

Strategy and Trends

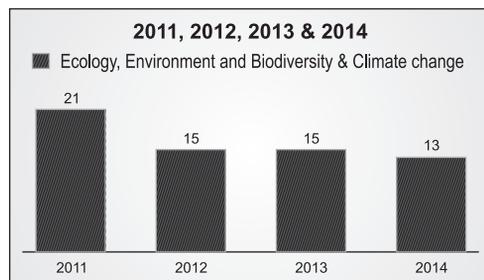
● In 2011, the UPSC added one more topic in the General studies paper. The syllabus prescribed by the UPSC states that questions would be asked on general issues on environmental ecology, bio-diversity and climate change-that don't require subject specialization. In 2014, prelims examination 13 questions were asked from the area of biodiversity and ecology.

● As the topic is a new addition to the UPSC syllabus candidates are still in dilemma about what to read for this, following text books may prove to be useful for the students: (a) NCERT Class XI-XII text books on biodiversity; (II) Text Book of Environmental Studies by E. Barucha; (III) Environment and Ecology by Savinder Singh; (IV) Ecology And Environment by Dr. P. D. Sharma; (V) Monthly editions of Civil Services Times covering all the issues related to bio-diversity and related topics.

Ecology, Climate change, and Biodiversity

2011, 2012, 2013 and 2014

In order to clearly under the nature of questions asked by the UPSC in CSAT, General Studies section, from the section of ecology, climate change, and biodiversity, we need to compare the nature and number of questions asked in the GS papers of last four years, i.e. 2011, 2012, 2013 and 2014.



CSAT, 2011; GS Section: In 2011, around 21 questions were asked from this section in the GS paper. The major topics from which the questions were asked were - (a) Animal living in sandy and saline area in India (b) Microbial fuel cells-statements (c) Coal combustion at thermal plants, pollutants emitted (d) Ozone hole in Antarctica (e) Why tropical rainforest does not regenerate quickly (f) Biodiversity between lower and higher latitudes (g) Why marine upwelling zones are important for ecosystem productivity etc.

CSAT, 2012; GS Section: In CSAT, 2012, there were around 15-16 questions from this section in the GS paper. The major topics from which the questions were asked were - (a) National Biodiversity Authority (NBA) (b) National Green Tribunal Act (c) Chlorofluorocarbons, known as ozone-depleting substances (d) Antelopes Oryx and Chiru (e) Carbon sequestration/storage in the soil (f) Millennium Ecosystem Assessment (g) Resistance to the introduction of Bt brinjal in India (h) Biomass gasification etc.

CSAT, 2013; GS Section: In CSAT, 2013, there were around 14 to 15 questions from this section in the GS paper. The major topics from which the questions were asked were - (a) Basic ecosystem in terms of productivity (b) Food chain in the ecosystem (c) Regarding some species of animals and their natural habitats (d) Oil-zapper (e) Threats to the biodiversity etc.

CSAT, 2014; GS Section: In CSAT, 2014, there were as many as 13 questions. This indicates that the role ecology and environment is persistently high. CST is proud to establish that

we managed to give direct answers to 12 questions out of 13. Please see the details:

1. With reference to 'Eco-Sensitive Zones', which of the following statements is/are correct?

1. Eco-Sensitive Zones are the areas that are declared under the Wildlife (Protection) Act, 1972 .

2. The purpose of the declaration of Eco-Sensitive Zones is to prohibit all kinds of human activities, in those zones except agriculture.

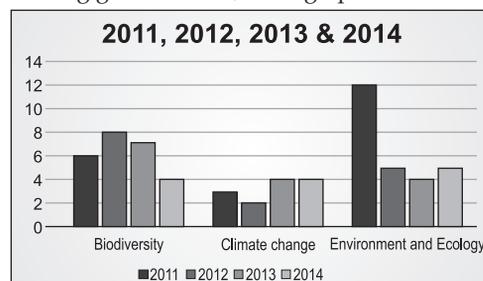
Select the correct answer using the code given below.

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Answer. D

Source: CST January 2014, Page 97 and Column No. 1

Felling of trees, change in agriculture systems, commercial use of natural water resources, including groundwater, setting up of hotels and



resorts, flying over protected areas in an aircraft or hot air balloon, discharge of effluents and solid waste in natural water bodies will be regulated.

CST January 2014, Page No. 98 and Column No. 1

The Government has notified eco-sensitive zones under the Environment (Protection) Act, 1986.

2. Consider the following statements:

1. Animal Welfare Board of India is established under the Environment (Protection) Act, 1986.

2. National Tiger Conservation Authority is a statutory body.

3. National Ganga River Basin Authority is chaired by the Prime Minister.

Which of the statements given above is/ are correct?

- (a) 1 only (b) 2 and 3 only
(c) 2 only (d) 1, 2 and 3

Answer. B: Source: CST January 2014, Page No. 108 and Column No. 2

To oversee the implementation of the GAP and to lay down policies and programmes, Government of India constituted the Central Ganga Authority (CGA) in February 1985, renamed as the National River Conservation Authority (NRCA) in September 1995, under the chairmanship of the Prime Minister. The Govern-

Ecology and Environment

● Coral reefs are amongst the most productive areas of the ocean. Each coral contains microscopic algae within its tissue that are able to capture the energy of the Sun and convert it into food. Moreover, reefs are ocean nurseries: they may cover less than 1% of the ocean floor, but support about 25% of all marine creatures.

● The Sunderbans is the largest single block of tidal halophytic mangrove forest in the world. It is the estuarine phase of the Ganges as well as Brahmaputra river systems. The forest covers of 4,000 sq km are on Indian Side. It has been declared as a UNESCO world heritage site in 1997. The Sunderbans are separately listed in the UNESCO world heritage list as the Sunderbans for India and the Sunderbans National Park, Bangladesh, which is 6000 sq km area. Sunderbans was designated a Ramsar site on May 21, 1992.

ment also established the GPD Ganga Project Directorate (GPD) in June 1985 as a wing of Department of Environment, to execute the projects under the guidance and supervision of the CGA.

3. Which of the following have coral reefs?

1. Andaman and Nicobar Islands
2. Gulf of Kachchh
3. Gulf of Mannar
4. Sunderbans

Select the correct answer using the code given below.

- (a) 1, 2 and 3 only (b) 2 and 4 only
(c) 1 and 3 only (d) 1, 2, 3 and 4

Answer. A: Source: CST January 2014, Page 124 and Column No. 2

As per the recommendation of the National Committee on Mangroves and Coral Reefs, the four major coral reefs areas identified for intensive conservation and management are: i) Gulf of Mannar, ii) Gulf of Kachchh, iii) Lakshadweep and iv) Andaman and Nicobar Islands.

4. Consider the following pairs :

Wetlands Confluence of rivers

1. Harike Wetlands: Confluence of Beas and Satluj/Sutlej
2. Keoladeo Ghana National Park: Confluence of Banas and Chambal
3. Kolleru Lake: Confluence of Musi and Krishna

Which of the above pairs is/are correctly matched?

- (a) 1 only (b) 2 and 3 only
(e) 1 and 3 only (d) 1, 2 and 3

Answer. A: Source: CST April 2014, Page No. 46 and Column No. 1

Deepor Beel in Assam, Kabar in Bihar, Surahthal in Uttar Pradesh), Lagoons (e.g., Chilika in Orissa), Crater Wetlands (Lonar lake in Maharashtra), Salt water Wetlands (e.g., Pangong Tso in Jammu and Kashmir and Sambhar in Rajasthan), Urban Wetlands (e.g., Dal Lake in Jammu and Kashmir, Nainital in Uttaranchal and Bhoj in Madhya Pradesh), Ponds/Tanks, man-made Wetlands (e.g., Harike in Punjab and Pong Dam in Himachal Pradesh), Reservoirs (e.g., Idukki, Hirakund dam, Bhakra-Nangal dam), Mangroves (e.g., Bhitarkanika in Orissa), Coral reefs (e.g., Lakshadweep), Creeks (Thane Creek in Maharashtra), seagrasses, estuaries, thermal springs are some kinds of wetlands in the country.

5. The most important strategy for the conservation of biodiversity together with traditional human life is the establishment of

- (a) biosphere reserves
- (b) botanical gardens
- (c) national parks
- (d) wildlife sanctuaries

Answer. A: Source: CST February 2014, Page 135 and Column No. 2

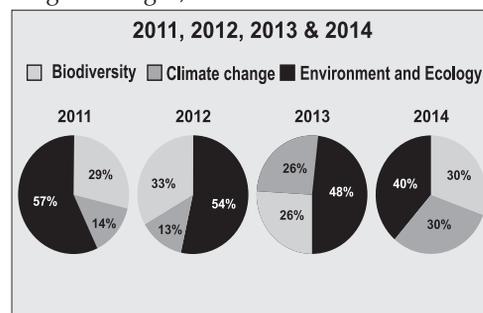
Biosphere Reserves are areas designated under UNESCO's Man and the Biosphere (MAB) Programme to serve as places to test different approaches to integrated management of terrestrial, freshwater, coastal and marine resources and biodiversity. Biosphere Reserves are thus sites for experimenting with and learning about sustainable development.

6. Lichens, which are capable of initiating ecological succession even on a bare rock, are actually a symbiotic association of

- (a) algae and bacteria
- (b) algae and fungi
- (c) bacteria and fungi
- (d) fungi and mosses

Answer. B: Source: CST March 2014, Page 28 and Column No. 2

Lichens representing symbiotic association of fungi and algae, constitute a dominant com-



ponent of epiphytic and saxicolous vegetation, and comprise 2,223 species in 283 genera and 72 families.

7. Consider the following international agreements:

1. The International Treaty on Plant Genetic Resources for Food and Agriculture.
2. The United Nations Convention to Combat Desertification
3. The World Heritage Convention

Which of the above has / have a bearing on the biodiversity?

- (a) 1 and 2 only (b) 3 only
(c) 1 and 3 only (d) 1, 2, and 3

Answer. D: Source: CST March 2014, Page 37 and Column No. 2

Establishment of a multilateral system to facilitate access to plant genetic resources for food and agriculture (PGRFA) through International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

8. Which one of the following is the correct sequence of a food chain?

- (a) Diatoms - Crustaceans - Herrings
- (b) Crustaceans - Diatoms - Herrings
- (c) Diatoms - Herrings - Crustaceans
- (d) Crustaceans - Herrings - Diatoms

Answer. A: Source: CST February 2014, Page

Ecology and Environment

● Zooplankton are little animals that live amongst, and eat, the phytoplankton. They are mostly made up of little crustaceans like shrimp, and little squids, and one of the most common zooplankton animals are small shrimp-like crustaceans called krill. Crustaceans are generally aquatic and differ from other arthropods in having two pairs of appendages (antennules and antennae) in front of the mouth and paired appendages near the mouth that function as jaws.

● As the UN system's development programme and a GEF Implementing Agency since 1991, UNDP supports countries in addressing development, climate, and ecosystem sustainability in an integrated manner. During the GEF-4 period (2006-2010), over 100 countries selected to work with UNDP in accessing over US\$ 1,3 billion from the GEF Trust Fund, and LDCF, SCCF Trust Funds and combining this with over US\$ 5,3 billion in co-financing to help them address priority global environmental issues in their countries.

134 and Column No. 1

Zooplankton are little animals that live amongst, and eat, the phytoplankton. They are mostly made up of little crustaceans like shrimp, and little squids, and one of the most common zooplankton animals are small shrimp-like crustaceans called krill.

9. If a wetland of international importance is brought under the 'Montreux Record', what does it imply?

(a) Changes in ecological character have occurred, are occurring or are likely to occur in the wetland as a result of human interference.
(b) The country in which the wetland is located should enact a law to prohibit any human activity within five kilo metres from the edge of the wetland.

(c) The survival of the wetland depends on the cultural practices and traditions of certain communities living in its vicinity and therefore the cultural diversity therein should not be destroyed.
(d) It is given the status of 'World Heritage Site'.

Answer. A: Source: CST April 2014, Page 47 and Column No. 2

The Montreux Record. Sites on the List of Wetlands of International Importance which are considered to have undergone, to be undergoing, or to be likely to undergo change in their ecological character brought about by human action may be placed on the Montreux Record and may benefit from the application of the Ramsar Advisory Mission and other forms of technical assistance.

10. With reference to 'Global Environment Facility', which of the following statements is/are correct?

(a) It serves as financial mechanism for 'Convention on Biological Diversity' and 'United Nations Framework Convention on Climate Change'
(b) It undertakes scientific research on environmental issues at global level
(c) It is an agency under OECD to facilitate the transfer of technology and funds to underdeveloped countries with specific aim to protect their environment.
(d) Both (a) and (b)

Answer. A: Source: CST June 2014, Page 43 and Column No. 1

To support such efforts, a new National Biodiversity Strategies and Action Plans Forum (NB-SAP Forum) was launch at COP11 by UNEP, CBD, The Global Environment Facility (GEF) and the UN Development Programme (UNDP). The online forum provides easy-to-access, targeted information such as best practices, guidelines and learning tools for countries.

11. Consider the following pairs:

1. Dampa Tiger Reserve : Mizoram
2. Gumti Wildlife Sanctuary : Sikkim
3. Saramati Peak : Nagaland

Which of the above pairs is /are correctly matched?

- (a) 1 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Answer. C

Source: CST April 2014, Page 55 and Column No. 2 in number 22.

It is situated in Tripura.

12. With reference to a conservation organization called 'Wetlands International', which of the following statements is/are correct?

1. It is an intergovernmental organization formed by the countries which are signatories to Ramsar Convention.

2. It works at the field level to develop and mobilize knowledge, and use the practical experience to advocate for better policies.

Select the correct answer using the code given below.

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Answer. B

13. With reference to Bombay Natural History Society (BNHS), consider the following statements :

1. It is an autonomous organization under the Ministry of Environment and Forests.

2. It strives to conserve nature through action-based research, education and public awareness.

3. It organizes and conducts nature trails and camps for the general public.

Which of the statements given above is/are correct?

- (a) 1 and 3 only (b) 2 only
(c) 2 and 3 only (d) 1, 2 and 3

Answer. C: Source: CST June 2014, Page 30 and Column No. 1

Bombay Natural History Society (BNHS) - a membership-driven organization - has been promoting the cause of a natural India for the past 130 years since 1883. It was started by 8 Mumbai citizens, of which two were Indians. The Society's guiding principle has always been that conservation must be based on scientific research - a tradition exemplified by its former president, late Dr Sálím Ali.

What does the UPSC prescribed syllabus says:

The new syllabus of the UPSC for Civil Services Examination clearly states that "the paper I will comprise General issues relating to environment ecology, Bio-diversity and climate change". This statement clearly states that the examination does not require subject specialisation but it is a test of student about his/her surroundings.

Major topics covered

Ecology and Environment

● Article 19 (1) (g) of the Indian constitution confers fundamental right on every citizen to practice any profession or to carry on any occupation, trade or business. This is subject to reasonable restrictions. A citizen cannot carry on business activity, if it is health hazards to the society or general public. Thus safeguards for environment protection are inherent in this. The Supreme Court, while deciding the matter relating to carrying on trade of liquor in *Cooverjee B. Bharucha Vs Excise commissioner, Ajmer* (1954, SC 220) observed that, if there is clash between environmental protection and right to freedom of trade and occupation, the courts have to balance environmental interests with the fundamental rights to carry on any occupations.

under Environment and Ecology:

(a) Question regarding National Biodiversity Authority (NBA); (b) Topics relating to National Green Tribunal Act, 2010; (c) On Biomass gasification; (d) Issues relating to lead, ingested or inhaled; (e) Why the ocean acidification is increasing; (f) What are the major threats to our biodiversity; (g) Regarding wetlands of India; (h) Resistance to the introduction of Bt food in India.

Suggested Study material for Environment and Ecology section: Candidates should keep in mind that while preparing this section for CSAT they should mainly rely on the Journal of National Institute of Ecology. To supplement this, they should read one or two of the books given below:

- (a) Science and Geography books of NCERTs
- (b) Civil Service Times' special issues on Environment and Ecology starting from January 2015 to July 2015.
- (c) The Hindu S&T portion
- (d) Surfing internet on regular basis

Environment under

constitutional provisions

In Atharvaveda, it has been said that "Man's paradise is on earth; this living world is the beloved place of all; It has the blessings of nature's bounties; live in a lovely spirit". Earth is our paradise and it is our duty to protect our paradise. The constitution of India embodies the framework of protection and preservation of nature without which life cannot be enjoyed. The knowledge of constitutional provisions regarding environment protection is need of the day to bring greater public participation, environmental awareness, environmental education and sensitize the people to preserve ecology and environment. The bio-industrial revolution expected in the coming millennium would be entirely dependent on the availability, richness and sustainable conservation and utilisation of our bio-resources. The Environment (Protection) Act, 1986 defines environment as "environment includes water, air and land and the interrelationship which exists among and between air, water and land and human beings, other living creatures, plants, micro-organism and property". India is the first country that has made constitutional provisions for protection and improvement of the environment. In the Directive Principles of State Policy of the Constitution, Article 47 provides that the State shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties. The improvement

of public health also includes the protection and improvement of environment without which public health cannot be assured. Article 48 deals with organization of agriculture and animal husbandry. It directs the State to take steps to organize agriculture and animal husbandry on modern and scientific lines. In particular, it should take steps for preserving and improving the breeds and prohibiting the slaughter of cows and calves and other milch and draught cattle. Article 48 -A of the constitution says that "the state shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country". The chapter on fundamental duties of the Indian Constitution clearly imposes duty on every citizen to protect environment. Article 51-A (g), says that "It shall be duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures."

