

# ECONOMIC DEVELOPMENT AND THE NEED FOR ENVIRONMENTAL MANAGEMENT IN THE ISLAND OF MAURITIUS

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## **Abstract**

The economy of Mauritius has already shown signs of environmental stress in resources pertaining to water, the fisheries and forestry. This paper essentially identifies key socio-economic areas, which could possibly account for environmental degradation and subsequently the depletion of natural resources. Such areas warrant careful attention and investigation since they largely determine the sustainability of future exploitation of natural resources and economic growth. We address the issue linking economic development with environmental stress by analysing exclusively, the business community, the household sector and the government, which are all stakeholders in the exploitation of the island's resources. In fact, it is found that there are several areas, which will require significant government intervention and collaboration of the private sector to harmonize the prudent utilization of resources while making a better Mauritius.

**Keywords:** *Agriculture, Natural Resources, Planning Policy, Technological Change, Land Ownership and Tenure, Environmental Management.*

## **1 INTRODUCTION**

Stress on the stock of resources is a usual phenomenon in an economy, which experiences economic growth. However, the severity of this stress depends to a great extent on the stage of economic development already attained. The concept environmental degradation, as growth occurs, is often dictated by the theoretical hypothesis characterised by the Environmental Kuznets Curve<sup>1</sup> (EKC) (See Dasgupta and Mäler (1995) and Arrow et al. (1995)). The EKC predicts that in its initial phase of economic development, a country experiences increasing environmental degradation, but after attaining a certain income threshold, this degradation subsides as further development sets in. This decline could be explained by the active intervention of the government through reforms, necessary pollution abatement and resource management programs. Thus, environmental degradation follows a quadratic path with respect to output. Moreover, depletion of available stock of resources to maximise current growth rates and its non-replacement constitute a high opportunity cost for future generations. Hence, this phenomenon greatly begs for our attention to ascertain the intensity of the problem and to design effective policies with an attempt to resolve the conflict between efficient resource management and maximisation of growth rates without seriously compromising the resource needs of future generations.

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<sup>1</sup> The whole idea of EKC originated from Kuznets (1955) theoretical postulate of the inverted-U hypothesis, which characterises income inequality as growth occurs. For a recent empirical discussion see Panayotou (1997).

Indeed, Mauritius provides an interesting case study both as a small open island and a rapidly growing economy typified by structural shifts. While agriculture still occupies a central place at a time when the economy is strengthening its manufacturing sector, the island is turning into an ever-increasing tourist resort. Consequently, one can easily reckon the strain that currently exists on natural resources and its future threat. At this stage of the country's economic progress, not much has been done to ascertain this strain on the renewable resources of the island. Growth has been taken for granted as a major challenge for the government with no significant endeavours towards efficient resource management. It was in the early 1990s that the state actually started to care for the environment and created subsequently a new Ministry for its purpose. For a review of the political economy of environmental reforms, see the 'State of the Environment (1991)' and 'Agenda 21, National Report (1997)'.

In recent years, the economy has shown remarkable growth rates, averaging 5% annually, while transiting into still a more industrialised economy. However, this promising tendency has brought about several costs to the nation as a whole and particularly towards resource utilisation and its sustainability. Given this trend, there is no doubt that environmental degradation has become a by-product of growth that potentially could easily jeopardize future growth performance. Actually, environmental stress has already been experienced in the fisheries, forestry and water resources. These sectors constitute the very basis of the economic well being of the nation and its sustainable development. Lack of government intervention and excessive reliance on free market forces necessitate at this stage a more efficient management of natural resources. What exacerbated the environmental stress over the last decade in the Mauritian economy is growth of its third pillar-tourism. This sector is expected to grow exponentially with the restructuring of the international airport and the expansion of airline networks, thereby putting more pressure on the natural resources of the island.

In this paper we address trends of key sectors of the Mauritian economy and their potential implications for natural resource management. We try not to be ambitious and simply identify areas that require our attention and evaluation. Rest of this paper is organised as follows: Section 2 deals with the business community, Section 3 addresses issues pertaining to the household sector, Section 4 analyses public infrastructure needs and limitations, whereas Section 5 concludes.

