

Key Ecological Indicators for Developing Standards for Certification of Natural Rubber



Rubber Plantations and their Importance in Natural Landscapes

For over a century, farmers in South India have tapped natural rubber from the *Hevea brasiliensis* tree. As a core raw material for many industrial and domestic products such as tyres, sports goods and footwear, condoms, gloves, etc., current market demand for latex is uncertain. It is well known that production in many traditional rubber growing areas have reached a stable maxima in the recent years.

Although rubber plantations are a major driver of the local economy and employ a large workforce, the large-scale conversion of a multi-species forest ecosystem to a simple monoculture ecosystem results in the loss and degradation of many ecological services. A large proportion of the rubber plantations in southern India are located in the biodiversity rich Western Ghats which is a major source for numerous rivers and streams that supply water to estates, human settlements and industries in the plains. In addition, these hotspots are home to several endemic and endangered flora and fauna. Without the active participation and involvement of all stakeholders in their conservation biodiversity and ecosystem services will be lost forever. Soil erosion and reduced soil fertility are other problems that could result from rubber monocultures. This directly impacts the production of rubber and also increases production costs. Also, without the agricultural security that comes from a diverse mix of species and crops, these monoculture plantations are vulnerable to market fluctuations, disease and other stressors -- ultimately threatening themselves.

Managing such landuses in an ecologically and sustainable way will not only protect the present and future livelihoods of plantation owners and workers who count on healthy and stable rubber yields, but also protect our natural treasures and resources.

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Foreword

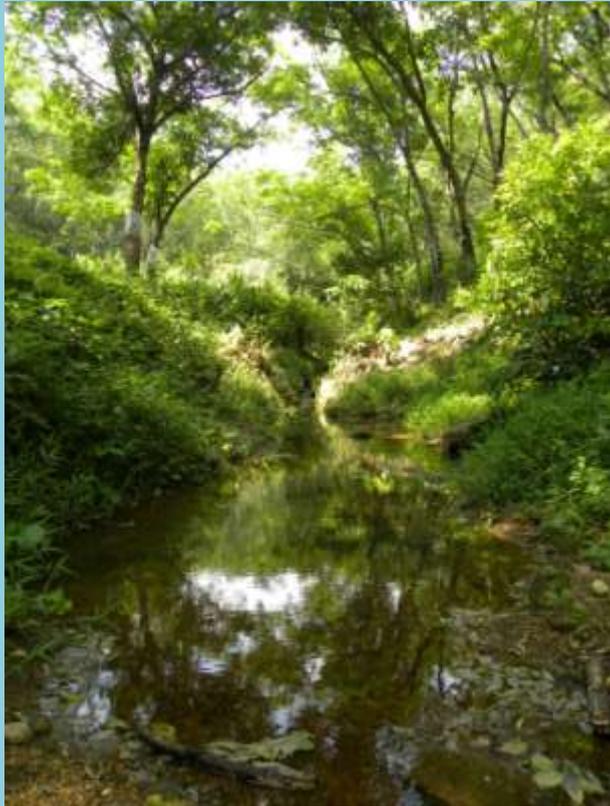
This document highlights key indicators for various environmental criteria that are pertinent to rubber plantations. This has been put together as an aid for developing standards for eco-certification of natural rubber. The document has been prepared with the Western Ghats, southern India as the focus, but can be adopted for other rubber growing regions within India.

In this document we identify ecologically important **criteria** that rubber plantations need to take into consideration to become ecologically sustainable. We cover **six criteria** that are loosely based on the SAN standard principles:

Water Resources and Conservation
Soil management and conservation
Biodiversity and ecosystem conservation
Wildlife protection and corridors
Chemical use
Soil waste management

Within each of these criteria we identify **key ecological indicators**, each of which has been included because of its importance to the environment. The **objective** of each indicator is explained briefly to help understand its importance. Indicators that are of higher priority for the environment have been indicated as “**Critical**”. For the purpose of monitoring compliance, **related guidance** for each indicator is given.

