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Abstract: This paper considers some contemporary environmental problems like carbon emission, deforestation etc, faced by mainly the developing nations of the world. In this context I have considered some facts and figures of Indian Tannery industry for realization of above mentioned issue. In this paper an attempt has been made to analyze theoretically, the effect of environmental pollution on the output of different sectors in a small open economy. Here, I have presented a theoretical model based on the general equilibrium framework, which mainly highlights on a paradoxical result. The paradox exists in the sense that, with strict environmental control, the formal sector subcontracts their production to the informal sector, thereby accentuating the total level of pollution faced by the society.

Key Words: Dirty goods, Environmental pollution, Applied General equilibrium and Informal sector.

JEL Classification: Q53, Q58, D58.

1. Introduction

The relationship between trade and environment is a complex and highly debated issue. Addressing this relationship is fundamental in order to achieve sustainable development. As a result of increasing global economic inter-dependence and further trade liberalization as well as growing pressure on the environment and the use of natural resources, there is an ever growing inter-face between trade and environment. It is widely recognized that trade and environment can be mutually supportive, but, differences remain on effective implementation. The Commission Communication on Trade and Environment, adopted in 1996, underlined that a mutually supportive relationship between trade and environment can occur but is in no way automatic. In fact, trade liberalization and trade policy have positive and negative impacts on the environment. However, a number of conditions should be met to ensure that the net gains deriving from trade liberalization will support and reinforce the protection of the environment.

One essential condition for making sure that trade and environment are mutually supportive is to ensure that the trade liberalization process is paralleled with the development and strengthening of effective and non-protectionist environmental legislation, at national, regional and international levels. Environmental policies could, in turn, provide an incentive for technological innovations, promote economic efficiency and, consequently, improve productivity. Having recognized the need for such policies, one should also ensure that trade rules do not unnecessarily constrain but rather support and promote the ability of countries to develop and implement adequate and non-protectionist environmental measures, at both national and international levels.

Trade policy as such has also a role to play in actively supporting sustainable trade flows and, in particular, environmentally friendly trade. Trade policy and trade related instruments should be further encouraged to act as a sustainable driver by providing incentives for more sustainable trade flows. This is valid at the multilateral level but even more so at the regional and bilateral levels where the identification of positive synergies among trading partners as well as convergence and co-operation should be easier than is the case at the international level. Trade tools could, for instance, be instrumental in making tangible progress towards more sustainable consumption and production patterns. Economic instruments also need to be more actively developed, notably with a view to allow for the necessary internalization of external environmental costs. In addition, positive synergies between trade, environment and development should be further considered, particularly regarding the elimination of environmentally damaging subsidies and the promotion of environmentally friendly goods and services, with a special focus on those originating in Developing Countries (DCs).

International trade contributes to economic growth, benefits all participating countries, while growth, in turn, increases the demand for environmental quality and provides the financial resource for environmental protection. It is commonly assumed by economists and environmentalists alike that greater economic openness will lead to increase pollution in developing countries, as free trade will increase environmental degradation in developing countries. Thus there are points at which trade and environmental objectives are in potential conflict. If left unattended, these conflicts can weaken the trade system and become an obstacle to sustainable development.

But what is the impact of trade liberalization on the environment is a matter of debate. Two conflicting hypotheses have emerged from the debate. First one is pollution haven hypothesis (PHH). This hypothesis suggests that the developed countries impose tougher environmental policies than do the developing countries, which results in distortion of existing patterns of comparative advantage. So the polluting industries shift operations from the developed to the developing countries; developing countries thus become "pollution havens." The second hypothesis, the factor endowment hypothesis (FEH), states that trade liberalization will result in trade patterns consistent with the Heckscher-Ohlin-Vanek (HOV) theory of comparative advantage based on factor endowment differentials. Rich countries are typically well endowed with capital. Since capital-intensive goods are often also pollution-intensive, factor-endowment theories of international trade predict that rich countries specialize in polluting goods. Thus the manifestation of the PHH is in direct conflict with the FEH. This debate is of great concern among economists, environmentalists and world bodies like WTO.