## **2 THE BUSINESS COMMUNITY**

In this section, three sectors are analysed separately, namely, agriculture, manufacturing and tourism. We focus on the agricultural sector in the first place. Agriculture in Mauritius remains dominated by the sugar industry as the major producing unit and contributor towards GDP. In the sub-sections that follow, we discuss recent trends and features of this sector and their implications for natural resource depletion.

### **2.1 Agriculture**

Over the last decade, the primary sector has been sinking. Its contribution has fallen from 12.3% of GDP in 1990 to 8.9% in 1998 and 6.0% in 1999. The decreasing importance of this sector could be attributable to the fact that many economic agents are finding it more profitable to invest in other sectors of the economy such as manufacturing, services or finance. Hence, several acres of land that were under the grip of agriculture have been released and offered for sale recently. Else, the fragmentation of land due to heritage and scale diseconomies have further accentuated the decrease in effective area cultivated as revealed in Table 1. Despite these drastic changes, agriculture remains a key sector for the Mauritian economy.

2.1.1 Water Pricing and Property Rights

Table 1 provides clear indication that the agricultural community exerts a strain on water resources over the island. The proportion of cultivated area being irrigated is on the rise while the effective area cultivated is decreasing, implying an increase in the average effective land under cultivation being irrigated. This may well substantiate mismanagement of water resources in Mauritius through the hypothesis that water is either priced too low<sup>2</sup> or the agricultural community has far too easy access to this resource through, for example, ill-defined property rights.

**Table 1: Land under irrigation and cultivation**

| <b>Attributes (in hectares)</b> | <b>1990</b> | <b>1998</b> | <b>1999</b> |
|---------------------------------|-------------|-------------|-------------|
| Hectares Irrigated              | 14248       | 18379       | 18876       |
| Effective area cultivated       | 85889       | 79148       | 78873       |

*Source: Central Statistical Office (2000).*

Altogether, the low water charge and the easy access to boreholes, will gradually make water resources scarcer for irrigation purposes especially during deficient rainy seasons. It is good to observe that many rivers and rivulets cut across several acres of agricultural land and if demand for non-conventional irrigation water is increasing, this only adds support to the systematic decline in the conventional water resources for irrigation. To have an idea of the external costs of increasing water demand for irrigation purposes we can consider Table 2 that focuses on users of bore holes.

**Table 2: Users of bore holes**

| <b>User group</b> | <b>Access to bore holes</b> |
|-------------------|-----------------------------|
| Household         | 109                         |
| Industry          | 104                         |
| Agriculture       | 101                         |

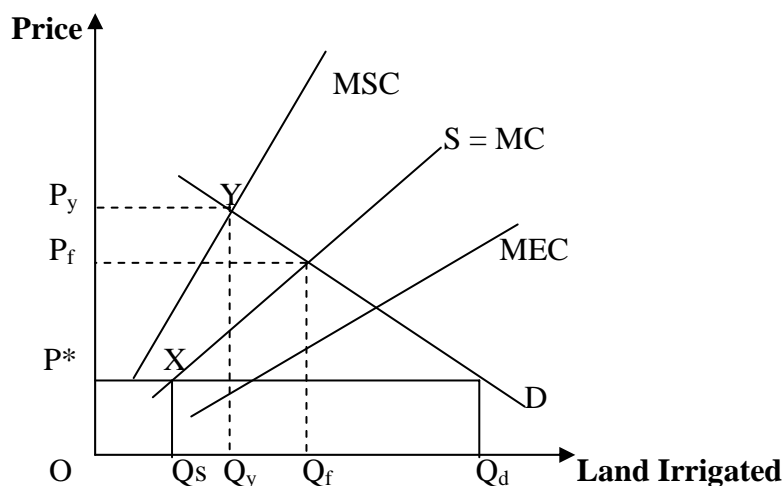
*Source: Irrigation Authority (2000)*

Water is a quasi public good, implying that its consumption by one sector will lead to a decline in the amount available for the remaining sectors. The rising demand for irrigation entails significant drilling of water that places negative externalities on the other sectors of the country, sharing groundwater resources. Water wastage by the agricultural community places a heavy external cost on household and industrial agents. The recent drought of 1999/2000 has proven to be exemplary in that the non-agricultural community had to bear several water cuts and disruption of supply to respond to the needs of the agricultural sector. If water resources are not properly managed, we are bound to find it even more difficult to sustain the ever-increasing demand for irrigation in future.