Water Resources and Conservation



Water Resources and Conservation

Priority	Key ecological Indicators	Objective of indicator	Related guidance
	Identification and mapping of water resources including ponds, lakes, streams and rivers flowing through the estate. This should include both seasonal and perennial sources.	Protecting and conserving natural resources in important for long term sustenance. To be able to plan efficient water usage and ensure protection, the grower should identify and map these resources.	Both small and large growers should do this, but is more important that large growers who are likely to have more resources within their boundary, identify and map these resources
Critical	i) <u>Location of watershed and water sources</u> : Is the watershed/source of the water used by the estate within your boundary limits? If yes, is it protected (for example, is the source buffered from the crop?)	Within and in proximity to production areas, the possibility of runoffs and contamination of water resources by agro-chemicals and blockage and choking from waste is possible. Grower should ensure water resources are sufficiently buffered from production areas and watersheds are conserved and protected from contamination and waste.	Vegetation buffers around most streams are lacking, where present they are degraded and occur only along single bank of the stream. In most rubber estates, chemical fumigation is limited, Taking the SAN standard as a reference, Annexure 1 gives the suggested buffer distance between crops and water sources taking into account the slope of the land.
Critical especially when rare and endangered species are	ii) <u>Biodiversity of these water bodies</u> : a. Is there a floral and faunal species inventory for these water bodies? b. Is the global status of these species and the local population size of the rare and endangered species known? c. If there are rare and endangered	The vegetation and animal diversity are an integral part of aquatic ecosystems and key to their functioning. The growers should ensure these are protected.	An example of an inventory is given in annexure 2 – an inventory for amphibians for estates in the southern Western Ghats is shown. We have recorded many rare and endangered amphibians near streams on the estate. This needs to be done for other taxa like fish, reptiles, etc. <i>Large growers should undertake population estimation of as many rare and endangered species as possible within their holdings in addition to an inventory.</i>