According to Article 21 of the constitution, "no person shall be deprived of his life or personal liberty except according to procedure established by law". Article 21 has received liberal interpretation from time to time after the decision of the Supreme Court in *Maneka Gandhi vs. Union of India*, (AIR 1978 SC 597). Article 21 guarantees fundamental right to life. Right to environment, free of danger of disease and infection is inherent in it. Right to healthy environment is important attribute of right to live with human dignity. The right to live in a healthy environment as part of Article 21 of the Constitution was first recognized in the case of *Rural Litigation and Entitlement Kendra vs. State*, AIR 1988 SC 2187 (Popularly known as *Dehradun Quarrying Case*). It is the first case of this kind in India, involving issues relating to environment and ecological balance in which Supreme Court directed to stop the excavation (illegal mining) under the Environment (Protection) Act, 1986. In *M.C. Mehta vs. Union of India*, AIR 1987 SC 1086 the Supreme Court treated the right to live in pollution free environment as a part of fundamental right to life under Article 21 of the Constitution.

The constitution of India under Article 19 (1) (a) read with Article 21 of the constitution guarantees right to decent environment and right to live peacefully. In *PA Jacob vs. The Superintendent of Police Kottayam*, AIR 1993 Ker 1, the Kerala High Court held that freedom of speech under article 19 (1)(a) does not include freedom to use loud speakers or sound amplifiers. Thus, noise pollution caused by the loud speakers can be controlled under article 19 (1) (a) of the constitution.

The Eleventh Schedule of the Constitution lists

Ecology and Environment

● Of the 60,000 square km area of the Western Ghats that the Union environment ministry notified as ecologically sensitive, 17,000 sq km fall in Maharashtra covering 2,133 villages across 12 districts. Raigad and Pune have the highest number of villages that will get the fragile zone tag, to protect them from any further mining, quarrying and high-polluting industries. Conspicuously missing from the list of protected zones, however, is a bunch of villages that have been ironically getting funds from the planning commission under the 'Western Ghat Development Programme' for 40 years now.

and township and area development projects with an area of 50 hectares and above or with built up area of 1,50,000 sq meters and above will be prohibited in these areas. The decision for the new tag is taken following recommendations from the Dr K Kasturirangan Committee that was set up to review the Madhav Gadgil Western Ghats Ecology Expert Panel Report, which had suggested that the entire Western Ghats be declared an ESA for its bio-diversity. But after a review, the Kasturirangan Committee divided the Western Ghats into natural (no development) and cultural (agriculture, plantations etc) landscapes. It said development activities can be carried out in nearly 60 per cent of the Ghats. Of the 60,000 square km area of the Western Ghats that the Union environment ministry notified as ecologically sensitive, 17,000 sq km fall in Maharashtra covering 2,133 villages across 12 districts. Raigad and Pune have the highest number of villages that will get the fragile zone tag, to protect them from any further mining, quarrying and high-polluting industries. Conspicuously missing from the list of protected zones, however, is a bunch of villages that have been ironically getting funds from the planning commission under the 'Western Ghat Development Programme' for 40 years now. There are 12 villages from Sangli, 8 from Kolhapur and 6 from Satara excluded from the latest ESA list, published by MoEF.

The World Heritage status has decided to a cluster of 39 biodiversity hotspots in the Western Ghats. Kerala leads with 20 sites being inscribed in the heritage list followed by Karnataka with ten, Tamil Nadu five and Maharashtra four. List of Western Ghats World Heritage clusters in Maharashtra, Karnataka, Kerala and TN:
Maharashtra: 1. Kaas Plateau; 2. Koyna Wildlife Sanctuary; 3. Chandoli National Park; 4. Radhanagari Wildlife Sanctuary.

Karnataka: 1. Brahmagiri Wildlife Sanctuary, 2. Talacauvery Wildlife Sanctuary, 3. Padinalknad Reserved Forest, 4. Kerti Reserved Forest, 5. Aralam Wildlife Sanctuary, 6. Kudremukh National Park, 7. Someshwara Wild-

life Sanctuary, 8. Someshwara Reserved Forest, 9. Agumbe Reserved Forest, and 9. Balahalli Reserved Forest.

Kerala-Tamil Nadu: 1. Kalakad-Tiger Reserve, 2. Shendurney Wildlife Sanctuary, 3. Neyyar Wildlife Sanctuary, 4. Peppara Wildlife Sanctuary, 5. Kulathupuzha Range, 6. Palode Range, 7. Periyar Tiger Reserve, 8. Ranni Forest Division, 9. Konni Forest Division, 10. Achankovil Forest Division, 11. Srivilliputtur Wildlife, 12. Tirunelveli North Forest Division, 13. Eravikulam National Park, 14. Grass Hills National Park, 15. Karian Shola National Park, 16. Parambikulam Wildlife, 17. Mankulam Range, 18. Chinnar Wildlife Sanctuary, 19. Mannavan Shola, 20. Silent Valley National Park, 21. New Amarambalam Reserve Forest, 22. Mukurti National Park, 23. Kalikavu Range, 24. Attapadi Reserved Forest, 25. Pushpagiri Wildlife Sanctuary and 26. Sanctuary.

Sahyadri: Chandoli National Park (Leopard), Koyna Wildlife Sanctuary, Radhanagari Wildlife Sanctuary, Kas Plateau

Kudremukh: Agumbe Reserved Forest (King Cobra), Kudremukh National Park, Someshwara Wildlife Sanctuary, Someshwara Reserved Forest, Balahalli Reserved Forest

Talacauvery: Pushpagiri Wildlife Sanctuary, Brahmagiri Wildlife Sanctuary (Both Elephant habitats), Talacauvery Sanctuary, Padinalknad Reserved Forest, Kerti Reserved Forest, Aralam Wildlife Sanctuary

Nilgiri: Silent Valley National Park (Home to Lion-Tailed Macaque), New Amarambalam Reserved Forest, Mukurti National Park, Kalikavu Range, Attapadi Reserved Forest

Anamalai: Eravikulam National Park (and proposed extension, famous for Nilgiris Tahr), Grass Hills National Park, Karian Shola National Park, Karian Shola (Part of Parambikulam Wildlife Sanctuary), Mankulam Range, Chinnar Wildlife Sanctuary, Mannavan Shola

Periyar: Periyar Tiger Reserve (Tigers, Elephants), Ranni Forest Division, Konni Forest Division, Achankovil Forest Division, Srivilliputtur Sanctuary, Tirunelveli (North) Forest Division (part)

COMMUNITY RESERVES

EXISTING				
S.N.	Name	Year of Estd.	Area (km ²)	Location
1.	Keshopur Chhamb	2007	3.40	Gurdaspur, Punjab
2.	Lalwan	2007	12.67	Hoshiarpur, Punjab
3.	Kadalundi	2007	1.50	Malappuram, Kerala
4.	Kokkare Bellur	2007	3.12	Mandya, Karnataka
PROPOSED				
Sl.No.	Name	Location		
1.	Wadvana Wetland	Vadodara, Gujarat		
2.	Pariyej and Kaneval Lakes	Kheda & Anand, Gujarat		

Ecology and Environment

● The ever-increasing need for food to support the growing population in the country demands a systematic appraisal of its soil and climate resources in order to prepare effective land-use plans. India has a variety of landscapes and climate conditions and this is reflected in the development of different soils and types of vegetation. An ecological region is characterized by district ecological responses to macro-climatic as expressed in vegetation and reflected fauna and equatic systems. Therefore an agro-ecological region is the land unit on the earth surface covered out of agro - climatic region, which it is super imposed on land form and the kinds of soils and soil conditions those act as modifiers of climate and LGP (Length of growing period). India has twenty agroecological regions (AER). This zonation is based upon physiography, soil characteristics and taxonomy, climate, growing period, land utilization and forest types.

Agro-ecological regions harbouring rich crop diversity in India

Agro-ecological regions	Crops
Western Himalaya	<ul style="list-style-type: none"> ● Barley, wheat, maize, buckwheat, amaranth, prosomillet, finger millet ● French bean, soyabean, lentil, black gram, peas ● Pumpkin, cucumber, Alliums pp., ginger, Brassicae ● Pome, stone, soft and nut fruits
Eastern Himalaya	<ul style="list-style-type: none"> ● Barley, maize, buckwheat, amaranth, finger millet, foxtail millet ● French bean, soyabean, cowpea, black gram, peas, scarlet bean ● Pumpkin, cucumber, Alliums pp. ginger, chayote, tree tomato, Brassicae ● Pome and stone fruits
North-Eastern Region	<ul style="list-style-type: none"> ● Rice, maize, sorghum, finger millet, foxtail millet, job's tears ● French bean, soyabean, pigeonpea (perennial), black gram, rice bean, Dolichos bean, winged bean ● Pumpkin, chayote, cucumber, okra, eggplant, chilli/capsicum spp., Pointed gourd, ash gourd ● Taros, yams ● Citrus-Lime/lemon/orange/grape fruit, banana ● Tea, tree cotton, jute, kenaf and mesta, large cardamom, ginger, long pepper, sugarcane
Gangetic Plains	<ul style="list-style-type: none"> ● Rice, sorghum, barnyard millet, little millet/Panicum ● Chickpea, cowpea, mung bean ● Okra, eggplant, bitterground, cucumis spp., Luffa spp. ● Jackfruit, mango, lemon/lime, orange, jujube, Indian gooseberry ● Emblica, jumun/Syzygium, melons ● Linseed, niger, sesame, Brassicae ● Sugarcane, mulberry
Indus Plains	<ul style="list-style-type: none"> ● Durum wheat, pearl millet ● Moth bean, cluster bean, chickpea, black gram ● Okra, Cucumis spp. ● Jujube, Khirni/Mimusops, Phalsa/Grewia ● Sesame, Taramira/Eruca, Cotton
Eastern Peninsular Region/E.Ghats/Deccan	<ul style="list-style-type: none"> ● Rice, sorghum, finger millet, pearl millet, foxtail millet, little millet, prosomillet, kodo millet ● Black gram, green gram, cowpea, horse gram, Mucuna, pigeonpea, Dolichos bean, rice bean ● Taros, yams, elephant-food yam ● Banana, mango, lemon/lime, jackfruit ● Niger, Brassicae, sesame ● Ginger, turmeric, chilli, kenaf, sugarcane, coconut, cotton
Western Peninsular Region/Western Ghats/Malabar	<ul style="list-style-type: none"> ● Rice, sorghum, finger millet, small millet/Panicum ● Black gram, green gram, cowpea, pigeonpea, Dolichos bean, horse gram, sword bean ● Okra, eggplant, cucumber, chilli/Capsicum ● Taros, yams, elephant-foot yam ● Jackfruit, banana, lime/lemon, orange, jumun/Syzygium ● Sugarcane, black pepper, turmeric, ginger, coconut, arecanut, cotton
The Islands Regions	<ul style="list-style-type: none"> ● Coconut, breadfruit, chilli, taros, yams, Xanthosoma

Agasthyamalai: Kalakad-Mundanthurai Tiger Reserve (Tigers, Elephants), Shendurney Sanctuary, Kulathupuzha Range, Palode Range, Neyyar Wildlife Sanctuary, Peppara Wildlife Sanctuary

Major Rivers: Godavari, Krishna, Mandovi, Zuari and Kaveri

Larger Tributaries: Tunga, Bhadra, Bhima,

Malaprabha, Ghataprabha, Hemavathi, Kabini
Smaller Tributaries: Chittar, Manimuthar, Kallayi, Kundali, Pachaiyar, Pennar, Periyar & Kallayi

WGEEP

It is involvement of local communities that would truly make a difference, believes Madhav Gadgil, Chairman of the Western Ghats Ecolo-

Ecology and Environment

● The WGEEP report had recommended banning mining in 60 per cent of hill areas falling in six states over the next five years and not permitting any new mines in another 15 per cent of the Western Ghats area - a globally recognized biodiversity rich zone. The panel has recommended that the Ghats should be classified into three classes of eco-sensitive zone with various degrees of restriction on land use for development and agriculture. It had also pushed the case for setting up an authority to monitor implementation of the report and the management of the eco-sensitive zones.

● The six states through which the Ghats pass have strongly objected to the report's recommendations as they fear it will bring "development" to a standstill. Now the Government has decided to set up another committee comprising central and state government experts to review the controversial report of the Western Ghats Ecology Expert Panel (WGEEP) after several states vehemently objected to the recommendations.

gy Expert Panel (WGEEP) who pointed out that a legislation, the Biodiversity Act, passed way back in 2002 had mandated that every village panchayat and local body have a biodiversity management committee to preserve its ecological heritage. Madhav Gadgil has expressed regret that biodiversity management committees have not been constituted in many states, including Maharashtra, though the Biological Diversity Act stipulates every local body to constitute such a committee in its jurisdiction. The committees, constituted by the MoEF in February 2010, are to help promote conservation, sustainable use and documentation of biological diversity. The WGEEP report had recommended banning mining in 60 per cent of hill areas falling in six states over the next five years and not permitting any new mines in another 15 per cent of the Western Ghats area - a globally recognized biodiversity rich zone. The panel has recommended that the Ghats should be classified into three classes of eco-sensitive zone with various degrees of restriction on land use for development and agriculture. It had also pushed the case for setting up an authority to monitor implementation of the report and the management of the eco-sensitive zones.

The report identifies several eco-sensitive zones in the region and recommends that they should be declared no-go areas. In its wide array of recommendations, the panel has also called for scrapping of Karnataka's Gundia and Kerala's Athirapally hydro-projects, and gradual phasing out of mining activities in ecologically sensitive areas of Goa by 2016.

The panel's advice has sparked strong reactions from states such as Kerala, which claimed that complete implementation of the recommendations would lead to unprecedented restrictions on development and infrastructure growth. Four of the 39 sites in the Western Ghats, which will now be on the World Heritage list, are in Maharashtra. The six states through which the Ghats pass have strongly objected to the report's recommendations as they fear it will bring "development" to a standstill. Now the Government has decided to set up another committee comprising central and state government experts to review the controversial report of the Western Ghats Ecology Expert Panel (WGEEP) after several states vehemently objected to the recommendations. Nonetheless, the IUCN has supported the recommendations of the committee. IUCN also noted it is ready to assist the states in protecting the hot bio-diversity hotspots in Western Ghats that is home to rain forests, rivers, waterfalls and a number of mammals including the endangered endemic lion-tailed macaque, the endangered Asian elephant and tiger.

Madhav Gadgil v Kasturirangan

In a major development, the Ministry of Environment and Forests (MoEF) has informed the National Green Tribunal (NGT), it would pursue the implementation of the report of the high-level working group (HLWG) headed by Dr K Kasturirangan, not that of its precursor, the Madhav Gadgil panel. The Gadgil panel had faced opposition from states for recommending that almost three-fourth of the hills, including plantations, cultivated lands and large habitations, in the Ghats be turned into a restricted development zone with an overarching authority to regulate the region superseding the elected authorities' role. The Kasturirangan panel has sought to balance the two concerns of development and environment protection, by watering down the environmental regulation regime proposed by the Gadgil report in 2012.

Gadgil committee recommendations:

1. The Kasturirangan panel has considerably diluted the Western Ghat report of Madhav Gadgil. It divided Western Ghats, one of the world's most important biodiversity hotspots, spanning six states: Kerala, Maharashtra, Tamil Nadu, Goa, Gujarat and Karnataka, into three ecologically sensitive zones.
2. Large scale measures should be taken to control environmental degradation in the ecologically sensitive area (ESAs).
3. No clearance be given to dams in some parts of Western Ghats.
4. In Goa, there would be an indefinite moratorium on clearances for mining.
5. For Ratnagiri and Sindhudurg districts of Maharashtra, no new coal based thermal power plants should be allowed.
6. The recommendations must be taken to the gram sabhas for their feedback.

K Kasturirangan panel recommendations:

1. Termed 60 per cent of Western Ghats into cultural landscape (human settlements, agriculture, plantations) and rest 40 per cent as biologically rich natural landscape.
2. The Gadgil committee had recommended certain restrictions to be put in place along the entire stretch of the Western Ghats to protect the unique biodiversity of the region. But Kasturirangan committee had relied on satellite data. It had recommended that merely 37 per cent of the region should be declared as an ecologically sensitive area (ESA).
3. The local communities can have no say in economic decisions.

Implications:

1. It simply means that a huge area of the ecologically sensitive Western Ghats area, which runs across several states including Maharashtra, would be open to activities like dams, min-

Ecology and Environment

● The Gadgil committee had recommended certain restrictions to be put in place along the entire stretch of the Western Ghats to protect the unique biodiversity of the region. But Kasturirangan committee had relied on satellite data. It had recommended that merely 37 per cent of the region should be declared as an ecologically sensitive area (ESA).

● The Eastern Ghats form a broken chain of mountainous terrain spreading in the states of Orissa, Andhra Pradesh and Tamil Nadu and two districts of Karnataka. The mountain ranges are rich in biodiversity, its forests range from dry deciduous mixed forest to semi evergreen rain forest. Asia's biggest tiger reserve — Nagarjunasagar-Srisailem Tiger Reserve — is located in the Nallamala forest range of the Eastern Ghats.

ing, power plants and irrigation projects. At present, mining, thermal power plants, hazardous industries, etc, are banned in ESAs. States have been demanding reduction in the ESA within their boundaries.

2. If the Gadgil committee is dumped, then the project related to mining, dam or other developmental activities that are outside the 37 per cent area ESA suggested by the Kasturirangan report would be started.