The issues associated with the link between trade and the environment are very complex and evolves in a dynamic manner, involving various states and other actors in the process. The development of this linkage often focuses on the North–South dynamics of international debates on trade and the environment. Renewed interest in trade and the environment has generated new concerns about the effects of environmental regulations/regimes upon trade-induced economic development, particularly in developing countries. This phenomenon has assumed and will continue to assume paramount significance in international trade negotiations. The magnitude of the debate arising from trade and environment policy tensions indicates that trade and environmental issues will play an increasingly large role both within and beyond the World Trade Organization (WTO).

At the heart of these issues is a fundamental conflict of interests between the North and the South. In the North, environmental protection issues are seen as matters to be addressed in order to protect the global environment, while in the South, environmental protection issues are considered to be linked with the economic development of the nations concerned.

While developing countries initially resisted the linkage between trade and environment, they later accepted the reality that economic development cannot be

separated from its environmental consequences. Economic development, in order to be sustainable, needs to take into account environmental concerns arising from the developmental process.

Developing countries oppose inclusion of trade and environment issues in the WTO as not favourable to their economic interests. The inclusion of trade-and-environment-related issues in the WTO also means that developing countries could be forced to engage in negotiations on trade and environment issues without an explicit inclusion of environment in the negotiating mandate. Unless resolved in a satisfactory way, these issues have the potential to dictate the terms of trade negotiations in the multilateral trade regime and may further exacerbate the North–South tensions that exist at the trade–environment interface.

Pollution haven hypothesis argues that the industries that are highly pollution intensive i.e. dirty industries have been migrating from developed economies to the developing world. It is argued that the environmental concerns of the developed economies caused them to enact strict environmental regulations, which have increased the cost of production of the dirty industries at home. On the other hand, the developing countries with their low wages and lax environmental regulations have been attractive alternative producers in these sectors. At the same time this migration is also beneficial for developing countries that are in need of financial resources for industrial development. Consequently, developing countries provide pollution havens for dirty industries. In this process while the dirty industries have been migrating to the developing countries, the developed countries also have become net importers of these sectors.

The maintenance of the sustainability of environmental functions constitutes a community interest, so that it demands responsibility, openness and a role for members of the community, which can be channeled by people individually, environmental organizations, such as non-government organizations, traditional community groups and others, for maintaining and increasing environmental supportive and carrying capacity which becomes a mainstay of sustainable development. Development which incorporates the environment, including natural resources, is a medium for attaining sustainable development which is a guarantee of prosperity and quality of life of present and future generations.

The main motivation behind this study is to review the existing works on trade and environment with special reference to India and also to suggest a theoretical model on the basis of which, we will examine the issues of trade and environment in the Indian context. This work mainly focuses on the Leather Tannery Sector in India and through this sector; the linkages between trade and environment have been established. There are many empirical and theoretical models on the "Issues between Trade and Environment". Mostly, there are models in which from the empirical data, a stylized theoretical model has been formulated but in my work, I have attempted to built a theoretical model that focuses on the effect of environmental pollution on the output of different sectors in a small open economy and which also entails a

paradoxical result, that strict environmental control accentuates the total level of pollution. This work will help us to provide answer for the questions- Is the informal sector mainly responsible for the increase in total level of pollution? Does strict environmental control leads to more pollution?

The paper is organized in the following manner: Section 2 deals with a brief review of the literature. Section 3 considers some facts and figures about environmental pollution in the context of the Indian leather industry. Section 4 deals with an analytical framework of the problem. Finally, the concluding remarks are made in section 5.