Water Resources and Conservation

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present	species, are these being protected; what steps can be taken to protect these?		<p><i>Proactive measures for their protection should be taken.</i></p> <p><i>Small growers should at least have an inventory in place. Rare and endangered species should not be hunted/disturbed/threatened.</i></p>																																																												
Critical	<p>iii) <u>Water quality:</u> Test for quality of water of the water body and in case of streams and rivers at the source/point where the stream enters the estate, within and at the point of exit from the estate.</p> <p>a. Does the estate take steps to ensure that water quality does not deteriorate?</p> <p>b. What are potential sources of pollution of the water through its course through the estate?</p> <ul style="list-style-type: none"> – Effluent from factory: is the effluent being treated or not? What is the quality of water at this point? – Gray water and sewage water from housing lines: Is this being treated or not? What is the quality of water at this point? – Agrochemicals leaching and run-offs from fields: At locations where the stream courses through the planted area; or where a water body is in close proximity to a production area, check for any trace of agrochemicals being applied to the farm in the water. <ul style="list-style-type: none"> ▪ Are there any systems in place to prevent such run-off? ▪ What is the minimum distance 	Quality of water should not deteriorate within the plantation making it unusable for users downstream.	<p>Buffers between production areas and water bodies are absent in many estates. In a few, natural vegetation along the banks of water bodies act as a buffer.</p> <p>Water (Prevention and control of pollution) Act 1974. The following table gives the limits (in mg/L for all other than pH) for specific parameters for treated effluents as approved by the State of Kerala:</p> <table border="1"> <thead> <tr> <th>Parameter</th> <th>inland surface water</th> <th>On land for irrigation</th> </tr> </thead> <tbody> <tr> <td colspan="3">For Centrifuging and creaming units</td> </tr> <tr> <td>pH</td> <td>6 – 8.5</td> <td>6 – 8.5</td> </tr> <tr> <td>BOD (3 days at 27oC)</td> <td>30</td> <td>100</td> </tr> <tr> <td>COD</td> <td>250</td> <td>*</td> </tr> <tr> <td>Oil and grease</td> <td>10</td> <td>10</td> </tr> <tr> <td>Total Kjeldahl Nitrogen (as N)</td> <td>100</td> <td>*</td> </tr> <tr> <td>Ammoniacal nitrogen (as N)</td> <td>50</td> <td>*</td> </tr> <tr> <td>Sulphides (as S)</td> <td>2</td> <td>*</td> </tr> <tr> <td>Total Dissolved Solids</td> <td>2100</td> <td>2100</td> </tr> <tr> <td>Suspended solids</td> <td>100</td> <td>200</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Parameter</th> <th>inland surface water</th> <th>On land for irrigation</th> </tr> </thead> <tbody> <tr> <td colspan="3">Crepe and block rubber units / craps and crumb units</td> </tr> <tr> <td>pH</td> <td>6 – 8.5</td> <td>6 – 8.5</td> </tr> <tr> <td>BOD (3 days at 27oC)</td> <td>30</td> <td>100</td> </tr> <tr> <td>COD</td> <td>250</td> <td>*</td> </tr> <tr> <td>Oil and grease</td> <td>10</td> <td>10</td> </tr> <tr> <td>Total Kjeldahl Nitrogen (as N)</td> <td>50</td> <td>*</td> </tr> <tr> <td>Ammoniacal nitrogen (as N)</td> <td>25</td> <td>*</td> </tr> <tr> <td>Sulphides (as S)</td> <td>2</td> <td>*</td> </tr> </tbody> </table>	Parameter	inland surface water	On land for irrigation	For Centrifuging and creaming units			pH	6 – 8.5	6 – 8.5	BOD (3 days at 27oC)	30	100	COD	250	*	Oil and grease	10	10	Total Kjeldahl Nitrogen (as N)	100	*	Ammoniacal nitrogen (as N)	50	*	Sulphides (as S)	2	*	Total Dissolved Solids	2100	2100	Suspended solids	100	200	Parameter	inland surface water	On land for irrigation	Crepe and block rubber units / craps and crumb units			pH	6 – 8.5	6 – 8.5	BOD (3 days at 27oC)	30	100	COD	250	*	Oil and grease	10	10	Total Kjeldahl Nitrogen (as N)	50	*	Ammoniacal nitrogen (as N)	25	*	Sulphides (as S)	2	*
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Water Resources and Conservation

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	<p>between the crop and aquatic ecosystems that is being maintained and does it comply with recommended distances (Annexure 1)?</p> <ul style="list-style-type: none"> ▪ What is the system for disposal of water contaminated with agrochemicals such as those from washing equipments? Does this get mixed with domestic wastewater, and is it being treated properly before release into the environment? <ul style="list-style-type: none"> – Are solid wastes, both organic and inorganic, rejected products, debris, soil, stone from excavations, rubbish from cleaning land, or any other waste material deposited into a natural water body? c. Does the water quality comply with local and national laws? 		<table border="1" data-bbox="1198 300 2016 367"> <tr> <td>Total Dissolved Solids</td> <td>2100</td> <td>2100</td> </tr> <tr> <td>Suspended solids</td> <td>100</td> <td>*</td> </tr> </table> <p>*To be prescribed by the State Pollution Control Board on a case to case basis For production areas within plantations the following standard (SAN standard (mg/L) can be adopted:</p> <table border="1" data-bbox="1198 470 2011 673"> <thead> <tr> <th>Water quality parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Biochemical Oxygen demand</td> <td><50</td> </tr> <tr> <td>Total suspended solids</td> <td><50</td> </tr> <tr> <td>pH</td> <td>6.0 -9.0</td> </tr> <tr> <td>Grease and oils</td> <td><30</td> </tr> <tr> <td>Fecal coliforms</td> <td>Absent</td> </tr> </tbody> </table>	Total Dissolved Solids	2100	2100	Suspended solids	100	*	Water quality parameter	Value	Biochemical Oxygen demand	<50	Total suspended solids	<50	pH	6.0 -9.0	Grease and oils	<30	Fecal coliforms	Absent
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	<p>iv) <u>Structural modifications to natural water bodies:</u></p> <ul style="list-style-type: none"> – Have any structural modification of the course of streams and rivers been done? If yes, when was this done? What impact has it had and what is the impact in the future on the biodiversity of the ecosystem and on the river/stream course? 	<p>Structural modifications can influence flows leading to drying up of water bodies in some cases, loss of biodiversity and a reduction in quality and quantity of water. Growers should ensure no structural modifications are done to natural water bodies that could have negative</p>	<p>To strengthen the banks of streams, stone walls are erected. This combined with natural vegetation on the banks can help in preventing soil erosion and debris from entering the water body. However changing the course of water, building new irrigation channels should not be allowed.</p>																		