Protection of Biodiversity of the Eastern Ghats

The Eastern Ghats form a broken chain of mountainous terrain spreading in the states of Orissa, Andhra Pradesh and Tamil Nadu and two districts of Karnataka. The mountain ranges are rich in biodiversity, its forests range from dry deciduous mixed forest to semi evergreen rain forest. Asia's biggest tiger reserve — Nagarjunasagar-Srisailem Tiger Reserve — is located in the Nallamala forest range of the Eastern Ghats. It is home to rich variety of flora, fauna, and minerals. The green cover of Eastern Ghats was spread on 2.5 lakh sq km and supported many river basins. Popular shrines like Simhachalam, Annavaram, Bhadrachalam, Srisailem, Mahanandi and Tirumala are located in Eastern ghats. The jurisdiction is covered in four sections, namely- Northern-Eastern Ghats which covers the area above Mahanadi to Northern boundary of Orissa- Mayurbhanj district. Other three sections are river Mahanadi to river Godavari, river Krishna to Chennai city and southern ghats i.e. tract between Chennai and Nilgiri hills to river Vaigai. The Government has taken many initiatives to protect biodiversity of the Eastern Ghats. Seshachalam hill ranges of Andhra Pradesh have been designated as Biosphere Reserve. Several Wildlife Sanctuaries established in the Eastern Ghats to preserve its Biodiversity. These include Gundla Brahmeswaram, Kambalakonda, Kaundinya, Nagarjunasagar -Srisailem, Papikonda, Pocharam, Rollapadu, Sri Lankamalleswaram, Sri Peninsula Narasimha and Sri Venkateswara Wildlife Sanctuaries. Botanical Survey of India (BSI) has published several floras to document the biodiversity of Eastern Ghats. These are Flora of Tamilnadu (including districts of Eastern Ghats), Flora of Nallamalais, Flora of Visakhapatnam, Flora of Nellore, Flora of Venkateshwara Wildlife Sanctuary, Flora of Araku Valley, Flora of Nagarjunakonda, Flora of Maredumalai, Flora of Medak and Flora of Chittor District. Zoological Survey of India (ZSI) has taken steps to document the faunal resources in the Eastern Ghats.

Plains on the east coast of India can be wealthy only if the Eastern Ghats remain healthy and it is the responsibility of the public to conserve

the ecological niche provided by these mountains.

Major threats:

1. The bauxite mining would cause ground water contamination, massive displacement of tribal communities, water scarcity due to excessive use by mining companies and would have impact on generations of tribal communities.

2. There is a deep concern over ineffective implementation of important laws such as Forest Rights Act and PESA.

The water scarcity that would result from the mining of various minerals in Eastern Ghats. The reservoirs such as Megadrigedda, Tatipudi, Mudusarlova, Raiwada, which supply water to Vizag city, might dry up to ineffective management of Eastern Ghats.

3. The effects of globalisation have had far-reaching consequences in the Eastern Ghats. With the advent of liberalisation, the Eastern Ghats witnessed a sudden invasion of macro-economic forces for the exploitation of its rich natural resources.

4. Virgin forests, with their enormous wealth of timber, mineral and non-timber resources have been ruthlessly, unscientifically and irresponsibly tapped first by the public sector industries and from the eighties onwards, by the private and multinational industries.

Zoological Survey of India (ZSI)

The Zoological Survey of India, the only taxonomic organization in the country involved in the study of all kinds of animals from Protozoa to Mammalia, occurring in all possible habitats from deepest depth of the ocean to the peaks of Himalaya, was established on 1st July, 1916 to promote survey, exploration and research leading to the advancement in our knowledge of the various aspects of the exceptionally rich animal life.

▶ Responsible for carrying out survey to list all endangered species.

▶ It has its headquarters at Kolkata and also has sixteen other regional stations. **1.** North Eastern Regional Centre (NERC), Shillong, Meghalaya (1959); **2.** Western Regional Centre (WRC), Pune, Maharashtra (1959); **3.** Central Zone Regional Centre (CZRC), Jabalpur, Madhya Pradesh (1960); **4.** Desert Regional Centre (DRC), Jodhpur, Rajasthan (1960); **5.** Northern Regional Centre (NRC), Dehra Dun, Uttarakhand (1960); **6.** Southern Regional Centre (SRC), Chennai, Tamil Nadu (1961); **7.** Gangetic Plains Regional Centre (GPRC), Patna, Bihar (1965); **8.** High Altitude Regional Centre (HARC), Solan, Himachal Pradesh (1968); **9.** Marine Biology Regional Centre (MBRC), Chennai, Tamil Nadu (1973); **10.** Andaman and Nicobar Regional Centre (ANRC), Port Blair (1977); **11.** Freshwater Bi-

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● The Zoological Survey of India will be using DNA barcoding technology to tag flora and fauna to ensure protection of the rich biodiversity, as well as to create a national biodiversity database for the benefit of the public. Barcode of life is a short DNA sequence, from a uniform locality on the genome, used for identifying species and DNA barcoding is an emerging global standard for identifying species.

● A DNA barcode, or a short standardized sequence that enables researchers to distinguish among many species, works the same way as the 12-number UPC identifies brands of flour or sugar.

ology Regional Centre (FBRC), Hyderabad, Andhra Pradesh (1979); 12. Sunderban Regional Centre (SRC), Canning, West Bengal (1979); 13. Estuarine Biology Regional Centre (EBRC), Gopalpur-on-Sea, Ganjam, Orissa (1980); 14. Western Ghat Regional Centre (WGRC), Kozhikode, Kerala (1980); 15. Arunachal Pradesh Regional Centre (APRC), Itanagar, Arunachal Pradesh (1983); and 16. Marine Aquarium cum Regional Centre (MARC), Digba, West Bengal (1989).

▶ Four status surveys one for Tibetan Wild Ass as earlier surveys. Ecological studies including status survey of endangered animals were also continued.

▶ The National Zoological Collection was further enriched by the addition of 9532 Identified specimens belonging to 487 species. Forty four species of Odonata, and 48 species of freshwater fishes were assessed by ZSI scientists and were incorporated in the IUCN Red List.

▶ Several faunal exploration and surveys including various eco-systems, Biosphere Reserves, National Parks and Wildlife Sanctuaries, Tiger Reserves, were undertaken by the ZSI and its various Regional Stations.

▶ Research work regarding Identification of new taxa, and fauna from various States were also continued during the year.

▶ Several studies on Butterflies and Moths of Madhya Pradesh, Amphibians of North-East India, Mammals of Kerala, etc., were undertaken by the ZSI and its various Regional Stations.

▶ The ZSI published several records, occasional papers, bibliographies of Indian Zoology and other special publications during the year.

▶ ZSI maintains 6 Galleries in the Indian Museum which are: (1) Mammal Gallery, (2) Bird Gallery, (3) Ecosystem Gallery, (4) Reptilia and Amphibia Gallery, (5) Fish Gallery and (6) Insect Gallery (under renovation).

Participation in Antarctica Expedition: ZSI is providing monthly e-News since January 2009, highlighting new discoveries, new records, published paper articles on its role in environmental protection, visit of the dignitaries, publication of checklists etc.

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the 12-number UPC identifies brands of flour or sugar.

Role in Red Data Book: ZSI on the basis of initial IUCN categories of rare animals published its first account in 1983: Threatened animals of India by B.K. Tikader. The book covers an account on 81 mammal, 47 birds, 15 reptiles and 3 amphibian rare species.

With the introduction of global revision of IUCN criteria, a need was felt by ZSI to present a Red Data Book with an updated data based on the revised IUCN 1993 guidelines. The Red Data Book on Indian Animals Part1: Vertebrata (Mammalia, Aves, Reptilia and Amphibia) Published in 1994 by A.K.Ghosh, Director, ZSI, Kolkata, is the outcome of the same. It covers an updated data on 77 mammals, 55 birds, 20 reptilian and 1 amphibian species coming under different IUCN categories. Species listed under various IUCN categories are considered as Red listed species and they strongly deserve immediate protection through conservation methods for their survival. In the year 2000 IUCN made major changes in the IUCN criteria for the threatened species listed under the Red List. The changes were major like inclusion of criteria like Critically Endangered, Near Threatened and Least Concern; removal of criteria like Rare, Lower risk-least concern and Lower risk-near threatened, Insufficiently Known, etc. Similarly there has been a major change in the IUCN 2000 guidelines as well. Taking into consideration the major changes occurred in the IUCN Red List Criteria and IUCN guidelines in the year 2000, it was felt absolutely necessary to revise the Red Data Book of 1994 published by ZSI.

Faunal Exploration and Surveys: Ecosystems: A total of thirty eight extensive surveys were undertaken during this year viz. Mountain (nineteen), Forests (two), Marine (two), Estuarine (nine), Desert (four), Manmade ecosystems (two). The new species, *Ichthyophis davidi*, a yellow striped caecilian has been discovered from the Belgaum district of Karnataka, which is part of the Western Ghat. The new species *Ichthyophis davidi* is one of the largest known yellow striped caecilians from Western Ghats and is named in honour of David Gower, Department of Zoology. Habitat destruction, due to human interference, and usage of chemical fertilizers in the plantations (areca, banana and cardamom) is limiting the distribution of these limbless amphibians in Western Ghats.

The faunal diversity survey conducted by the Zoological Survey of India (ZSI), Pune, at the Chandoli National Park in Sangli district and the Radhanagari Wildlife Sanctuary in Kolhapur district, has recorded presence of 374 species, marking them as rich biodiversity sites.

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● The Bhimashankar wildlife sanctuary in Pune district harbours 529 species of animals, a study conducted by the Zoological Survey of India (ZSI) revealed. Out of the 79 endemic species of birds in the Indian region, 19 are found here. Out of the 330 species of butterflies recorded from Western Ghats (Gujarat, Goa, Maharashtra, Karnataka, Tamil Nadu and Kerala), 213 are in Maharashtra and, of which, 65 are found in this sanctuary.

● A well grown porcupine fish is the new attraction at the marine aquarium at the Zoological Survey of India (ZSI) premises. The porcupine fish mainly feeds on crabs, oysters, clams, snails and jelly fish. They are also found in the coral reef areas.

The ZSI scientists documented the animal species in both the protected areas during the three-year survey. The species include 35 species of zooplankton (organisms), 40 species of dragon flies, 10 species of molluscs (invertebrates), 10 species of grasshoppers, 88 species of butterflies, 40 species of freshwater fish, 82 species of birds and 69 species of mammals. ZSI said that out of the 16 endemic birds seen in Western Ghats, eight of endemic birds are found in Chandoli National Park and Radhanagari Wildlife Sanctuary. One can also find endangered and threatened bird species here. The eight endemic species of birds includes Nilgiri Wood Pigeon, Blue-Winged Parakeet, Malabar Grey Hornbill, Small Sunbird, White-bellied Blue Flycatcher, Rufous Babbler, Grey-headed Bulbul. The Bombay Natural History Society (BNHS) has identified Radhanagiri Wildlife Sanctuary as one of the important bird areas (IBA) of the state.

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The shy Slaty-legged Crake, the uncommon Spotted Creeper and the Streaked Weaver are the latest of the winged species to be documented by Indian bird conservation network (IBCN).

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Protected Areas: The faunal diversity of the following Protected Areas has been documented:

National Parks: Nanda Devi National Park, Uttarakhand; Corbet National Park, Uttarakhand; Rajaji National Park, Uttarakhand; Sanjay Gandhi National Park, Maharashtra; Eravikulam National Park, Kerala; Kudremukh National Park, Karnataka; Mount Harriet National Park, South Andaman; Desert National Park, Rajasthan; Pench National Park, Maharashtra; Gulf of Kutch Marine National Park, Gujarat; Banerghata National Park, Karnataka North, Middle and South Button National Parks, Andaman.

Wildlife Sanctuaries: Chandaka Dampara Wildlife Sanctuary, Orissa; Asola Bhatti Wildlife Sanctuary, Delhi Gobind Pashu Vihar Wildlife Sanctuary, Uttarakhand; Saipung Wildlife

Sanctuary, Meghalaya; Kaimur Wildlife Sanctuary, Bihar Tiger Reserves: Indravati Tiger Reserve, Chhattisgarh; Kanha Tiger Reserve, Madhya Pradesh; Valmiki Tiger Reserve, Bihar; Sundarbans, Palamau, Simlipal and Manas TRs; Melghat Tiger Reserve Biosphere Reserves: Nanda Devi Biosphere Reserve, Uttarakhand; Sundarbans Biosphere Reserve, West Bengal Nilgiri Biosphere Reserve, Karnataka, Tamil Nadu & Kerala; Gulf of Mannar Biosphere Reserve, Tamil Nadu.

Botanical Survey of India (BSI)

The Botanical Survey of India (BSI) was established on February 13, 1890 with its headquarter at Kolkata and its 10 circle offices throughout the country with the basic objective to explore the plant resources of the country and to identify the plants species with economic virtues. As a part of scientific development of the country it was reorganised and during the successive plan periods, the functional base of BSI was further expanded to include various new areas in this field. One new family, 36 new genera and 1,104 new species, subspecies, varieties have been discovered as new to science. Inventorying of about 1,700 Rare, Endangered and Threatened (RET) species.

▶ During the field/ exploration/ collection tours, more than 5,500 specimens were collected including lower groups of plants viz. Algae, Fungi, Lichens, Bryophytes and Pteridophytes. About 3,000 specimens belonging to 900 species were identified by different circles and units of Botanical Survey of India.

▶ Seven herbarium consultation tours/ study tours were also undertaken in connection with the revisionary and floristic studies under National/State/Regional/District flora.

▶ Seventy Five field tours for collection of plant specimens/materials for floristic, ethnobotanical and pharmacognostical studies on flowering and non-flowering plants were undertaken by different regional centre and units of BSI covering the following regions, including four biodiversity hotspot, viz. the Himalaya, the Indo-Burma, Sundaland and the Western Ghats-Sri Lanka. These include 26 protected areas and 07 Sacred Groves. In addition, 09 tours for the collections of live germplasm were also undertaken in these areas.

- **Western Himalaya:** Uttarakhand (in and around Sonanadi Wildlife Sanctuary, Namik and Hiramani glacier valleys, Pithoragarh, Kumaon);

- **Eastern Himalaya:** Arunachal Pradesh (Lohit district, Changlang district and Kamlang Wildlife Sanctuary); Sikkim

(Shingba Rhododendron Sanctuary and different areas of North Sikkim & South Sikkim);

- **North-East India:** Assam (Laokhowa Wild-

Ecology and Environment

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life Sanctuary); Mizoram (Murlen National Park);

- **Arid - Semi Arid:** Haryana (Sultanpur National Park and Kalesar National Park); Gujarat (Shoolpaneshwar Wildlife Sanctuary, Dang District); Rajasthan (Jamwa Ramgarh Wildlife Sanctuary);

- **Gangetic Plains:** Uttar Pradesh (Upper Ganga Ramsar Site); Bihar & Jharkhand (Koderma Wildlife Sanctuary, Palkot Wildlife Sanctuary, Gautam Buddha Wildlife Sanctuary, Vikramshila Gangetic Dolphin wildlife Sanctuary, Rajmahal hills, Pakur, Godda, Sahibganj, Dumka and Deogarh districts); West Bengal (Buxa Wildlife Sanctuary, Jaldapara Wildlife Sanctuary); Orissa (Koraput, Jajpur and Balasore);

- **Deccan Peninsula:** Chattisgarh (Surguja & Korba area); Andhra Pradesh (Mamillapalli and Maddimadugu sections of Kadapa range of Seshachalam Biosphere Reserve, Amarabad, Mannanur, Achampet and Lingal ranges of Achampet division of Nagarjunasagar Srisailem Wildlife Sanctuary);

- **Western Ghats:** Maharashtra (Koyana Wildlife Sanctuary, Chandoli Wildlife Sanctuary for ferns, Junnar, Harishchandragarh, Ganesh kind, Karzat, Matheran, Sanjay Gandhi National Park, Alibag and Phansad Wild Life Sanctuary for follicolous fungi); Karnataka (Sharavathi valley Wildlife Sanctuary, Shimoga and Biligirirangaswamy Temple Wildlife Sanctuary); Tamil Nadu (Srivilliputhur Wildlife Sanctuary);

- **Coastal Region:** Kerala (Coastal area and Malabar Wildlife Sanctuary); - Andaman & Nicobar Islands: S. Andaman (Rani Jhansi Marine National Park);

Indian Botanic Garden, Howrah: Established in 1787 at Howrah, the IBG has an area of ca 273 acres with a National Orchidarium, 25 Lakes and number of conservatories.

Central Botanical Laboratory, Howrah: Established in 1954 at Kolkata and later shifted to Howrah with Economic Botany, Cytology & Plant physiology section.

Industrial Section, Indian Museum, Kolkata: Established in 1887 at Kolkata has 20,000 exhibits of economic plants and plant products arranged in eight Bays for public awareness; 70,000 herbarium specimens; 18 volumes containing 700 samples of Indian textiles in silk, cotton, muslin and wool, representing one of the 20 sets captioned Textiles Manufactures and Costumes of the People of India, and a 15 volume companion set on Natural Dyes.

Central National Herbarium, Howrah: Established in 1795 at Howrah, holds ca 2.05 million specimens of seed plants, 10,000 type specimens, 12,000 Wallichian specimens and 10,000 non-flowering plants.

Arunachal Pradesh Regional Centre, Itanagar: Jurisdiction - Arunachal Pradesh. Established in 1977, the circle has 13,500 herbarium specimens, including 34 types representing 20 species discovered as new to science.

Eastern Regional Centre, Shillong: Jurisdiction - Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura. Established in 1956 at Shillong.

Sikkim Himalayan Regional Centre, Gangtok: Jurisdiction - Sikkim. Established in 1979, the circle has 40,000 herbarium specimens.

Central Regional Centre, Allahabad: Jurisdiction - Madhya Pradesh, Chhattisgarh, Uttar Pradesh. Established in 1962 at Allahabad, the circle has ca 69,000 herbarium specimens, including three types.

Andaman & Nicobar Regional Centre, Port Blair: Jurisdiction - Andaman & Nicobar Islands. Established in 1972, the circle has 22,000 herbarium specimens, including 100 types representing two genera and 66 species discovered as new to science.