2. Literature review

Trade enables a country to consume a good without incurring the pollution externality created during its production. So a country importing a good effectively displaces the implicit pollution load to the exporting country. Low and Yeats (1992) find that the share of "dirty" industries in exports from developed countries fell from 20% to 16% over the 1965-1988 period, while the share of dirty goods in exports from poor countries rose. The last numbers are different by regions: in West Asia the percent rises from 9% to 13%, in Eastern Europe from 21% to 28%, in Latin America from 17% to 21%, and in South-East Asia the share of dirty goods exports in total exports is flat at 11%. Lucas et al. (1992) empirically examine how the structure of manufacturing production varies, both across countries and over time, in relation to the toxic emission of component industries. They find evidence for an inverse U-shape relationship between industrial pollution intensity and income. On the other hand Mani and Wheeler (1997) examine the Pollution Haven Hypothesis (PHH) using international data on industrial production, trade and environmental regulation for the period 1960-1995. Their cross country analysis gives a result that is consistent with the PHH. They find that pollution intensive output as a percentage of manufacturing has fallen consistently in the OECD economies and risen steadily in the developing world. Besides, it is revealed that periods of rapid increase in net exports of pollution-intensive product coincide with periods of rapid increase in the costs of pollution abatement in the OECD countries. The tanning industry wastes have been extensively examined for their environmental impact, consequently they are branded as one of the worst anthropogenic polluters (Eye and Lawrence, 1971). Davis et al. (1994) have shown that the reducing environment created due to these wastes can result in the precipitation of amorphous iron sulphide and subsequent increased Cr(III) solubility leading to an increased Cr(III) mobility.

Two conflicting hypotheses emerge from the debate. The first competing hypothesis, known as the pollution haven hypothesis (PHH), argues that changes in environmental legislation can distort existing patterns of comparative advantage. In the developed world the costs of complying with environmental regulations appear to be increasing steadily. Since the stringency of environmental regulations increases with income and economic development (Dasgupta and others, 1995) the PHH

assumes that developing countries possess a comparative advantage in pollution intensive production. Thus "pollution havens" arise.

There has been a tremendous change in the trade policy of the Indian economy since July 1991 which has been motivated by a full recognition of the important role that trade can play in promoting sustained economic growth in the context of sustainable development. This section will briefly review some of this literature. Grossman and Krueger (1992); Lucas and
others (1992); Antweiler and others (2001); and Eskeland and Harrison (2003) have made significant contributions on this issue. The role of international trade in determining the environmental damage has been addressed by specialists using input-output techniques Wright (1974;) Hann (2002); Hayami and Nakamura, (2002); Lange and Hassan (2002); and Wadeskog,(2002). Unfortunately very little work has been done in India. Recently, preliminary attempts have been made by Mukhopadhyay (2004), Mukhopadhyay and Chakraborty (2004), Dietzenbacher and Mukhopadhyay (2004) and Jha and Rabindran (2004).

Chaudhuri and Gupta (2004) have considered a three sector general equilibrium model with an informal manufacturing sector. They have shown that, under some reasonable conditions, an inflow of foreign capital raises total domestic pollution, raises national income and also raises national welfare. These results are true both in the presence and in the absence of transfer of environmentally sound technology (EST).

Mukhopadhyay and Chakraborty (2005)' work aims at testing both hypotheses, PHH and FEH, for India's trade with the rest of the world and the European Union during the 1990s when radical economic reforms were introduced. The input-output method is used and suitably modified to test both the hypotheses considering three pollutants, carbon dioxide, sulphur dioxide and nitrogen dioxide (CO2, SO2 and NOx). It is clear from the results that import-related pollution is much greater than the export-related pollution for India. The findings of the present work challenge the pollution haven hypothesis, arguing that liberalization of trade policy in India has not been associated with pollution-intensive industrial development and attempts to contribute to the environment and trade debate by examining the impacts of international trade with the rest of the world and also with the EU on emissions of CO2, SO2 and NOx in the Indian economy during the 1990s using input-output techniques. At testing both hypotheses, PHH and FEH, for India's trade with the rest of the world and the European Union during the 1990s when radical economic reforms were introduced. The input-output method is used and suitably modified to test both the hypotheses considering three pollutants, carbon dioxide, sulphur dioxide and nitrogen dioxide (CO2, SO2 and NOx). It is clear from the results that import-related pollution is much greater than the export-related pollution for India. The findings of the present work challenge the pollution haven hypothesis, arguing that liberalization of trade policy in India has not been associated with pollution-intensive industrial development.