Water Resources and Conservation

Priority	Key ecological Indicators	Objective of indicator	Related guidance
	v) <u>Loss of water bodies:</u> <ul style="list-style-type: none"> – Have any streams/ rivers and other sources of water dried up and become lost? If this resulted due to any purposeful farm management activities some analysis and mitigation plans need to be followed 	impacts. Any loss of water bodies as a result of management practices followed by the grower should be identified and mitigation plan made and implemented.	
	vi) <u>Water Conservation:</u> <ul style="list-style-type: none"> – Is the water consumption rational and wherever possible, are systems to recycle and reuse put in place to ensure water conservation. – Water used for the crop should not be excessive or wasteful: The amount of water used should be checked against soil characteristics, climatic information, and soil moisture. The irrigation system used should be well maintained with minimal wastage through leaks. Are these being followed? – Is there natural vegetation cover present and maintained along the banks of water channels? 	Preventing wastage of water and using this resource rationally is important for long term sustenance.	Small farmers use mulch and also allow grass to grow to conserve the soil moisture. However in many of the larger plantations, the use of weedicide is common, leading to exposure of the soil to natural elements and reducing the soil moisture.

Soil Management and Conservation



Soil Management and Conservation

Priority	Key ecological Indicators	Objective of indicator	Related guidance
	i) <u>Fertilizers:</u> The use of fertilizers should be based on soil properties and soil analyses and as far as possible organic fertilization using residues generated by the farm is recommended. Are these being practiced on the estate?	Indiscriminate use of fertilizers can impact the quality of water, can lead to algal bloom and eutrophication of water bodies, impacting the biodiversity of water bodies, nutrient imbalance,	Typically in this landscape, the recommended frequency of application of fertilizer is once every four months. The fertilizers commonly used are urea, rock phosphate, potash, magnesium sulphate, zinc sulphate, and NPK as also farmyard Manure. The rubber board of India recommends mixing the chemical fertilizers with manure for application. Small farmers here do not follow this frequency of application as ability to buy fertilizer depends largely on availability of funds. Also, the use of manure is much higher among small farmers. They however, indicated that procurement of manure was becoming difficult. Large rubber estates on the other hand, follow the recommended frequency of fertilizer application. They also are known to undertake soil tests before application of fertilizers, which small farmers do not. In both large and small farmers, effort should be taken to ensure excess fertilization is not done and only the required supplements are applied.
Critical	ii) <u>Land preparation:</u> Are natural forest cover destroyed and is burning largely done as part of land preparation activity for new areas for cropping?	Burning as part of land preparation leads to loss of soil microbes, exposes the soil to erosion, runoff and leaching of nutrients, resulting in	For rubber, the recommended land preparation mainly involves clearing and burning to remove brushwood and branches of trees. Burning should be avoided.
	iii) <u>Soil conservation measures:</u> What measures are taken for soil conservation?	Many of the plantations are located on slopes, requiring the grower to take measures to conserve the soil.	The land in the southern Western Ghats is sloping and soil conservation measures are important. Terracing the land is common on both large and small rubber holdings and should be suggested as a possible solution in areas where soil erosion is seen. Other recommended soil conservation steps for rubber plantation include silt pits, and contour bunds to restrict surface run-offs. Often, stone walls are erected to prevent loss of soil due to erosion. It is important to ensure sufficient ground cover is present especially during rainy seasons and in seasons when wind velocities are very high. It is advised that instead of using weedicides to remove all undergrowth in rubber plantations, mechanical removal method could be employed to remove the hardy species leaving the soft weeds in place.
	iv) <u>Cover crops:</u> Are cover crops being used as part of soil	As a measure of soil conservation and to improve the water retention	Of the four species that are most commonly used as per information from the Rubber Board of India, two are non-natives, while one has been brought from