Western Regional Centre, Pune: Jurisdiction - Maharashtra, Karnataka, Goa, Daman, Diu, Dadra & Nagar Haveli. Established in 1955 at Pune, the circle has ca 1,70,000 herbarium specimens, including 571 types representing two genera and 146 species discovered as new to science.

Southern Regional Centre, Coimbatore: Jurisdiction - Tamil Nadu, Kerala & Lakshadweep Islands. Established in 1955 at Coimbatore, the circle has ca 2,75,000 herbarium specimens, including 2594 types representing 08 genera and 155 species discovered as new to science.

Deccan Regional Centre, Hyderabad: Jurisdiction - Andhra Pradesh, Orissa. Established in 2005 at Hyderabad, the circle has ca 10,000 herbarium specimens.

Arid Zone Regional Centre, Jodhpur: Jurisdiction - Rajasthan, Gujarat. Established in 1972 at Jodhpur, the circle has ca 24,800 herbarium specimens, including 17 types representing nine species discovered as new to science.

Northern Regional Centre, Dehradun: Uttarakhand, Chandigarh, Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir. Established in 1956 at Dehradun, the circle has ca 1, 21,500 herbarium specimens, including 112 types representing two genera and 66 species discovered as new to science.

Botanic Garden of Indian Republic, NOIDA: Jurisdiction - National Capital Territory Region of Delhi. 4300 indigenous saplings and 554 seedlings of medicinal plants have been procured different parts of Terai region and Orissa for BGIR. Database on Oil Yielding Plants completed; hard copy format published (2008).

Ecology and Environment

● GSI launched specialized theme oriented large-scale (1:25,000 or larger) studies/mapping items (Specialised Thematic Mapping) from VIII Plan period.

● National Geochemical Mapping (NGCM) Programme in India was initiated by GSI in 2001-02 with launching of a number of pilot surveys in different States all over the country. The prime objective of this endeavour is to produce a body of geochemical data on 1:50,000 scales for the Indian landmass based primarily on stream sediments, analyzed using a consistent set of methods.

Geological Survey of India (GSI)

GSI is a premier earth science organisation, meets the geosciences information requirement in diverse fields;

▶ Established in 1851 with the main aim of locating coal resources.

▶ Has strength of about 2,900 scientists and technical professionals.

▶ Its functions are to encompass wide spectrum of earth science activities e.g. geological, geophysical and geo-chemical surveys, marine surveys, geo-environmental studies and various laboratory studies.

▶ It has opened full-fledged seism-otectonic divisions at **Lucknow, Jaipur, Shillong, Calcutta, Nagpur and Hyderabad.**

▶ Has also opened technical consultancy divisions at many of its regional centres to collaborate and cooperate with the potential investors in mineral fuel and other developmental sectors.

▶ New activities initiated during Ninth Plan period are development of village economy by Mineral Resource Appraisal Programme and Geochemical Mapping.

GSI launched specialized theme oriented large-scale (1:25,000 or larger) studies/mapping items (Specialised Thematic Mapping) from VIII Plan period. The studies involve application of multidisciplinary techniques, often complemented by precision laboratory studies. The outcome of these mapping efforts have already proven its importance in the areas of prognostication of natural resources, environmental analysis, natural hazard recognition and risk management, land use management, evaluation of major civil engineering projects etc.

Systematic ground gravity - magnetic surveys under the Geophysical Mapping (GPM) programme was initiated during X Plan Period and is being continued in XI Plan Period. The mapping process involves acquisition of gravity and magnetic data with an average station density of one station per 2.5 sq km area for compilation of standardized gravity and magnetic maps of the country on 1:50,000 scale.

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2,91,976 sq.km. was covered by deploying multi sensor systems. A total of 14,761 lkm. (36,902 sq.km.) was flown over parts of West coast from Hosadurga to Vengurla, over parts of Karnataka and Maharashtra. The flight (TOASS) was operative till April, 2010.

Modernization in GSI: The Geological Survey of India has undertaken an extensive programme of modernization during the XI Plan period. The modernization programme is aimed at refurbishing and upgrading the in-house capabilities of GSI. Under the Modernization programme, GSI proposes to acquire a new Ocean-going research vessel as a replacement for the aging RV Samudra Manthan, a new Geotechnical Vessel with shallow drilling capacity, a Heliborne Geophysical Survey System and a replacement of its fixed-wing aircraft. The Government has approved the proposal for procurement of the new research vessel at an estimated cost of Rs. 448 crores. The procurement action has started with Shipping Corporation of India (SCI) identified as the Indian Consultant. The Government has also accorded approval for the acquisition of a Geotechnical Vessel at a cost of Rs. 72 crores. Proposal for appointment of SCI as the Indian Consultant has been initiated. Procurement action for Heliborne Survey System of 4 sensors (gravity, magnetic, time domain electromagnetic and radiometric) along with a hyperspectral camera to be fitted to the helicopter is underway. The Feasibility Report for acquisition of a new Fixed Wing Aircraft and geophysical sensors (gravity, magnetic, electromagnetic and hyper spectral) are to be finalized by GSI shortly. In addition, Inductively Coupled Plasma Mass Spectrometer (ICPMS) equipment for chemical analysis, Electron Probe Micro Analyzer (EPMA) to study of mineral phases in rocks and Scanning Electron Microscope (SEM) to study naturally occurring specimens up to a magnification of about 1 lakh times, are planned for many laboratories.

Marine geo-scientific programmes: The Territorial Waters, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976, (the Act) lays down the sovereign rights that India retains for itself in relation to the territorial waters and contiguous areas adjoining its landmass. Equally, the air space over such areas is also subject to these sovereign rights. While the territorial waters extend up to a distance of 12 nautical miles from the landmass, the Act extends the sovereign rights to the Continental Shelf of India (CSI), which extends significantly beyond the territorial waters up to a maximum of 200 nautical miles from the landmass. India, a traditionally maritime country with rich maritime heritage, has an Exclusive

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● India, a traditionally maritime country with rich maritime heritage, has an Exclusive Economic Zone (EEZ) of about 2.37 million sq. km wherein India enjoy the exclusive legal right to utilize all living and non-living resources. In 2010, India had submitted its claim to extend its coastal EEZ from 200 nautical miles to 350 to the UN Commission on Law of Seas (UNCLOS).

● Considering the large area of the Indian EEZ in excess of 2 million km² and the need to extend the studies to the continental shelf areas beyond 200 M in view of India's submission for an extended continental shelf to the United Nations Commission on the Limits of the Continental Shelf (CLCS), it is proposed to continue the bathymetric mapping and systematic sampling on a mission mode using a dedicated chartered oceanographic vessel during the XII Plan.

Economic Zone (EEZ) of about 2.37 million sq. km wherein India enjoy the exclusive legal right to utilize all living and non-living resources. In 2010, India had submitted its claim to extend its coastal EEZ from 200 nautical miles to 350 to the UN Commission on Law of Seas (UNCLOS). The project mainly focuses on mapping the entire EEZ of India using the state-of-the-art technologies of Multibeam apart from systematic sediment sampling and its analysis. The entire EEZ have been divided into two areas viz. deep water areas (> 500 m water depth) and shallow water areas (< 500 m water depth). Systematic mapping of the Indian EEZ utilising state-of-the-art multibeam bathymetric instruments was initiated during the XI Plan period, and to date, nearly 30 per cent of the deep-water regions of the EEZ beyond 500 M water depth has been mapped. Some of the significant observations include the presence of channellevée systems between Ninety east Ridge to its west and Andaman Trench in east. Two Seamounts off Lakshadweep, and pockmarks on the seabed off Goa. In addition to bathymetric observations, sampling of the seabed-sub-seabed at select locations has also been carried out and the analytical studies are in progress. Considering the large area of the Indian EEZ in excess of 2 million sq. km and the need to extend the studies to the continental shelf areas beyond 200 M in view of India's submission for an extended continental shelf to the United Nations Commission on the Limits of the Continental Shelf (CLCS), it is proposed to continue the bathymetric mapping and systematic sampling on a mission mode using a dedicated chartered oceanographic vessel during the XII Plan.

Till now, GSI has surveyed more than 95 per cent of the 2,012 million sq km Exclusive Economic Zone (EEZ), including about 1,05,000 sq km of territorial waters (TW) of India. The surveys have been done in the coastal waters of Arabian Sea, Bay of Bengal, Andaman-Nicobar and northern part of Indian Ocean through its fleet of three ships and vessels - R V Samudra Manthan, R V Samudra Kaustubh and R V Samudra Shaudhikama. The research agency has conducted over 700 cruises to collect data on India's coastal waters and maintains a dedicated multidisciplinary marine wing, having offices in Mangalore, Chennai, Vishakhapatnam, Cochin, Kolkata, Gandhinagar and Bhubaneswar.

RV Samudra Manthan: Multibeam Bathymetric Survey to the East of Nicobar Islands between West Andaman Fault and Sewell Rise was taken up from 10th November to 2nd December 2010. Study of sea bed morphology and magnetic anomaly pattern across the arc-

trench gap of Great Nicobar Island was taken up from 6th December to 29th December, 2010. **RV Samudra Kaustubh:** Placer Mineral resource evaluation in the territorial waters off Bhimunipatnam, Andhra Pradesh was taken up between 27th October 2010 to 20th November, 2010. Placer mineral resource evaluation in the territorial waters off Palur - Malud, Orissa was taken up from 22nd November 2010 to 16th December 2010. Geotechnical appraisal off Harichandi - Puri, Orissa (part) was taken up in the period between 20th and 29th December, 2010.

RV Samudra Shaudhikama: Mapping of the seabed off Okha, Gujarat Coast was taken up between 3rd November and 22nd November 2010. Swath bathymetric survey of part of Gulf of Cambay off Valsad, Gujarat was undertaken from 1st December to 26th December, 2010.

RV Samudra Ratnakar: The ship is equipped with high-end technologically advanced instruments needed for geological, geophysical and geochemical explorations in the offshore areas. The vessel is a unique multitasking and multidisciplinary ship with modern on-board laboratories, designed to carry out sea-bed mapping, mineral exploration etc. in the deep waters and also research activities. The Ship has been built by M/s. Hyundai Heavy Industries (HHI), Ulsan, South Korea, one of the largest ship building yards in the world. RV Samudra Ratnakar is an all-weather ship fitted with Differential Global Positioning System (DGPS), Heading and Motion sensors and Dynamic Positioning System to keep it stationary during coring operations. R.V. Samudra Ratnakar has the capability to explore and identify the favourable zone of accumulation of Gas Hydrates, which are known to be the future source of hydro-carbon energy.

The Dam Safety Review Panel formed by the World Bank and the Government of Tamil Nadu, as part of the Dam Safety Assurance and Rehabilitation Project (DSARP) headed by Dr G N Tandon, in its report dated July 1991 had recommended that 'two accelerographs could be installed in Periyar Dam - one in old and one in new backing concrete to monitor the real response of the composite dam to seismic events in the area, the monitoring of which is said to be being regularly done at Idukki.'

Accelerographs are used to monitor structures for earthquake response and are useful when the ground motion is very strong during earthquakes, when the more sensitive seismometers tend to go off-scale. In 1995, the Geological Survey of India (GSI) had again conducted a geological mapping of the Mullaperiyar Dam area as part of the Dam Safety Assurance and Rehabilitation Project aided by the World Bank.

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● A UN tribunal has awarded Bangladesh nearly four-fifths of an area sprawling over 25,000 sq km (9,700 sq miles) in the Bay of Bengal, ending a dispute over a sea border with India that has ruffled ties between the neighbours for more than three decades.

In its report, GSI had advocated to 'study the seismogenic capability of the lineaments by instrumentation and monitoring of the Mulla-periyar area'.

Lankans arrested: As per the Maritime Zones of India (Regulation of Fishing by Foreign Vessels) Act, 1981, as well as the Wildlife Protection Act, 1972, sea cucumber is a prohibited specie. ICGS Rajdoot with assistance from fishing boat St Antony apprehended the Sri Lankan fishermen with bonafide identity cards issued by their government on board Colombo Marine, a high seas tuna long liner at Chereapani Reef, northern most point of Lakshadweep islands, 188 nautical miles from this coastal city on April 7. Coast Guard personnel recovered two tonnes of sea cucumber whose value in international market is US \$1.20 lakh.

India and Bangladesh EEZ dispute: Indo-Bangladesh bilateral relations have always been seen through the prism of their 4,000-odd-kilometre land frontier - the largest that India shares with any other country. A UN tribunal has awarded Bangladesh nearly four-fifths of an area sprawling over 25,000 sq km (9,700 sq miles) in the Bay of Bengal, ending a dispute over a sea border with India that has ruffled ties between the neighbours for more than three decades. The verdict, binding on both countries, opens the way for Bangladesh to explore for oil and gas in the Bay of Bengal, the site of important energy reserves. Bangladesh, with a population of 160 million and strong economic growth, has battled supply shortages to keep its gas-fired power plants and industries running.

Bangladesh had suggested that the judges take a compass and pencil, and mark the maritime boundary by dividing the angle created by the abutting Indian and Bangladesh coasts equally. In effect, this "180-degree principle" meant drawing a straight line down from the starting point of the demarcation, to a point where both nations accept that their EEZ ends.

The present Law of the Sea is the outcome of United Nations Conference on the Law of the Sea of 1958 (UNCLOS I), UNCLOS II of 1960 and UNCLOS III of 1982. According to the UNCLOS III Articles 3 & 15, every State has the right to establish the breadth of its Territorial Sea up to a limit not exceeding 12 nautical miles, measured from baselines in the line of low water tide along the seashore of a state. Besides that UNCLOS III of 1982 in its Article 76 gives rights to the coastal states to own some more areas beyond the exclusive economic zone called the Continental Shelf.

The award brings to an end an arbitration process Bangladesh kicked off in 2009 under the U.N. Convention on the Law of the Sea, over

disputes with Myanmar and India. The Myanmar dispute was settled in 2012 after arbitration at the International Tribunal on the Law of the Sea in Hamburg. Bangladesh finally won more than 118,813 square km of waters comprising territorial sea and an exclusive economic zone extending out to 200 nautical miles. This is the second successive diplomatic victory for Bangladesh over its maritime concerns as in 2012 the UN tribunal had resolved the issue after Bangladesh had taken a similar matter with Myanmar to the tribunal.

As a result of this verdict, for India any commercial activities such as fishing and oil exploration in the hitherto disputed region will be treated as violating Bangladesh's territorial integrity. Nonetheless, for India too it is a matter of satisfaction and also a diplomatic victory for several reasons. At the initial level, the United Nations' Permanent Court of Arbitration in Hague acknowledged India's sovereignty over New Moore Island and grants India concomitant access to the Hariabhanga river.

Besides that the disputed region was near the mouth of the Hariabhanga river, an area of huge strategic importance for India in the coming time. It should be noted that in 2006, India had discovered 100 trillion cubic feet of natural gas in a creek about 50km to the south of the mouth of the Hariabhanga within the contested region. The Hariabhanga gas reserves are estimated to be almost twice what the entire Krishna-Godavari basin holds. Therefore, it can be of major importance in ensuring India's energy security.

Moreover, New Moore Island (called South Talpatti in Bangladesh) has been claimed by both India and Bangladesh ever since it came into being in Bay of Bengal following a cyclone in 1970. The uninhabited island disappeared in March 2010 due to climate change-related issues. Nonetheless, the UN tribunal's acknowledgment of the Indian sovereignty in the area hands over considerable strategic leverage to India.

Forest Survey of India (FSI)

- ▶ Established in 1981.
- ▶ Has its headquarters at Dehradun and four regional offices at (1) Bangalore, (2) Kolkata, (3) Nagpur and (4) Shimla.
- ▶ It was a successor to "Pre-investment Survey of Forest Resources" (PISFR), a project initiated in 1965 by Government of India and sponsored by FAO and UNDP.
- ▶ It prepares thematic maps on 1:50,000-scale and forest vegetation map of the country. The forest types in 48 categories and 14 non-forest categories of land uses are depicted in these thematic maps, at 1:50,000 scale.
- ▶ Vegetation maps are prepared after every

Ecology and Environment

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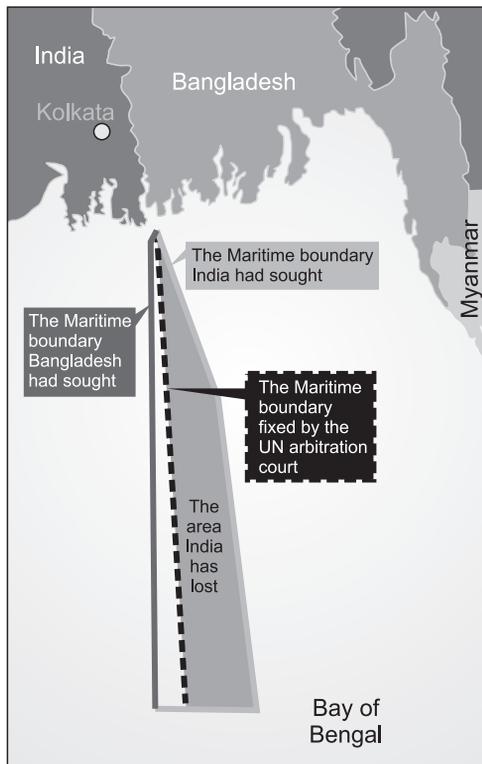
two years.

► The activities of FSI include: (i) Forest Cover Mapping; (ii) Inventory Data Processing; (iii) Training; (iv) Creation of National Basic Forest Inventory System (NBFIS); (v) Special Studies; and (vi) Consultancy.

► A part from the above, the FSI is also in the process of carrying out assessment of Trees outside forest (TOF), both rural and urban for which necessary statistical techniques have been evolved by FSI.