In spite of the existence of vast literature on this subject, the significance of this study originates from the fact that, in none of the works, the focus has been given on the different trade and environmental issues with reference to a particular informal sector, say the tannery sector .The present paper tries to cover the effect of environmental pollution on the output of different sectors in a small open economy and which also entails a paradoxical result, that strict environmental control accentuates the total level of pollution. Thus, this paper can be considered as a new contribution in this arena.

3. Some Data on Environmental Pollution, with Special Reference to the Leather Tannery sector in India

The leather industry is India's fourth largest export industry, employing 2.5 million people and having a target value of about A$10 billion in 2002. The preparation of leather requires the use of large amounts of salt. Tannery discharges are causing loss of agricultural production due to the salinisation of rivers and groundwater. It is also adding to the salinity of drinking water. In the past few years, Indian authorities have set stringent regulations for tannery discharges. Regulations for biochemical oxygen demand, chemical oxygen demand and chromium levels are now being met, though at considerable cost. However, levels of total dissolved solids (TDS) remain too high. If the tanning industry does not deal with this problem, it will face legal action and closures, leading to social and economic hardship. The leather industry has been identified as a thrust sector for export promotion in India but it is also perceived to be highly polluting as well. The leather industry has both some sustainable aspects as well as some unsustainable aspects. Until 2002, the leather sector was reserved for small scale sector and this may have prevented Foreign Direct Investment (FDI) in this sector. The FDI in this sector from August 1991 to December 2005 is US$ 51.84 millions. This is only 0.15% of total FDI inflows and ranked at 30. Today the industry ranks 8th in the export trade in terms of foreign exchange earnings of the country. Leather sector has been included among red categories of industries on account of the potential environmental impact of tannery wastes. Since 1996, the Indian tannery sector has increased its environmental preparedness. Tanneries in Punjab, UP and Tamil Nadu are now connected to pollution control devices. In Calcutta, the problem is being addressed comprehensively with the industry undergoing relocation into a new leather city. A successful lesson has been-learnt in the tannery sector in Tamil Nadu during the last two years.

Waste minimization in tannery sector has benefited significantly. The Ministry of Environment and Forests; Government of India has recognized the need for gaining environmental security of the leather sector. In order to develop a holistic action plan for prevention and control of pollution in tanneries, the Ministry has formed a working group under the chairmanship of Central Pollution Control Board (CPCB) with a directive to-submit the report before 30 September 1999.Need for technological up gradation of the tannery sector on an all India basis has been

recognized. Scope for implementing waste minimization circles in Punjab, UP and Calcutta has been identified. Consolidation of outputs in the tannery sector in Tamil Nadu has been felt necessary.

Let us first focus on the sustainable aspects. The leather industry plays a main role in the substantial export earnings. It also provides employment to the marginalized section of the society and gives them the opportunity to participate to the small scale sector. The water pollution due to discharge of untreated effluent from the slaughterhouse, the air pollution due to the foul smell from the slaughterhouse and tannery, unhygienic surroundings due to lack of proper cleaning activities and occupational health hazards to the worker due to the use of chemicals in tanneries are some of the unsustainable aspects of the leather industry.

The Indian leather industry has earned a special status in the national economy as the fourth largest foreign exchange earner with a share of around 7% in the total country's exports. The tanning sector is the basic skeleton on which the entire leather industry depends and it is also one of the largest polluters. The leather processing capacity in India is more than 1900 tanning units out of which 75% are in the small scale sector. The inherent nature of the tanning process is such, that large quantities of water are consumed. Attributed to this factor this industry is chiefly located near river banks: Ganga river system in UP, Bihar and West Bengal and Palar and Cavery river systems in Tamil Nadu .The leather tanning industry in India is made up of a few large export-oriented units and a large number of manual, small-scale units producing mainly for the domestic market.These facilities are mostly rather primitive and do not meet the minimum discharge standards. Release of wastewater from them is seriously compromising groundwater quality, and the problem is compounded by the discharge of heavy metals. Most of the small tanneries are concentrated in clusters which could facilitate common effluent treatment facilities after heavy metals and sulphides have been removed by pre-treatment. But toxic solid residues and sludge continue to be disposed without treatment, producing noxious gases which cause air pollution. The tanneries cause water pollution problem as well with high BOD and COD values in their discharges, together with chromium, phenols, sulphides, ammonia, dyestuff, heavy metals, detergents and antiseptic agents. Average compliance with national discharge standards is estimated at a meagre 2per cent. Even the largest tanneries remove less than 20 percent of the required pollutants, and 435 tonnes (at least 36times the standard) of highly toxic chromium compounds are discharged annually into rivers. Substantial amounts of solid waste — approximately 73 million tonnes a year — are disposed of similarly**.** The environmental problems created by industry stem primarily from the use of a strictly linear production process of extracting raw materials and fossil energy, processing the material and energy, and dumping the waste back into natural systems. In response, an innovative new theory termed Sustainable Industrial Network (SINET) is emerging to guide industries towards sustainable production. SINET aims to incorporate the cyclical patterns of ecosystems into designs for industrial production processes that will work in unison with natural systems.