Soil Management and Conservation

Priority	Key ecological Indicators	Objective of indicator	Related guidance
	improvement and soil conservation activity?	capacity and soil moisture cover crops are recommended. These when leguminous also help in improving soil fertility.	Northeast India. The farm should try to use as many native species as possible rather than opt for a non-native species.
Critical	v) <u>New production areas</u> : Are these located in land that is climatically suitable, soil and topographical condition are ideal for rubber crop? Are the locations identified based on land use capacity studies that demonstrate long-term production capacity?	Landuse capacity studies, knowing climatic , soil conditions and topography will indicate the potential productivity of an area and will allow informed investment while expanding production areas	Both small and large growers should ensure that new areas where they plan to expand into should be suitable for the crop and has potential for sustained production.

Biodiversity and Ecosystem Conservation¹



¹ As aquatic ecosystems have been covered under water resources and management, only terrestrial ecosystems are covered here

Biodiversity and Ecosystem Conservation¹

Priority	Key ecological Indicators	Objective of indicator	Related guidance
Critical	<u>Terrestrial ecosystems</u> : Identification of key terrestrial ecosystems, their location within the estate or with respect to the estate and extent if within	Each ecosystem, be it an evergreen forest, a thorny scrub or a grassland provides essential services. These need to be preserved – effort to identify and conserve them and if they are degraded take initiative to restore them	Forest and grassland ecosystems are found as enclaves or contiguous with these rubber plantations. Some of these are classified as Reserve Forests and come under the purview of the Forest Department
	i) <u>Biodiversity richness</u> : A list of animals and plants in these forests and identification of rare and endangered species should be done. Are there any management plans in place to restore key habitats and protect these species?	The vegetation and animal diversity are an integral part of any ecosystems and key to their functioning. The growers should ensure these are protected.	Species list of a number of taxa for the landscape has been put together by FERAL, and these are available as reference material for this exercise.
Critical	ii) <u>Direct Impact of cultivation</u> : Have any ecosystems been affected or destroyed by or due to any purposeful farm management activity? If yes, need to follow some analysis and mitigation plans.	Loss or deterioration of any ecosystem as a result of management practices followed by the grower should be identified and mitigation plan made and implemented.	
Critical	iii) <u>Buffer zone</u> : Is there a buffer area between the forest and the production area? Does it comply with the SAN standards given in Annexure 1	Within and in proximity to production areas, the possibility of agro-chemical drifts is possible. Grower should ensure identified ecosystems are sufficiently buffered from production areas	The suggested buffer zone by the SAN standard for terrestrial systems is given in Appendix 1
	iv) <u>Production areas</u> : How diverse is the production area in terms of average number of native species per hectare? As per SAN standard, for agroforestry crops such as rubber in	Native biodiversity should be conserved. Increasing biodiversity in the farm helps with lower intensity of pest attacks, better soil management, reduced loss due to diseases, etc.	In most large estates in this landscape, there is very little diversity in the production areas and rubber is largely cultivated as a monoculture crop. Given this there is unlikely to be more than one storey of canopy in these plantations. However, overall canopy density in most areas will comply with the recommended 40% cover. Although Rubber Board prescribes planting multiple varieties of rubber, these