Forest Survey of India (FSI) assesses forest cover of the country every two years by digitally interpretation of remote sensing satellite data and publishes the results in a biennial report called 'State of Forest Report' (SFR).

► Beginning in 1987, 13 SFRs have been brought out so far. The India State of Forest Report 2013 is 13th report in the series. As per the present assessment, the total forest and tree cover of the country is 78.92 million hectare which is 24.01 percent of the geographical area of the country. As compared to the assessment of 2011, there is an increase of 5871 sq km in the forest cover of the country. The majority of the increase in the forest cover has been observed in open forest category mainly outside



forest areas. The maximum increase in forest cover has been observed in West Bengal (3810 sq. km.) followed by Odisha (1444 sq. km.) and Kerala (622sq km). Madhya Pradesh has the largest forest cover of 77,522 sq. km. in terms of area in the country followed by Arunachal

Pradesh with forest cover of 67,321 sq. km. In terms of percentage of forest cover with respect to total geographical area, Mizoram with 90.38 percent had the highest forest cover in terms of percentage of forest cover to Geographical area followed by Lakshadweep with 84.56 percent. The present assessment also reveals that 15 States/UTs had above 33 percent of the geographical area under forest cover. Out of these States and UTs, eight states namely Mizoram, Lakshadweep, A&N Island, Arunachal Pradesh, Nagaland, Meghalaya, Manipur and Tripura had more than 75 percent forest cover while 7 States namely Goa, Sikkim, Kerala, Uttarakhand, Dadra & Nagar Haveli, Chhattisgarh and Assam had forest cover between 33 per cent to 75 per cent. The total growing stock of India's forest and trees outside forests is estimated as 5,658.046 million cum which comprises 4,173.362 million cum inside the forests and 1484.68 million cum outside the forests. In the present assessment, total carbon stock in country's forest was estimated to be 6941 million tonnes. There was an increase of 278 million tonnes in the carbon stock of country as compared to the year 2004 as reported in ISFR 2011.

The report is based on interpretation of LISS III sensor data of indigenous Resources at-II satellite with spatial resolution of 23.5 meter with minimum mapable area of one ha for the period October, 2010-January, 2012.

► Several short duration intensive surveys for ecological studies were also undertaken and detailed taxonomic studies were carried out on the material collected during these as well.

► The FSI celebrated the year 2006 as its Silver Jubilee Year on September 28-29, 2006. Workshops, film shows were organized and a number of publications were also brought out by the FSI on this occasion.

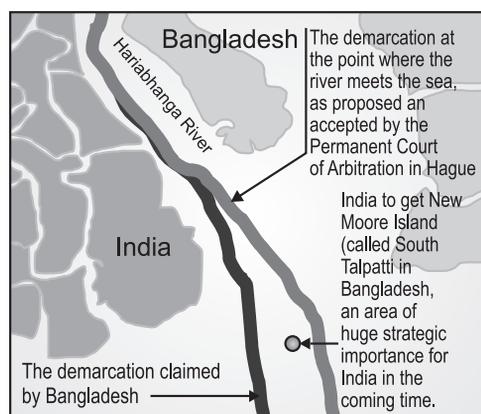
► During the year data collection and data processing work in respect of forest inventory, TOF (R & U) for 60 districts pertaining to period 2004-06 has been completed. Data collection work in respect of additional 30 districts pertaining to 2006-07 is being done. The inventory provides information on growing stock of wood, diameter and species distribution of trees, regeneration status of forests and biodiversity to some extent and the soil carbon.

► FSI has further taken up the inventory of Tree Outside Forest (TOF) in the current year of selected five districts of Uttarakhand State namely Dehradun, Haridwar, Nainital, Pauri Garhwal and Udham Singh Nagar, based on the request of the State government. The inventory, data processing and final report is about to be completed which will provide the available timber resource outside the forests in the state.

Ecology and Environment

● India is a producer-member of the International Tropical Timber Organizations (ITTO) which was established by the International Tropical Timber Agreement (ITTA), 1983. At present, there are 59 Member-Countries in ITTO out of which, 33 are Producer-Member countries and 26 are Consumer-Member countries.

This is mainly to help the state government to decide issue of license to the wood based industries to run them.



► Since year 2004, Forest Survey of India has been monitoring forest fire across the country on near time basis using MODIS satellite data (Moderate-Resolution Imaging Spectrometer) and GIS based technology. From year 2012, FSI under a collaboration program with NRSC/ISRO, National Remote Sensing Centre started disseminating fire signals on Real Time basis. Under the program, signals received from NRSC were filtered, followed by value addition and disseminated to State Forest Departments.

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National River Conservation Plan

The Centre has expressed confidence that by 2020 the polluted river Ganga would be cleaned and Rs 15,000 crore will be spent on it. The Ganga is more polluted now than in 1985, when the then prime minister, Rajiv Gandhi, launched the Ganga Action Plan. The Ganga basin is the largest in the country and the fourth-biggest in the world. It is a source of livelihood for the 400 million people who live along its 2,500-km length from Gangotri in the Himalayas to Ganga Sagar, where it merges into the Bay of Bengal. Out of 2,510 km length of Ganga, about 1,000 km lies in UP, 520 km in WB, 450 km in Uttrakhand and 405 km in Bihar, with a little stretch lying in Jharkhand. At present, under national water quality monitoring programme, quality of Ganga water is monitored at 21 locations in UP in Ghaziabad, Bulandshahr, Badaun, Kannauj, Kanpur, Rae-

bareli, Kaushambi, Allahabad, Varanasi, Mirzapur, Ghazipur and Muzaffarnagar. A third of India's 1.2 billion people live along the 2,510-km sacred river. Ganga Action Plan (GAP) is being implemented since 1985 for undertaking pollution abatement activities in the identified polluted stretches of river Ganga through implementation of works like interception and diversion of sewage, setting up of sewage treatment plants, low cost sanitation works, crematoria work etc. Total Sewage Treatment capacity of 1091 million liters per day (mld) has been created under the GAP. With the pollution abatement works completed so far, despite significant increase in urbanization, industrialization and growth in population in cities along the banks of river Ganga, the water quality in terms of BOD (Bio-chemical Oxygen Demand) values reported to have improved as compared to the pre-GAP water quality on major monitoring locations. However, the levels of bacterial contamination in terms of fecal coliform are reported to be exceeding the maximum permissible limit at a number of locations.

The pollution load on rivers has increased over the years due to rapid urbanization and industrialization as also due to abstraction of water for irrigation, drinking, industrial use, power etc. Disposal of untreated/partially treated sewage generated in the cities and towns are also a major source of pollution in the river. Direct use of bacterial contaminated river water may cause water borne diseases.

As reported by Central Pollution Control Board, nearly 2723 million litres per day (mld) of sewage is generated from Class I cities and Class II towns along river Ganga. Under the GAP, a sewage treatment capacity of 1092 mld (GAP-I: 869 mld, GAP-II: 223 mld) has been created. The total expenditure incurred so far, on conservation of river Ganga is Rs.950.32 crore. The study makes a comparison between what the conditions would have been without the GAP and the conditions with the GAP. The results show that some improvements in water quality measured in terms of DO (dissolved oxygen) and BOD (biochemical oxygen demand) were observed everywhere, although the improvements were quite small in some places.

The central assistance is being provided by Ministry to states under two schemes – Repair, Renovation and Restoration (RRR) of Water Bodies and Flood Management Programme (FMP) during 12th Plan. Under the RRR scheme, a total of 3341 water bodies were taken up for restoration in 12 states, out of which 2033 water bodies have been completed till date. Under the FMP, a total of 420 works were approved during XI Plan out of which

● The Ganga basin is the largest in the country and the fourth-biggest in the world. It is a source of livelihood for the 400 million people who live along its 2,500-km length from Gangotri in the Himalayas to Ganga Sagar, where it merges into the Bay of Bengal. Out of 2,510 km length of Ganga, about 1,000 km lies in UP, 520 km in WB, 450 km in Uttrakhand and 405 km in Bihar, with a little stretch lying in Jharkhand.

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● The pollution load on rivers has increased over the years due to rapid urbanization and industrialization as also due to abstraction of water for irrigation, drinking, industrial use, power etc. Disposal of untreated/partially treated sewage generated in the cities and towns are also a major source of pollution in the river. Direct use of bacterial contaminated river water may cause water borne diseases.

● The Central Government has signed loan agreement with the Government of Japan for implementation of pollution abatement work for river Ganga in Varanasi city at a total cost of Rs 496.90 crores on a cost sharing basis of 85:15 between Centre and State.

252 works were completed. During XII Plan, a total of 97 new workers have been approved under FMP.

The Central Government has signed loan agreement with the Government of Japan for implementation of pollution abatement work for river Ganga in Varanasi city at a total cost of Rs 496.90 crores on a cost sharing basis of 85:15 between Centre and State. The pollution abatement works under the project include construction and rehabilitation of sewerage facilities and non-sewerage components including river front development such as improvement of ghats between Assi and Rajghat on the bank of river Ganga at Varanasi.

To oversee the implementation of the GAP and to lay down policies and programmes, Government of India constituted the **Central Ganga Authority (CGA)** in February 1985, renamed as the **National River Conservation Authority (NRCA)** in September 1995, under the chairmanship of the Prime Minister. The Government also established the GPD Ganga Project Directorate (GPD) in June 1985 as a wing of Department of Environment, to execute the projects under the guidance and supervision of the CGA. The Government renamed the GPD as the NRCD (National River Conservation Directorate) in June 1994. The Central Ganga Authority (CGA) established in 1985, lays down the policies for works to be taken under the Ganga Action Plan (GAP)-I. On 31st March 2000, the GAP phase I was over. All the 261 schemes have been completed by 30th September 2001. The main component of the Ganga Action Plan is diversion of sewage flowing into the river to other locations for treatment and conversion into valuable energy sources.

The GAP, Phase II has been merged with the **National River Conservation Plan (NRCP)**. Besides other pollution abatement works, a sewage treatment capacity of 869 mld. (million litres per day) was created under Phase-I and an amount of about Rs. 452 crore was spent under the Plan. This phase was declared completed in March 2000. Since GAP Phase-I did not cover the pollution load of Ganga fully, GAP Phase-II was taken up which included, Ganga and its four tributaries i.e. Damodar, Gomti, Mahananda and Yamuna.

At present, the National River Conservation Plan (NRCP) includes works in 195 towns (39 West Bengal, 25 UP, 18 Punjab, 14 MP) along polluted stretches of 42 rivers spread over 20 states on 70:30 funding pattern between Centre and States. This includes works undertaken under GAP-II. The main rivers under this Plan are Ganga, Yamuna, Gomti and Damodar, Mahananda, Godavari, Musi, Sabarmati, Tungabhadra, Krishna, Satluj, Cauvery Rani-

chu, Veehar, Narmada etc.

Under the National Water Quality Monitoring Programme of Central Pollution Control Board, the water quality is monitored at 3 locations along the river Pamba and 2 locations along the river Bharathapuzha in Kerala. In both the rivers, water quality is meeting the prescribed standards for key parameters of Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD). Faecal coliform levels, however, exceed the norms at some locations. A project for abatement of pollution of river Pamba in Kerala has been sanctioned at a cost of Rs. 18.45 crore under the National River Conservation Plan (NRCP). The project includes interception & diversion of sewage, sewage treatment plant, bathing ghats, community toilets, public participation etc. An amount of Rs 2.78 crore has been released to the State Government for implementation of the project.

Under **Gomati Action Plan**, pollution abatement works are being taken up along the Gomati river in Lucknow, Sultanpur and Jaunpur in UP. The sanctioned cost of Gomti Action Plan Phase-II at Lucknow is Rs.263.04 crore. The project cost is to be shared in the ratio of 70:30 between Government of India and State Government. The works in this phase will include two sewage treatment plants of a total capacity of 375 MLD (over and above the 47 MLD capacity being set up in the first phase), interception & diversion works of sewage of the remaining drains and other miscellaneous items such as river front development, toilets, plantation, public awareness and participation, and acquisition of land. Out of thirty schemes, works on seven schemes have been completed.

Damodar Action Plan (DAP): The scheme of Damodar Action Plan was approved in October 1996 on 100 per cent funding pattern with stipulated period of implementation up to December 2005 covering eight towns namely, Bokaro-Kargali, Chirkunda, Digdha, Jharia, Ramgarh, Telmachu, Sindri and Sudamdih in the State of Jharkhand and Andal, Asansol, Durgapur and Raniganj in the State of West Bengal.

Yamuna Action Plan (YAP): Under Yamuna Action Plan Phase-I, assisted by the Japan Bank for International Cooperation (JBIC), a total of 753 mld. sewage treatment capacity was created and this Phase was declared completed in March, 2003. A loan assistance of Yen 13.33 billion has been extended by the Japan International Cooperation Agency (JICA) which has been merged with JBIC for implementation of Yamuna Action Plan (YAP) Phase II, which is part of the National River Conservation Plan (NRCP). External assistance from bilateral/multilateral agencies is availed of from time to

Ecology and Environment

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time by the Government. For the Yamuna Action Plan (YAP) Phase-I, loan assistance of Yen 17.77 billion was provided by the Japan International Cooperation Agency (JICA), Government of Japan and an assistance of Yen 13.33 billion is being availed for YAP Phase-II from the agency. JICA has agreed to provide a loan assistance of Yen 32.571 billion for the next phase of the Programme.

The Cabinet Committee on Economic Affairs (CCEA) has approved the proposal of Japan International Cooperation Agency (JICA)-assisted Yamuna Action Plan (YAP) Phase - III project at Delhi. This will be implemented under the Centrally Sponsored Scheme of National River Conservation Plan at an estimated cost of Rs 1,656 crore. The project will be implemented on 85:15 cost sharing basis between the Union Government and the Delhi Government for seven years. Under YAP-III, it is proposed to rehabilitate the damaged trunk sewers to maximize the utilization of available treatment capacity, rehabilitate and modernize the STPs in three catchment areas of Delhi namely Okhla, Kondli and Rithala and to equip them with tertiary level treatment facilities to achieve treated effluent quality of 10 mg/l for Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) so as to improve the water quality of river Yamuna. The proposed works are (a) Rehabilitation/modernization of STPs, totalling 814 MLD capacity at Okhla, Kondli and Rithala in Delhi. (b) Setting up of Tertiary Treatment Facilities at the above STPs (c) Construction of a new state of art STP in place of old STP of 136 MLD capacity at Okhla. (d) Rehabilitation of sewer lines/Rising mains in the two catchments of Delhi viz Kondli and Rithala. (d) Public Outreach Activities. These works will be integral to the Sewerage Master Plan being prepared by Delhi Jal Board (DJB).

National Ganga River Basin Authority: A National Ganga River Basin Authority (NGRBA) was constituted in February 2009, as an empowered, planning, financing, monitoring and coordinating authority with the objective to ensure effective abatement of pollution and conservation of the river Ganga by adopting a holistic river basin approach. The river conservation strategy was reviewed in the first meeting of the NGRBA held on 5th October 2009 which resolved that under 'Mission Clean Ganga', no untreated municipal sewage and industrial effluent may flow into Ganga by the year 2020. Besides Central funds, a World Bank assistance of Rs.7000 crore has been approved for a period of 8 years for conservation of river Ganga.

The NGRBA has been set up as an empowered planning, financing, monitoring and coordinat-

ing authority for the conservation of Ganga River with a holistic approach under the Environment (Protection) Act, 1986.

The Authority has both regulatory and developmental functions. The Authority will take measures for effective abatement of pollution and conservation of the river Ganga in keeping with sustainable development needs. These include; development of a river basin management plan; regulation of activities aimed at prevention, control and abatement of pollution in Ganga to maintain its water quality, and to take measures relevant to river ecology and management in the Ganga basin states; issue directions under section 5 of the Environment (Protection) Act, 1986 for the purpose of exercising and performing these functions and for achievement of its objectives.

Since inception of the National Ganga River Basin Authority (NGRBA) programme, 76 schemes (70 infrastructure investment, 5 institutional development and 1 implementation support) in 48 towns in Ganga States have been sanctioned at a total cost of Rs. 5004.19 crore. Against this, Rs. 1229.87 crore has been released by the Centre including the matching share of the States so far and a total expenditure of Rs. 838.76 crore has been incurred till March, 2014 for implementation of the projects.

The GAP has a number of limitations:

The Ganga Action Plan phase-I(GAP-I) started in 1985 at a cost of Rs 500 crore and GAP-II launched in 1993 at a cost of Rs. 2,285 crore had failed to yield the desired results. And the Parliamentary Standing Committee on Environment and Forests has flayed the MoEF for the deteriorating water quality in the Ganga, despite spending a whopping Rs.39,000 crore. A bench of SC comprised Justice T.S. Thakur, Justice Adarsh Kumar Goel and Justice R. Banumathi has told that since 2007 only one sewage treatment plant was set up in Dehradun and repeated reminders from the Central Pollution Control Board to the State Pollution Control Boards in Uttar Pradesh, Bihar and West Bengal to act against grossly polluting industries have fallen on deaf ears. The court said that the first phase should commence with preventing the industrial waste from 764 grossly polluting industries from flowing into the river as it would take care of 30 per cent of the most toxic industrial waste in it. It also asked the CPCB to tell it what steps was taken by the pollution control boards in Uttar Pradesh, Bihar and West Bengal on the 222 grossly polluting units - 215 in Uttar Pradesh, one in Bihar and six in West Bengal which were identified by it.

The CPCB checked 51 out of 64 sewage treatment plants (STPs) along the Ganga in 2013. It

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● In 2013, Ganga was ranked as second-most polluted river in the world after Citarum river in Indonesia. The report published in international journal Nature said that pollution level in Ganga was about 3,000 times of the safe limit prescribed by the World Health Organisation (WHO) for human use. Another study quoted the Indian Council of Medical Research to say that the people living in the vicinity of the river were vulnerable to cancer.