One possible way to reduce the loss of water from irrigation and to restrict demand at the same time is to internalise the externality through a Pigouvian tax. To understand this, we can look at Figure 1.

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<sup>2</sup> Madhoo (1999) reports inefficient pricing of water in Mauritius using the hedonic method to public good analysis.



**Figure 1: Inefficiency in and External Costs of Irrigation**

The diagram represents the market conditions for irrigation, in which the market-clearing price is  $OP_f$  at the intersection of demand (D) and supply ( $S = \text{Marginal Cost (MC)}$ ). However, with a price fixed instead at  $OP^*$ , there is bound to be a shortage of irrigation on the market, denoted here by extent  $Q_d - Q_s$ . The inefficient price at  $OP^*$  could characterise the case of Mauritius. There is always a potentially unsatisfied demand for irrigation, which the water authorities would like to overcome. Besides, the curve MEC constitutes the marginal external cost of wastage in irrigation in terms of opportunity costs to the other sectors. To rationalise this market, there is need for intervention, through the imposition of Pigouvian tax. This would have the effect of restricting supply to Marginal Social Cost (MSC). In this way a rate equivalent to  $OP_y$  would be charged and this will reduce effective demand to the socially desirable level of  $OQ_y$ . The elimination of excess demand would bring altogether a reduction in the potentially higher external cost.

### 2.1.2 Agricultural Sprays and Environment-Friendly Products

Still within the agricultural sector we come across the use of pesticides and alternative forms of agricultural sprays applied to maximise crop yields. In recent years, at the same time, the amount of fertilisers consumed has increased. No serious study has been conducted so far to evaluate the impacts of these effluents on our aquifers and ultimately on water quality. Given the topography of the island and presence of many rivers, rivulets and drains in fields, the probability that these chemical substances are carried away into aquifers cannot be underestimated.

The expected changes that will happen in the field of international trade through the advocacy of free trade policy and the eventual disappearances of protective laws will set the competitiveness of Mauritian exported agricultural goods at stake. The agricultural community must develop new ways and means to improve the quality of products, for instance, producing seedless fruits. Moreover, the international community is interested in bio-products, which are produced under environmentally friendly conditions. Hence, massive investment is required within agriculture to accommodate these future challenges and at the same time to research on the accompanying implications for natural resources.

## 2.1.3 Land Use and Deforestation

In addition to the above, we may also look at how forestry resources are threatened by economic development. Given that the effective area cultivated is decreasing, it is a fact that due to greater population, urbanisation and rural development, built – up areas will absorb a greater proportion in land utilisation. Agricultural plots are already being converted into industrial and residential areas. However, growth of these sectors will surely lead to a greater destruction of forests and grassland in the long run. Needless to say, this will adversely interfere with bio-diversity and the natural flora and fauna. Table 3 shows the transformation in terms of land utilisation in Mauritius between 1986 and 1996.

