including forests[53], as well as a general willingness to expand the universe of protected public uses far beyond its traditional bounds.

In M.C. Mehta v. Kamal Nath[54] casea wide interpretation of the doctrine was adopted in protecting a valuable river and forest area from private tourist enterprise.[55] In this case the apex court approved this doctrine for the first time stating that the area being ecologically fragile should not have been permitted to convert into private ownership for commercial gains. In this case Justice Kuldip Singh has exhaustively gathered information on this Public Trust Doctrine from various juristic writings and decisions of the American Courts. Again in M.I. Builders Pvt. Ltd. V. Radhey Shyam Sahu and others[56] case, the Court reiterated the doctrine by stating that the proposed construction of an underground shopping centre below a park was in violation of the doctrine. The court held that the municipality of Mahapalika held the park on trust for the citizens of Lucknow and it could only manage the park and could not alienate it or convert it into something different from the park. Further in K.M. Chinnappa v. Union of India [57]case, The Supreme Court held that "the aesthetic use and the pristine glory cannot be permitted to be eroded for private, commercial or any other use unless the Courts find it necessary, in good faith, for public good and in public interest to encroach upon the said resources". In this was

[52]Sahasranaman, note 47, p. 37.
[53] The ecological value of forests as carbon dioxide ("CO2") sinks has been thrown into sharp relief by the mergence of anthropogenic climate change as a serious threat to the stability of ecosystems and the human societies that depend on them worldwide. A CO2 sink is any process, activity, or mechanism that removes CO2 from the atmosphere. Barresi, Paul A (2012), " Mobilizing the Public Trust Doctrine in Support of Publicly Owned Forests as Carbon Dioxide Sinks in India and the United States", Colorado Journal of International Environmental Law and Policy, 23: 41-74. And also See Annex II: Glossary (Alfons P. M. Baede, Paul van der Linden & Aviel Verbruggen, eds.) to INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT. CONTRIBUTIONS OF WORKING GROUPS I, II AND III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 76, 86 (Core Writing Team, R. K. Pachauri & A. Reisinger, eds., 2007), available at http://www.ipcc.ch/pdf /assessment- report/ar4/syr/ar4_syr_appendix.pdf (defining "sink" in the context of greenhouse gases and aerosols).
[54] (1997) 1 SCC 388.
[55] In this case the Minister for Environment and Forests, Kamal Nath, approved the project during his tenure but when the project commenced he ceased to hold this position. And he acknowledged that his family held a business interest but denied any management responsibility of the said company and denied any right, title or interest in the property.
[56] AIR 1999 SC 2468.
[57] Air 2003 Sc 724 (736).

brought before the court challenging the renewal of mining lease granted to Kudremukh iron Ore Company in the Kudremukh National park.

In India, the Supreme Court and High Courts, more implicitly have given effect to this doctrine than the explicit with the traditional protection access to the common for public benefit. However now the doctrine is being applied even to prevent over exploitation of the environment. It is being used as a legal and planning tool for the fulfillment of sovereign's role as Trustee of environment for future generations.[58] It is interesting to note that in MP Ramababu v. District Forest Officer[59] case the Andhra Pradesh High Court observed that deep underground soil and water belong to the state, so any person uses his land in such a manner as to pollute the underground water or soil, the state can interfere and prevent contamination even in the absence of a specific law, under this doctrine.

Doctrine Of Sustainable Development

Like no other environmental issue, global warming threatens the well being of both developed and developing countries. While global warming is conspicuous by its near exclusion in the preparations for the World Summit on Sustainable Development (WSSD), energy an issue intimately linked to global warming is prominent on the WSSD agenda, and it needs to be addressed with global warming in mind.[60] According to J. Kuldip Singh "Sustainable Development" is a balancing concept between ecology and development.[61] And further he views that "Precautionary Principle" and "Polluter Pays Principle" are essential features of "sustainable development". He says "polluter Pays principle means that the absolute liability for harm to the environment extends not only to compensate the victim of the pollution and the cost of restoring environmental degradation. It is a right approach to development at the cost of environment without regard for its restoration is not going to last forever.[62] For more detail about this doctrine see the chapter II. However related cases are discussed in this heading.

In Rural Litigation and Entitlement Kendra v. State of U.P.[63] interestingly it was the first case in India involving issues relating to environment and development. The Court said that tapping of resources have to be done with the requisite attention and care so that ecology and environment may not be affected in any serious way, there may not be depletion of water resources and long term planning must be undertaken to keep up the national wealth. Further in M.C. Mehta v. Union of India[64] case, the

[58] Shanthakumar, note 7, p. 110.
[59] AIR 2002 AP 256.
[60] see to detail A Center for International Environmental Law Issue Brief For the World Summit on Sustainable Development 26 August - 4 September 2002 available at http://www.ciel.org/ Publications/climate.pdf
[61] Vellore Citizens Welfare Forum v. Union of India, AIR 1996 SC 2715 p. 2720.
[62] For details see chapter II
[63] AIR 1985 Sc 652.
[64] AIR 1987 SC 965.

Supreme Court said that wherever certain element of hazard or risk inherent in the very use of science and technology and it is not possible to totally eliminate such hazard or risk altogether, then can only hope to reduce the element of hazard or risk to the community by taking all necessary steps for locating such industries in a manner, which would pose least risk of danger to the community and maximizing safety requirements.

Again, in Indian Council for Enviro-Legal Action v. Union of India[65] case, the Supreme Court emphasized the doctrine as "While economic development should not be allowed to take place at the cost of ecology or by causing wide spread environmental destruction and violation; at the same time, the necessity to preserve ecology and environment should not hamper economic and other developments. Both development and environment must go hand in hand, in other words, there should not be development at the cost of environment and vice –versa, but there should be development while taking due care and ensuring the protection of environment." New dimension to the sustainable development by the Supreme Court observation in Vellore Citizens Welfare Forum v. Union of India[66] case, that sustainable development has come to be accepted as a viable concept to eradicate poverty and improve the quality of human life while living within the carrying capacity of the supporting eco-system. Hence, the court strikes the balance between development activities and protection of environment.

Subsequently in Goa Foundation v. Daksha Holdings Pvt. Ltd.[67] Case, the court held that "no activities which would ultimately lead to unscientific and unsustainable development and ecological destruction should at all be allowed and the courts must scrupulously try to protect the ecology and environment".It was reaffirmed again in State of Himachal Pradesh v. Ganesh Wood Products[68] that the obligation of sustainable development requires a proper assessment of the forest wealth, and the entitlement of industries based on forest produce should not only be restricted accordingly but their working should also be monitored closely to ensure that the required balance is not disturbed. Further forest based industries do not have an absolute or unrestricted right to operate their units where forest resources are scarce.

Later in M.C. Mehta v. Union of India[69]case, the Supreme Court emphasized the significance of the principle of sustainable development and held that sustainable development is one of the principles

[65] (1996) 5 SCC 281.
[66] (1996) 5 SCC 647.
[67] AIR 2001 SC 184.
[68] AIR 1996 SC pp.149, 163 and also see UP Kathha Factories' Association v. State of UP 1996 (2) SCC 97, T.N. Godavarman Thirumulkpad v. Union of India AIR 1998 SC pp.769, 772 and also Samatha v. State of Andhra Pradesh AIR 1997 SC 3297 p. 3347.
[69] (2002) 4 SCC 356.

underlying environmental law and that precautionary principle and polluter pays principle are two essential features of sustainable development. In the court's view, far greater tragedies than those of Bhopal gas leak lie dormant in the governmental neglect over CNG. The continuing air pollution does have a more devastating effect on the people and present oil companies who present international desirable standards produce low quality petrol and diesel at the cost of public health.

In K.M. Chinnappa v. Union of India[70] case, the Supreme Court observed that "it cannot be disputed that no development is possible without some adverse effect on the ecology and environment, and the projects of public utility cannot be abandoned and it is necessary to adjust the interest of the people as well as the necessity to maintain the environment. The balance has to be struck between the two interests. Where the commercial venture or enterprise would bring in results, which are far more useful for the people, difficulty of a small number of people has to be by passed. The comparative hardships have to be balanced and the convenience and benefit to a larger section of the people has to get primacy over comparatively lesser hardship.

In situations of this kind there are certain restrictions on such properties such as the property subject to the trust must not only be used for a public purpose, but it must be available for use by the general public; the property may not be sold, even for a fair cash equivalent; the property must be maintained for particular use.[71]

Inter-Generational Equity

The inter-generational equity aims at preserving the nature and its systems for not only the present generation but also the future generations in the same quality. Every generation owes a duty to all succeeding generations to develop and conserve the natural resources of the nation in the best possible way. More pressure on the present generation to take minimum but contribute maximum to the environment and to the other way leaving degraded environment for the coming generation.[72] Because all man's progress in civilized world is being made at the expense of damage to the environment, which he cannot repair and cannot foresee.[73]

We can remember here that Principles 1, 2, and 6 of the Stockholm Declaration. Principle 1 says about solemn responsibility of men to protect and improve the environment for the present and future generations and Principle 2 about planning and management aspect which says that the natural

[70] AIR 2003 SC 724.
[71] Sahasranaman, note 47 , p. 37.
[72] Shanthakumar, note 7, p.113.
[73] Jariwala,note 1, p. 186.

resources of the earth must be safeguarded for the benefit of present and future generations through careful planning and management, as may be appropriate. Principle 6 specifically refers to the obligation to halt the discharge of toxic and other substances in excess of the capacity of the environment to render them harmless, "to ensure that serious or irreversible damage is not inflicted upon ecosystems". Applying intergenerational equity the, global warming evidences all three types of intergenerational equity problem which may arise in the use of planetary resources: depletion of resources for future generations; degradation in the quality of resources available for future generations; and reduced or barred access to the use and benefit of resources passed on from previous generations.[74] The obligation resting on this generation is to leave the atmosphere in no worse condition than it received it, and to improve it if degraded, which requires strategies to minimize input of CO_2 into the atmosphere and focus on alternatives to fossil fuels and prevention of deforestation.[75] This principle is emphasized in State of Tamil Nadu v. Hind Stone[76] case, where in the Supreme Court opined that "every generation should leave water, air and soil resources as pure and unpolluted as and when it came to earth. Each generation should leave undiminished all the species of minerals it found existing on earth."In K.M. Chinnappa v. Union of India$_{77}$ case, the Supreme Court held that while thinking of the developmental measures the needs of the present and the ability of the future to meet its own needs and requirements have to be kept in view.

Judiciary does not lean always towards the environment protection even it balanced conflicting values for many times with giving directions for disciplining the developmental processes, keeping in view the demands of ecological security and integrity. Again judiciary most of the time tried to fill the gaps in law[78] and lacunae in administration[79].Further the apex Court imposed monitoring of the anti-pollution

[74] Weiss, Edith Brown (1989), In Fairness to Future Generations: International Law, Common Patrimony and Intergenerational Equity, Tokyo: United Nations University Press, pp. 245-289.and also see McCaffrey, Stephen(2009), Global issues in Environmental Law, American Casebook Series, West Thomas Reuters Business, pp.21-23 wherein the author opined that Professor Edith Brown Weiss outline the contours of intergenerational equity with three significant components: conservation of options(each generation should be required to conserve the diversity of the natural and cultural resource base), conservation of quality(each generation should be required to maintain the quality of the planet), and conservation of access(each generation should provide its members with equitable rights of access to the legacy from past generations).

[75] Redgwell, note 12, p.54.

[76] AIR 1981 SC 711.

[77] AIR 2003 SC 724 (737).

[78] Through issuing direction to fill yawning gaps in existing law see CERC v. Union of India AIR 1995 SC 922, Samatha v. State of A.P. AIR 1997 SC 3297.