The overall objective of the proposed Initiative is to develop and adapt solutions to promote sustainability of the micro regions, specifically through making the Industry network(key economic activity) of the micro region more effective and efficient, thereby making products, processes & services at the micro region more resource efficient and less polluting. The leather industry occupies a prominent place in the Indian economy in view of its substantial export earnings, employment potential and growth. The Indian Leather industry is the third largest export earner in the country. The industry covers a vast spectrum of inputs, activities, skills and products i.e. livestock, hides and skins, tanning, leather products and exports. The industry generates huge amount of waste which is utilised by other allied industries for by-product manufacturing and the remaining amount of waste is then best treated for waste minimization**.**

Here we will focus on the current export basket of the leather industry.

Current export basket of Indian leather industry:

Product category	Exports	US$ million % on total exports
Finished leather	688.05	23%
Leather footwear	950.90	32%
Leather garments	308.98	10%
Footwear goods	212.65	7%
Leather goods	690.66	23%
Saddlers and harness	81.85	3%
Non-leather footwear	48.69	2%

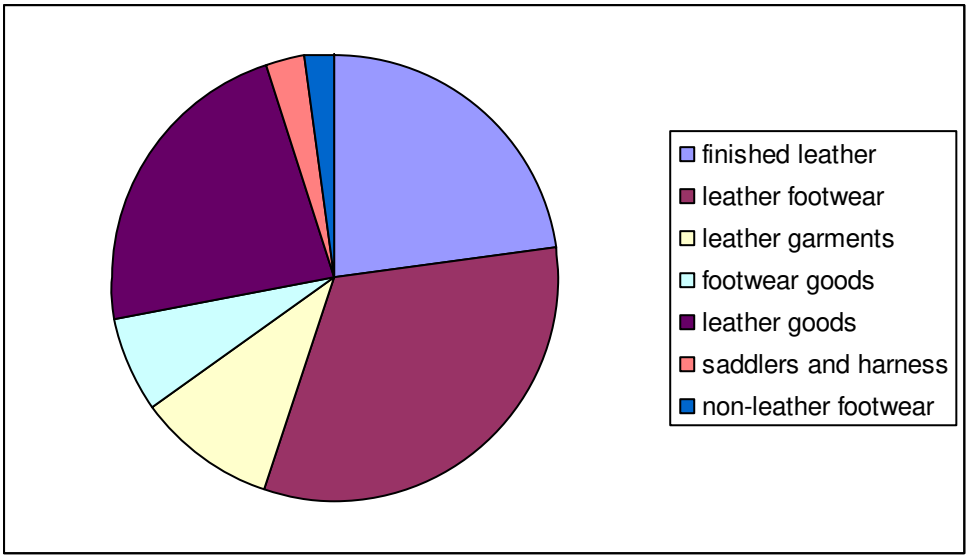

Table 1A and 1B- Current export basket of Indian leather industry.
Source - *http://leather.webindia.com/exec.htm*

