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ECO-FRIENDLY CREDENTIALS OF NATURAL RUBBER

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Natural rubber is one industrial raw material that is produced from a renewable and non-polluting source. Natural rubber enjoys excellent green credentials that are generally overlooked. This paper describes the various eco-friendly and people-friendly credentials of natural rubber that we often take for granted. But, for modern man who is very sensitive about the quality of his habitat, they are of great importance. It is true that for every developmental activity we have to pay an environmental cost, but in the case of natural rubber this cost has been a minimum.

The contribution of world rubber plantation towards global carbon sequestration is quite significant. Natural rubber plantations are efficient users of solar energy in producing plant biomasss. Apart from being a high biomass producer, *Hevea* is also an efficient user of water and nutrients. The water use efficiency of natural rubber is better than several forest tree species. The addition of organic matter to the soil through the litter from both the rubber leaves and the cover crop improves the physical, chemical and biological properties of the soil. Natural rubber cultivation has actually improved and sustained soil productivity. Its cultivation does not deteriorate the environment but it reclaims, improves and preserves the ecosystem and maintains the long-term productivity of the soil. A mature rubber plantation is a self sustaining and dynamic ecosystem with relatively minimum external agronomic inputs compared to many agricultural systems. The use of chemical fertilizers, insecticides, pesticides and fungicides is only to a very minimum in a rubber plantation.

Natural rubber cultivation is not only friendly to the ecosystem but also farmer friendly. Cultivation of this crop led to significant improvement in the living standards of millions of people in all rubber producing countries in South and South East Asia which are also some of the most populous and fast developing nations in the world. The contribution of natural rubber to their national economies has been remarkable. Rubber cultivation provides significant employment opportunities with fairly high degree of gender equity and also has the capacity to act as a catalyst for desirable social changes in the rural areas. The contribution of condoms that are produced from natural rubber latex has far reaching ecological significance since population growth is a fundamental cause of environmental pollution as well as poverty.

Compared to various forms of synthetic rubbers, natural rubber production is less energy demanding. While synthetic rubbers are obtained from non-renewable, polluting and finite fossil sources, natural rubber production is a renewable activity through which the atmosphere is purified. Natural rubber cultivation is a good example of ecologically sustainable, socially acceptable and economically viable agriculture with minimum environmental cost and social harm.

INTRODUCTION

Natural rubber (NR) is one industrial raw material that is produced from a renewable and non-polluting source. This paper describes the various eco-friendly and people-friendly credentials of NR. Though we often take them for granted, for modern man who is very sensitive about the quality of his habitat, they are of great importance. Modern trade is often linked to environmental issues and therefore, possibilities of marketing the green image of this vital industrial raw material need to be explored in good earnestness. While dealing with issues related to environmental conservation, the need to give due consideration for human issues is also discussed.

MAN AND ENVIRONMENT

Human 'development' and environmental degradation are somewhat inversely related. For every 'developmental activity' there is an environmental cost. Sustainable development aims at reducing this ecological cost (Swaminathan, 1998). Modern man has become very sensitive about the decline in the quality of his living environment. It is in this context that we should analyse the green credentials of NR. International trade is sensitive to matters related to human rights such as child labour, gender issues and environmental issues. But more often than not, due to geo-political and socio-economic reasons, such issues do not get the serious attention that they deserve. In the case of NR, the eco-friendly credentials of this vital industrial raw material are taken for granted. Natural rubber enjoys excellent green credentials that are generally overlooked and not brought to the notice of the policy makers, economic planners and the public and the consumers at large. It is a renewable industrial raw material of plant origin. Modern man is so much dependent on NR that we can not imagine a world without rubber. No other plant species has influenced human life as much as rubber has. It is true that for every developmental activity we have to pay an environmental cost, but in the case of NR this cost has been a minimum.

Natural rubber plantations: A large terrestrial CO_2 sink

The rubber tree, *Hevea brasiliensis* is a fast growing tree species that is extremely efficient in harvesting and converting solar energy into biomass through the process of photosynthesis. The rubber plantation is an excellent example of an energy plantation, because they are efficient users of solar energy in making plant biomass through the process of photosynthesis. Compared to several tree species, rubber tree has a high rate of photosynthesis (Table 1).