[79] See reminding statutory responsibility of the authorities see LK Koolwal v. State AIR 1988 Raj, 2, BL Wadehra v. Union of India (1996) 2 SCC 594, Municipal Council, Ratlam v. Vardhichand AIR 1980 SC 1622, M.C. Mehta v.
Union of India (1996) 4 SCC 750, Vellore Citizens Welfare Forum v. Union of India AIR 1996 SC 2715, The Supreme court requested the Chief Justice of High Courts of Madras, Bombay and Calcutta to constitute a "Green Bench" for the purpose of adjudicating public interest environment cases.

laws responsibility on the high courts.[80] However, the inherent limitations of the judicial system to review substantive questions relating to the environment make it desirable to establish an alternative forum, with an alternative strategy. Conferring environmental decision making power entirely on scientists and administrators is untenable in a rule of law society. Perhaps the observation made by Mc Auslan is more apt when he said that "fusion of diverse expertise in planning, science, technology, environment, law and public policy into a new institution for environmental decision making is essential for integrating environmental values with developmental issues."[81]

National Green Tribunal Act, 2010

The court's ability to handle complex issues has always been a matter of debate. This has led to demand of an alternative environment dispute resolution mechanism. [82] The need for environmental court was first advocated by former P.N. Bhagawati J inM.C. Mehta v. Union of India (Oleum Gas Leak Case)[83] that the cases involving issues of environmental pollution, ecological destruction and its conflicts over natural resources involved assessment and evolution of scientific data and, therefore, there was an urgent need of involvement of experts in the administration of justice. This view was supported by Jagannadha Rao J in Indian Council for Enviro-Legal Action v. Union of India[84]. Later in the year 2001, the apex court requested the Law Commission of India to examine this matter.[85]

Accordingly, the Law Commission, in its 186 the Report 2003 recommended, inter alia, setting up of environmental courts having original and appellate jurisdiction related to environmental laws. The Ministry of Environment and Forests set up the National Environment Appellate Authority under the National Environment Appellate Authority Act, 1997 to review the administrative decisions on Environment Impact Assessment, but remain in paper as no judicial member was appointed. In addition to it, the National Environment Tribunal Act was not notified both remain only paper.

Now, by repealing the above stated enactments, the National Green Tribunal has been established on 18th October 2010 under the National Green Tribunal Act 2010 for effective and expeditious disposal

[80] Anti pollution laws have been passed by the Parliament in order to provide for a clean and healthy environmental regime and these Acts impose obligation on authorities i.e. Central Pollution Control Board and State Pollution Control Boards to take effective steps for proper preservation of natural resources and abatement of pollution. See Indian Council for Environ-legal Action v. Union of India, (1996)5 SCC 281, p. 301, Vellore Citizens Welfare Forum v. Union of India, AIR 1986 Sc 2715, p.2727.

[81] McAuslan, P(1991), "The Role Of Courts and Other Judicial Type Bodies In Environmental Management', Journal of Environmental Law, 3: 195-208,p.206.

[82] Mishra, Vinod Shankar, (2010), "National Green Tribunal: Alternative Environment Dispute Resolution Mechanism", in Special Issue on Climate Change and Environmental, Journal of the Indian Law Institute, 52:522- 552, p.523.

[83] AIR 1987 SC 965.982.

[84] (1996) 2 SCC 212, 252.

[85] A.P. Pollution Control Board v. M.V. Nayudu II, 2001 (2) SCC 62.

of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto. It is a specialized body equipped with the necessary expertise to handle environmental disputes involving multi-disciplinary issues. The Tribunal shall not be bound by the procedure laid down under the Code of Civil Procedure, 1908, but shall be guided by principles of natural justice.

The Tribunal has exclusive jurisdiction for environmental matters to provide speedy justice and reduce the burden of the higher courts. The Tribunal has to dispose the applications or appeals within 6 months of filing of the same. The NGT is set up at five places of sittings and New Delhi is the principal place of sitting of the Tribunal. Bhopal, Pune, Kolkata and Chennai are the four other places of sitting of the Tribunal.[86]

[86] For further reading see National Green Tribunal, available at http://www.greentribunal.in/

Environmental Challenges In Urban India- An Analysis

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ABSTRACT

Probably most of the environmental problems of the next century will result from the continuation and sharpening of existing problems that currently do not receive enough political attention. The problems are not necessarily noticed in many countries or then nothing is done even the situation has been detected. Urbanization is closely linked to modernization, industrialization, and the sociological process of rationalization. Urbanization is not merely a modern phenomenon, but a rapid and historic transformation of human social roots on a global scale, whereby predominantly rural culture is being rapidly replaced urban culture. Growth of Industries especially service sector had contributed to the growth of cities. As a result of industrialization people have started moving towards the industrial areas in search of employment. This has resulted in the growth of towns and cities from tier 1 to tier 3 leading to occupy areas like dried tanks, lakes and other places. Cities in developing countries become over-populated and over-crowded partly as a result of the increase in population over the decades and partly as a result of migration. Due to uncontrolled urbanization in India, environmental degradation has been occurring very rapidly and causing many problems like land insecurity, worsening water quality, excessive air pollution, noise pollution, the problems of waste disposal, Global warming, climate change, deforestration etc. Although it is impossible to restrict urbanization it has to be ensured that urbanization proceeds in the right path causing minimum impact on environment. The available remedies in the form of polluter pay principle under the Constitution[1] cannot be considered as an alternative. This paper focus on the remedies available to regulate environmental challenges arise out of urbanization. This paper seeks to review the effects of fast growing urbanization in Indian society through analysis of its multi-dimensional impact and also suggest measures to reduce the impact of rapid urbanization on environment.

Key words: Urbanization; Industrialization; Environment; remedies; Polluter pay principle

Earth Provides Enough To Satisfy Every Man's Needs, But Not To Every Man's Greed

- Mahatma Gandhi.

Introduction

Urbanization is an index of transformation from traditional rural economies to modern industrial one. It is a progressive concentration of population in urban unit. In other words, urbanization is the physical growth of urban areas as a result of rural migration and it is closely linked to modernization,

[1] Article 21 of the Indian Constitution

industrialization, and the sociological process of rationalization. Urbanization in India was mainly caused after independence due to adoption of mixed system of economy by the country which gave rise to the development of private sector. After India becoming independent, a strong need for industrialization was felt not only for creating employment opportunities, but to increase Gross Domestic Product (GDP) as well. The Industrial Policy Resolution adopted in 1947 and in 1956 resulted in large scale industrialization and multipurpose river valley projects. Environment protection was a least priority in India's post- independence era due to need of industrialization and other political disturbances. The growth achieved by haphazard and reckless industrialization, created an ecological imbalance which resulted in no real economic growth because of environmental destruction. During the early years of Indian independence, there was no candid environmental policy and all the statutes were scattered and piecemeal. Two early post-independence laws were only related to water pollution. Some other acts such as the Factories Act, 1948 were introduced which also dealt with the effective arrangements for waste disposal.

Being the second most populous country in the world after China, India's growing urbanization has a regional as well as world-wide impact. After independence, India faced poverty, unemployment and economic backwardness. The first Prime Minister of India, Pandit Jawaharlal Nehru, focused on the domain of science and technology, for economic development. The mixed economy system was adopted, resulting in the growth of the Public sector in India. With private sector boom post LPG (Liberalization, Privatization and Globalization), urbanization process took a major leap. The contribution of the agricultural sector to the GDP of India started to decline and the percentage contribution from secondary sector increased. The period after 1941, witnessed rapid growth of four metropolitan cities in India, which were Kolkata, Delhi, Mumbai, and Chennai. The nation's economy saw a rise due to industrial revolution and the invention of new technologies increased the standard of living of people living in urban areas. The growth of public

sector resulted in development of public transport, roads, water supply, electricity, and hence the infrastructure of urban areas has reached tremendous height.

Causes Of Urbanisation In India:

The main causes of urbanization in India include: expansion in government services, migration of people from Pakistan after partition of India, the industrial revolution, infrastructure facilities in the urban areas, growth of private sector after 1990, eleventh and twelfth five year plans which aimed at urbanization for the economic development of India, mechanization of agriculture, employment opportunities, modernization, rural urban transformation, social infrastructure like hospitals,

educational institutions, etc. are some of the very important reasons for people moving towards cities. India has the potential to unlock many new growth markets in its cities. Many of these things are not traditionally associated with India, including infrastructure, transportation, healthcare, education, and recreation. Before LPG there were limited urbanization but after industrialization, urbanization is increasing fast with very good pace. At present in our country the city having population more than one lac is about 302, which were only 151 in 1971. India is among those countries where urbanization is very much faster. Observing these trends, analysts are expecting that many people will prefer to live in Indian cities by 2050.

Problems Relating To Urbanization:

Since in our country urbanization is unplanned due to uncontrolled migration. Due to unplanned urbanization, India is facing too much problem such as unemployment, inadequate supply of electricity, pollution, social problems, improper sanitation facilities etc. Rapid rise in urban population in India is leading to many problems like increasing slums, decrease in standard of living in urban areas, also causing environmental damage. India has around 300 million people in metro area. This has caused slum problems mainly. Due to a large unregulated influx of people from all over the India has caused very much crowded cities and forcing people to live in unsafe conditions which also includes illegal buildings. Public drinking water distribution, good roads and constant electricity are very much required. It is also adding the problem of all types of pollution. Urbanization also results in the disparity in the market, owing to the large demands of the growing population and the primary sector struggling to cope with them. City means industrialization, but due to unplanned industry several rivers were polluted. Many emerging cities of country are expanding without any plan, so there is no electricity, no security, and no transportation and so on.

Issues Associated With Urbanization:

There is increasing competition for facilities in urban areas, which results in several negative effects. Many people mainly farmers who move to cities in search of a better life and better occupational opportunities end up as casual labourers. This leads to menacing problems of urbanization – the growth of slums.

Slums are urban areas that are heavily populated with substandard housing and very poor living conditions. These resultin several problems.

- **Land insecurity –** Slums are usually located on land, not owned by the slum dwellers. They can be evicted at any time by the landowners.

- **Poor living conditions –** Crowding and lack of sanitation. This often contributes to outbreak of diseases. Utilities such as water, electricity and sewage disposal are also lacking in these areas.

- **Unemployment –** Since the number of people aspiring for jobs is more than jobs available, unemployment is a natural outcome of situation.

- **Crime –** Slum conditions make maintenance of law and order difficult. Patrolling of slums is often not on priority list of law enforcing officers. Unemployment and poverty force people to engage in anti-social activities. Slums therefore, often become a breeding ground for criminal activities.

Environmental Impact:

- **Temperature Increase-** Due to factors such as paving over formerly vegetated land, increasing number of residences and high-rise apartments and industries, temperature increase due to increased absoption of Sun's energy and production of more and more heat due to very intense human activity.

- **Air pollution-**Factories and automobiles are most visible symbols of urbanization. Due to emissions of harmful gases and smoke from factories and vehicles, air pollution results. High amount of suspended particulate matter in air, particularly in cities, which contributes to allergies and respiratory problems becoming a huge health hazard.

- **Changes in Natural Water Cycle –** When urbanization takes place, water cycle changes as cities have more precipitation than surrounding areas. Due to dumping of sewage from factories in water bodies, water pollution occur which often resulting in outbreaks of epidemics. Destruction of Natural Habitats of Flora and Fauna – In making of an urban area, a lot of forested areas are destroyed which otherwise would have been natural habitats to many birds and animals.

- We have extended the urbanisation to the sea also. This tendency is damaging the ocean ecosystem also.