4. The Benchmark Model

We have considered a four sector general equilibrium model, in which, a small open economy is broadly divided into a formal domestic manufacturing sector, a non-traded intermediate informal manufacturing sector, an agricultural sector and a foreign enclave. Due to small open economy assumption, the product prices are internationally given. Production function exhibits constant returns to scale with diminishing marginal productivity to each variable input .The formal domestic manufacturing sector uses labour and intermediate good as inputs. The foreign enclave uses sector-specific foreign capital and labour as inputs. The agricultural sector and the non traded intermediate sector use labour and domestic capital as inputs. Domestic capital is perfectly mobile between the agricultural sector and the informal sector. Wage rate is fixed at w_M in the formal manufacturing sector by the trade union. Wage rate of the agricultural workers and the informal sector workers is flexible. All the input output coefficients are variable. The formal sector is made to pay a pollution emission tax for any pollution level higher than the permissible level that is determined by the regulatory authority. Since the informal manufacturing sector creates pollution, increase in the use of informal sector output in the formal sector raises the level of pollution and widens the discrepancy between actual and permissible levels of pollution. The efficiency of a representative worker is inversely related to the level of pollution. In this framework, we show that even if the permissible level of pollution is reduced, the polluting informal sector may expand and worsen the environmental standard. Here, we have assumed that pollution is

mainly from the informal sector and there is no pollution from the agricultural sector. We have also assumed that the informal manufacturing sector is capital intensive.

The following notations are used to describe the equational structure of the model.
P_i : price of the i^{th} product; i=M,A, I,F.
X_i: output of the i^{th} sector, i=M,A,I,F.
h: nutritional efficiency of each worker.
Lh (Ω): total calories intake of total labour.
a_{Li} : labour-output coefficient in the i^{th} sector,i=M,A
a_{Ki} : capital-output coefficient in the i^{th} sector,i=M,A
$\overline{w}_m$: unionized wage of the workers in the formal manufacturing sector.
r: rate of return on domestic capital.
r_f : rate of return on foreign capital.
Ω : maximum permissible level of pollution.
α_I : emission coefficient.
Z : total level of pollution.
K_D : domestic capital stock
K_F :foreign capital stock.

Here, the maximum permissible level of pollution is denoted by Ω.
We have,$\alpha_F X_F + \alpha_M X_M + \alpha_A X_A \leq \Omega$

Total level of pollution is denoted by Z and we can express it as: $Z= \Omega + \alpha_I X_I$
where,α_I is the emission coefficient .
Without the loss of generality, we have assumed that, the product of sector 'A' as the numeraire.Thus,$P_A=1$.

The competitive equilibrium conditions can be written as

$$P_M = a_{LM}.\overline{w}_M + a_{IM}.P_I \quad (1)$$

$$1 = a_{LA}.w + a_{KA}.r \quad (2)$$

$$P_I = a_{LI}.w + a_{KI}.r \quad (3)$$

$$P_F = a_{LF}.w + a_{KF}.r_F \quad (4)$$

From the domestic demand-supply equality of the intermediate good we get
$$a_{IM}X_M = X_I \quad (5)$$

The full employment conditions are given as
$$a_{KA} X_A + a_{KI}n X_I = K_D \quad (6)$$
$$a_{KF} X_F = K_F \quad (7)$$
$$a_{LM} X_M + a_{LA} X_A + a_{LI} X_I + a_{LF} X_F = Lh (\Omega) \quad (8)$$

Here, we have 8 equations with 8 unknowns namely, w, P_I, r, r_F, X_M, X_A, X_I, X_F. Thus, the system is consistent. From equation (1), P_I can be determined, as $\overline{W}_M$ is fixed and then from equation (2) and (3), w and r can also be determined. Again, from equation (4),r_F can be determined. So, we can say that, factor prices are independent of factor endowments and hence, *Decomposability Property* holds.