Table 1. **Comparison of leaf photosynthesis and water use efficiency of rubber with other trees**

Name of tree	Photosynthesis (µmol CO_2/m²/s)	Water use efficiency
Rubber	11-12	4.4
Acacia	7	2.7
Eucalyptus	10	2.6
Mahogany	6	2.7
Dalbergia	8-12	2.2
Terminalia	7	2.8

Source: Nataraja *et al.*, (1999)

Photosynthesis by the rubber leaves removes carbon dioxide from the atmosphere and re-charges it with life giving oxygen. This is of particular importance given the fast changing global climate scenario, particularly the increasing concentration of carbon dioxide in the atmosphere that is contributing to global warming. From the present day concentration of about 360 ppm carbon dioxide in the atmosphere, it has been

predicted to go up to 550 ppm by 2050 AD. The current annual rate of increase in atmospheric carbon dioxide concentration is 0.5% (UNEP 1992) which is the net result of human activities particularly burning of fossil fuels and deforestation. Assuming a total rubber plantation area of 10 million ha globally, a rough estimate of the carbon sequestered by the rubber plantation amounts to about 0.1 Gt Carbon globally per year. Although this is a very preliminary and rough estimate, the contribution of world rubber plantation towards global carbon sequestration needs to be studied and appreciated in more details. It may be noted that there is a lot of current interest in harvesting solar energy in the form of plant biomasss because of the increasing global demand for carbon-emission-free power and fuel production (Hoffert *et al.*, 1998; Victor,1998).

Natural rubber plantation: An efficient user of water and nutrients.

Apart from being a high biomass producer, *Hevea* is also an efficient user of water and nutrients. The water use efficiency of NR is better than several forest tree species (Table 1). Our studies have shown that while an eight year old *Eucalyptus* tree consumes about 90 l of water a day, a *Hevea* tree of similar age consumes only 50 l of water (unpublished data). It is because of this efficient use of water that a mature rubber plantation in a drought-prone area like the North Konkan can survive with even 0.25 ETc irrigation during peak summer with practically no adverse effects on its physiology (Jacob *et al.*, 1999) or on yield (Table 2).

While the nutrient removal via yield in rubber trees is far less than other perennial crops such as tea, coconut, oil palm etc. (Table 3), with about six tonnes leaf litter added to a hectare every year, the nutrient recycling through litter decomposition is very high in a rubber plantation. The addition of organic matter to the soil through the litter from both the rubber leaves and the cover crop improves the physical, chemical and biological properties of the soil. While the surface feeding roots of the rubber tree provide good binding to the soil and thus reduce soil erosion, the thick foliage of the rubber plantations helps to protect the soil surface from direct radiation and rainfall. (Jacob, 2000; Jacob *et al.*, 2002).

Minimum use of chemicals

A mature rubber plantation is a self sustaining and dynamic ecosystem with relatively minimum external agronomic inputs compared to many other agricultural systems. The use of chemical fertilizers, insecticides, pesticides and fungicides is only very minimum in a rubber plantation. The

Table 2. **Dry rubber yield of clone RRIM 600 under different levels of irrigation in Dapchari (summer 2001 and 2002)**

Irrigation*	Projected yield for January - May (kg/ha)		Yield (g/tree/tap)	
	2001	2002	2001	2002
Unirrigated (A)	302.68	279.24	21.62 ± 2.89	17.90 ± 1.90
Partial irrigation (B)(deep soil)	481.60	560.97	34.04 ± 2.14	35.96 ± 3.94
1.0 ETc (C) (shallow soil)	387.80	402.00	27.65 ± 1.10	25.75 ± 3.30

* In 2002 B and C are significantly different. Further reduction of the irrigation level from 0.25 ETc to 0.20/ ETc did not reduce the yield in deep soil. In shallow soil continuous 1 ETc irrigation for one more year did not give any yield improvement over the previous year's yield.