India is witnessing an unprecedented rise in urbanization and cities like Delhi, Mumbai, Calcutta and Chennai are over-crowded with people. The urban population, however, is economically very important and contributes 50 to 55 percent to the total GNP. It also means that the hub of all modern activity is concentrated in major cities, which continuously attract migrant workers in search of their livelihood. However, unlike the big cities in rich countries, Indian cities are not able to take in more and

more people because of poor urban management and resource constraints. The people continuously confront problems of safe drinking water, power, and sewerage and garbage disposal. With rapid natural increase and inflow of rural population, cities are growing rapidly and there is an urgent need for better governance, transport and basic amenities for the growing population. Here it is worthwhile to point out that most people including many social scientists and journalists believe that rural to urban migration is the prime factor of urbanization. This myth has already been exploded by demographers. Studies have clearly established that natural increase has been the most potent factor behind rapid rise in urban population not only in India but also in most developing countries of the world.

Whatever development in the name of Urbanization that we have achieved till date is at the cost of environment. Due to improper implementation of existing laws and lackadaisical approach, the country had a poor track record on ecology maintenance necessitating Indian judiciary to step in. The Indian courts have created ground-breaking decisions for effective environmental compliance and enforcement of laws. The Supreme Court has used its extraordinary power under Article 142[2] of the Constitution to fill the gap in the existing environmental laws and legislate, whenever and wherever necessary. Indian judiciary have breathed life into the provisions of Articles 48-A[3] and 51-A(g)[4] by linking and enforcing environmental related issues to the constitutionally guaranteed right to life contained in Article 21[5]. Constitutional provisions were expansively and purposely interpreted and applied by which the concept of sustainable development is advanced for the protection of the rights and freedoms of future generations.

Judicial Remedies For Adverse Effect Of Urbanization:

The environment protection was a least priority in India's post-independence era due to need of industrialization and political disturbances. However, the Bhopal Gas tragedy[6] acted as an eye opener

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[2] Article 142. Enforcement of decrees and orders of Supreme Court and unless as to discovery, etc (1) The Supreme Court in the exercise of its jurisdiction may pass such decree or make such order as is necessary for doing complete justice in any cause or matter pending before it, and any decree so passed or orders so made shall be enforceable throughout the territory of India in such manner as may be prescribed by or under any law made by Parliament and, until provision in that behalf is so made, in such manner as the President may by order prescribe 2) Subject to the provisions of any law made in this behalf by Parliament, the Supreme Court shall, as respects the whole of the territory of India, have all and every power to make any order for the purpose of securing the attendance of any person, the discovery or production of any documents, or the investigation or punishment of any contempt of itself.

[3] Article 48-A. Protection and improvement of environment and safeguarding of forests and wildlife. " State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country".

[4] Article 51-A(g). Fundamental Duties. It shall be the duty of every citizen of India (g) to protect and improve the natural environment including forest, wildlife and to have compassion for living creatures.

[5] Article 21. Protection of Life and Personal Liberty: No person shall be deprived of his life or personal liberty except according to the procedure established by law.

[6] Union Carbide Corporation Vs. Union of India, 1989 SCC (2) 540.

and brought Environment protection at the Centre stage. After which, there was a widening of existing environmental laws in the country and increase in judicial activity. The Supreme Court and High Court have worked from case to case for making environment as a fundamental right and then extending its meaning to right for compensation, clean water and air. The closure of limestone quarries in U.P.[7], halting of polluting tanneries along the Ganges river, the introduction of the principle of Absolute Liability, polluter pays principle, precautionary principle, public trust doctrine for hazardous firms are some of the landmark decisions. In recent years, there has been a sustained focus on the role played by the higher judiciary in devising and monitoring the implementation of measures for pollution control, conservation of forests and wildlife protection. Many of these judicial interventions have been triggered by the persistent incoherence in policy-making as well as the lack of capacity-building amongst the executive agencies. Devices such as Public Interest Litigation (PIL) have been prominently relied upon to tackle environmental problems, and this approach has given positive results to a remarkable extent. The remedies available in India for environmental protection comprise of tortuous as well as statutory law remedies. The tortuous remedies available are trespass, nuisance, strict liability and negligence. The statutory remedies incorporates: Citizen's suit, e.g.,

- an activity brought under Section 19[8] of the Environmental (Protection) Act, 1986,
- an activity under Section 133, Criminal Procedure Code, 19739.and
- an activity under Section 133, Criminal Procedure Code, 1973[9].

[7]Rural Litigation Entitlement Kendra Vs. State of U.P., 1985 SCC (2) 431.

[8]Section 19 in The Environment (Protection) Act, 1986
Cognizance of offences. No court shall take cognizance of any offence under this Act except on a complaint made by (a) the Central Government or any authority or officer authorised in this behalf by that Government; or (b) Any person who has given notice of not less than sixty days, in the manner prescribed, of the alleged offence and of his intention to make a complaint, to the Central Government or the authority or officer authorised as aforesaid.

[9]Section 133 in The Code Of Criminal Procedure, 1973 133. Conditional order for removal of nuisance.
(1) Whenever a District Magistrate or a Sub- divisional Magistrate or any other Executive Magistrate specially empowered in this of behalf by the State Government, on receiving the report of a police officer or other information and on taking such evidence (if any) as he thinks fit, considers-
(a) that any unlawful obstruction or nuisance should be removed from any public place or from any way, river or channel which is or may be lawfully used by the public; or
(b) that the conduct of any trade or occupation, or the keeping of any goods or merchandise, is injurious to the health or physical comfort of the community, and that in consequence such trade or occupation should be prohibited or regulated or such goods or merchandise should be removed or the keeping thereof regulated; or
(c) that the construction of any building, or, the disposal of any substance, as is likely to occasion configuration or explosion, should be prevented or stopped; or
(d) that any building, tent or structure, or any tree is in such a condition that it is likely to fall and thereby cause injury to persons living or carrying on business in the neighborhood or passing by, and that in consequence the removal, repair or support of such building, tent or structure, or the removal or support of such tree, is necessary; or
(e) that any tank, well or excavation adjacent to any such way or public place should be fenced in such manner as to prevent danger arising to the public; or
(f) that any dangerous animal should be destroyed, confined or otherwise disposed of, such Magistrate may make a conditional order requiring the person causing such obstruction or nuisance, or carrying on such trade or occupation, or keeping any such goods or merchandise, or owning, possessing or controlling such building, tent, structure, substance, tank, well or excavation, or owning or possessing such animal or tree, within a time to be

- and activity brought under the Section 268[10] for open irritation, under Indian Penal Code,1860

Apart from this, a writ petition can be filed under Article 32[11] in the Supreme Court of India or under Article 226[12] in the High Court.

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[9] fixed in the order-
(i) to remove such obstruction or nuisance; or
(ii) to desist from carrying on, or to remove or regulate in such manner as may be directed, such trade or occupation, or to remove such goods or merchandise, or to regulate the keeping thereof in such manner as may be directed; or
(iii) to prevent or stop the construction of such building, or to alter the disposal of such substance; or
(iv) to remove, repair or support such building, tent or structure, or to remove or support such trees; or
(v) to fence such tank, well or excavation; or
(vi) to destroy, confine or dispose of such dangerous animal in the manner provided in the said order; or, if he objects so to do, to appear before himself or some other Executive Magistrate subordinate to him at a time and place to be fixed by the Order, and show cause, in the manner hereinafter provided, why the order should not be made absolute.
(2) No order duly made by a Magistrate under this section shall be called in question in any Civil Court. Explanation- A" public place" includes also property belonging to the State, camping grounds and grounds left unoccupied for sanitary or recreative purposes

[10] Section 268 in The Indian Penal Code
Public nuisance.—A person is guilty of a public nuisance who does any act or is guilty of an illegal omission which causes any common injury, danger or annoyance to the public or to the people in general who dwell or occupy property in the vicinity, or which must necessarily cause injury, obstruction, danger or annoyance to persons who may have occasion to use any public right. A common nuisance is not excused on the ground that it causes some convenience or advantage.

[11] Article 32. Remedies for enforcement of rights conferred by Part- III.
(1) The right to move the Supreme Court by appropriate proceedings for the enforcement of the rights conferred by this Part is guaranteed
(2) The Supreme Court shall have power to issue directions or orders or writs, including writs in the nature of habeas corpus, mandamus, prohibition, quo warranto and certiorari, whichever may be appropriate, for the enforcement of any of the rights conferred by this Part
(3) Without prejudice to the powers conferred on the Supreme Court by clause (1) and (2), Parliament may by law empower any other court to exercise within the local limits of its jurisdiction all or any of the powers exercisable by the Supreme Court under clause (2)
(4) The right guaranteed by this article shall not be suspended except as otherwise provided for by this Constitution.

[12] Article 226. Power of High Courts to issue certain writs
(1) Notwithstanding anything in Article 32 every High Court shall have powers, throughout the territories in relation to which it exercise jurisdiction, to issue to any person or authority, including in appropriate cases, any Government, within those territories directions, orders or writs, including writs in the nature of habeas corpus, mandamus, prohibitions, quo warranto and certiorari, or any of them, for the enforcement of any of the rights conferred by Part III and for any other purpose
(2) The power conferred by clause (1) to issue directions, orders or writs to any Government, authority or person may also be exercised by any High Court exercising jurisdiction in relation to the territories within which the cause of action, wholly or in part, arises for the exercise of such power, notwithstanding that the seat of such Government or authority or the residence of such person is not within those territories
(3) Where any party against whom an interim order, whether by way of injunction or stay or in any other manner, is made on, or in any proceedings relating to, a petition under clause (1), without
(a) furnishing to such party copies of such petition and all documents in support of the plea for such interim order; and
(b) giving such party an opportunity of being heard, makes an application to the High Court for the vacation of such order and furnishes a copy of such application to the party in whose favour such order has been made or the counsel of such party, the High Court shall dispose of the application within a period of two weeks from the date on which it is received or from the date on which the copy of such application is so furnished, whichever is later, or where the High Court is closed on the last day of that period, before the expiry of the next day afterwards on which the High Court is open; and if the application is not so disposed of, the interim order shall, on the expiry of that period, or, as the case may be, the expiry of the aid next day, stand vacated
(2)The power conferred on a High Court by this article shall not be in derogation of the power conferred on the Supreme court by clause (2) of Article 32.

Till 1980s not much contribution was made by the courts in preserving the environment, but one of the earliest cases which came to the Supreme Court of India formed the foundation of judicial response. In Ratlam Municipality Versus Vardhichand,[13] Justice Krishna Iyer highlighted the need for environmental consciousness and has elaborated the scope of the criminal law concept of public nuisance. In this case the Supreme Court increased the range of section 133 of the Code of Criminal Procedure to uphold a magistrate's order directing the municipality to carry out its duty towards residents. The municipality was ordered to remove the nuisance caused to the residents of the locality by the existence of open drains and of public refuse from nearby slum dwellers. The court observed that the non-availability of funds cannot be pleaded as ground for non- performance of municipality's statutory obligations. The case put forth the need of clean environment in all aspects. In the early 1980s, Forest Conservation Act, 1980 and the Air (Prevention and Control of Pollution) Act, 1981 were passed. But the authorities had shown reluctance to use their statutory power against the polluters which resulted in an accelerated degradation of the environment. Therefore the judiciary took the lead and played a key role in protecting and preserving the environment through its judicial pronouncements.

For the first time indication towards a wholesome environment as part of life was given in the Rural Litigation Entitlement Kendra, Dehradun Versus State of Uttar Pradesh,[14] popularly known as Dehradun Quarrying Case. The case categorically emphasized that the right to life without clean and hygienic environment is meaningless. In this case the court observed that Industrial development is necessary for the economic growth of the country. If, however, industrial growth is sought to be achieved by haphazard and reckless working of the mines, resulting in loss of life, property and basic amenities like the supply of water, creating thereby an ecological imbalance, there may ultimately be no real economic growth and no real prosperity. It is necessary to strike a proper balance. Thus, the courts filled the gaps in the existing legislative system through the process of judicial law-making and referring to article 51A (g) of the constitution held that it is not only the state but the duty of citizens to protect the environment. The case indicates that though pollution control laws could be used to redress a particular environmental problem (for example, industrial or commercial activities) but they are not capable of addressing complicated issues like environmental sustainability.