**Table 3: Land use in Mauritius (1986 and 1996)**

| Land Use           |  | 1986<br>Area<br>(hectares) | %    | 1996<br>Area<br>(hectares) | %    | Change |
|--------------------|--|----------------------------|------|----------------------------|------|--------|
| <b>Agriculture</b> |  | 91,574                     | 49.1 | 84,424                     | 45.3 | -7,150 |
|                    | Sugar cane   | 83,289                     |      | 76,814                     |      | -6,475 |
|                    | Tea  | 3,776                      |      | 1,109                      |      | -2,667 |
|                    | Tobacco  | 600                        |      | 611                        |      | 11     |
|                    | Food crops   | 1,791                      |      | 1,333                      |      | -458   |
|                    | Fresh vegetables                                     | 2,118                      |      | 4,557                      |      | 2,439  |
|                    |  |                            |      |                            |      |        |
| <b>Forestry</b>    |  | 65,400                     | 35.6 | 56,639                     | 30.4 | -8,761 |
|                    | Planted forests                                      | 12,307                     |      | 13,089                     |      | 782    |
|                    | Natural forests <sup>1</sup>                         | 8,485                      |      | 8,325                      |      | -160   |
|                    | Savannah, scrub,<br>grazing and other<br>forest land | 44,608                     |      | 35,225                     |      | -9,383 |
|                    |  |                            |      |                            |      |        |
| <b>Community</b>   |  | 29,526                     | 15.8 | 45,437                     | 24.4 | 15,911 |
|                    | Reservoirs   | 1,180                      |      | 1,165                      |      |        |
|                    | Swamps and<br>rocks                                  | 1,430                      |      | NA <sup>2</sup>            |      |        |
|                    | Roads (including<br>agricultural roads)              | 3,465                      |      | NA <sup>2</sup>            |      |        |
|                    | Built up areas                                       | 23,451                     |      |                            |      |        |
| <b>TOTAL</b>       |  | 186,500                    | 100  | 186,500                    | 100  |        |

**Notes:** <sup>1</sup> Includes mountain reserves (government and private owned) excluding river reservoirs. <sup>2</sup> NA (Not Available)

**Sources:** *State of the Environment in Mauritius (1991) & Agenda 21, National Report (1997)*

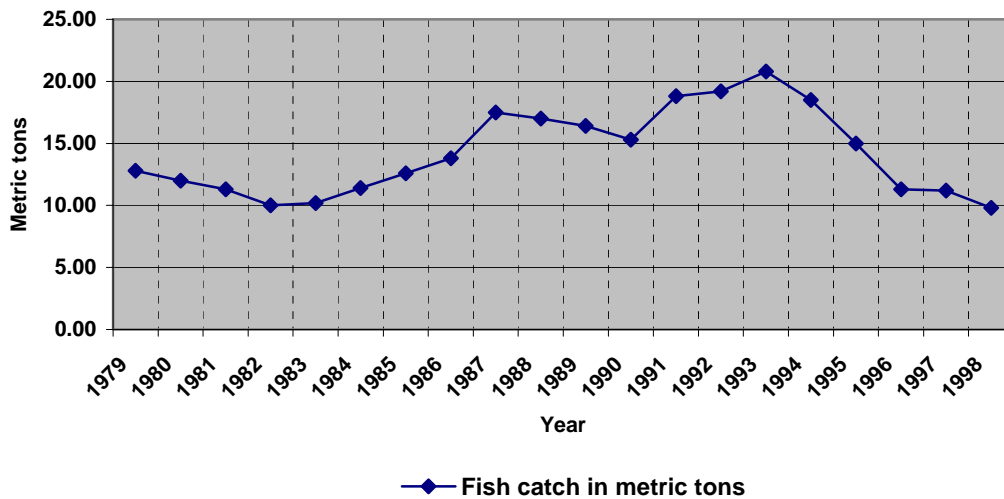
While clearly the share of agriculture is sinking, it is found that forestry resources are being degraded at the same time. Though the Conservation Department of the Ministry of Agriculture has done a remarkable job by increasing the amount of planted forests, this is insufficient to offset the dramatic fall in this sector. Further, the table reveals that it is principally the community that utilises more land through road networks, residential or commercial buildings. Conservation of forests in Mauritius is an essential activity, since forestry resources are used for various socio-economic purposes, such as, rearing of animals in

general and deer, in particular, preventing soil erosion in highly exposed areas of the island, providing catchment areas for rainfall, leisure resorts and more importantly for eco-tourism.

### 2.1.4 The Fisheries

Despite guesses have been made regarding the possible effects of industrial wastes in certain parts of our lagoon and overexploitation of the fisheries resources, very little research has been carried out on this issue. Figure 2 shows how fish catch has been decreasing rather surprisingly over the last few years.

