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Rubber Plantation and Environmental Degradation in North East: Myth or Reality- A Case Study of Tripura

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Abstract

The North East India popularly known for its primeval beauty, lush greenery and rich biodiversity is observed to suffer from a gradual degradation of its environment and shrinkage of genetic resources. The people of the region who live in close proximity with nature is seen to get alienated from nature and natural resources mainly the land and forest resources and experience a threat to its environment and livelihood associated with the nature. But the issue of environmental degradation of the region has not got sufficient attention in academic discussions which necessitate delving into the issue in minute details. Hence the paper tries to highlight on the gradual degradation of the environment in the region with special reference to the state of Tripura and strives to analyses the impact of rubber plantation on such degradation.

Keywords: Environment, Degradation, Ribbed Smokes Sheet (RSS), Natural Rubber (NR), Latex, Soil Contamination, Indian Meteorological Department (IMD), Bio-diversity.

Introduction

The North East India popularly known for its primeval beauty, lush greenery and rich biodiversity is observed to suffer from a gradual degradation of its environment and shrinkage of genetic resources. The people of the region who live in close proximity with nature is seen to get alienated from nature and natural resources mainly the land and forest resources and experience a threat to its environment and livelihood associated with the nature. But the issue of environmental degradation of the region has not got sufficient attention in academic discussions which necessitate delving into the issue in minute details. Hence the paper tries to highlight on the gradual degradation of the environment in the region with special reference to the state of Tripura and strives to analyses the impact of rubber plantation on such degradation.

Rubber plantation in the state is mostly rain dependent,andany fluctuation in monsoon poses a serious threat to the Natural Rubber crops plantations in the state. The effect of such fluctuation in climate impact surface and ground water level variation, air quality and soil preservation. Though at present no assessment is available to critically review the impact of large scale Natural Rubber plantation on environment. The present paper assesses the effect and impact of annual rainfall deficit, depleted ground water level, average local atmospheric temperature variation and rainfall ground water recharge on Natural Rubber plantation is studied for the state of Tripura.

An effort has been made to figure out the consequences related to water management. The multidirectional environmental threat to the state comprising annual rainfall deficit of 23.3 %[1], depleted ground water level and significant rise in average atmospheric temperature has severely affected the production of Natural Rubber in the region. Moreover, the estimated requirement of water to produce ribbed smokes sheet (RSS) may escalate to more than ten times in the next ten years. The predicted amount of wastewater generated (directly or indirectly) in ribbed smokes sheet collection and industry processing effluents has cause large environmental issue due to their open disposal in many cases. Thus, also claims a threat to the rubber production and growth of the sector.

Natural Rubber plantation covers large extension of land however, the environmental and socioeconomics impacts of rubber expansion have not been explored at various scales[2].

Detail Research is needed to fully understand the hydrological consequences of extensive land-cover conversion to rubber at basin scale[3].

An attempt has been made:

1. To study the effect Natural Rubber production on local environment and
2. Assess the ecological implications of Natural Rubber production in state.

Area of Study

Tripura being a small state with 10,486 km^2 geographical area in the North-Eastern region of India, located between 22^o 56‟and 24^o32‟N latitude to 90^o 09‟and 92^o 20‟E longitudes. Tripura is typical monsoon climate with sub-tropical to temperate conditions. The amount of total annual rainfall in the State varies between 1500-2500 mm. The soils of Tripura are predominantly red loamy soils, which cover a total area of 4,514 km^2 covering about 43.0 % land area of the state[4].

Forest Development and Plantation Corporation Limited (TFDPCL) of Tripura adopted rehabilitation of degraded forestland through commercial rubber plantations on 7087 ha area as its primary objective along with sustainable rehabilitation of tribal shifting cultivators in the state of Tripura. The Corporation is the pioneer in developing successful models for permanent settlement of tribal shifting cultivators through rubber cultivation by providing each family 1 ha of Rubber plantation for latex extraction. Forest Development and Plantation Corporation Limited (TFDPCL) of Tripura organized resettlement of more than 1133 scheduled tribe families and 70 scheduled caste families under different schemes and projects and creating employment for around 3585 people directly and to an almost equal number indirectly.