Most of the industrial factory owners do not perceive an improvement in environmental conditions to be in their interest. If that interest is to be promoted it is not enough to merely remind them of their social responsibilities. Towards this purpose the Supreme Court in 1996 and 1997 delivered five landmark

[13] Municipal Council, Ratlam Vs. Shri Vardhichand & Ors, 1981 SCR (1) 97.
[14] AIR 1985 SC 1259.

judgements[15] adopting the polluter pays principle in India as an improvement over the absolute liability principle.

Polluter Pays Principle:

The polluter pays principle is an extension of the principle of absolute liability. The principle of absolute liability is invoked regardless of whether or not the person took reasonable care and it makes him liable to compensate those who suffered on account of his inherently dangerous activity. The polluter pays principle extends the liability of the polluter to the costs of repairing the damage to the environment. The polluter pays principle broadens the ambit of the principle of absolute liability. The importance of this principle is that the damage to the environment may be remedied and this is extremely essential to sustainable development. "The polluter is liable to pay the cost to the individual sufferers as well as the cost of reversing the damaged ecology"

Polluter Pays Principle[16] has become a very popular concept lately. 'If you make a mess, it's your duty to clean it up '- this is the fundamental basis of this slogan. It should be mentioned that in environment law, the 'polluter pays principle' does not allude to "fault." Instead, it supports a remedial methodology which is concerned with repairing natural harm. It's a rule in international environmental law where the polluting party pays for the harm or damage done to the natural environment. "The Polluter Pays" principle has been held to be a sound principle by this Court in Indian Council for Enviro - Legal Action Versus Union of India[17]The Court observed, "We are of the opinion that any principle evolved in this behalf should be simple, practical and suited to the conditions obtaining in this country". The Court ruled that "Once the activity carried on is hazardous or inherently dangerous, the person carrying on such activity is liable to make good the loss caused to any other person by his activity irrespective of the fact whether he took reasonable care while carrying on his activity. The rule is premised upon the very nature of the activity carried on". Consequently the polluting industries are "absolutely liable to compensate for the harm caused by them to villagers in the affected area, to the soil and to the underground water and hence, they are bound to take all necessary measures to remove sludge and other pollutants lying in the affected areas".

The 'Polluter Pays' principle as interpreted by the Court means that the absolute liability for harm to the environment extends not only to compensate the victims of pollution but also the cost of restoring the

[15] Indian Council for Enviro-Legal Action and others v. Union of India, (1996) 3 SCC 212 , Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647, M.C. Mehta v. Union of India (1997) 2 SCC 353, M.C. Mehta v. Union of India, (1997) 2 SCC 411 and M.C. Mehta v. Kamal Nath, (1997SCC 388. Making the Polluter Pay, http://www.cei.org/ebb/polluterlhtml.

[16] Article 21 of the Constitution of India

[17] 1996 (3) SCC 212.

environmental degradation. Remediation of the damaged environment is part of the process of "Sustainable Development" and as such polluter is liable to pay the cost to the individual sufferers as well as the cost of reversing the damaged ecology. In M.C.MehtaVs Union of India[18] the Apex court referred the case of Enviro-Legal Action and Vellore Citizens case and ordered the Calcutta tanneries to relocate and pay compensation for the loss of ecology/environment of the affected areas and the suffering of the residents.

Apart from the constitutional mandates provided under Articles 21[19], 47[20], 48A[21], 51A(g)[22] to protect and improve the environment there are plenty of post-independence legislations on the subject but more relevant enactments for our purpose are : The Water (Prevention and Control of Pollution) Act, 1974 (the Water Act)[23], The Air (Prevention and Control of Pollution) Act, 1981 (the Air Act)[24] and the Environment Protection Act 1986 (the Environment Act)[25]. The Water Act prohibits the use of streams and wells for disposal of polluting matters. Also provides for restrictions on outlets and discharge of effluents without obtaining consent from the Central/State Boards. Prosecution and penalties have been provided which include sentence of imprisonment. The Air Act provides that the Central Pollution Control Board and the State Pollution Control Boards constituted under the Water Act shall also perform the powers and functions under the Air Act. The main function of the Boards, under the Air Act, is to improve the quality of the air and to prevent, control and abate air pollution in the country.

Conclusion And Suggestions:

Thus, after the analysis of above cases, we find that, the Supreme Court is, at the present time, stretching the different legal provisions for environmental protection. These new innovations and developments in India by the judicial activism open the numerous approaches to help the country. In India, the courts are extremely cognizant and cautious about the special nature of environmental rights, considering that the loss of natural resources can't be renewed. There are some recommendations which need to be considered.

[18] 1996 (4) SCC 425.
[19] Article 21: No person shall be deprived of his life or personal liberty except according to procedure established by law.
[20] Article 47 Duty of the State to raise the level of nutrition and the standard of living and to improve public health The State shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties and, in particular, the State shall endeavour to bring about prohibition of the consumption except for medicinal purposes of intoxicating drinks and of drugs which are injurious to health
[21] Article 48A. Protection and improvement of environment and safeguarding of forests and wild life The State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country
[22] Article 51 A (g) to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures;
[23] Water (Prevention and Control of Pollution) Act, 1974 (Act NO. 6 OF 1974).
[24] The Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981).
[25] The Environment (Protection) Act, 1986 (Act No. 29 OF 1986).

Public Awareness:

The issue of environmental pollution can be checked by making mindfulness in the general population, in which media's part is extremely critical. The compelling agency of correspondence not just influences the mind of the individuals but is also capable of developing thoughts and desirable attitudes of the people for protecting environment.

Regular Inspection:

There is a requirement for a standard review apparatus, which can inspect and examine periodically every one of those exercises which are threatening the environment. This would be a successful step towards environment protection, since prevention is better than cure.

Environmental Education:

There is no means for any law, unless it's an effective and successful implementation, and for effective implementation, public awareness is a crucial condition. Therefore, it is essential that there ought to be proper awareness. This contention is additionally maintained by the Apex Court in the instance of M.C. Mehta Versus Union of India26. In this case, Court directed the Union Government was obliged to issue directions to all the State governments and the union territories to enforce through authorities as a condition for license on all cinema halls, to obligatory display free of expense no less than two slides/messages on environment amid each show. Moreover, Law Commission of India in its 186th report made a proposal for the constitution of the environment court. Hence, there is an urgent need to strengthen the hands of judiciary by making separate environmental courts, with a professional judge to manage the environment cases/criminal acts, so that the judiciary can perform its part more viably.

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Determining The Contravention Of Land Property On The Coastal Areas: An Example From Atakum/Samsun

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ABSTRACT

It is clearly stated in the Constitution Law, Civil Law, Municipal Law, Cadastral Law and Coastal Law that the coasts are under the provision and auterity of the government and that public interest shall be pursued for benefiting from these areas. In the Civil Law, Cadastral Law and Municipal Law, it is specified that private landownership cannot be in question on the coasts and those areas cannot be suspended. Additionally, in accordance with the 5th article of the Coast law, numbered 3621/3830, the determination of the shore border line is compulsory in order to perform planning and application on the coast and shore line. Since the available real estate on the coastal areas are very significant, where public interest shall be given particular importance, determination and plannings of the shore border line shall be made very carefully. In this study, coastal areas were determined in the Samsun. The study areas located in Samsun and extends about 20 km during the Black Sea coasts. Investigated the relationships of the shore border line- landownership were examined in the given areas. In order to make researches and examinations in these areas, primarily; cadastre sheets were supplied from the Cadastral Directorate, landownership information related to the real estates were supplied from the Real Estate Registration Offices and determinations of the shore border line were supplied from the Provincial Directorates of Public Works. Digitizing the acquired data, softwares of the Geographical Information Systems and data which were kept on different layers could be superposed, shore border line was processed onto the status of landownership and the relationships of the shore border line-landownership were examined through making the required spatial analysis and inquisitions. In the examinations, the extents of the shore border line contraventions were calculated for the parcels in which the shore border line passes through the landownership border. The examinations here were performed by taking the determination dates of cadastre and shore border line into consideration, as well. In this study; results show that the firstly, totally 235 parcels at the Black Sea coast having shore border line contravention were determined in the study area and the total amount of the shore border line contravention of these parcels was determined to be approximately 16.1 hectares. Work to be done is specified in the 10th Item of the regulations concerning the application of the same law that the proceedings of the annulment of titles shall be conducted by the relevant financial office for the real estates that remain on the coast by infringing shore border line.

Keywords: Coast, Shore Border Line, Landownership, Real Estate, Cadastre, Geographical Information Systems, Coastal Contravention

Introduction

Coastline changes maybe caused by natural processes and human activities. The natural processes

include phenomena such as waves, currents, and storms. The human activities involve changes in the environment, sometimes expressed as modification at landscape levels. The magnitude of these activities and their effects are related to urban growth, and therefore urban development must be seen as part of the ecological systems (Bailly and Nowell 1996; Bedford 1999; Ji et al. 2001; Jackson et al. 2001, Ruiz-Luna and Berlanga-Robles, 2003). In recent years, the coastal zone, probably more than any other part of society has been exposed to pressure and processes of change. Among these changes are urbanization and new infrastructure, exploitation for recreation and tourism, acute nature and environmental problems, retreat of coastal occupations, reorganization of freight traffic between land and sea and changed functional demands and working conditions for harbours (Anker et al., 2004). The coastline can be defined as the line of contact between land and a body of water (Pajak and Leatherman, 2002; Alesheikh et al., 2004). In solving the coastal problems usually multidisciplinary studies including remote sensing and geomatics engineering have proved to be quite useful. So far, various studies have put forth solutions and similar approaches to overcome the aforementioned difficulties (Jensen 1996; Foody and Body 1999; Tapiador and Casanova 2002; Small 2002; Kaya and Curran 2006; Marangoz et al. 2013; Aydın and Uysal, 2013; Song et al. 2013).

Management of the spatial information have gained importance in all the worldwide studies for the decision-maker authorities and planners, the necessity of establishing a spatial data infrastructure arose for the control of natural sources and environmental changes. As a result of this, usage of developing information technologies such as Geographical Information Systems (GIS) came into prominence. Since GIS enables the analysis of the space-based data and information by means of visual and analytical tools after being processed and interactive use of information by the user, it has become more than a computer program and an effective system that could be used in problem solving.

Coastal Areas Management is described as a constant, precautious and adapted source management process for a sustainable development in the coastal areas. Sustaining the sustainable life within the triangle of nature, environment and creatures as a whole, determining and removing or minimizing the pollutive resources could be possible through GIS (Alkış, 1997; Kay and Alder, 1999).

GIS is an information system which executes the functions of collecting, hiding, processing the graphic-nongraphic information which are obtained through space-based observations and presenting them to the user as a whole (Yomralıog lu, 2000). The use of the GIS technology in the coastal management could be considered as an extended field. With the help of this system which can manage the spatial information efficiently, the process of decision-making could be supported (Sesli et al., 2003). Developments within the GIS systems enabled the access to the functions to extend to personal

computers or internet users. GIS provides a mechanism for storing, analyzing, using and displaying the geographical-based information (Aydınog lu and Yomralıog lu, 2002).

In this study, different areas were determined in the Atakum District in the Samsun Province. A coastal area of 20 km, including the towns of Taflan, Çatalçam, Çakırlar, I ncesu, Bu yu koyumca, Alanlı, Atakum from the town of Atakum on the western shore of the province of Samsun, was determined as the study area.Definitions in Accordance with the Turkish Coastal Law and the Related Legislations in Turkey

According to the Coastal Law numbered 3621/3830 (Eke, 1995);

Coastline: It is a natural line on the sea, lakes and rivers that changes due to some meteorological events which is formed by the fusion of the points on which the water touchs the earth on the positions other than flood.