Figure 2: Fish Catch in Mauritius



Source: Central Statistical Office (Multiple Issues)

Decreasing fish catch could be the result of overexploitation in certain areas where poverty is significant. Incidentally, it is found that income inequality has worsened in recent years. The Gini coefficient, which in 1991/92 was 0.379, was 0.387 in 1997/98. Poor families in coastal Mauritius overexploit fisheries resources because they do not have the proper educational attainment and skills to secure a job elsewhere in the economy. Worse, while it has become customary to use child labour to catch fish, children are expected to spend several hours at fishing and to do more than one trip daily. In the process, juvenile species are often caught and sold at lower prices. Tourism further complicates matters since it adds pressure to the exploitation of fish given that tourists like seafood and hotels usually pay very high prices for these products. Furthermore, the increasing number of hotels around the coast leads to greater disruption of marine life, through the erection of sophisticated infrastructures along the shore. Sobhee (2000) has analysed the implications of access to public education, the growing Mauritian population and tourism for the degradation of fisheries resources in Mauritius. It was found that the prohibitive costs of attending schools refrain many parents in coastal Mauritius to send their kids to school. The latter are instead used as workers and contributors towards family income. They do not have any alternative other than using the natural capital for an income or a living. This is how many fishermen end up performing the same job as their father and grandfather.

## 2.2 Industrial Production

Manufacturing constitutes the first pillar of the Mauritian economy. Its contribution towards GDP has always been increasing over the past few decades; for example, it was 32% in 1990

and rose to 32.8% in 1999. This growth is however complemented with the rise in industrial permits issued; 485 in 1990 to 537 in 1999. While the contribution of industrialisation towards economic growth cannot be underestimated, it bears however significant external costs on the Mauritian community in terms of pollution and disturbances of aquatic life.

Recently, some industries have been caught for spreading effluents into the sea. Examples of such catastrophes could be seen in the northern part of the island. It is only some time back that the necessary action was taken to remedy the problem. Altogether, there is lack of control over the technology being used in certain industries that could cause a lot of damage to the environment. Sustainable economic growth requires the use of an environment-friendly know-how. Like agriculture, the industrial sector is also going to be affected with the move towards greater trade liberalisation. In fact, the case of Mauritius is not very bright when we consider the various factors that will interact to determine the sustainability of this sector. At present, Mauritius is already facing a problem of competitiveness in its manufacturing exports. The high and escalating labour costs are at the apex of this problem, and given the strong commitments of trade unions, it would not be easy for enterprises to cut down production costs. It is good to observe that while unit labour cost index in the Export Processing Zone (EPZ) rose from 230 in 1990 to 380 in 1999, productivity rose from 261.3 to 422 for the same period. In addition, the international community emphasizes the adoption of environment-friendly goods and technology that does not seem to be forthcoming at least in the short-run. Therefore, Mauritius has to face these two economic challenges; to lower labour and production costs and to develop environment-friendly products. In the economic jargon, this constitutes a trade off between labour and capital. The industrial sector must think of moving more towards a capital-intensive technology, which may solve the problem of expensive labour costs and ease the adoption of an environment-friendly technology. However, given the socio-economic problems that this will cause, particularly on unemployment, an in depth investigation is required.

### 2.3 Tourist Industry

Tourist earnings constitute around 5.0% of the Mauritian GDP and an income multiplier of 0.96 (see Swarbrooke, 1998). In spite of its enormous contribution towards raising growth rate of the country and improving the economic wellbeing of each citizen, tourism has got serious environmental implications. Table 4 shows the tourist statistics over the past decade.

**Table 4: Tourist statistics**

| <b>Attributes</b>   | <b>1990</b> | <b>1998</b> | <b>1999</b> |
|---------------------|-------------|-------------|-------------|
| Arrivals            | 2916        | 558.2       | 578.1       |
| Average Expenditure | 12,500      | 21,300      | 23,600      |
| Hotels Number       | 75          | 90          | 92          |