Research Methodology

In analysing the impact of Natural Rubberplantation on environment available data such as quantum of Natural Rubber production in the state, rainfall statistics, average temperature variation and ground water recharge characteristics of the state provided by various government agencies was used. Natural Rubber production data of the state from 2002 to 2012 was collected from the Rubber Board of India (RBI)[5]. Yearly rainfall variation and deficiencies in rainfall data available from 2007 to 2012 was obtained from local Indian Meteorological Department (IMD), Agartala[6]. Temperature fluctuations data (Degree Celsius) available from 1994 to 2006 was obtained from IMD. The groundwater level from 1999 to 2008 for both South and North Tripura district was obtained from Central Ground Water Board (CGWB)[7]. Natural Rubber processing requirements, present and future estimates of waste effluents generation (fromNatural Rubberprocessing) was documented and discussed. Climatic data variations were analyzed for rainfall, rainfall deficit and atmospheric temperature rise with ground water level recharge.

Analysis &Discussion

Generation of Waste Water and Soil Contamination

Three-fourth of the total Natural Rubberlatexproduced in India is processed through Ribbed Smoked Sheet (RSS) and it is considered as the simplest method of Natural Rubber processing. In this method, the latex is added with acetic acid or formic acid (about 1:100 dilution in water) and is allowed to coagulated in rectangular shaped containers into thin slabs of coagulum. Then the coagulum is rolled through a set of smooth rollers to a thickness of about 3 mm followed by grooved set rollers and then dried to obtain sheet rubber. In this process the coagulum is continuously washed with water and about 1 liter of running water is required per ½ kg sheet production. The Natural Rubberproduction and processing, waste water is mainly generates in the form of reminder water in the rectangular shaped containers, spray of water during thin sheet formation in roller, washing of sheets, containers and factory floor[8].

This cause environmental pollution and emission of Green House Gasses (GHGs) like CO2 and CH_4 from the processing unit especially from the smoke house which is a matter of serious concern as the emitted gases escalate global warming.

The organic constituent of waste water coming out of processing are decomposed by microorganism, where many coli form bacteria grows in course time and may contaminate the adjacent soil and surface water table.

At present contribution of Ribbed Smoked Sheet (RSS) toNatural Rubber production in Tripura is about 18112 Tonnes, which is almost 70% of the 25875 Tonnes of annual Natural Rubber (NR) production of Tripura (RBI). Based on this amount of Ribbed Smoked Sheet (RSS) production, it is suggest that a waste water of about 36224 kiloliter is generated (at the rate of 1 liter per ½ kg of RSS) during Ribbed Smoked Sheet (RSS) production (mainly washing) in Tripura per annum. As per the Rubber Board of India, the productivity of Natural Rubber in India is 1867 kg/ha (2008-09, Rubber Board of India). Keeping the above facts in consideration in the next 10 years the Natural Rubberproduction of Tripura may be estimated to 109475 Tonnes (considering present 58637 ha of Natural Rubber Plantation).

Thus an increase of about 4.2 times of the present production can be expected. In near future the annual requirement of water in Ribbed Smoked Sheet (RSS) production may escalate to 152140 kiloliters, considering the future estimate of 109475 Tonnes of Natural Rubber(NR)production in the state. The standard process of RSS processing suggests that, to produce ½ Kg Ribbed Smoked Sheet (RSS) sheet 4 liter of latex mixture is required (may slightly vary depending on the dry rubber content in latex region wise). Hence the total quantity of latex used for Ribbed Smoked Sheet (RSS) sheet production is 144896 kiloliter as per present production of Ribbed Smoked Sheet (18112 Tonnes). Out of this 144896 kiloliter of latex 89637 kiloliter is water content, considering 65% water content presence in the latex (Rubber Board of India). Hence production of Natural Rubberis also accompanied with an indirect groundwater exploration of 89637 kiloliters per annum. This quantity of the water content is

essentially the body fluid of the Natural Rubber tree and is grafted by the plant from the dynamic replinishible groundwater level. But this quantity of water content exploration will soon increase many times, because the effective yielding area under Natural Rubber production is going to increase each year.

Thus an increase of 4.2 times of the present production of RSS NR (18112 Tonnes) may also contribute to indirect ground water exploration of about 376475 kiloliters of water content per annum, considering linear increase in production.

This is equivalent to filling 21 soccer fields (100 X 60 meter) with waste water of about 1 meter depth at present and 88 of them in next 10 years as projected. Such a huge amount of waste water and effluents so generated in the process of latex collection and processing is mostly dispossessed directly in ambiance of the processing center. The rapid growth of the sector will accelerate the generation of effluents in near future.

Thesituation becomes more complex & serious in the light of the fact that the present condition of waste water and other effluent treatment scenario in the state of Tripura is very poor. Except some few organized industry in the state, others are discharging it directly to the atmosphere, thus inviting serious health hazards and environmental degradationMohammadi et al. (2010) in their study suggested the general characteristics of rubber waste water, and it shows the presence of considerable amount of suspended solid and sulphate[9].