Shore border line: It is a natural border of sandy, gravel, rocky, marsh, rushy, and other similar areas formed by the water motions against the earth after the coast line of sea, lakes and rivers. This border can't be changed even though sea is filled to obtain land.

Coast: This is an area between coast and shore border line.

Shore buffer zone: It is an area of at least 100 m with horizontally from the shore border line of sea, lakes and rivers to earth.

The detection of a sash as shore buffer zone especially in the developing countries, aims to prevent from coastal erosions, to provide public reach to the coast and to be open to coastal view (Sorensen, 1993). According to the article 43 of the Constitution Law of Turkish Republic, the coasts are at the disposal of the government. In utilizing from the sea, lake and river coastlines one must take care of first of all the Public Benefit. According to the 2001 date Turkish Civil Law, the places with no property and the goods in the benefit of the public are in no ones landownership and can never be a subject of a private landownership.

According to the Coastal Law numbered 3621, the detection of the shore border line is obligatory to be able to make plans and plan's implementation on the coast and shore buffer zone. But unfortunately, the usage out of public benefit is being seen because of the agitated in planning and the detection of shore

border line not in the way or at the time it must be done (Sonmez, 2002).

Materials And Methods

In In this study, different areas were determined in the Atakum District of Samsun. Samsun is located in the Black Sea Region. Samsun is a province in Turkey, located with a length of 208 km on the coast of Black Sea. Its adjacent provinces are Sinop to the west, Tokat and Amasya to the south, Black Sea to the north, and Ordu to the east. The climate is oceanic due to its close proximity to the Black Sea. The coastal zone is located between longitudes 37°08′ E and 34°27′ E and between latitudes 40°50′ N and 41°51′ N. In this study; a coastal area of 20 km, including the towns of Taflan, Çatalçam, Çakırlar, I ncesu, Bu yu koyumca, Alanlı, Atakum from the town of Atakum on the western shore of the province of Samsun, was determined as the study area (Figure 1).

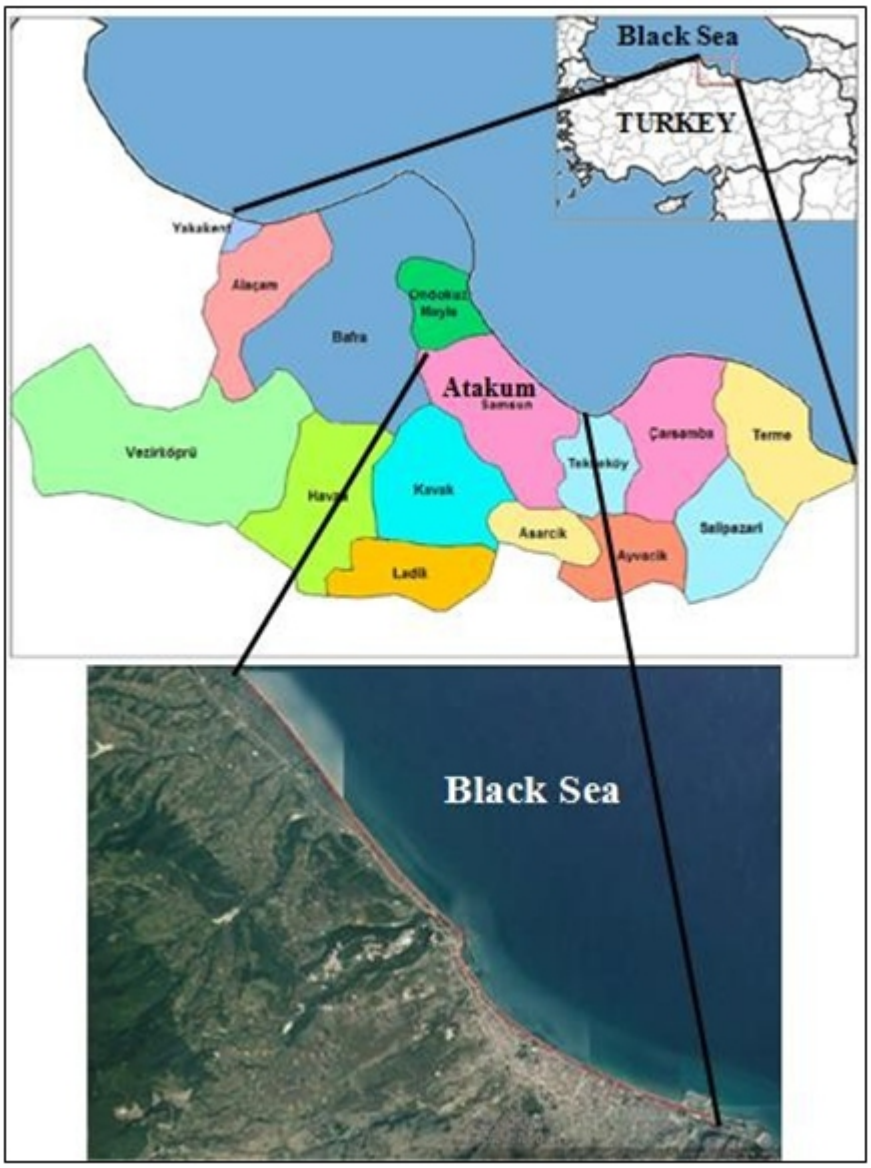

Fig - 1: Location of study area

The graphical analyses which can take a long time with classical methods or CAD programs and the statistical informations produced after these methods can be available by the softwares which are important tools in GIS. In the light of these informations by using GIS we are able to detect the amount of areas for the public benefit in the zonning plans made on the coastal areas. Graphic and nongraphic data required in this study classified and digitized as coverages with AutoCAD programme according to their properties.

Map sheets provided on the digital environment have been transformed and graphical corrections and area quatity controls have been done. They have been made the topology of graphic datas by the NetCAD GIS programme as separate coverages. These map sheets' attribute information input on the same programme. Various samples to spatial query that can be available on the coastal areas with GIS are given.

Results And Discussion

In order to make researches and examinations in these areas, primarily; cadastre sheets were supplied from the Cadastral Directorate, landownership information related to the real estates were supplied from the Real Estate Registration Offices and determinations of the shore border line were supplied from the Provincial Directorates of Public Works. Digitizing the acquired data, softwares of the Geographical Information Systems and data which were kept on different layers could be superposed, shore border line was processed onto the status of landownership and therelationships of the shore border line-landownership were examined through making the required spatial analysis and inquisitions. In the examinations, the extents of the shore border line contraventions were calculated for the parcels in which the shore border line passes through the landownership border. The examinations here were performed by taking the determination dates of cadastre and shore border line into consideration.

Table -1: Amount of Shore Border Line Contravention on the basis of towns

Name of the Town	Number of Parcels Committing Shore Border Line Contravention	Amount of Shore Border Line Contravention (m^2)
TAFLAN	39	790,02
ÇATALÇAM	10	709,92
ÇAKIRLAR	23	23.532,58
I NCESU	43	23.079,99
BU YU KOYUMCA	40	3.995,71
ALANLI	8	99,35
ATAKUM	72	129.402,30
Total	**235**	**160.909,87 (16.1 hectares)**

Table -2: Landownership distribution of parcels within Shore Border Line

Owners of the Parcel Committing Contravention	Number of the Parcels Committing Contravention	Ratio %	Amount of Shore Border Line Contravention (m^2)	Ratio %
PUBLIC DOMAIN	39	16,6	122.617,14	76,2
CITIZEN	196	83,4	38.292,73	23,8
Total	**235**	**100**	**160.909,87**	**100**

In this study; as it is seen in Table 1-2, totally 235 parcels at the Black Sea coast having shore border line contravention were determined in the study area and the total amount of the shore border line contravention of these parcels was determined to be 160.909,87 m^2 (approximately 16.1 hectares).

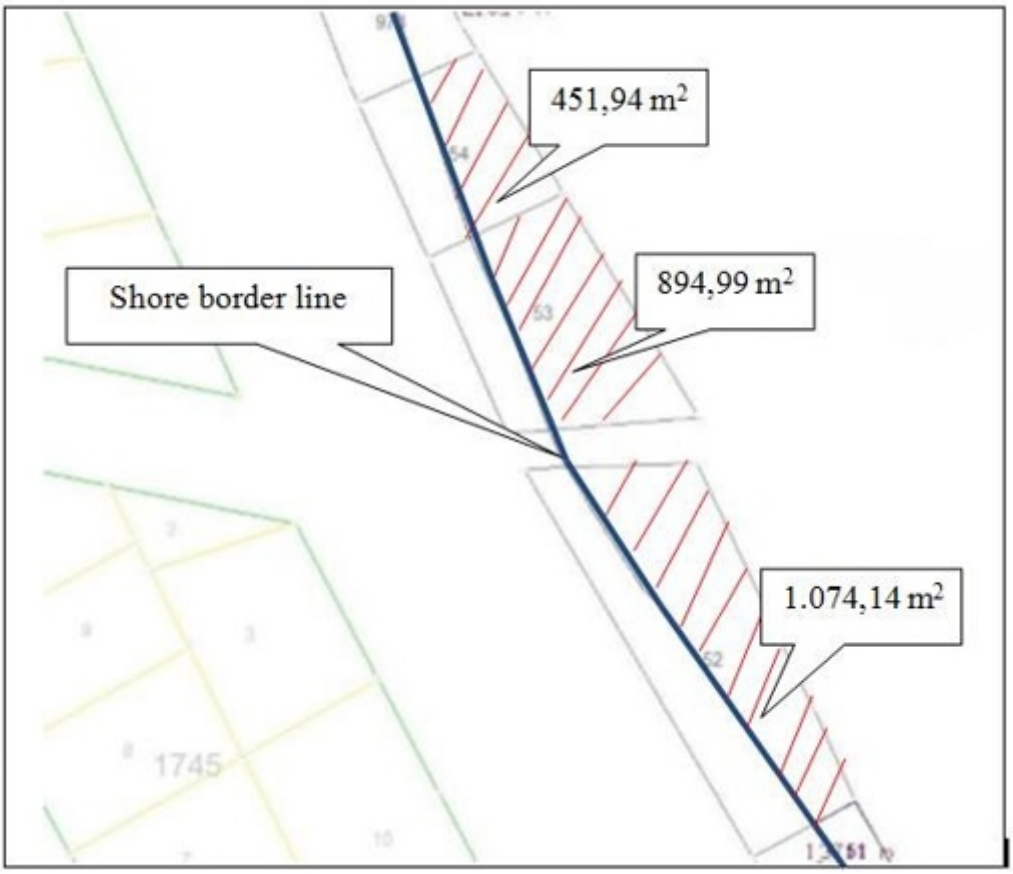

Fig -2: Examples to parcels committing shore border line contravention during the Black Sea coats

Conclusions

Totally 235 parcels having shore border line contravention were determined in the study area and the total amount of the shore border line contravention of these parcels was determined to be 160.909,87 m^2 (approximately 16.1 hectares). Work to be done is specified in the 10th Item of the regulations concerning the application of the same law that the proceedings of the annulment of titles shall be conducted by the relevant financial office for the real estates that remain on the coast by infringing shore

border line.

All kinds of analyses and query associated with coastal areas are available by using GIS technology. By this way, meaningful plans can be made for the future. For the purpose of using the coasts for the public benefit;

The authorities must be determined clearly by the laws arrangement to ease the applications on the coastal region. An administrative structure providing the cooperation and coordination between foundations must be constituted, Shore border line urgently must be detected, landownership boundary and their legal states must immediately be defined clearly.