● The MoEF documents have outlined the major short-comings of GAP that include inadequate investment, resources thinly spread, visible improvement lacking, high level of coliform in the river. Besides, the schemes were town centric, focused on interception, diversion and treatment. Slow implementation, weak enforcement by state pollution control boards and lack of civil society involvement were other factors responsible for the short-comings.

found that only 60 per cent of installed capacity of the plants was being used; 30 per cent of the STPs were not even operational. Uttar Pradesh has 687 grossly polluting industries. These mainly small-scale, often illegal units – tanneries, sugar, pulp, paper and chemicals – contribute 270 mld of wastewater. But what really matters is the location of the plants. While over 400 tanneries contribute only 8 per cent of the industrial discharge, they spew highly toxic effluent into the river and are located as a cluster near Kanpur.

In 2013, Ganga was ranked as second-most polluted river in the world after Citarum river in Indonesia. The report published in international journal Nature said that pollution level in Ganga was about 3,000 times of the safe limit prescribed by the World Health Organisation (WHO) for human use. Another study quoted the Indian Council of Medical Research to say that the people living in the vicinity of the river were vulnerable to cancer.

The failure of past tactics is clear from the fact that, despite splurging over Rs 20,000 crore on the Ganga Action Plan, the water of the country's longest river is dirtier today than it was before the launch of this plan in 1986. The MoEF documents have outlined the major short-comings of GAP that include inadequate investment, resources thinly spread, visible improvement lacking, high level of coliform in the river. Besides, the schemes were town centric, focused on interception, diversion and treatment. Slow implementation, weak enforcement by state pollution control boards and lack of civil society involvement were other factors responsible for the short-comings.

There is a strong disregard for the critical issue of maintaining adequate river flow, which has been severely curtailed owing to the construction of barrages and diversion of water through canals. Much of the Ganga's indigenous water has been diverted into western and eastern Ganga canals from Bhimgoda barrage near Haridwar and a large part of the remainder into lower Ganga canal from Narora. Most of the downstream stretch now carries water drawn from its tributaries, besides wastewater from cities. The 100 big, medium and small towns on the river's banks generate over 3,000 million litres of sewage every day. There are 900 class I and II towns, which generate 40,000 million litres of sewage daily and as of now we have capacity of only treating 11,000 million litres daily. For transporting and treating one million litres of sewage, we need Rs. 3-5 crore so one can imagine the amount of money we would need for the whole. Much of this sewage is discharged into the river without appropriate treatment. Most industrial units located

near the river also dispose of their untreated effluents in the river. The other scourges of the river include habitations and farming on the riverbed itself, religious rituals like idol immersion, cremation of human bodies on its banks and disposal of corpses in it. As a result, degradation of Ganga water begins right from Rishikesh and Haridwar, where it enters the plains, and continues to worsen as it moves on. It begins to stink by the time it reaches Kanpur.

The quality of the Ganga's water at most places downstream of Uttarakhand is unfit even for irrigation or bathing, let alone drinking. The count of harmful organisms, including hazardous faecal bacteria, at many locations is more than 100 times the limit set by the government. According to the CPCB's monitoring data, biochemical oxygen demand (BOD) levels are high downstream of Haridwar, Kannauj and Kanpur, and peak at Varanasi. But what is worrying is that pollution is getting worse in all the stretches. The water's biochemical oxygen content, which is vital for the survival of aquatic wildlife, has dipped drastically. Consequently, some of the unique native species of the Ganga, such as the river dolphin, the river turtle and the gharial, have been pushed to the verge of extinction. The most serious cause of this is the presence of urban wastewater and untreated discharge from hundreds of chemical plants, textile mills, distilleries, slaughterhouses, tanneries, etc.

Further, the strategy mooted in the 1980s by the Central Ganga Authority, subsequently renamed as the National Ganga River Basin Authority (NGRBA), for cleaning the Ganga envisaged sewage treatment plants and oxidation ponds to raise the dissolved oxygen (DO) content of water before letting it into the river. It also stipulated measures to reverse the denudation of the river's catchments to ensure that only clean, mud-free water pours into it, to reduce its turbidity. These plans failed largely because they required, for their success, the cooperation of state governments and a large number of civic bodies; this was not forthcoming in the manner required.

The discharge of untreated urban sewage, industrial waste and dumping of refuse have polluted major rivers across the country. About 2.6 billion litre of untreated sewage and effluent is discharged into the river daily. Cremation and the disposal of leftovers of religious rituals on river banks have also become an important water polluter. Civic bodies and industries are the main culprits for discharging untreated sewage in water bodies. It is generally believed that hardly 10 per cent of the waste water, including that carrying sewage and industrial discharges containing highly hazard-

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● Delays in completion of schemes due to lack of inter-agency coordination at field level, delays in acquisition of land for STPs and Pumping stations, contractual problems, court cases, etc. leading to cost overruns. The Ganga Action Plan (GAP) Phase-II project which should have been completed by March 2014 in Varanasi, has so far attained only 12 per cent progress.

ous substances, is suitably treated before being let out in the rivers, the sea or other water bodies. The Yamuna remains a river only till it enters the National Capital Region. After that it becomes a drain. Its water, which emits an unbearable stink, is unfit for any human use, let alone bathing and drinking, without meticulous treatment. Most aquatic fauna of this river has perished because of the decline of the water's oxygen content.

(a) the implementation is worst as six states namely Bihar, Jharkhand, Orissa, Rajasthan, Goa and Kerala out of the 18 states under NRCF have failed to complete even a single sanctioned plan;

(b) the agencies are more concerned in the creation of the pumping stations and **sewage treatment plants (STPs)**;

(c) even GAG has criticised the poor functioning of GAP;

(d) the corruption is on rampant; it suffers from ad hocism; some of the states have blamed that the liquidity crisis is the main reason of the delay of the project;

(g) increasing gap between requirement of Sewage treatment infrastructure and actual pollution load being tackled due to continuous increase in population in towns along the river banks, inadequate financial resources invested in river cleaning;

(h) delays in completion of schemes due to lack of inter-agency coordination at field level, delays in acquisition of land for STPs and Pumping stations, contractual problems, court cases, etc. leading to cost overruns. The Ganga Action Plan (GAP) Phase-II project which should have been completed by March 2014 in Varanasi, has so far attained only 12 per cent progress. If this remains the pace of work one can imagine how the Mission Clean Ganga will be achieved by 2020. One of the reasons for the delay is the unavailability of land. The project was proposed at Sathwa village, but it was shifted to Dinapur due to protest of the villagers;

(i) shortage of Skilled manpower and regular staff and inadequate provision of funds by the States and ULBs for O&M of the sewage treatment infrastructure. Further, the cost involved in other river cleaning up programmes have been enormous, and given the similar type of objectives with relatively larger scale operations, the cost earmarked for the GAP is much smaller;

(j) erratic/ non-availability of power supply for operation of operation of assets, under – utilization of STPs, in some cases, due to non-conveyance of sewage generated in the absence of upstream systems such as branch sewers and house connections;

(k) lack of involvement of civil society in the programme;

(l) the audit revealed that the performance of projects undertaken under NRCF was unsatisfactory and that 82 per cent of the projects were completed after the scheduled date of completion. As many as 28 projects costing R251.27 crore were completed but not utilised as yet. This is so because states implementing the projects faced problems in land acquisition, getting requisite permissions, especially forest clearances, technical problems and problems from contractors. As for lake conservation, the CAG report says: "NLCP programme has been ineffective in achieving the objective of conservation and restoration of lakes in India." CAG found that at present only 10 per cent of the waste water generated is treated. Similarly, lakes and ground water are under severe threat from the impact of pollution;

(m) in order to formulate long-term policies and actions, the MoEF commissioned a consortium of seven IITs to prepare a comprehensive River Basin Management Plan for the Ganga. This Plan would recommend comprehensive measures to restore and maintain the ecological health of the river giving due regard to the competing water uses. This Plan will be the basis for the NGRBAs long term Action Plan to deal with the multiple challenges faced in the task of cleaning the Ganga and maintaining its flow. The consortium has already submitted five initial reports; and

Finally, there should be a provision of the creation of **river regulation zone** under an independent autonomous body. The plans should executed by the NGOs and the panchyats. The schemes should be target based. The flood plain conservation is also very important.

A town approach adopted instead of a holistic river basin approach before constitution of the National Ganga River Basin Authority (NGRBA).

1. Increasing gap between requirement of Sewage treatment infrastructure and actual pollution load being tackled due to continuous increase in population in towns along the river banks, inadequate financial resources invested in river cleaning.

2. Delays in completion of schemes due to lack of inter-agency coordination at field level, delays in acquisition of land for STPs & Pumping stations, contractual problems, court cases, etc. leading to cost overruns.

3. Shortage of Skilled manpower and regular staff and inadequate provision of funds by the States and ULBs for O&M of the sewage treatment infrastructure.

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● The pollution abatement works under NRCP, (excluding Ganga Action Plan[GAP] - I & GAP - II, and NGRBA) presently cover identified polluted stretches of 40 major rivers in 121 towns spread over 19 States in the country. The sanctioned cost of the projects under NRCP (excluding GAP-I, GAP-II and NGRBA) is Rs.5334.97 crore against which expenditure of Rs.4680.30 crore has been incurred so far and sewage treatment capacity of 3729.49 million litres per day (mld) has been created.

● The Central Pollution Control Board (CPCB) along with State Pollution Control Boards (SPCBs), is monitoring water quality of rivers in terms of Dissolved Oxygen, Bio-chemical Oxygen Demand (BOD) and Fecal Coliforms etc. Based on BOD levels, 150 polluted stretches have been identified along various rivers in the country.

utilization of STPs, in some cases, due to non-conveyance of sewage generated in the absence of upstream systems such as branch sewers & house connections.

5. Lack of involvement of civil society in the programme.

National River Conservation Directorate: For rivers other than Ganga, National River Conservation Directorate (NRCD) implements the Centrally Sponsored Scheme of National River Conservation Plan (NRCP), jointly with the State Governments on a cost-sharing basis. The pollution abatement works under NRCP, (excluding Ganga Action Plan[GAP] - I & GAP - II, and NGRBA) presently cover identified polluted stretches of 40 major rivers in 121 towns spread over 19 States in the country. The sanctioned cost of the projects under NRCP (excluding GAP-I, GAP-II and NGRBA) is Rs.5334.97 crore against which expenditure of Rs.4680.30 crore has been incurred so far and sewage treatment capacity of 3729.49 million litres per day (mld) has been created.

National Lake Conservation Plan (NLCP): The Central Pollution Control Board (CPCB) along with State Pollution Control Boards (SPCBs), is monitoring water quality of rivers in terms of Dissolved Oxygen, Bio-chemical Oxygen Demand (BOD) and Fecal Coliforms etc. Based on BOD levels, 150 polluted stretches have been identified along various rivers in the country. The water quality, in terms of BOD values, where works have been completed, is reported to have improved at most of the locations, as compared to the water quality before taking up pollution abatement works under National River Conservation Plan (NRCP) and National Lake Conservation Plan (NLCP).

Conservation of rivers and lakes is an ongoing and collective effort of the Central and State Governments and the Ministry of Environment & Forests is supplementing the efforts of the State Governments in abatement of pollution in rivers and lakes under NRCP and NLCP respectively for implementation of projects on a cost sharing basis between the Central and State Governments.

The scheme of National Lake Conservation Plan was initiated with the approval of conservation and management plans of three lakes namely, Powai (Maharashtra), Ooty and Kodaikanal (Tamil Nadu), in June, 2001 at a cost of Rs. 14.90 crore. NRCP presently covers 41 rivers in 191 towns spread over 20 States at a sanctioned cost of Rs.8847.22 crore. Various pollution abatement schemes taken up under the Plan, inter-alia, include interception and diversion of raw sewage, setting up of sewage treatment plants, creation of low cost sanitation facilities, setting up of electric/improved

wood crematoria and river front development. Under NLCP, the Ministry has sanctioned projects for conservation of 61 lakes in 14 States with a total cost of Rs.1031.18 crore. Works taken up under the Plan include; core components of interception, diversion and treatment of wastewaters before their entry into the lake, catchment area treatment, shoreline protection, in-lake treatment such as aeration, de-weeding, de-siltation, bio-remediation etc.

Proposed merger: To avoid overlap and promote better synergies, both the schemes have been merged in February, 2013 into a new scheme called 'National Plan for Conservation of Aquatic Eco-systems' (NPCA).

The previous UPA Cabinet Committee on Economic Affairs had approved the proposal for the merger of National Lake Conservation Plan (NLCP) and National Wetlands Conservation Programme (NWCP) into a new scheme called the 'National Plan for Conservation of Aquatic Eco-systems' (NPCA). The merged scheme shall be operational during the XII Plan Period at an estimated cost of Rs.900 crore on 70:30 cost sharing between the Central Government and respective State Governments (90:10 for North-East States). For conservation of lakes and wetlands, the Ministry of Environment and Forests is presently, implementing two separate Centrally Sponsored Schemes (CSS), namely the NWCP and the NLCP. To avoid overlap, promote better synergies and to ensure conservation and management works, an integrated scheme, NPCA is proposed, with the objective of conserving aquatic ecosystems (lakes and wetlands), through implementation of sustainable conservation plans and governed with application of uniform policy and guidelines. The principal objectives of the new scheme will be holistic conservation and restoration of lakes and wetlands for achieving desired water quality enhancement, besides improvement in biodiversity and the ecosystem, through an integrated and multidisciplinary approach with a common regulatory framework. The scheme would contribute to reduction of pollution loads and improvement in goods and services provided by these water bodies to stakeholders. The new scheme will have conservation and management of lakes and wetlands in the country within its scope, to include inventory and information system on lakes and wetlands national level directive on criteria for lakes and wetlands, regulatory framework, capacity building at state government and local body levels, evaluation etc.

▶ Four more lakes namely, Kundawada Lake (Karnataka), Rani Talab (Madhya Pradesh), Kote Tavarekere (Karnataka), Rankala Lake (Maharashtra), with an approved cost of

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● Besides the Ganga, the river conservation programme also looks into the Yamuna, Gomti and Damodar rivers across major projects. According to the ministry, the project has so far covered 39 rivers across 20 states. According to reports, the fund requirement for the Ganga alone till 2020 will be more than Rs 10,000 crore.

● The Union Cabinet has approved the establishment of the Clean Ganga Fund (CGF). The CGF would be set up with voluntary contributions from residents of the country and Non-Resident Indian (NRIs) / Person of Indian Origin (PIO) and others to harness their enthusiasm to contribute towards the conservation of the river Ganga.

Rs.19.02 crore have been included in the programme for conservation and management of polluted lakes under National Lake Conservation Plan.

Besides the Ganga, the river conservation programme also looks into the Yamuna, Gomti and Damodar rivers across major projects. According to the ministry, the project has so far covered 39 rivers across 20 states. According to reports, the fund requirement for the Ganga alone till 2020 will be more than Rs 10,000 crore. With financial assistance from Uttar Pradesh, Delhi and Haryana, the Yamuna Action Plan in its phase-I and II, came up with 40 sewage treatment plants with a total capacity of 902.25 MLD, covering 21 towns. The phase III of this project is now being implemented at a cost of Rs 1,656 crore, with assistance from Japan International Cooperation Agency.

Recent initiatives: Clean Ganga Fund (CGF)

The Union Cabinet has approved the establishment of the Clean Ganga Fund (CGF). The CGF would be set up with voluntary contributions from residents of the country and Non-Resident Indian (NRIs) / Person of Indian Origin (PIO) and others to harness their enthusiasm to contribute towards the conservation of the river Ganga. The Fund will have the objective of contributing to the national effort of cleaning of the river Ganga. Domestic donors to the Fund shall be eligible for tax benefits as applicable in the case of the Swachh Bharat Kosh. The Fund would be managed by a Trust to be headed by Finance Minister. The secretariat of the Trust will be set up in Ministry of Water Resources, River Development and Ganga Rejuvenation under the Mission Director, Clean Ganga. The following broad activities will be financed from the Fund: (a) activities outlined under the 'Namami Gange' programme for cleaning of river Ganga; (b) control of non-point pollution from agricultural runoff, human defecation, cattle wallowing, etc.; (c) setting up of waste treatment and disposal plants along the river around the cities; (d) conservation of the biotic diversity of the river; (e) community based activities to reduce polluting human interface with the river; (f) development of public amenities including activities such as Ghat redevelopment; (g) research and Development and innovative projects; (h) research and Development projects and innovative projects for new technology and processes for cleaning the river; (i) independent oversight through intensive monitoring and real time reporting; and (j) any other activity as approved by the Trust.

Considering that the measures taken till now are inadequate and a national effort is required to mobilize resources for improving the condition of the river Ganga, the Government an-

nounced the setting up of an Integrated Ganga Conservation Mission called "Namami Gange" and an initial sum of Rs. 2,037 crore has been allocated in the Union Budget 2014-15.

High-tech sensors: The new NDA government will over the next six months install high-tech sensors at critical points along the Ganga to monitor industrial runoff from about 700 units – the first steps towards the long and daunting task of cleaning the 2,510-km river. The sensors will self-monitor the levels and nature of effluents and pollutants. They will send real-time data on discharges from factories to a central server and will automatically send alerts when effluents breach permissible limits. Non-compliant industries will face action.

Suggestions: Salvaging Ganga does not only require spending crores but having in place proper planning and active monitoring. More than Rs 39,000 crore spent on cleaning the national river since 1985 under Ganga Action Plan has not given desirable results. A comprehensive solution to the Ganga pollution lies in dealing with three problem areas: one, finding water to dilute and assimilate waste; two, finding innovative ways to check the growing amount of untreated sewage discharged into the river; and three, fixing the enforcement to stop industries from discharging waste into the river.