Depletion of Groundwater Table

Analysis of the available ground water data from year 1999-2012 shows that, there were no fall in ground water level in 1999, but the trend changes significantly and fall of ground water level is observed both in pre monsoon and post monsoon season in some parts of south Tripura, in the range of 0.011 to 0.205 m/year[10]. Looking at the ground water utilization pattern in India as on 2004, the ground water draft in Tripura both for domestic and industrial purpose is more than 15% which is far above then the national average of 8%[11]. This has contributed to the depletion ofground water level in the state of Tripura[12].

The simulated study showed greater water losses occurs through rubber evapotranspiration from rubber dominated landscapes compared with traditional vegetation[13] .

With regard to rubber water consumption, extensive field observations in Xishuangbanna suggest that rubber trees are depleting the subsurface water resources, as significant water uptake occurs during leave flushing coinciding with the driest and hottest period of the year[14]. In addition, rubber trees are responsible for accelerated suction of ground water and cause more water loss from the earth surface due to greater plant to plant distance as compared to rainforest vegetation, resulting reduced surface runoff and deplete in ground water[15].

Impacts on Local Rainfall and Temperature

The overall rainfall statistic for the year 2008 to 2012of Tripura is showsa deficiency of rainfall in the state as compared with LPA (Long Period Average). The trend is showing an overall deficiency of rainfall for the year 2008 to 2012. The monsoon rainfall deviation for the period of June & July in Tripura is minus 23.3% for the period (Indian Meteorological Department). In the absence of rain, the scenario may become susceptible towards intense drought periods[16]. The precipitation interception of rubber tree canopy is seasonal. The water holding capacity of the canopy is low. The average annual interception rate of rubber tree canopy is 11.45% of the rainfall. The water loss from rubber plantation in the form of water from soil might be negligible but nutrient loss is significant. Around 50% of the rainwater flows down the slope (through run-off, but mainly lateral flow in the soil),

The Rubber tree tends to reduce the flow of water and also tends to dry the moist land. Thus, influences the regulation of the hydrological cycle.

While, from the analysis of local average maximum and minimum temperature during 1994 to 2006 it is suggested that the average temperature increases annually in Tripura. Record of temperature data of the state is available from 1994 to 2012, shows that both the average maximum and minimum temperature are increasing significantly. The increase is observed to be more in case of average minimum temperature. The rise in temperature may be coherent with the global warming and climate change. Eventually, the continuous rise in temperature will contribute to the accelerated evaporation of water from all natural sources of water.

Impact of Rubber on Soil

Varghese and others (1996) in their study on five-year-old Rubber Plantation from Tripura showed that there was not any definite pattern of pH across soil depth (range 4.22 to 4.80) but percentage of Organic Carbon (OC) decreases with depth and it varies from 0.97 (0-18 cm) to 2.11 (36-54 cm)[17]. Organic Carbon Concentration of fine root in top layer (0-18 cm) was highest and it varied from 33% to 76%. Soil under rubber plantation is strongly acidic (pH 4.51±0.07) and sandy loam in texture; while soil of the mixed forest in surrounding of rubber plantation was highly acidic (pH 4.62± 0.06) and sandy clay loam in texture[18]. Conversion of natural forest into deciduous mono culture of rubber might be expected to disrupt this pattern of spatial and temporal controls over nutrient cycling. For example, most of the leaf fall in the rubber plantation occurs in a two month dry period. Following the onset of monsoon, the litter decomposes rapidly with a half-life (50) of about 30 days, leads to rapid leaching of nutrients. Below ground fluxes of carbon and nutrient in rubber plantations are influenced by soil moisture availability and when soil moisture stress is more severe, fine root production and turnover and consequent nutrient cycling is more. There is evidence that fast-growing trees have an extractive effect upon soil fertility and that they tend to impoverish the soil and unbalance its structure[19]. Recent studies suggested that rubber management practices significantly affected soil C, N, pH, soil moisture and vegetation (including plant diversity and quantity of plant litter and roots) and thus affected soil nematode communities [20].

Loss of Bio-Diversityandshrinking of Natural Forest Areas

Tripura has mainly tropical semi evergreen and moist deciduous forest. The forest covers about half of the 6292.681 sq km of the state and out of total forest cover, 3588.183 sq km are Reserve Forests (RF), 509.025 sq km are Proposed Reserve Forests (PRF) and Unclassified Govt. Forests (UGF) is 2195.473 sq km based on satellite data[21]. The flora of Tripura comprising 1545 species and 28 extra-typical varieties in 862 genera and 193 families of vascular plants, representing about 12.86% of the Flora of India[22]. In Tripura, 8.94% of the geographical area is covered with bamboo forest. Plantation of various species covers an area of 218503.68 ha of which teak, sal and rubber constitutes the major part. The miscellaneous hardwood forest with bamboo consists of 17.43% and 4.15% of the geographical area. Several species like sissoo, kanak, koroi, garjan, rubber, tea, and coffee etc. plantation were also developed by clearing natural forests. Among which rubber plantation alone consists of about 36,000 ha.