The information required for the management of coastal areas must be provided, to be available to use the coastal areas for the public benefit. On the intensive coastal settlements the studies to obtain datas for the management of coasts is being performed with GIS,

The protection of natural balance on the coastal area and shore lines, the analyses of the land ownerships and the decisions of planning associated with these studies can be realized with Coastal Management Information Systems, GIS and other information technologies for analyzing and querying functions related tocoastal areas must be used, Coast is the place with no property and the goods in the benefit of the public are in no ones landownership and can never be a subject of a private landownership. Shore border line must be detected on all coastal region of Turkey. Land ownership boundary and their legal states must immediately be defined clearly. If there is an ownership on Coast, this gives up Public Benefit, The information required for the management of coastal areas must be provided, to be available to use the coastal areas for the public benefit. On the intensive coastal settlements the studies to obtain data for the management of coasts is being performed with GIS, Using the techniques of GIS Technologies for analyzing and querying functions related to coastal areas must be used seems promising for detecting changes in the coastal zone, The protection of natural balance on the coastal area and shore lines, the analyses of the land ownerships and the decisions of planning associated with these studies can be realized with GIS Technologies.

Shore border line shall immediately be conveyed on all coasts and landownership limit and legal status shall be clarified as soon as possible, authorizations and missions shall be determined clearly by performing legislation regulation in order to simplify the applications on the coasts, and studies shall be started as early as possible in order to establish a system that would solve the determination problems with an integrated approach.

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Impact Of Industrial Pollution On Land, Water And Agricultural Production In Sipcot Industrial Region In Tamilnadu

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ABSTRACT

This paper deals with impact of industrial pollution on land, water and agricultural production in Cuddalore SIPCOT industrial region in Tamil Nadu. It outlines the impact of water pollution and land pollution on crop yield. This study makes an experimental analysis of crop yield in SIPCOT industrial region and non industrial region. In this study, impact of industrial activities on land and water quality has been examined on the basis of appropriate scientific method. The crop yield decline is explained with the help of soil and water test. This paper concludes with some interesting findings along with policy suggestions.

Introduction

Industrial pollution is the contamination of the environment by businesses, particularly plants and factories that dump waste products into the air and water. Industrial waste is one of the largest contributors to the global pollution problem endangering people and the environment. Many dangerous pollutants, by-products of manufacturing, enter the air and water, risking health and lives. Common pollutants include carbon monoxide, formaldehyde, mercury and lead. Waste released into the water systems, including medical waste, kills river and ocean life. Cities are particularly at risk for the direct effects of industrial pollution, but the ultimate results filter down throughout the environment. Industrial pollution can negatively affect public health by distributing harmful chemicals into water, the air and the soil. The quality of the environment is also at risk, as industrial pollution can impact climate change, hinder the growth of natural plants and grasses, cause the loss of species and aid in the erosion of buildings. The health of humans and animals is a primary concern with industrial pollution. Air pollution that impacts the ground-level ozone can weaken respiratory systems, reduce lung function and increase respiratory inflammation in humans and animals alike. When exposed to air pollution, people may experience nausea, pulmonary congestion and chest pains.

Industrial pollution affects the growth of plants, crops and animals, thus reducing natural resources. When air quality is low due to industrial pollution, the ozone damages the forest ecosystems and crops.

Bodies of water that are polluted by industrial chemicals can infect drinking water and also the natural habitats of aquatic species. Industrial pollution events such as fires, radioactive material leaks and oil spills directly affect the level of pollution within water, the soil and the air. Natural habitats, such as forests and oceans, remain polluted, which has a negative impact on the species that live within the habitats.

This study aims at analysis environmental impact of SIPCOT Industrial Complex (State Industries Promotion Corporation, Tamilnadu) of the Cuddalore region. The cause, nature and extent of environmental degradation in India have been whichever upon before the statement of the objectives, aims and scope of the present study. Environmental degradation expressed as the pollution of the natural resources and eroding the capacity of the eco-system support healthy living in the wake of the proliferation of industries in residential neighborhood is a significant indicator of the suffering that industrialization imposes on generations of people to come. Industrialization associated with technological progress is itself a major cause of environmental pollution even as technological progress and innovation could also be part of the solution. Usually land pollution occurs in various forms such as loss of soil fertility, ground water pollution, accumulation of chemical pollutants, changes in the structure of soil and so on. Land pollution results in ground water pollution and crop yield decline in the industrial region. In order to study the effect of industrial pollution on agricultural development, a comparative study can be preferred. In general Agro eco system in industrial region is highly polluted with the accumulation of pollutants in water and land contrastingly agro eco system in non-industrial region is free from pollutants. Hence undertaking a comparative study on crop yield in village situated in industrial region and villages situated in non industrial region is desired to analyze the status of land degradation and water pollution in SIPCOT industrial region by taking non industrial region as control group.

Review on the Subject

The study of review of literature is an important aspect of any research. It aims at analyzing the past trends in research output of any subject. This study deals with industrial pollution. Hence there is a need to identify the area coverage, subject coverage, content coverage and objective coverage in research on industrial pollution with the help of review of literature. Hence, there is a need to review a few works for the purpose of present study.

Vasisht A-K; Singh,-R-P; and Mathur,-V-C (2003) estimate the land degradation in the country. Widely accepted estimates indicate that nearly 57% of the geographical area or 187.8 million hectares of land are degraded to different intensities.

Sharma,-S-K; and Chandel,-C-P-S (2004) evaluate the groundwater samples from Jaipur, Rajasthan, India for their structural and functional attributes, both quantitatively and qualitatively, in order to determine their suitability for irrigation and drinking purposes.

Randall,-C-W (2004) study highlights that nutrient pollution of estuaries and coastal waters has resulted in the impairment of ecosystems and major reductions and collapse of fisheries at numerous sites around the world, resulting in major socio-economic implications.

Alka-Tangri (2005) study on river Pandu highlights that about 200000 gallon wastes per day the effluents of various industries, like thermal power station, fertilizer plant, Panki industrial estate, dyes, Chemical and others industries, Small Arms factory, and Ordinance factory.

Kolotov,-B-A; Demidov,-V-V; Volkov,-S-N (2003) have observed that chlorophyll content can be a primary indicator of environment degradation due to heavy metal contamination. Most pollutants decrease chlorophyll content, was evident when environmental pollution was monitored in the areas of heavy metal contamination.

Venkatachalam,-L (2004) study has identified certain specific sources of government failure that are potentially affecting the groundwater quality in the state of Tamil Nadu, India.

Kaplay,-R-D and Patode,-H-S (2004) analysis of the 67 samples collected from 25 borewells and 42 dug wells in the basaltic aquifer at Tuppa, New Nanded, Maharashtra, India over a period of three years reveal that groundwater from this region shows higher content of pollutants like TDS, Cl, TH, Ca, Mg and SO4 The geochemical characteristic of groundwater is related to pollution.

The study by Antil,-R-S and others (2004) highlight that land degradation in Haryana has been due to soil erosion, soil salinity and sodicity, water logging, sewer water and industrial effluents, and agrochemicals.

Umamaheswari,-S (2004) has made an attempt to assess the water quality of river Thamirabarani at Ambasamudram, Tamil Nadu, India, by selecting two sites, one beneath the railway bridge (Up stream site) and the other beneath the highway bridge (Down stream site). Physico- chemical and microbial analysis of water was made from June 2001 to February 2002 at an intermittent period of four months. pH, alkalinity, BOD, and COD, were found to be greater in the order of 8-3-8.5, 140, 250-320 and 2411.0 mg/l respectively in the downstream site of the river water, whereas the dissolved oxygen

analyzed varied from 2.05-2.50 mg/l in the downstream site of the river.

Kannan,-V; Ramesh,-R; Sasikumar,-C (2005) have investigated the physio-chemical characteristics of groundwater samples mixed with effluents discharged from the textile industries at Chellandipalayam (Site-I), Senaparatti (Site-II) and Pasupathipalayam (Sites-III and IV) in Karur District, Tamil Nadu, India. Results reveal the very high levels of Ca, Mg, Na, Cr, K, Ni, Cu, Zn, CO3, SO4, NO3 and Cl. The concentrations of these ions exceed the limit prescribed by ISI.

Paudel, K. P, H. Zapata and D. Susano (2005) have investigated the Environmental Kuznets Curve (EKC) on water pollution with both semi parametric and parametric models using watershed level data for the state of Louisiana, USA.

Abdalla, C. W., B. A. Roach and D. J. Epp. (1992) have reported that pollution from nonpoint sources is the single largest remaining source of water quality impairments in the United States.

Thus many studies have been conducted on industrial pollution in different parts of the world and also in India. However there is no specific study on industrial pollution consequent upon establishment of SIPCOT industrial complex in Tamil Nadu. It is a research gap. In order to fulfill this gap, the present Project is being undertaken.

Methods And Materials

A comparative analysis of SIPCOT industrial region and non-industrial region with respect to economics of crop cultivation based on land and water quality test has been made. This type of analysis is preferred to analyze the impact of industrial pollution in SIPCOT industrial region on crop yield and economics of cultivation. The extent to which the crop yield has been affected in the industrial region could be learnt from the situation in non industrial region which has pollution free environment along with supplementary data from the results of soil and water tests. In this study six villages are selected. Out of them three villages are selected in and around the SIPCOT industrial region and another three villages are selected 10 km away from the SIPCOT industrial region. From each village 20 farm households are selected sample under sampling method.

Totally 12 groundwater and soil samples have been collected from 6 different villages in and around the SIPCOT industrial area. In SIPCOT industrial region, 6 ground water and soil samples have been collected from the three villages, viz., Kudikadu, Nainarkuppam and Kayalpattu. From each village, samples have been collected from two locations. In the non-industrial region, 6 ground water and soil

samples have been collected from three villages, viz., Panchaiyankuppam, Thaikkal and Sangolikuppam. From each village, samples are collected from two locations. The water samples were collected in clean two-litre polythene bottles. Analysis is carried out for pH, turbidity colour, odour, electrical conductivity, total dissolved solids, total hardness, calcium, magnesium, sodium, potassium, iron, nitrate, chloride, fluoride and solids, total hardness, calcium, magnesium, sodium, potassium, iron, nitrate, chloride, fluoride and sulphate as per APHA (1995) and Trivedy & Goel (1986). The soil samples are collected in polyethylene bags. Analysis is carried out for PH value electric conductivity, soil organic carbon, density of microorganisms and soil porosity.

Results And Discussion

This section deals with primary data analysis. The impact of industrial pollution on crop yield has been analyzed on the basis of control group and experimental group method. The experimental group is the SIPCOT industrial region particularly villages situated around the 2km radius of the industrial agglomeration and control group covers the villages, situated above 10km away from the industrial region. Further the impact of industrial pollution can be assessed on the basis of land quality and water quality both in the control group region and in the experimental group region.

A study of data in table 1 indicates the economics of crop cultivation in the industrial region and non-industrial region. The data relating to industrial area are collected from three villages Kudikadu, Nainarkuppam and Kayalpattu. The data relating to non industrial area are collected from three villages viz., panchaiyankuppam, Thaikkal and Sangolikuppam and these villages are located about 10 km away from the industrial location. The selected villages around the industrial area are located withier the radius of 2 – 3 kms from the industrial area. This type of analysis is made to assess the impact of land pollution in consequent upon establishment of SIPCOT industrial region.