Conclusion: A purely technological and technocratic approach, using a billion dollars of

Zero liquid discharge

The government's Ganga clean-up mission is facing a dire test, as it seeks to embark on a critical phase of the challenging task: Lack of effective, quickly deployable and economically viable technologies, which hold the key to success. Industrial waste from over 700 "grossly polluting industries", including the pulp and paper sector, has been a notorious source of pollution in at least five states through which the river flows. However, a likely increase of 30 per cent-40 per cent in the cost of paper production, after accounting for investment in green technologies, make the goal of zero discharge "impractical in the present scenario", assessment by the government shows.

The 'zero liquid discharge' (ZLD) is a concept where the entire industrial and municipal waste water can be reused after recycling without discharging a drop into any river. At present, after being treated in different sewage treatment plants (STPs) and common effluent treatment plants (CETPs), the municipal/industrial waste water goes into drains and eventually gets discharged into river.

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● Mangrove forests are also called Mangals. Mangrove plants have cone-shaped projections that help in breathing, called Pneumatophores.

● West Bengal has nearly half of the country's mangroves. The unique Sunderbans get their name from the mangrove species *Heritiera fomes*, locally known as Sundari, a common species in the region. The Sunderban mangrove forests are home to more than 35 species of reptiles, 270 species of birds, and 42 species of mammals.

World Bank money and expertise from the Indian Institutes of Technology is not going to work on its own. There has to be a coming together of administrative, technological, scientific, socio-religious, cultural and popular interventions – all working in tandem with the singular aim of reclaiming a lost river – for the Ganga to be cleansed of our sins.

New Projects:

Kundaliya Major Irrigation Project: The Union government has given a nod to the Rs 2,000-crore Kundaliya Major Irrigation Project in Madhya Pradesh, slated to also later form part of the Parbati-Kalisindh-Chambal (PKC) river linking project involving Rajasthan, too. The Kundaliya project is proposed to build a dam on the Kalisindh river in Rajgarh and Shajapur districts of MP.

Mangroves

The word "Mangrove" is considered to be a combination of the Portuguese word "Mangue" and the English word "grove". Mangroves are salt-tolerant plants of tropical and subtropical intertidal regions of the world. The specific regions where these plants occur are termed as 'mangrove ecosystem'. These are highly productive but extremely sensitive and fragile. The mangroves are protected through a range of regulatory measures such as Environment Protection Act (1986), the Coastal Regulation Zone Notification (1991) issued under the said Act, the Indian Forest Act (1927) and the Forest (Conservation) Act, 1980. The Ministry accords high priority to the conservation and management of mangroves and coral reefs in the country. The Coastal Regulation Zone Notification (1991) under the Environmental Protection Act (1986) recognizes the mangrove and coral reefs areas as ecologically sensitive and categorizes them as CRZ-I (i) which implies that these areas are afforded protection of the highest order. The National Policy, 2006 recognizes that mangroves and coral reefs are important coastal environmental resources. They provide habitats for marine species, protection from extreme weather events; and a resource base for sustainable tourism.

Wetland ecosystems such as lakes, estuaries and mangroves provide vital habitats to several waterfowl species, particularly as wintering grounds for many migratory bird species. Mangrove forests are also called Mangals. Mangrove plants have cone-shaped projections that help in breathing, called Pneumatophores. Mangroves mainly belong to Rhizophoraceae; the farming of Shrimps species is a major cause of destruction of mangrove forests. Anaerobic bacteria type of bacteria causes the release of gases and other substances from mangrove

plants. Mangrove trees are Hermaphrodites. Globally, there are 60 true mangrove species in 27 genera and 20 families. Mangroves are found in over two-thirds of the saltwater coastal areas of tropical and subtropical Africa, Asia, Australia, and North and South America. Indonesia has the largest area under mangroves, with 30 per cent of the global coverage, followed by Brazil, Australia and India. Many of the islands in the Indian Ocean, Arabian Sea, Bay of Bengal, the South China Sea, and the Pacific Ocean are mangrove habitats. In India, there are 34 species of true mangroves. India is home to more than 7 per cent of the world's mangrove forests. Mangroves make up for 8 per cent of the Indian coastline. Eighty per cent of these forests are found on the eastern coast of India. Mangrove trees are hermaphrodites. This means that they have both male and female flowers on the same tree, and pollinate and reproduce on their own. Bhitarkanika (Orissa) has 31 species, the Sunderbans have 27, and the Andaman & Nicobar islands have 24 species.

West Bengal has nearly half of the country's mangroves. The unique Sunderbans get their name from the mangrove species *Heritiera fomes*, locally known as Sundari, a common species in the region. The Sunderban mangrove forests are home to more than 35 species of reptiles, 270 species of birds, and 42 species of mammals. Among them is the saltwater or estuarine crocodile – the largest of all living reptiles. In India, this globally endangered species is also found on the Andaman and Nicobar islands. The Sunderbans is the single-largest block of mangrove forests in the world, covering nearly 10,000 square kilometers (3,861 sq miles) of the Bay of Bengal delta. Sunderbans was the only Indian entry in the final list of 28 that included the Grand Canyon of the US, the Amazon of Brazil, the Great Barrier Reef of Australia, the Halong Bay of Vietnam and other natural sites. With 2118 sq km of total mangrove forest cover, the Indian Sunderbans have soaked in 4.15 crore tonnes of carbon dioxide, valued at around USD 79 billion in the international market.

India State of Forest Report 2013 says that India's mangrove cover measures 4,628 sq km or 0.14 per cent of the total area; "compared with the 2011 assessment, there has been a net decrease of 34 sq km." The drop has been noted in West Bengal on account of exclusion of creeks and in Gujarat. In Maharashtra, the report states, mangroves are spread over 186 sq km – the same figure proffered in every State of Forest Report since 2005. This constancy in the statistic is hard to understand, an official in the state forest department conceded. As per

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● Mangroves in India account for about five percent of the World's mangrove vegetation and are spread over an area of about 4500 square kilometres along the coastal States/UTs of the country.

satellite mapping by the state, "we have 30,000 hectares, or 300 sq km, of mangroves. Of these, 17,000 hectares are on government land and 13,000 hectares on private land. Odisha, which has India's richest mangroves in terms of biodiversity and comes second in the world, lost 9 sq km of mangrove forest in 2011-12. This reversed the trend of actually gaining 1 sq km of mangrove the year before that, reports the Forest Survey of India in 2013. It is believed that the prawn mafia backed by local politicians are to be blamed for the losses. Odisha has just 213 sq kms of mangroves, but it is the most rich ecologically. Bhattarkanika has 62 species of mangroves and associates, unparalleled by any other state in the country.

As per the State of Forest Report 2011, published by Forest Survey of India, India has recorded a net increase of 23.34 sq km of mangrove cover between 2009 and 2011, mainly due to efforts of one of the most industrialised states, Gujarat, in planting and regenerating the ecosystem rich in biodiversity. Mangroves in India account for about three per cent of the world's mangrove vegetation. The report says mangrove cover in India is 4,662 sqkm, which is 0.14 per cent of the country's total geographical area. Sundarbans in West Bengal accounts for almost half of the total area under mangroves in the country. The very dense mangrove comprises 1,403 sqkm (30.10 per cent of the total mangrove cover), moderately dense mangrove is 1,658.12 sqkm (35.57 per cent) while open mangroves cover an area of 1,600.44 sq km (33 per cent). The East Godavari River Estuarine Ecosystem in Andhra Pradesh is the second largest area of mangroves along India's East coast.

Compared with 2005 assessment, there has been an increase of fifty eight sq km in mangrove cover mainly because of the plantations and protection measures in the States of Gujarat, Orissa, Tamil Nadu and West Bengal.

Decrease in mangrove cover in Andamans & Nicobar Islands is attributed to after effects of tsunami. Gujarat's mangrove cover is the second largest in the country, after West Bengal. Of the 4,639 sq km area of mangrove plantation in India, Gujarat covered 1,046 sq km in 2007 compared to 991 sq km in 2005. In 2008-09, the state added another 30 sq km of mangrove forest cover to protect its coast from sand erosion. The highest mangrove cover in Gujarat is found in Kutch district (775 sq km), followed by Jamnagar (157 sq km) and Bharuch (42 sq km). The coastal districts of Surat, Valsad and Navasari in south Gujarat have the lowest mangrove cover.

In nutshell, there was an increase of 55 sq. km in mangrove cover of Gujarat, 16 sq. km in West Bengal, 4 sq. km in Orissa and 3 sq. km in Tamil Nadu. However, there was a loss of 20 sq. km in Andaman and Nicobar Islands, due to the effect of tsunami in December 2004. This loss stood reduced by 1 sq. km as compared to the previous assessment in 2005.

▶ Based on an average of an annual target of 3,000 hectares on a country wide basis, the areas supported under the scheme are among the 38 areas as already identified by Ministry for intensive conservation. New areas are added to the existing list of the 38 ones on the basis of recommendation by the National Mangrove Committee.

▶ Mangroves in India account for about five percent of the World's mangrove vegetation and are spread over an area of about 4500 square kilometres along the coastal States/UTs of the country. The Forest Survey of India is assessing the vegetation cover of the country including mangroves using remote sensing since 1987. West Bengal has maximum of mangrove cover in the country followed by Gujarat and Andaman & Nicobar Islands. India is home to some of the best mangroves in the world. The Ministry has established a Nation-

Mangrove Cover Assessment in States/UTs

(Area in km²)

States/UTs	Assessment Year											
	1987	1989	1991	1993	1995	1997	1999	2001	2003	2005	2009	2011
Andhra Pradesh	495	405	399	378	383	383	397	333	329	354	353	352
Goa	0	3	3	3	3	5	5	5	16	16	17	22
Gujarat	427	412	397	419	689	901	1,031	911	916	991	1,046	1,058
Karnataka	0	0	0	0	2	3	3	2	3	3	3	3
Kerala	0	0	0	0	0	0	0	0	8	5	5	6
Maharashtra	140	114	113	155	155	124	108	118	158	186	186	186
Odisha	199	192	195	195	195	211	215	219	203	217	221	222
Tamil Nadu	23	47	47	21	21	21	21	23	35	36	39	39
West Bengal	2,076	2,109	2,119	2,119	2,119	2,123	2,125	2,081	2,120	2,136	2,152	2,155
A & N Islands	686	973	971	966	966	966	966	789	658	635	615	617
Daman & Diu	0	0	0	0	0	0	0	1	1	1	1	1.56
Puducherry	0	0	0	0	0	0	0	0	1	1	1	1
Total	4,046	4,255	4,244	4,256	4,533	4,737	4,871	4,482	4,448	4,581	4,639	4,663

Ecology and Environment

● India is home to some of the best mangrove species in the world, comprising 69 species under 42 genera and 28 families. Sunderbans, West Bengal have been included in the World List of Biosphere Reserves by UNESCO. It represents the largest stretch of mangroves in India.

al Mangrove Genetic Resources Centre in Orissa.

▶ Mangroves are very naturally vegetated estuaries serve to preserve both coast and coastal inhabitants in times of cyclones, tidal waves and the rare tsunamis. Mangrove ecosystem has a very vital role in protecting the coastline during natural disasters.

▶ India is home to some of the best mangrove species in the world, comprising 69 species under 42 genera and 28 families. Sunderbans, West Bengal have been included in the World List of Biosphere Reserves by UNESCO. It represents the largest stretch of mangroves in India.

▶ The United Nations Development Programme (UNDP) has sanctioned a community-based natural resource management and mangrove conservation project in Godavari estuary, Andhra Pradesh, similar to the Gulf of Mannar Marine Conservation Project in Tamil Nadu. The Godavari project would be implemented in 44 villages situated in East Godavari River Estuarine Ecosystem and thus supporting biodiversity conservation in the Coringa Wildlife Sanctuary, an IUCN category IV protected area with high biodiversity value. The sanctuary was the second largest mangrove area in the country with a high diversity of mangrove species, including endangered flora and fauna.

Features

▶ Mangroves actually constitute a heterogeneous group of plants with similar adaptations to a particular environment.

▶ They colonise tidal shores and brackish waters in the tropics and subtropics and in doing so not only stabilize shorelines but also create new land by trapping debris, silt and mud along their interlacing roots.

▶ Mangroves spread out to the water by sending their branches roots that reach into the mud and develop into sturdy supporting props.

▶ A distinctive feature of mangroves is their large fruit, the seeds of which germinate and grow into sturdy seedlings before they leave the parent plant.

▶ Mangroves are salt tolerant forest ecosystems, found mainly in the tropical and subtropical incinal regions of the world.

▶ Mangroves plants can survive high salinity, tidal extremes, strong wind velocity, high temperature and muddy anaerobic soil.

All these conditions are hostile for other plants. Saline inter-tidal zone at the interface between the land and the sea along the deltas, shallow lagoons, mud flats, bays and backwaters in the tropical and subtropical sheltered coastlines are most favourable inhabitant for the colonization of mangrove forests.

Role and Importance: Found in 123 countries and covering 152,000 square kilometers, over 100 million people around the world live within 10 kilometres of large mangrove forests, benefiting from a variety of goods and services such as fisheries and forest products, clean water and protection against erosion and extreme weather events.

Mangrove forests are among the most productive ecosystems on land. They are natural marvels not only due to their adaptations, but also for the important role they play in our environment. Mangroves are self-propagating plants and if it is undisturbed, can grow quite easily in conducive soil and locations. These are the plants that grow in the inter-tidal zone along the coastline of India. They are very hardy plants that have adapted over millennia to grow in difficult conditions. Gujarat has increased its mangrove cover by almost 10 times which acts as protection from tsunami. Similar is the case with West Bengal.

Mangroves are plants that survive high salinity, tidal regimes, strong wind velocity, high temperature and muddy anaerobic soil – a combi-

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Mangrove Cover Assessment 2013

(Area in km²)

States/UTs	Very Dense Mangrove	Moderately Dense Mangrove	Open Mangrove	Total	Change with respect to ISFR 2011
Andhra Pradesh	0	126	226	352	0
Goa	0	20	2	22	0
Gujarat	0	175	928	1,103	45
Karnataka	0	3	0	3	0
Kerala	0	3	3	6	0
Maharashtra	0	69	117	186	0
Odisha	82	88	43	213	-9
Tamil Nadu	0	16	23	39	0
West Bengal	993	699	405	2,097	-57
A & N Islands	276	258	70	604	-13
Daman & Diu	0	0	1	1	0
Puducherry	0	0.14	1.49	1.63	0.07
Total	1,351	1,457	1,819	4,628	-34

Ecology and Environment

● Mangroves are very leafy, and take in a lot of carbon dioxide from the atmosphere to make biomass. This reduces the amount of carbon dioxide in the atmosphere. Mangrove deforestation is contributing to decline in fisheries, degradation of clean water supplies, increasing salinity of coastal soils, erosion, and land subsidence.

● Mangroves are plants that survive high salinity, tidal regimes, strong wind velocity, high temperature and muddy anaerobic soil – a combination of conditions hostile for other plants.

nation of conditions hostile for other plants. In the temple town of Chidambaram, near Pichavaram, Tamil Nadu, the thillai tree (*Excoecaria agallocha*), a type of mangrove, is believed to have active chemicals that cure leprosy. Mangroves are very leafy, and take in a lot of carbon dioxide from the atmosphere to make biomass. This reduces the amount of carbon dioxide in the atmosphere. Mangrove deforestation is contributing to decline in fisheries, degradation of clean water supplies, increasing salinity of coastal soils, erosion, and land subsidence. If mangroves are destroyed, migratory birds will no longer have a safe haven to halt and rest. In Pichavaram district, Tamil Nadu, the mangrove forest along the coast reduced the speed and intensity of the furious waves during the 2004 tsunami. The amount of water carried by the waves was also reduced as most of it was deposited in the forest. Mangrove wetlands and forests act as a shelter belt against cyclones. (In Orissa a few years ago, villages surrounded by mangrove forests survived the fury of cyclones, unlike other villages).

▶ As they have their existence on mudflats and survive the daily tidal cycles, most species of mangroves either have prop roots or pneumatophores, i.e. additional roots, underground root system and grow erect out of the mud. This underground root system can obtain oxygen in an anaerobic substrate.

▶ Mangrove trees develop aerial or air-breathing roots to avoid suffocation in the oxygen-poor mud.

▶ All aerial tree roots have special tiny pores on their surface to take in air keeping water and salt out.

▶ Their roots contain large air space and not only they transport air but also provide reservoir of air during high tide when all the other aerial roots may be under water.

▶ Aerial roots can take different forms in different species of mangroves, such as 'Avicennia' which develops shallow cable roots that spread out from the trunk under the soil. Along these cable roots emerge short pencil like rods called 'Pneumatophores' (air carrier).

▶ '*Sonneratia*' also produce can shape pneumatophores.

▶ *Rhizophora* send out roots from their trunks and branches that arch down to the ground for extra support and air absorption.

▶ *Bruguiera* send out knee shaped roots that radiate out from the trunk.

▶ With the help of these roots the mangroves form an effective bio-shield that protects the shoreline from the tidal damage.

▶ Mangroves not only protect the coastal life from the fury of cyclones and coastal storm but also promote sustainable fisheries and prevent

sea erosion.

▶ Mangrove forests serve as the home for a wide range of flora and fauna; they provide medicine and fuel wood.

▶ In spite of all such gifts they confer, many mangrove ecosystems have been cleared for aquaculture ponds and other alternative uses. Others have been exploited unsustainably, leading to their degradation.

▶ In order to protect Indian nuclear reactors from the fury of tsunamis of the kind that has hit Japan, it has been suggested that the government promote the growth of mangroves and similar other 'bio-shields' along the coast adjoining the atomic energy installations.