*Source: Central Statistical Office (2000)*

Tourism indeed has a serious impact on the coastal environment. With the construction of more hotels to satisfy tourists' demand around the coast, the coastline of the island is being constantly modified. The construction of sophisticated hotels has greatly interfered with marine life. Also, the increased boating and surfing activities have led to the destruction of coral reefs that constitute the marine flora and fauna of the island. Besides being part of our national heritage, coral reefs are also the homes and hunting zones of different species of fish. In the South East, the coastal morphology has been transformed with the eradication of casuarinas and mangroves. Needless to say, this was done to make room for swimming resorts

and to facilitate the practice of sports. One can summarise the problems associated with the tourism industry as follows:

- Developments are seen often to be too large scale, that is, their scale is not appropriate to the location
- High-rise styles of architecture, which are out of place and at odds with traditional local buildings
- The infrastructure often lags behind the building development with the result that water pollution occurs
- The inflationary implications on land prices

Before things grow worse, it is high time to make a careful evaluation of the damages caused by the increasing number of tourists to the marine and coastal environment as well as stress on fresh water resources. There is need as well to strike a balance between economic growth and tourist arrivals, by determining an optimal number of tourists that can be accommodated<sup>3</sup>. Lastly, we need to make sure that the whole concept of ecosystems is respected in the very first place whenever it comes to the construction of a new hotel.

### 3. HOUSEHOLD COMMUNITY

Not only should we express concerns for the environmental implications of the growing world of businesses but as well as the household community. The main source of environmental stress occurs because of the rising population – the greater need for housing, land conversion, infrastructural demand, space and energy. To broaden this perspective, let us first observe the demand for household and household amenities as illustrated in Table 5.

**Table 5: Housing units and amenities**

| Type                                  | 1990         | 1999           |
|---------------------------------------|--------------|----------------|
| Units                                 | 198.6        | 223.8          |
| Amenities: Toilet<br>(of which flush) | 98%<br>47.5% | 99.3%<br>62.8% |
| Acceptable refuse<br>Disposal         | 61.3%        | 68.4%          |

*Source: Central Statistical Office (2000)*

This table provides astonishing facts about the Mauritian household that have serious environmental implications. Regarding amenities, still 37.2% of households did not have a flush toilet in 1999. This would mean that some Mauritian households are still using pits. Undoubtedly, this cause of wastewater has very adverse consequences on aquifers and underground water quality. Besides, 31.6% of households do not possess an acceptable refuse disposal of wastes. Here again a lot of apprehension can be expressed as to the direct effects of these effluents on the physical environment.

In addition to the effects on water resources, growth of household units may also have adverse effects on forestry resources. The rising units of housing would substantiate the conversion of agricultural land and subsequently forest and grassland into residential areas. Probably it is high time to investigate into housing infrastructure or design in such a way to limit the demand for land conversion. Also, the increasing demand for housing has accentuated the demand for sand removal. Around 800,000 to 900,000 tons of sand used to be

<sup>3</sup> Nath (1998) proposed an environmental tax on tourism in the Mauritian context to compensate for the environmental damages caused by this industry.



extracted every year. Consequently, this had caused serious distortion to the coastal line and marine life. Despite new legislation to prohibit sand removal, there are still several constraints to be overcome, such as supply of an alternative and its socio-economic cost implications.

26.3% of households still use wood and charcoal for cooking. Hence it is a case that prompts investigation to find out the households' sources of wood supply. Households are also responsible for carbon emissions. Though Mauritius is not a producer of non-renewable resources, it does import a lot of these. Table 6 below reports energy consumed over the last decade.

**Table 6: Housing units and amenities**

| Type                                  | 1990         | 1999           |
|---------------------------------------|--------------|----------------|
| Units                                 | 198.6        | 223.8          |
| Amenities: Toilet<br>(of which flush) | 98%<br>47.5% | 99.3%<br>62.8% |
| Acceptable refuse<br>Disposal         | 61.3%        | 68.4%          |

*Source: Central Statistical Office (2000)*

These imports provide clear indication of carbon emissions<sup>4</sup>. No study has been conducted to find ways and means probably to restrict these emissions through market based strategies or government intervention. Technical change can bring a lot of gains or economies of scale whereby the amount of energy consumed will decrease substantially and so will the amount of carbon emitted. We consider it to be a fundamental objective for the reduction of carbon dioxide emissions to minimise their impacts on the health of people and the environment in general.