Biodiversity and Ecosystem Conservation¹

Priority	Key ecological Indicators	Objective of indicator	Related guidance
	<p>an original vegetation cover of forest; permanent agroforestry structure which comply with below criteria should be followed:</p> <p>a) The tree community on the cultivated land should consist of 12 native species per hectare on average</p> <p>b) The tree canopy should comprise of at least 2 stories</p> <p>c) The overall canopy density on the cultivated land should be at least 40% (if the original ecosystem is non-forest, the plantation should set aside at least 30% of the area for conservation or restoration of that ecosystem). A plan needs to be put in place and implemented within a fixed period of time.</p>		<p>guidelines often not followed.</p> <p>Small farmers intercrop with Jack, ginger, turmeric etc., while on the large estates, intercropping is rarely seen.</p>
Critical	Conservation programmes should be put in place to identify, protect and restore ecosystems	Proactive planning to identify important ecosystems and implementing steps to protect and restore them will be important in ensuring long term sustenance of services rendered by these ecosystems	Both large and small growers should have a plan in place for the conservation of ecosystems.

Wildlife protection and corridors



Wildlife protection and corridors

Priority	Key ecological Indicators	Objective of indicator	Related guidance
	Wildlife species inventory should be done and habitats used by wildlife on the farm should be identified.	Many wild animals make use of rubber plantations when moving between natural ecosystem patches These patches need to be identified.	Standard inventory methods need to be followed. For the southern Western Ghats landscape, there is already an exhaustive list for most taxa. (See ecological status report and other FERAL reports from the landscape).
Critical	i) <u>Rare and threatened species</u> : Are there any rare and endangered animal species present on the farm and are they protected?		There are several species that follow into these categories. Some of the better known and charismatic mammal species include the tiger, elephant, gaur, lion-tailed macaque, and the Nilgiri langur.
	ii) <u>Status of habitats used by wildlife</u> : Once key habitats/wildlife use areas are identified, the status of these habitats should be assessed Are the habitats used by rare and endangered species protected/restored?	Improving wildlife habitats especially for the rare and endangered species should be an integral part of a sustainable farm.	The estate/farmer will have to plan for protection and restoration activities where required with inputs from a competent person(s)
Critical	iii) <u>Connectivity</u> : Does the production area affect connectivity for wildlife? If yes, is there sufficient native vegetation along roadsides, along water courses, live fences, shade trees, or live barriers that can act as corridors?	When the animals are provided with safe passage between resource patches (and in many cases forest fragments) there is a lower likelihood of animals straying into production areas. These animal-use areas need to be identified and the best possible corridors should be established for their movement while steps to protecting the crop are also taken.	Vegetation along roadside, water courses, etc. is mostly present. However, this may not be native tree/plant species.
	iv) <u>Vegetation</u> : Is there a list of common and rare native species including trees, shrubs, herbs and lianas present in production areas, in wastelands, and in natural forest areas within the estate. Also, how rampant are invasive species?	Identifying the natural flora of the area is important. Invasive plant species can impact native species population and can introduce new diseases and pests that could be detrimental to the crop and the natural ecosystems. The population of these need to be checked.	Invasive species such as <i>Mikania micrantha</i> and <i>Chromolaena odorata</i> are found on these estates
Critical	v) <u>Threats to wildlife</u> : Are there any signs of poaching on the	Several wild animals and plants are threatened as a result of poaching and	Workers on the farm can be educated and sensitized to the wildlife conservation issues as a step towards ensuring this.