From equation (5),$X_M=X_I/a_{IM}$ and again, from equation (7),$X_F=K_F/a_{KF}$
Substituting these values in (8), we get,

$a_{LM} X_I/a_{IM} + a_{LA} X_A + a_{LF} K_F/a_{KF} + a_{LI} X_I = Lh\ (\Omega)$

or, $X_I(a_{LM}/a_{IM} + a_{LI}) + a_{LA} X_A + a_{LF} K_F/a_{KF} = Lh\ (\Omega)$

or, $X_I\{(a_{LM}+a_{LI}.a_{IM})/a_{IM}\}+ a_{LA} X_A + a_{LF} X_F = Lh\ (\Omega)$ (9)

Totally differentiating (9), we get,

$\{(a_{LM}+a_{LI}.a_{IM})/a_{IM}\}dX_I + a_{LA}\, dX_A = 0$

or, $dX_I/dX_A\big|_{LL} = \{-a_{LA}/(a_{LM} + a_{LI}\, a_{IM})\}/a_{IM} < 0$

The above equation represents a locus of X_A and X_I named LL, such that the labour market is in equilibrium and is negatively sloped.

Totally differentiating equation (6),we get,

$a_{KA}\, dX_A + a_{KI}\, dX_I = 0$

or, $dX_I/dX_A\big|_{KK} = -a_{KA}/a_{KI} < 0$

The above equation represents the locus of X_A and X_I named KK, such that the domestic capital market is in equilibrium and is negatively sloped.

Note, $\left|\ \{a_{LA}/(a_{LM}+a_{LI}\, a_{IM})\}/a_{IM}\right| > \left|a_{KA}/a_{KI}\right|$

or, $a_{LA}/a_{KA} > \{(a_{LM}+a_{LI}\, a_{IM})/a_{IM}\}/a_{KI}$

or, $a_{LA}/a_{KA} > (a_{LM}/a_{IM} + a_{LI})/a_{KI}$

From the above expression, it can be stated that, the agricultural sector is more labour intensive than the informal sector when labour requirement is measured in direct and indirect terms. Thus, we can say that LL is steeper (see figure-1).