Table 3. **Nutrient removal of different crops through yield (kg/ha/year)**

Crops	N	P	K	Mg
Rubber	17.8	3.6	14.5	3.6
Tea	60	5	30	4.8
Coconut	62	17	56	16.5
Oil palm	162	30	217	30

Source: Jones (1994)

most widely adopted plant protection in *Hevea* is the use of copper fungicides to control abnormal leaf fall disease, but they are some of the most safe fungicides in the world. Other major diseases only require localized chemical control with little ecological impact.

Of late there has been some unfounded criticism against the use of ethephon as an yield stimulant in rubber plantations. Apart from the fact that the mode of application of this plant growth regulator is local application on the bark of the rubber trees, it may be noted that if used as per the standard recommendations of the Rubber Board, the total amount of the active ingredient applied to a ha of rubber plantation would not exceed 30 g/ha/year. However, a quick survey of the published information on the use of this plant growth regulator in various edible crops as given in the various scientific data bases available on the internet shows that the usage is much more in several fruit crops than in rubber plants (Table 4). Again, in the case these fruit crops the mode of application is either aerial spraying or drenching the fruit or foliage in a solution of ethephon.

Table 4. **Use of ethephon* in various edible crops**

Crop	Usage kg (a.i.)/ha/year
Tomatoes	1.97
Cherries	1.21
Grapes	0.61
Apple	2.42
Walnut	1.51
Capsicum	1.21

Source: Various public domain databases on internet. Mode of application was either aerial spraying or direct dipping to drench the foliage and fruits.

Natural rubber cultivation: An example of sustainable agriculture

We are now celebrating the centenary of commercial cultivation of rubber in India (1902-2002). Its common knowledge that continuous growing of rubber in India for the past one century has not resulted in any reduction in the productivity of the soil unlike several other agricultural systems. NR cultivation has actually improved and sustained soil productivity. NR cultivation does not deteriorate the environment but it reclaims, improves and preserves ecosystems and maintains the long-term productivity of the soil (Figure 1). Studies have shown that NR cultivation can reclaim the marginal and denuded ecosystems such as the severely drought prone dry jungles in the North Konkan and the extremely eroded and degraded *jhummed* lands in the North East. Rubber plantations have become an important source of timber of commercial value and non-forest firewood. This reduces the pressure on natural forests and forest plantations for timber and firewood.

The recent studies on the ecological impact of NR cultivation compared to two other popular afforestation species, namely teak and jarul (Jacob *et al.*, 2002) have proven that none of the indicators of ecological health were seriously affected by NR cultivation. Rubber soils had comparable or better physical, chemical and biological properties and improved biodiversity than the other two tree species when they were naturally grown with no external interference. In fact the number of soil microbes and macrofauna (invertebrates) harboring per unit land area was more in the rubber soils than in the other two species.