Wildlife protection and corridors

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	<p>farm or in the surrounding forested areas?</p> <p>Is fuelwood being collected and trees felled especially in the forested areas, habitats that are being used by wildlife within the farm or in the forests bordering the farm? If yes, is the grower/estate taking steps to reduce these threats?</p>	<p>habitat destruction. When such threats are present on a plantation, they should be identified and addressed.</p>	
	<p>vi) Animals in captivity: Are there any endangered/non-native animal species kept in captivity on these estates?</p>	<p>Species that have been identified as rare and endangered should not be kept in captivity without the required permissions of the appropriate authority.</p>	<p>If there are any rare and endangered native species kept in captivity on the farm/estate, steps should be taken to hand them over to appropriate authorities. Steps to be taken to ensure that any non-native species that are kept in captivity are not released into the wild.</p>

Chemical use in rubber plantations



Chemical use in rubber plantations

Priority	Key ecological Indicators	Objective of indicator	Related guidance
Critical	Several chemicals are used in rubber plantations. Are any of these on the prohibited list? How frequently are these applied? Are there any mechanisms followed for the judicious use of chemicals and any initiative to use organic and other biological substitutes?	Agrochemicals – fertilizers, pesticides, weedicides, fungicides, etc. are commonly used in plantations. These when indiscriminately used can have negative consequences for the environment. Hence growers should judiciously use chemicals and where possible organic and other biological substitutes should be used.	Pesticides that are commonly used by both small farmers and larger rubber estates are Bordeaux mixture, and sulphur powder. These are often considered to be acceptable inorganic farming practices and are not listed in the list of prohibited chemicals of SAN. However, several banned chemicals are recommended for use in rubber plantations in India, which are given in more detail in the document titled “Current ecological and social status of rubber plantations” available on FERAL’s ecoagriculture website. Annexure 3 gives a list of banned chemicals in Kerala.
	Transgenic crops should not be introduced, cultivated or processed. If introduced accidentally, need to plan isolation and implemented	The use of genetically modified crops has been controversial and is believed to have many negative effects in the long run.	Small and large growers should be aware of the issues with genetically modified crops and should ensure they are not introduced into their farms.

Solid Waste Management



Solid Waste Management

Priority	Key ecological Indicators	Objective of indicator	Related guidance
	Is there a waste management programme in place on the estates to deal with solid waste coming from a) factories; b) production area; c) residential lines?	Solid waste when not managed appropriately, can be highly detrimental to wildlife, ecosystem functioning and for human health. Growers need to ensure appropriate systems are in place to deal with solid wastes generated on the plantation or farm.	To allow tapping during rainy seasons, the tapping cut is protected from rain water by using a rain guard made of polythene sheets. This when replaced or removed in the dry season, are not disposed off properly and are strewn around the plantation as seen in this photo. Tourists visiting the plantations, often, litter the place with plastics, bottles, etc. especially close to the streams. Both small and large growers should where possible follow the three R's of waste management – Reduce, Reuse, and Recycle
Critical	Are there open waste dumps? Are wastes burnt in open air?	Dumping wastes in the open and burning waste in the open has environmental and health issues and should be prevented.	Both small and large growers should take steps to ensure that open dumps and open air burning are not practiced on their land. Also, where possible, use of natural resources should be reduced; resources should be reused, and recycled. Waste should be segregated before disposal and disposed of in a proper and safe manner.

Annexure 1: Recommended buffer zone width between production area and natural ecosystems (SAN Agricultural Standards, July 2010, version 3)

A: Wetlands and water bodies

Agrochemical	Type of crop management					
	High input use ^a		Low input use ^b		Organic	
Slope:	≤ 8% ¹	> 8% ²	≤ 8%	> 8%	≤ 8%	> 8%
Perennial and seasonal streams, brooks, creeks (width less than or equal to 3 m)	10	20	5	10	3	5
Rivers (width greater than 3 m), lakes, lagoons, swamps, marshes, bogs	10	20	10	10	5	10
Springs	15	30	10	20	10	10

B: Terrestrial ecosystems

Agrochemical	Type of crop management					
	High input use ^a		Low input use ^b		Organic	
Slope:	≤ 8% ¹	> 8% ²	≤ 8%	> 8%	≤ 8%	> 8%
a. Secondary growth (without significant human disturbance for minimum 10 years)	10	20	5	10	3	5
b. Primary and secondary forests, bush lands, grasslands and paramos	10	20	10	10	5	10

a: Typically larger estates use higher inputs of agrochemicals

b: Small growers use low input of agrochemicals

1: Slopes less than and equal to 8%

2: Slopes greater than 8 %

Annexure 2:

Some Amphibians found in the plantation areas and in the adjoining forest

S.No.	Name of Species	Family	Habitats Sighted*	Local Status	IUCN Status
1	<i>Duttaphrynus melanostictus</i>	Bufoidea	T	Common	Least concern
2	<i>Fejervarya keralensis</i>	Dicroglossidae	F+P	Common	Least concern
3	<i>Limnonectes limnocharis</i>	Dicroglossidae	F+P	Common	Least concern
4	<i>Minervarya sahyadris</i>	Dicroglossidae	F	Rare	Endangered
5	<i>Ichthiophis sp.</i>	Ichthiophidae	F	Rare	
6	<i>Indirana beddomii</i>	Ranixalidae	F+P	Common	Least Concern
7	<i>Indirana brachitarsus</i>	Ranixalidae	F+P	Not Common	Endangered
8	<i>Indirana leithii</i>	Ranixalidae	F+P	Not Common	Vulnerable
9	<i>Indirana leptodactyla</i>	Ranixalidae	F+P	Not Common	Endangered
10	<i>Indirana Sp</i>	Ranixalidae	F+P	Rare	
11	<i>Indirana Sp.1</i>	Ranixalidae	F	Rare	
12	<i>Indirana Sp.2</i>	Ranixalidae	F	Rare	
13	<i>Micrixalulas saxicola</i>	Micrixalidae	F	Rare	Vulnerable
14	<i>Micrixalus fuscus</i>	Micrixalidae	F+P	Common	Near Threatened
15	<i>Micrixalus sp1</i>	Micrixalidae	F	Rare	
16	<i>Micrixalus thampi</i>	Micrixalidae	F+P	Rare	Data deficient
17	<i>Nyctibatrachus alicae</i>	Nyctibatrachidae	F+P	Not Common	Endangered
18	<i>Nyctibatrachus major</i>	Nyctibatrachidae	F+P	Not Common	Vulnerable
19	<i>Nyctibatrachus Sp</i>	Nyctibatrachidae	P	Rare	
20	<i>Raorchestes Sp</i>	Rhacophoridae	F+P	Rare	
21	<i>Raorchestes Sp.1</i>	Rhacophoridae	F+P	Rare	
22	<i>Raorchestes Sp.2</i>	Rhacophoridae	P	Rare	
23	<i>Pseudophilautus wynaadensis</i>	Rhacophoridae	F+P	Common	Endangered
24	<i>Hylarana temporalis</i>	Ranidae	F+P	Not Common	Near Threatened

*F= Forest, P=Production (rubber and tea)

Annexure 3:

List of Pesticides/Herbicides used in Rubber that are either recommended only for restricted use or Banned in the State of Kerala (Source: The Rubber Board, Government of India, Rubber growers guide, 2013)

Technical Name	Trade Name	Status
Phorate	Thimet	Distribution, sale and use prohibited
Kelthane	Dicofol	Distribution, sale and use prohibited
Chlorpyriphos	Classic 20	Recommended for restricted use
Lambdacyhalothrin	Karate	Recommended for restricted use
Fenvalerate	Sumicidin	Recommended for restricted use
Deltamethrin	Decis	Recommended for restricted use
Tridemorph	Calixin	Recommended for restricted use
Propiconazole	Tilt	Recommended for restricted use
Mancozeb	Indofil M-45	Recommended for restricted use
Zinc phosphide	Ratol	Recommended for restricted use. Use with great caution
Bromadiolone	Roban	Recommended for restricted use. Use with great caution
Paraquat	Gramaxone	Distribution, sale and use prohibited
2,4-D	Fernoxone	Recommended for restricted use
Diuron	Klass	Recommended for restricted use
Glyphosate	Round up	Recommended for restricted use

Notes



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