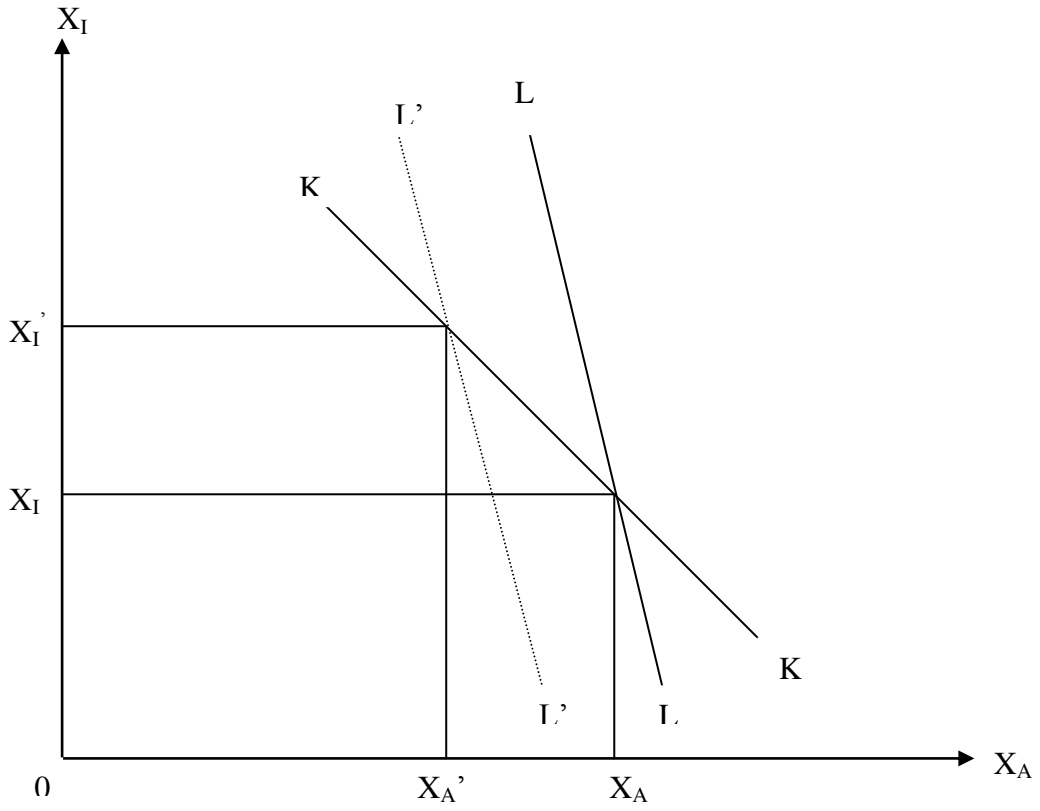

Figure 1

Intuitively, from figure 1, we can say that, with the increase in the level of pollution, the maximum permissible level of pollution also increases and the environmental standard gets degraded.Consequently,the health of workers' get affected and their nutritional efficiency (h) deteriorates.So,total calories intake of total labour falls and eventually, effective labour also gets deteriorated and hence,LL shifts to the left to L'L'As a result, output of the informal sector,X_I rises and the output of the agricultural sector,X_A falls. In other words, pollution emanating mainly from the informal sector, has affected health of the workers' and so, output of the labour intensive agricultural sector falls whereas, output of the capital intensive informal sector rises.So, we can say that this is a 'Rybczynski type' effect.

Again, from equation (5) we can say that, since, output of the informal manufacturing sector,X_I rises so, output of the formal manufacturing sector, X_M must also rise.

Next, we will focus on what happens when a strict environmental control is exercised:

We know that formal sector's pollution can never exceed the maximum permissible level, Ω, so they subcontract a part of their production to the informal sector. When there is strict environmental control, formal sector subcontracts production to the informal sector and hence, output of the informal sector, that is, X_I rises.

It is to be noted that, total pollution can be expressed as: $Z= \Omega + \alpha_I X_I$. Therefore, strict environmental control means, maximum permissible level of pollution is restricted to a lower limit. Since, we have just seen that, with strict environmental control, the output of the informal sector rises, it basically implies, total pollution will increase. Note, here, we get a paradoxical result in which, the strict environmental control leads to local outsourcing and hence, leads to more pollution, thereby degrading the environment even more. We can infer from this model, that, it is the Informal sector that plays a major role in increasing the level of environmental pollution. If the informal sector has not been taken into consideration, then, the total level of pollution would have been within the maximum permissible level of pollution.

5. Concluding remarks:

In this paper an attempt has been made to analyze theoretically, the effect of environmental pollution on the output of different sectors in a small open economy consisting of an informal intermediate goods sector. It also shows that we get a paradoxical result, that strict environmental control accentuates the total level of pollution. Here a hybrid type of general equilibrium trade model has been used to analyze the problem. From the theoretical framework, it is obvious that one cannot deny the key role played by the informal sector in degrading the environment. Apart from that in this short article we have captured the argument behind the outsourcing of formal sector services to informal sector. Therefore, we basically promote pollution intensive sector and in turn we enjoy the gains from trade due to favorable comparative advantage.

References:

Antweiler, W, B.R. Copeland and M.S Taylor (2001): "Is free trade good for the environment?" *American Economic Review,* 91(4), 877-908.

Chaudhuri, S. and K.Gupta (2004): "*Inflow of Foreign capital, Environmental Pollution and Welfare in the presence of an Informal sector*", paper presented at the Indian Statistical Institute, Kolkata conference, January, 2004.

Hettige, H., M.Mani and D.Wheeler (2000): "Industrial pollution in economic development: the Environmental Kuznets curve revisited", Journal *of Development Economics* 62,445-476.

Lucas, R. E., B. D. Wheeler and H. Hettige (1992): "Economic development, Environmental regulation and the International migration of toxic industrial

pollution :1960-1988" ,in P. Low (ed.) *International Trade and the Environment,* World Bank discussion paper 159,World Bank ,Washington D.C.

Mani,M. and D.Wheeler (1998): "In search of pollution havens? Dirty industry in the world economy: 1960-1995", *Journal of Environment and Development* 7(3), 215-247.

Mukhopadyhay,K., Chakravorty, D. and Dietzenbacher, E., (2005): "Pollution Haven and factor endowment hypotheses revisited: Evidence from India", *paper presented in the 5th international input-output conference at Renmin university in Beijing, China, during June27-July 1.*