Table 1 Economics of Crop Cultivation in Industrial Region and Non Industrial Region

	Industrial region				Non-Industrial region			
Crop	**Yield**	**Total cost**	**Crop revenue**	**B/c**	**Yield**	**Total cost**	**Crop revenue**	**B/c**
Paddy	2505	8415	16815	1.99	3146	7645	20291	2.65
Cholam	882	3105	4267	1.37	1525	2768	6862	2.47
Cumbu	856	3015	5615	1.86	1938	2417	9690	4
Ragi	784	3490	10882	3.11	3000	3419	12690	3.71
Maize	675	3712	5115	1.37	1125	3475	6850	1.97
Blackgram	345	3026	7125	2.35	652	2518	9815	3.89
Green gram	426	3217	6105	1.89	596	2452	7896	3.22
Red gram	422	2145	5215	2.43	625	1965	9750	4.96
Groundnut	925	5418	8166	1.5	1985	4505	9965	2.21
Gingelli	512	6025	8415	1.39	819	5965	13466	2.25
Sunflower	331	5252	10655	2.02	665	4816	16177	3.35
Turmeric	2000	2815	14650	5.2	3715	2618	16860	6.44
Onion	2715	3445	10568	3.06	4506	1996	13518	6.77
Vegetables	512	3965	5632	1.42	676	3576	7436	2.07
Cotton	241	4050	5425	1.33	482	4553	6968	1.53
Sugar cane	65	14902	55250	3.7	96	12905	81600	6.32
Banana	33013	6128	11415	1.86	42149	5676	14174	2.49

Source Computed:

'T' Statistics Summary Result

	Yield	**Total cost**	**Crop revenue**
T value	2.317	3.78	3.02
Df	16	16	16
T-test	2.12	2.12	2.12

It is observed that the yield per hectare of paddy in industrial region is worked out to 2505 kg/hectare and non-industrial region records 20.37 per cent of higher yield. Though yield is more in the case of non-industrial region, the cost of cultivation is low. In the industrial region land degradation is quite common. As a result farmers spend more for the cost of cultivation and at the same time low yield of crop due to decline in the fertility of soil consequent upon industrial pollution. In the case of Cholam, there is a 42.16 per cent of increase in the yield of Cholam in non-industrial region compared to industrial region.

The yield of Cumbu in industrial region works out to 856 kg/hectare and it is 1938 kg/hectare in the case of non-industrial region, showing 55.83 per cent of higher yield. The higher yield of Cumbu in non industrial region is attributed to fertility of soil. The yield of Ragi shows 73.86 per cent of increasing trend in the case of non industrial region along with low cost of production and maize yield records a 40 per cent higher in the non industrial region.

The yield of black gram in industrial region works out to 345 kg/hectare and it is 682 kg/hectare in the case of non-industrial region, showing 47.08 per cent of higher yield. The higher yield of black gram in non-industrial region is attributed to the fertility of soil. It is observed that 28.52 per cent of higher yield of green gram is observed in the non-industrial region and it is 32.48 per cent increase in the case of red gram. The yield of groundnut in industrial region is worked out to 925 kg/hectare and it is 1985 kg/hectare in the case of non industrial region, showing 53.40 per cent of higher yield.

It is seen that there is 37.48 per cent increase in the yield of gingelly in non industrial region and it is 50.22 per cent in the case of yield of sunflower compared to the industrial region. The yield of turmeric in industrial region works out to 2000 kg/hectare and it is 3715 kg/hectare in the case of non industrial region, showing 46.16 per cent of higher yield. It is observed that 39.74 per cent of higher yield of onion is observed in the non industrial region and it is 24.26 per cent of increase in the case of vegetables. The yield of cotton in industrial region works out to 241 kg/hectare and it is 482 kg/hectare in the case of non industrial region, showing 55.60 per cent of higher yield. It is observed that 32.29 per cent of higher yield of sugarcane is observed in the non industrial region and it is 21.67 per cent increase in the case of banana. It is observed that the cost of cultivation is quite high in the case of industrial region due to decline in soil fertility and it results in low productivity of all crops. Ultimately, low income and low benefit are found in the cost ratio. The non industrial region is free from land pollution as it is located 10 kilometers away from the industrial site. It is the reason for higher yield of crops with less cost and ultimately farmers get more benefits with less cost.

The t-test is applied for further discussion. The computed t-value is 2.31, which is greater than its tabulated value at 5 per cent level of significance. Hence, there is significant difference between yield of crops in industrial region and non-industrial region. A similar result has been observed with respect to cost of cultivation and crop revenue between industrial region and non- industrial region.

The reason for low yield of crops in industrial region is attributed to the following facts. The effluents produced from the existing units in SIPCOT are acidic or neutral. The TDS content is high, in addition to the levels of Total Suspended Solids, Chemical Oxygen Demand, Biological Oxygen Demand, Chlorides and Sulphates. Fluoride content is in the effluents discharged from the chemical manufacturing units.

It is observed that in the absence of any facilities to deal with poisonous wastewater or toxic wastes, companies have resorted to indiscriminate discharge of their wastes. Besides directly affecting the fertility of the land, such practices also poison the groundwater used for irrigation. Farmers in the region

report that yields have plummeted even while costs of extracting water have increased because new or deeper borewells have to be dug as an alternative to the contaminated groundwater in the existing wells. The ability of plants to absorb nutrients can be altered by changes in TDS. Discharge of effluents on land, as has been and continues to be the practice in many SIPCOT industries, alters the soil's organic matter content and hampers the ability of soil organisms to replenish the organic content. The wastewater has affected the water springs, and therefore, agriculture. Coconut, mango, tamarind and cashew yields are affected right at the flowering stage due to air pollution." Farm workers complain of sores on their limbs because of contact with contaminated water and sludge. Those working in fields close to factories also face the threat of injury due to gas leaks or other such mishaps.

Land Quality Assessment

This section is devoted to analyze the soil quality in two different types of farming locations. Soil fertility is the main factor for determining agriculture yield. This study has monitered the soil characteristics in the SIPCOT industrial region and non industrial region. The industrial region denotes the three villages, situated with the 2 kilometers radius of the SIPCOT industrial region. The non industrial region comprises three villages. Soil samples are collected from both regions. From each region soil samples are collected from six locations. In order to compare the soil fertility between the lands in SIPCOT industrial region and non industrial region, soil testing has been carried out to know the parameters: pH, EC, organic carbon, porosity, and maximum water holding capacity and available nutrients. On the basis of soil testing is the following observations have been made during the period of analysis.

Table 2 : Soil pH value in SIPCOT industrial region and non industrial region

Location	Location (Name of the village	Industrial region	Location	Location (Name of the village	Non - Industrial region
S1	Kudikadu	8.23	S7	Panchaiyankup pam	7.12
S2	Kudikadu	8.15	S8	Panchaiyankup pam	7.09
S3	Nainarkuppam	8.96	S9	Thaikkal	7.05
S4	Nainarkuppam	8.52	S10	Thaikkal	7.01
S5	Kayalpattu	7.68	S11	Sangolikuppam	7.02
S6	Kayalpattu	8.25	S12	Sangolikuppam	7.03

Source Computed:

A study of data in table 2 indicates the pH level in soil of both SIPCOT regions. The SIPCOT industrial region has high level of soil ph value and it is above eight. The prevalence of high soil ph value in SIPCOT industrial region is due to land pollution and accumulation of alkaline substances in soil. This is due to toxic nature of effluents discharged into the cropland situated around the industrial complex. All the six locations in the industrial region have high soil ph value. On the other hand, all the six locations in the non-industrial region have more or less neutral soil ph value. This is because of non-pollution of land and such regions are located away from the industrial region.

Table 3 Soil Electrical Conductivity Between SIPCOT Industrial Region and Non Industrial Region

Location	Location (Name of the village	Industrial region	Location	Location (Name of the village	Non - Industrial region
S1	Kudikadu	1.35	S7	Panchaiyankuppam	2.59
S2	Kudikadu	0.96	S8	Panchaiyankuppam	2.52
S3	Nainarkuppam	0.85	S9	Thaikkal	2.65
S4	Nainarkuppam	0.77	S10	Thaikkal	2.9
S5	Kayalpattu	0.65	S11	Sangolikuppam	2.95
S6	Kayalpattu	0.33	S12	Sangolikuppam	2.97

Source Computed:

Table 3 presents data on the electric conductivity of soil in SIPCOT industrial region and non industrial region. It is observed that soil electric conductivity is relatively high in non industrial region. Contrastingly, soil electric conductivity level is quite low in SIPCOT industrial region. The declining soil electric conductivity in SIPCOT industrial region is due to land pollution along with accumulation of pollutants on the surface of soil. The non industrial region is free from pollution, so the soil of the region is rich in organic content and it leads to high level of electric conductivity.

Organic Carbon

Organic matter content of soil is the chief medium in which it enhances the availability of nutrients for crop growth and development. Building up of organic matter in a soil is a slow and tedious process, but application of more organic manure's over the years may sustain and enhance organic content in the soil. But in tropical climate, due to hygroscopic nature of constituents of organic matter, its carbon content is very meager. The soil organic carbon level is declined in consequence of industrial pollution. Hence there is a need to analyse the extent of soil organic carbon level in SIPCOT industrial region and non industrial region.

Table 4 Soil Organic Carbon Level in SIPCOT Industrial Region and Non Industrial Region

Location	Location (Name of the	Industrial region	Location	Location (Name of the village	Non – Industrial
S1	Kudikadu	0.71	S7	Panchaiyankuppam	1.12
S2	Kudikadu	0.77	S8	Panchaiyankuppam	1.26
S3	Nainarkuppam	0.65	S9	Thaikkal	1.18
S4	Nainarkuppam	0.52	S10	Thaikkal	1.25
S5	Kayalpattu	0.64	S11	Sangolikuppam	1.33
S6	Kayalpattu	0.5	S12	Sangolikuppam	1.42

Source Computed:

Data presented in table 4 indicate the soil organic carbon level. It could be noted that the non industrial region has the highest level of 1.42 per cent of soil organic carbon level and the lowest 1.12 per cent of soil organic carbon level. The present of high level of soil organic carbon level in non industrial region is due to its location in the pollution free environment. Contrastingly, the SIPCOT industrial region has low level of soil organic carbon and it is due to its location in the industrial complex region.

Table 5 Population Density of Selective Microorganisms in SIPCOT Industrial Region and Non Industrial Region

	Bacteria THC x 105		Actinomycetes CFU x 104		Fungi CFUU x 103	
Location	Industrial region	Non – Industrial region	Industrial region	Non –Industrial region	Industrial region	Non – Industrial region
1	45	95	10	42	45	80
2	46	90	16	45	50	85
3	40	96	18	40	55	70
4	50	85	22	38	40	76
5	52	87	24	43	35	60
6	55	84	22	35	37	65

Source Computed:

Table 5 presents data in the Population Density of Selective Microorganisms in SIPCOT industrial region and non industrial region. The farming system in the non industrial region has high level of bacteria actinomycetes and fungi population. On the other hand, farming system in SIPCOT industrial region has lesser number of microbial population. This is due to industrial pollution and pollutants destroy the soil microbial population.

Table 6 Soil Porosity in SIPCOT Industrial Region and Non Industrial Region

Location	Name of the village	SIPCOT Industrial region	Location	Name of the village	SIPCOT Non industrial region
S1	Kudikadu	44.26	S7	Panchaiyankuppam	50.87
S2	Kudikadu	42.05	S8	Panchaiyankuppam	55.05
S3	Nainarkuppam	46.32	S9	Thaikkal	50.46
S4	Nainarkuppam	48.05	S10	Thaikkal	56.05
S5	Kayalpattu	49.06	S11	Sangolikuppam	57.05
S6	Kayalpattu	45.06	S12	Sangolikuppam	54.07

Source Computed:

1. Porosity

Porosity is the percentage of pore space present in the soil; higher the pore space more will be the aeration, this helps in better root growth; ultimately better absorption of nutrients and water.

It is observed from the data in table 6 that soil porosity is relatively low in SIPCOT industrial region in all locations. On the other hand, the soil porosity is relatively high in the case of non-SIPCOT industrial region.