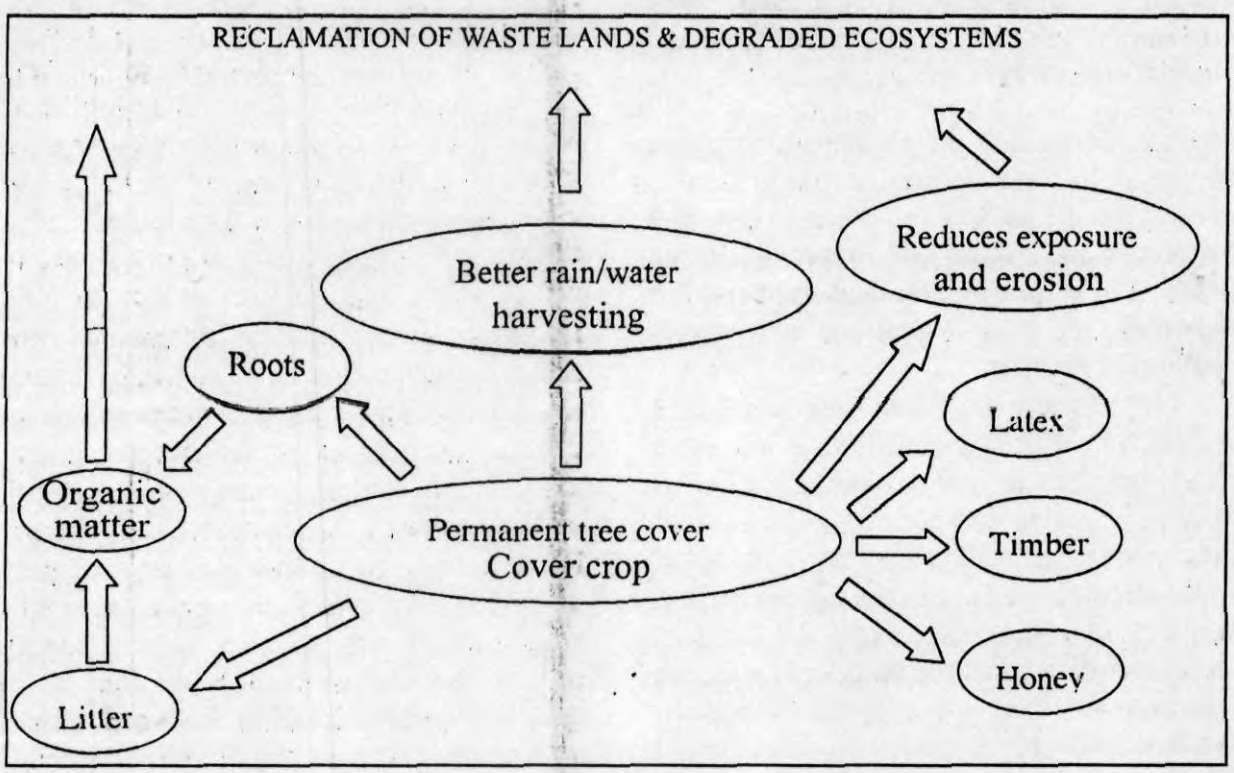

Figure 1. Flow chart depicting the eco-restoratiion capability of natural rubber plantation.

Environmental issues: The human component

There is a general tendency to treat environmental issues separately from human issues. Human beings are an integral part of the ecosystem and being the most powerful and intelligent component of the whole system, his well being is naturally tied up with that of the ecosystem. Any environment conservation exercise that does not take into account the socio-economic well being of the human inhabitants in the system is bound to fail. Poverty and underdevelopment are the main causes of environmental pollution which in turn causes more poverty and underdevelopment. Thus there exists a vicious circle of poverty and ecological degradation. Natural rubber is a shining example of how an industrial raw material can be both environment and people friendly at the same time.

Rubber cultivation is not only friendly to the ecosystem but also to the farmer. Cultivation of this crop led to significant improvement in the living standards of millions of people in all rubber producing countries in South and South East Asia. These are some of the most populous and fast developing nations in the world and the contribution of NR to their national economies has been remarkable. Rubber cultivation provides significant employment opportunities with fairly high degree of gender equity and also has the capacity of act as a catalyst for desirable social changes in the rural areas. Cultivation of NR is a good example of ecologically sustainable, socially acceptable and economically viable agriculture with minimum environmental cost and social harm – a fitting example of an evergreen revolution.

The contribution of a tiny product made

from NR latex, namely condom to the well being of the global environment needs special mentioning. Condoms are perhaps the single largest factor that is controlling the world's population and preventing the spread of many sexually transmitted diseases including AIDS even today. This has far reaching ecological significance since population growth is a fundamental cause of environmental pollution as well as poverty.

Table 5. **Energy requirement for the production of natural and synthetic rubbers**

Material	Energy consumption (GJ/t)
NR	16
SBR	130
Polybutadience rubber	108
EPDM	142
Polyurathane rubber	174
Butyl rubber	174

Compared to various forms of synthetic rubbers (SR), NR production is less energy demanding (Table 5). While SR is obtained from non-renewable, polluting and finite fossil sources, NR production is a renewable activity through which the atmosphere is purified. When it comes to a choice between synthetic and natural rubbers, the actual choice is between factory and greenery. It is also important that we give a human face to developmental and environmental issues. Unless the well being of the human race is ensured, whatever we do to preserve the quality of the environment, whether at a micro level or at a global scale is bound to fail. Removal of economic and gender inequities assumes significance in this regard. NR cultivation has played a very crucial role in improving the economic well being of millions of people in several fast developing and populous countries in South and South East Asia. Efforts need to be taken to market the green image of NR that will fetch a premium price for this green commodity without which we can not run the world any more.

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