This because of better economic returns, immense market demands, &suitable climate and soil of the state trends of rubber mono plantation have increased especially in private sectors. Being a mono culture technique, rubber plantation generally develops by completely clearing previous forest stands and managed by annual clearing the ground flora. Due to regular maintenances for latex collection and canopy shielding, plant diversity is very poor under this plantation. Only few shade tolerant herbs and shrubs can exists. A recent study found that diversity and density of trees in rubber plantation including its marginal forest fragments were low compared to other semi-natural plantation and natural vegetation Rubber plantations do not provide any food or foraging items for birds and other wildlife, they can use it for shelter only and forced to feeds on nearby agricultural lands or orchards which may increase man-wildlife conflicts. Present. It is now recognized that land-cover transitions to rubber monocultures are responsible for significant losses of aboveground and belowground biomass and carbon stocks[23] and biodiversity[24].

Conclusion

According to the Rubber Board of India, the productivity of Natural Rubber in India is 1867 kg/ha (2008-09). Taking this into consideration future estimate for Natural Rubber production of Tripura would cross 109475 Tonnes in a few years (considering present 58637 ha of Natural Rubber Plantation), and if Natural Rubber production of Tripura is studied in terms of quantity, this would mean that an increase of 4.2 times of the present production can be expected and in near future the requirement of water in RSS production may escalate to 152140 kiloliters of water.

The combine effect of average deficit rainfall of about 23.3%, continuous average variation of maximum and minimum temperature and depletion of ground water level of the state may cause a potential threat to environmental balances. The untreated or partly treated effluents of Natural Rubber production may also cause contamination of surface and ground water, soil and air. This increases the potential threat to environment resulting from rubber processing.

However, it may safely be concluded that the current data of relative climatic conditions of the region are insufficient to quantify the overall impact of Natural Rubber cultivation on local environment. But, accelerated suction of ground water and greater water losses through rubber evapotranspiration from rubber dominated landscapes compared with traditional vegetation have already degraded the existing environment.

A comprehensive long term and localized study is required to quantify the effects of the following parameters on the bio-diversity and environment of Tripura:

1. Annual deficit of rainfall,
2. Continuous depletion of ground water level and
3. Variation in maximum and minimum temperature of the state on Natural Rubber plantation and ecological balance.

This will enable to estimate and predict more correctly the nature and extent of environmental damage. Instead of Natural Rubber monoculture there should be need to introduce Natural Rubber poly culture model. The indigenous agroforestry model should be incorporated within Natural Rubber plantation. There also need further investigation on the of socioeconomic and environmental sustainability of rubber based Agro-ecosystem models. Such action will help to adopt accurate and suitable preventive measures, to protect the environment and growth of Natural Rubber production simultaneously. Suitable and modern sustainable technology of pollution control may be implemented, to reduce the contamination of surface and ground water, soil and air.

Suggestions & Recommendations

1. Increasing intensity of the environmental degradation in the North East, necessitate a deep need to devise long-term, sustainable solutions for the region. A large part of the environmental degradation arises from economic need, and hence the solution lies in economic (and social) development of the region.
2. The government will have to facilitate an ecosystem where business practices can occur smoothly and without hassle.
3. Despite several attempts by the Government and Planning Commission to enhance local development, the current strategy has led to a distribution-oriented, politically-led economic process and not the efficiency-led process envisioned. This has resulted in natural resources and savings moving away from the region to other high productivity regions. Thus the direction of development has to be efficiency-led process, withequitable distribution goal
4. The dependence on the Central Government for both funds and employment has led to a passive attitude towards development in the States. The onus should be shifted to the local government agencies for a sense of responsibility and ownership over economic activities to develop.

5. Business and social entrepreneurs should take the lead in building enterprise which involves the local community. For the self-sustained growth of a region, there needs to be a thriving entrepreneurial ecosystem which is able to take business strategies, contextualize them for local needs, and create systems of demand and supply for the area.
6. There is also a needs of a market – where entrepreneurs can target their goods and services and consumers can find the things that they need. By focusing on economic factors (but not ignoring political and cultural factors) like labour cost, comparative advantages, technology, and efficiency, such a market can be developed within the North East.

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Footnotes

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