T-Test Summary Result

Variable	t-value	Df	t-criticalvalue
Soil pH value	7.15	5	2.01
Soil Electric conductivity	9.3	5	2.01
Soil Organic Carbon	8.21	5	2.01
Population Density of Selective Microorganisms	9.87	5	2.01
	7.21	4	2.13
	8.69	5	2.01
Soil porosity	6.8	4	2.13

Source Computed:

T-test is applied for further discussion. The computed t-value is 7.15, which is greater than its tabulated value at 5 per cent level of significance. Hence, there is a significance difference in soil pH value between SIPCOT industrial region and non industrial region.

Table 7 Water Sampling Locations.

Code	Location (Name of the village)	Distance from the site (km)	Direction w. r to site
S1	Kudikadu	0.5	N
S2	Kudikadu	1.5	SW
S3	Nainarkuppam	1	NW
S4	Nainarkuppam	1.7	N
S5	Venkatapuram	1.53	SE
S6	Venkatapuram	1.84	E
S7	Panchaiyankuppam	10.35	W
S8	Panchaiyankuppam	10.5	NE
S9	Thaikkal	12	NW
S10	Thaikkal	11.5	S
S11	Sangolikuppam	12.5	SW
S12	Sangolikuppam	11.25	SW

Source Computed:

A similar result has been observed with respect to soil electric conductivity level, soil organic carbon level, population density, selected microbial organisms, and soil porosity. The significant difference is due to variation in soil quality and soil fertility. Land quality is quite low in industrial region. This is due to discharge of pollutants in the soil.

The SIPCOT industrial area is located among the villages of. Therefore, environmental monitoring study is needed for the surroundings of SIPCOT, realty Kudikadu, Nainarkuppam, Kayalpattu, Panchaiyankuppam, Thaikkal, and Sangolikuppam

Water Quality Assessment

This section deals with water quality assessment on the basis of standard parameters. An analysis of water quality assessment enables one to understand the deviation of water quality from the universally prescribed standard. The industrial pollution can alter the water quality consequent upon discharge of solid waste storm water and effluents.

Table 8 Physico- Chemical Analysis of ground waters of the Selected Villages

	Industrial Region						Non-Industrial Region					
Parameters	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**
PH	8.02	8.05	8.86	8.56	7.59	7.69	7	7.01	7.03	7	7.01	7.02
Turbidity	5	3	7	8	6	6	5	3	4	3	5	5
Colour	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Odour	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
EC	3560	2370	2940	4020	2870	1880	1450	1475	1488	1380	1500	1499
TDS	2000	2050	2058	2814	2009	2336	1050	966	1092	1134	856	1218
TH	756	880	872	1120	840	416	556	472	480	500	496	496
Ca	104	112	176	240	176	93	65	70	72	73	74	69
Mg	60	66	103	124	96	54	28	27	29	25	27	25
Na	155	150	210	520	220	180	102	76	120	121	130	135
K	32	43	45	140	58	42	85	24	30	30	40	40
Fe	0	0.12	0.12	0.14	0.1	0	0	0.1	0	0	0.01	0.02
NO3	62	67	72	110	63	86	30	32	39	40	37	35
CI	720	540	512	880	528	288	164	172	172	180	224	224
F	0.2	0.8	1.4	0.4	0.4	0.2	1.2	0.4	0.4	1	1	1
SO4	252	97	70	26	185	70	52	56	64	84	134	134

Source Computed:

Classification of water on the basis of EC values (Wilcox 1995).

EC (μmhos/cm)	Class	No. of samples
<250	Excellent	Nil
250-750	Good	Nil
750-2000	Permissible	6
2000-3000	Doubtful	3
>3000	Unsuitable	2

The results of water analysis are given in table 8. The results compared with standards for drinking water as per IS: 10500-1983 specifications for drinking ground water and WHO. In the industrial region the pH value of water has been observed range from 7.59 to 8.86. All the sites in the industrial region have a high level of pH value showing alkaline nature of soil in consequence of industrial pollution. In the case of non-industrial region the pH value of water has been observed range from 7 to 7.03. Almost all the sites show that pH is slightly neutral in the non-industrial region which is within the permissible limits. If pH values are higher than the permissible limits; this will affect adversely alkalinity of soils, microbial life and corrosion rate. The turbidity ranges from 3 to 8 NTU and these values are found to be within the limits in the case of industrial region. The turbidity level is above the tolerable limits in four of the non-industrial locations.

Electrical conductivity values are found to vary from 1380 to 4020 mmhos/cm, which are quite higher

than the limits of the prescribed standard (1500 mmhos/cm) as recommended by WHO[1]. The electric conductivity level is quite normal in the case of non-industrial region. The electrical conductivity values are quite high in the six locations of industrial region. The higher EC and TDS values reflect greater salinity of water and it is not suitable for drinking and irrigation in ordinary conditions, but may be used occasionally under special circumstances. By using only EC values Wilcox (1995)[2] has classified the limits of EC for irrigational water. According to Wilcox, classification of more than 40% of samples for the study area are found to be doubtful and belong to unsuitable classes.

Total dissolved solids are observed in the range of 966 to 2841 mg/L and these values exceed the limits as prescribed by IS: 10500-1983. The samples which have high values of TDS are unsuitable for drinking and irrigation. These samples may affect the soil porosity. In general, the total dissolved solids are quite high in the water samples of industrial region and it is low in the case of water samples of non-industrial region. Total hardness of the samples ranges from 416 to 1120 mg/L. On the basis of total hardness, water samples analysed can be classified either as soft (0 to 70 mg/L), moderately hard (75 to 150 mg/L), hard (150 to 300 mg/L) and very hard (above 300 mg/L) (Gawas et al. 2006). Hence, it is observed that the samples are very hard. Calcium ranges from 65 to 240,g/L and these values are above the desirable limit of 75 mg/L. Magnesium values range from 25 to 124 mg/L in all the samples. Magnesium vales are higher than the prescribed standard value of 30 mg/L in all locations in SIPCOT industrial region. In the case of non-SIPCOT industrial region the Magnesium level in water is within permits table limit.

All the values are in mg/ L, except pH, turbidity (NTU) and electrical conductivity (mmhos/cm).

Sodium values vary form 76 to520 mg/L. The samples in SIPCOT industrial region are with higher Na value than the standard value (200 mg/L) as recommended by WHO. Potassium ranges from 24 to 140 mg/L. These minerals, however, are insoluble so that potassium levels in groundwaters normally are much lower than sodium concentration. The concentration of iron ranges from 0.1 to 0.14 mg/L and the values are within the limits except in samples S2, S3 and S4 in the SIPCOT industrial region as prescribed by IS: 10500-1983. Presence of iron leads to the growth of some microorganisms. Excess iron causes indigestion and constipation in human beings.

Nitrate of the samples ranges from 30 to 110 mg/L. Much of the nitrate in the groundwater reaches with the percolating water through the soil. Nitrates are very loosely bound with the soil particles and easily leak out. Six samples in the present study in the SIPCOT industrial region (S1, S2, S3, S4, S5, S6,) have

[1]WHO, 1997. Regoinal publication, South East Asia Series No: 14, WHOm New Delhi.

abnormal by high value of nitrate exceeding 45 mg/L. The high concentration of nitrate in drinking water is toxic and causes blue body disease/methaemoglobinaemia in children and gastric carcinomas.

Chloride values vary from 164 to 880 mg/L. Among the 12 water samples, six water samples in the SIPCOT industrial region (S1,S2, S3, S4, S5, and S6,) have high concentration of chloride which exceed the permissible limit of 250 mg/L. Chlorides in drinking water do not cause harmful effects on public health, but high concentration can cause salty taste that most people find objectionable, and it may increase the corrosivity of water.

In this study, the fluoride concentration is found between 0.2 and 1.4 mg/L. It has a dual effect on the physiology. Concentration less than 0.7 mg/Land and more than 1.5 mg/L are injurious. Approximately 1 mg/L of fluoride ion is desirable in public water for optimal dental health. Sulphate ranges from 26 to 252 mg/L and these values are within the limits except sample S1 in SIPCOT industrial region. Higher concentrations of sulphate in drinking water may produce objectionable taste or unwanted laxative effects, but there is no significant danger to public health from sulphate.

Conclusion

The findings of the economics of crop cultivation in SIPCOT industrial region and non- industrial region bring out the following facts. The yield of all crops is quite low in SIPCOT industrial region compared to non-industrial region. The cost of cultivation is quite high in SIPCOT industrial region than with non industrial region. Similarly income generation through crop cultivation is quite high in non industrial region than in the SIPCOT industrial region.

The reason for low yield of crops in industrial region is attributed to the following facts. The effluents produced from the existing units in SIPCOT are acidic or neutral. The TDS content is high, in addition to the levels of Total Suspended Solids, Chemical Oxygen Demand, Biological Oxygen Demand, Chlorides and Sulphates. Fluoride content is in the high range for effluents discharged from the chemical manufacturing units.

It is observed that the absence of any facility to deal with poisonous wastewater or toxic wastes, companies have resorted to indiscriminate by discharge their wastes. Besides directly affecting the fertility of the land, such practices also poison the groundwater used for irrigation. Farmers in the region report that yields have plummeted even while costs of extracting water have increased because new or deeper borewells have to be dug as an alternative to the contaminated groundwater in the existing wells. The ability of plants to absorb nutrients can be altered by changes in TDS. Discharge of effluents on

land, as has been and continues to be the practice in many SIPCOT industries, alters the soil's organic matter content and hampers the ability of soil organisms to replenish the organic content. The wastewater has affected the water springs, and therefore, agriculture. Coconut, mango, tamarind and cashew yields are affected right at the flowering stage due to air pollution." Farm workers complain of sores on their limbs because of contact with contaminated water and sludge. Those working in fields close to factories also face the threat of injury due to gas leaks or other such mishaps.

The findings of soil test between SIPCOT industrial region and non industrial region reveal the following facts. The yield of crops is quite low in SIPCOT industrial region in addition to high cost of production. This is due to land degradation; it has been proved with high soil ph value, low soil electric conductivity level, low density of microbial population and low soil porosity. On the other hand, the yield of crops is high in non-industrial region along with low cost of production. The non- industrial region is free from land degradation and such areas are located faraway from the SIPCOT industrial region.

The findings of ground water quality test between SIPCOT industrial region indicate the following facts. On the basis of physico-chemical studies, it may be concluded that the quality of groundwater near the SIPCOT region is affected and the groundwater from these sites are not fit for human consumption. However, in the non-industrial region groundnut water quality is good in terms of present permissible limits of pH value, electrical conductivity value, total hardness and other mineral compositions. The groundwater source, once get polluted, the effects of pollutants, may persist for longer durations. Therefore, proper disposal of industrial effluents with periodical monitoring of groundwater in the industrial area is necessary; otherwise alarming situations will arise soon.

Suggestions

The following suggestions are made on the basis of findings of the study.

1. The Government must initiate steps to identify the extent and nature of environmental degradation, and begin remediation of the land and water at the expense of the polluting factories in SIPCOT.

2. Illegal units, including a majority of factories operating with out valid licences, should be shut down and the Pollution Control Board should set right the in institutional inadequacies that led to inaction despite knowledge of the illegalities. Industries must be allowed to continue only if they function in full compliance with the existing regulations. The suggestion is to issue a lawyer's notice calling upon the Tamilnadu Pollution Control Board to direct closure of defaulting industries and call upon all industries

to get consent within a period of one month from the notice. If the notice is not complied with, a PIL may be file in the High Court, Chennai seeking relief.

3. SIPCOT should be restricted to non-polluting industries which are not water-intensive. Such industries must commit to providing employment locally, beginning with people who may have lost their lands to SIPCOT.

4. Statewide, industries must be required to implement a time-bound program towards clean production and pollution prevention, rather than pollution control.

5. The Tamilnadu Government should ban the extraction of groundwater from coastal aquifers for industrial purposes, and launch an aggressive groundwater regulatory regime based on scientific assessments of groundwater capacity, and the prioritised needs of drinking water for communities and agriculture.

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