Furthermore, the energy consumed is imported and if proper resource management is undertaken in output generation, Mauritius would surely benefit from a strong cut in its energy imports which would bring a lot of economic gains in terms of improved balance of payments and lower production costs. With an environment-friendly technology and a cut in carbon emissions, the negative externalities of industrial production could as well be reduced substantially.

#### **4. PUBLIC INFRASTRUCTURE**

An indirect relationship exists between public infrastructure and environmental pollution. If public infrastructure in a country is not properly or efficiently built, it is likely to generate external costs to the nation in terms of pollution and road accidents. Mauritius faces this problem especially in city centres in general but Port – Louis, the capital, in particular, due to lack of decentralisation of both public and private services. Nearness to the harbour is a major reason for the location and concentration of many businesses in this city. Altogether, the efficacy of infrastructure, which exists that links the other places to the city, is questionable. To provide some insights of the effectiveness of public infrastructure in Mauritius in general we can consider Table 7 which provides us with the necessary statistics regarding vehicles and road accidents.

With an increasing number of motor vehicles and an inefficient public infrastructure one is likely to encounter more road accidents and more energy being wasted. Traffic congestion, which is a by-product of an unreliable infrastructure, causes a lot of wasted energy that leads to more carbon emissions.

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<sup>4</sup> Bertram (1996) discusses the tradable emission quotas for several countries including Mauritius. He found that 0.33 metric tonnes of carbon constitute the hypothetical quota for Mauritius.

**Table 7: Road accidents and number of motor vehicles registered**

| Item                             | 1990  | 1998  | 1999  |
|----------------------------------|-------|-------|-------|
| <b>Motor Vehicles registered</b> | 123.5 | 222.3 | 233.4 |
| <b>Road Accidents</b>            | 10316 | 18055 | 17877 |
| <b>Fatality rate</b>             | 13.9  | 14.4  | 14.9  |

*Source: Central Statistical Office (2000)*

Public infrastructure is an important resource for production or for the exchange of transactions. Inefficient public infrastructure combined with rising population are bound to cause diminishing returns to output and trade. A reorganisation of public infrastructure will improve the transport and communication networks and will impact positively on growth. Further, it will help to reduce external costs such as road accidents and traffic congestion. In this way, energy consumed by vehicles can be saved and carbon emissions minimised. Sobhee (1999) found that public infrastructure and private capital formation are positively related. This complementary relationship necessitates greater public investment in road and communication networks. While this policy will raise output in the long run, through greater private capital formation, it will also provide a more reliable infrastructure for foreign direct investment. Such capital inflows could provide in a way the necessary capital formation for the acquisition of new technology thereby easing the production of environment-friendly goods. Altogether, road networks must be built in such a way that their distortionary impacts on forestry resources are minimised. To achieve this, careful planning is required beforehand and probably the whole engineering of public infrastructure must be revised.

Regarding water networks, state intervention is essential to improve rain harvest, treatment of water and its distribution. One of several reasons that can explain wastage of water is the obsolete network characterising water distribution across the island. The Central Water Authority, the monopoly supplier of water, which already faces severe financial constraints must benefit from judicious financial assistance to update and strengthen its water networks throughout the island.

Public investment in infrastructure is also of paramount importance to the household community regarding waste disposal. While several households do not possess an acceptable means of waste disposal, the government can mobilise funds to construct more waste disposal sites throughout the island. However, this arrangement may be necessary but not sufficient to prevent wastewater to leak out into the country's aquifers, like the case of Mare Chicose. Hence it is essential to ensure qualitatively that such infrastructures are strongly built to avoid interferences with water resources and water quality.

## **5. CONCLUSION**

This paper has attempted to pinpoint the grey areas that require our attention in natural resource management. Mauritius has experienced remarkable growth rates in the past and this has altogether generated some costs in the form of stress on natural resources. It is high time for the government to adopt significant reforms that will prevent further environmental degradation and will lead to more efficient natural resource management. If both the private sector and the state collaborate in this objective one can expect sustainable economic development in the near future, that is, growth with significant reduction in environmental costs.

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