▶ Mangrove trees act as a natural tank for carbon dioxide storage. They absorb carbon for their own needs. The more such biomass we have on earth, the more CO₂ will be pulled from the atmosphere. This will ultimately result in controlling the rise of atmospheric temperature and the subsequent climate change. This process of removing carbon from the atmosphere and depositing it in a reservoir is known as **carbon sequestration**. As a primary greenhouse gas, large-scale CO₂ emission is responsible for global warming as it leads to a rise in sea levels and temperature, adversely affecting agriculture, fishery and human health.

▶ **Mangroves to receive huge boost from new carbon credit rules:** A new method for calculating the role that mangrove restoration plays in slowing climate change, by capturing and storing carbon dioxide from the atmosphere has been adopted. The important role of mangroves in trapping carbon from the atmosphere and locking it into sediments has begun to be recognised. The methodology was developed by IUCN, Ramsar and Sylvestrum for the Clean Development Mechanism and was based on field experiences from a 3-year partnership with Danone. The project was initiated by food and water company Danone and its brand Evian in partnership with IUCN and Ramsar, which implemented large mangrove restoration initiatives together with local communities in Africa and Asia.

▶ To protect Indian nuclear reactors from the fury of tsunamis of the kind that has hit Japan, eminent agriculture scientist MS Swaminathan has suggested that the government promote the growth of mangroves and similar other 'bio-shields' along the coast adjoining the atomic energy installations.

▶ Mangroves are also called 'tropical littoral ecosystem' more dynamic than the sea itself. They not only act to prevent soil erosion but also as a catalyst in retaining land from the sea. They are a breeding and nursery grounds for a

Ecology and Environment

● In a new report launched at the 16th Global Meeting of the Regional Seas Conventions and Action Plans, held in Athens, Greece, the UN Environment Programme (UNEP) warned that the deforestation of the planet's mangroves was exceeding average global forest loss by a rate of three to five times, resulting in economic damages of up to \$42 billion annually and exposing ecosystems and coastal habitats to an increased risk of devastation from climate change.

● In a recent case, a large chunk of wetland along the Thane Creek designated as an Important Bird Area (IBA) by the Bombay Natural History Society (BNHS) and Bird Life International (UK), is now allegedly being destroyed by an upcoming Special Economic Zone (SEZ) project. Researchers said an area of about 20 hectares along the Thane Creek near Mithbunder Road, Kopri, is being reclaimed for an upcoming SEZ project of Sun-stream City.

number of varieties of marine organisms including shrimp, crab and fish. Hence, the loss of mangrove not only affects us indirectly but also there is a direct economic repercussion through the loss of fishing.

Mangrove under threats

In a new report launched at the 16th Global Meeting of the Regional Seas Conventions and Action Plans, held in Athens, Greece, the UN Environment Programme (UNEP) warned that the deforestation of the planet's mangroves was exceeding average global forest loss by a rate of three to five times, resulting in economic damages of up to \$42 billion annually and exposing ecosystems and coastal habitats to an increased risk of devastation from climate change. The escalating destruction and degradation of mangroves – driven by land conversion for aquaculture and agriculture, coastal development, and pollution – is occurring at an alarming rate, with over a quarter of the earth's original mangrove cover now lost. This has potentially devastating effects on biodiversity, food security and the livelihoods of some of the most marginalized coastal communities in developing countries, where more than 90 per cent of the world's mangroves are found. The report argues that in spite of the mounting evidence in support of the multitude of benefits derived from mangroves, they remain one of the most threatened ecosystems on the planet. The report describes financial mechanisms and incentives to stimulate mangrove conservation, such as REDD+, private sector investments, and the creation of Nationally Appropriate Mitigation Actions for developing countries to reduce greenhouse gas emissions while increasing national capacity.

▶ In a recent case, a large chunk of wetland along the Thane Creek designated as an Important Bird Area (IBA) by the Bombay Natural History Society (BNHS) and Bird Life International (UK), is now allegedly being destroyed by an upcoming Special Economic Zone (SEZ) project. Researchers said an area of about 20 hectares along the Thane Creek near Mithbunder Road, Kopri, is being reclaimed for an upcoming SEZ project of Sun-stream City. Dumping for the project is affecting vital intertidal habitats such as mangroves and salt pans. This is in addition to the existing threats such as garbage dumping and other human encroachments, noted Atul Sathe at BNHS India.

▶ On the banks of the river Nethravathi at Jep-pinamogaru thousands of mangrove saplings have grown, providing natural cover and enhancing the beauty also. But, now they are facing a threat because of an unbridled sand mining in the area. If the mining and illegal transport of sand continue, mangroves face a grave

threat.

▶ A large number of *Avecennia Alba* plants, locally known as Bain, were found uprooted in a small swamp in Pakhirla, just opposite the Sajnekhali forest, recently. Interestingly, Bain is among the salt-tolerant plants in the Sunderbans and its survival is key to the future of the mangroves.

▶ The government has received a complaint from a civil society activist, who happens to be a member of the state-sponsored Gujarat Coastal Zone Management Authority, that heavy mangroves plantation is in the danger of being wiped out. The plantation was carried out under a programme funded by the Indo-Canadian Environment Facility (ICEF) in 1999-2001 in about 25 sq km area. The complaint comes at a time when recently released annual report of the Union ministry of forests and environment said the mangroves cover in Gujarat has increased from 1,046 sq km in 2009 to 1,058 sq km in 2011.

▶ Human interference is clearly visible as pollen signatures are poorly recorded in the modern sediments at a few locations in Navi Mumbai. It shows that the mangrove vegetation has been under environmental stress affecting poor phenological conditions (flowering, fruiting). The Kanjurmarg dumping ground is spewing hazardous fluids into Thane creek, and mangroves there are dying as debris has blocked off sea water, reveals a report by the Maharashtra Pollution Control Board (MPCB).

Further, Large illegal aquaculture ponds and trenches created in the midst of mangroves by the local 'koli' and 'agri' coastal communities are ringing alarm bells for the survival of the dense coastal vegetation in pockets of Bhandup, Vikhroli, Diva and areas in Navi Mumbai such as Airoli, Gothivli, Ghansoli, Kopar Khairane.

▶ According to UNDP report at least 15 per cent of the Sunderbans-the world's largest mangrove forests-will be submerged by 2020 and neglecting the area further can have global implications as it is highly vulnerable to climate change. The Sundarbans is the largest single block of tidal mangrove forest in the world and is a World Heritage Site. The Sundarbans is intersected by a complex network of tidal waterways, mud flats and small islands of salt-tolerant mangrove forests. The area is known as the abode of the Royal Bengal Tigers.

▶ As per the report of a committee a ship-collision near the Mumbai coast that led to one of the worst oil spills in recent times has destroyed 1,273 hectares of mangroves along the Mumbai and Raigad coast. The report was commissioned by the Union Ministry of Environment and Forests after the merchant ships MSC Chitra and MV Khalija collided near Uran's shore

Ecology and Environment

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● Two mangrove species are endemic to India, namely *Rhizophora annamalayana* occurring in Pitchavaram, Tamil Nadu and *Heritira benikensis* which exists only in Bhitarkanika of Orissa.

on August 9, 2010.

▶ Mangrove ecosystems have been subjected to various anthropogenic and biotic pressures resulting in habitat destruction, loss of biodiversity, affecting avifauna and their migration paths.

▶ Unsustainable aquaculture, siltation, weed infestation, uncontrolled discharge of waste water, industrial effluents, surface run off, encroachment around these water bodies, etc. is resulting in shrinkage of mangrove area.

▶ Two mangrove species are endemic to India, namely *Rhizophora annamalayana* occurring in Pitchavaram, Tamil Nadu and *Heritira benikensis* which exists only in Bhitarkanika of Orissa.

▶ Bangladesh and India share the 26,000sqkm mangrove kingdom, which is vulnerable to climate change.

▶ If that airport comes up in the proposed area, 400 acres of mangroves would be destroyed.

▶ The oil spill from MSC Chitra has caused massive damage to the 25-km mangroves stretch in and around 10-12 km coastline between Revas and Mandwa and 5-6 km coastline at Elephanta and Vashi have been found massively damaged.

▶ The International Union for Conservation of Nature (IUCN), a network of several conservation groups, has set alarm bells ringing by warning that more than one in six mangrove species worldwide are in danger of extinction due to coastal development and other factors, including climate change, logging and agriculture.

Recent development: The Bombay High Court has allowed the Maharashtra government's town planning agency, City and Industrial Development Corporation (CIDCO), to cut mangroves in an area of 108 hectares today, paving the way for the much awaited international airport in Navi Mumbai. Clearance was given by the High Court after CIDCO said it had obtained necessary permissions from the Union Ministry of Environment and Forests (MoEF), Wildlife Authority and other bodies. Besides, an exemption had been given to CIDCO from Coastal Regulation Zone (CRZ) regulations for development of the airport.

Effective measures:

Vivipary measures: Mangroves are adaptive, even in hostile conditions such as high salinity, hypoxic (deficiency of oxygen), water logged soil strata, tidal pressure, strong winds and sea wash. To cope with such hostile environments, the mangroves exhibit highly evolved morphological and physiological adaptation to extreme conditions. They have special root systems like arial roots, stilt roots and breather roots. They share two forms of reproductive strategy. One is by dispersal by means of water and the other is vivipary.

Vivipary means that the embryo develops continuously while attached to the parent tree and during dispersal. They may grow in place attached to parent tree for one to three years. Their length will increase up to one meter before they break from the parent tree and fall into water. These seedlings (propagule) then travel in an amazing method. In the buoyant sea water, they lie horizontally and move quickly. Upon reaching fresher (brakish) water, they turn vertical, set down roots and bud, making it easier for them to lodge in the mud at a suitable less salty area. Once lodged in the mud they quickly produce additional roots and grow.

The Government seeks to sustain mangroves in the country by both regulatory and promotional measures. The Coastal Regulation Zone Notification (1991), as amended subsequently, recognizes the mangrove areas as ecologically sensitive and categorizes them as CRZ I(i), which implies that these areas are accorded protection of the highest order. Keeping the importance of mangrove ecosystem in view, the Ministry of Environment and Forests launched Mangrove Conservation Programme in 1987 and, has so far, identified 35 mangrove areas for intensive conservation and management in the country.

▶ Mangrove areas are identified on the recommendation of National Committee on Mangrove and Coral Reefs on the basis of their unique ecosystems, biodiversity, etc.

▶ Hundred per cent central assistance is given under Management Action Plans (MAPs) for undertaking activities like raising mangrove plantations, protection, catchment area treatment, biodiversity conservation, sustainable resource utilization, survey and demarcation, education and awareness, etc.

▶ Recognizing the importance of mangrove ecosystem, the number of mangrove areas has grown from 15 to 35 to be put under conservation and management.

▶ Presently efforts have been on to persuade the State Governments to identify new and additional mangroves conservation areas.

▶ The Ministry of Environment and Forests has established a National Mangrove Genetic Resources Centre in Orissa.

▶ Two mangrove species are endemic to India, namely *Rhizophora annamalayana* occurring in Pitchavaram, Tamil Nadu and *Heritira benikensis* which exists only in Bhitarkanika of Orissa.

▶ Sunderbans, West Bengal have been included in the World List of Biosphere Reserves by UNESCO. It represents the largest stretch of mangroves in India. The UNESCO World Heritage Site is known for its exceptional biodiversity in flora and fauna with as many as 334 plant species and 693 species of wildlife which

Ecology and Environment

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● The situation is quite alarming, especially in the central part. The capacity of the mangrove forest, especially the Byne species, to absorb carbon dioxide has eroded to a large extent. This will effect the entire ecosystem of the area.

include 49 mammals, 59 reptiles, eight amphibians, 210 white fishes, 24 shrimps, 14 crabs and 43 mollusks species. Climate change is causing toxic metals trapped in the sediment beds of the Hooghly estuary in the Indian Sunderbans to leach out into the water system due to changes in ocean chemistry, say scientists, warning of potential human health hazards. The scientists predict that after about 30 years, increasing ocean acidification - another dark side of spiked atmospheric levels of carbon dioxide - could in fact unlock the entire stock of metals like copper and lead gathered in the sediment layer, and release them into the water system, leading to health issues.

► The situation is quite alarming, especially in the central part. The capacity of the mangrove forest, especially the Byne species, to absorb carbon dioxide has eroded to a large extent. This will effect the entire ecosystem of the area. The vast mangrove forest in the Sunderbans is fast losing its capacity to absorb carbon dioxide, one of the main greenhouse gases, from the atmosphere due to rise in the salinity of water, rampant deforestation and pollution, a study has found. The mangrove forest, marsh grass, phytoplanktons, molluscus and other coastal vegetation in the world's largest delta are the natural absorbers of carbon dioxide (CO₂), according to the study. The stored carbon in the plants is known as "Blue Carbons". The absorption of CO₂ is a process which contributes to reduction of the warming of the earth and other ill effects of climate change. It has to be mentioned that in the central part of Sunderbans near Matla, the capability of Byne trees to absorb carbon was 22 tonnes per hectare, whereas the scenario is a bit different in the eastern Sunderbans where the capacity of Byne to absorb carbons is near about 35 tonnes per hectare.

Throughout the country, the mangrove areas are being subjected to various threats. Their survival is being threatened by felling, grazing, reclamation, urban development, industrialization and mining. Thus effective programme and regulated management plans with community participation is the pre-requisite for the protection and maintenance of this Bio-shield. This will provide the human genre a safe coastal life and economic prosperity at present and ensure for the future.

They stabilise the shoreline and act as a bulwark against encroachments by the sea.

► The Ministry has established a **National Mangrove Genetic Resources Centre in Orissa**. Two mangrove species are endemic to India. One species is *Rhizophora annamal-ayana*, occurring in **Pichavaram** in Tamil Nadu.

► Another species in *Heritiera kanikensis* that

exists only in **Bhitarkanika**, Orissa.

Areas identified: In all, 38 mangrove sites have been identified by the Government on a nation-wide basis for intensive conservation and management. Of these, Andhra Pradesh has three sites namely Coringa, East Godavari and Krishna.

State/UTs	Mangrove Sites
West Bengal	1. Sunderbans
Orissa	2. Bhitarkanika
	3. Mahanadi
	4. Subernarekha
	5. Devi
	6. Dhamra
	7. Mangrove Genetic Resources Centre,
Andhra Pradesh	8. Chilka
	9. Coringa,
	10. East Godavari
	11. Krishna
Tamil Nadu	12. Pichavaram,
	13. Muthupet, 14. Ramnad
	15. Pulicat, 16. Kazhuveli
Andaman & Nicobar	17. North Andamans
	18. Nicobar
Kerala	19. Vembanad
	20. Kannur (N. Kerala)
Karnataka	21. Coondapur
	22. Dakshin Kannada/ Honnavar, 23. Karwar,
	24. Manglore Forest Division
Goa	25. Goa
Maharashtra	26. Achra-Ratnagiri
	27. Devgarh-Vijay Durg
	28. Veldur, 29. Kundalika- Revanda, 30. Mumbra Diva
	31. Vikroli,
	32. Shreevardhan
	33. Vaitarna, 34. Vasai- Manori, 35. Malvan
Gujarat	36. Gulf of Kutchh
	37. Gulf of Khambhat
	38. Dumas-Ubhr

Total area covered: It is estimated at about 6,700 sq. km., which constitutes about 7 per cent of the world's mangroves. Sunderbans is the largest with 4,200 sq.km, Andaman & Nicobar Islands account for an additional 1,200 sq. Km., while small patches are found in Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Orissa and Tamil Nadu.

► Government is implementing a Plan Scheme on Conservation and Management of Mangroves since 1986-87. Management Action Plans: (1) **Sunderbans** (West Bengal), (2) **Pichavaram** (Tamil Nadu), (3) **Muthupet** (Tamil Nadu) (4) **Goa** and (5) **Andaman and Nicobar** Islands. Under the scheme on conservation and management of mangroves, 15 areas have been identified: (1) Northern Andaman, (2) Sunderbans, (3) Bhitarkanika (Orissa), (4) Cor-

Ecology and Environment

● Zoological Survey of India has been undertaking studies on the serious threat to coral colonies only of Palk Bay continuously for more than a decade. Study initiated in 2010-11, monitoring assessments for which were carried out in 2013 confirm that there is reduction in the live coral cover and increase in rubbles, macro-algae and calcareous algae which indicate continuing degradation of these reefs.

● The Wildlife Crime Control Bureau has also been set up to strengthen the enforcement of law for control of poaching and illegal trade in wildlife and its products.

inga (Andhra Pradesh), (5) Godavari Delta (Andhra Pradesh), (6) Krishna Estuary (Andhra Pradesh), (7) Mahanadi Delta (Orissa), (8) Pitchavaram (TN) (9) Point Calimer (TN), (10) Goa, (11) Gulf of Kutch, (12) Coondapur (Karnataka) (13) Achra/Ratnagiri; (Maharashtra) (14) Vembanad (Kerala); (15) Nicobar.

A National Mangrove Genetic Resource Centre in Orissa has been established.

▶ The additional 15 mangrove centres are: (1) Subarnekhya, (2) Devi, and (3) Dhamra-all in Orissa; (4) Ramnad in Tamil Nadu, (5) Dakshin Kannada (Karnataka), (6) Devgarh (Maharashtra), (7) Vijaydurg, (8) Veldur, (9) Kundlika, (10) Revdanada, (11) Mumbra-Diva, (12) Vaitrana, (13) Vasoi Manori, (14) Shreevardhan-Varal-Turmbadi-all in Maharashtra and (15) Puducherry.

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The Ministry of Environment & Forests also provides financial assistance to Coastal States/ Union Territories, who so request, under its Centrally Sponsored Scheme for conservation and management of mangroves and coral reef. In addition Coral reef is included in Schedule I of the Wild Life Protection Act, 1972 which affords it the highest degree of protection. Further Protected Areas, viz. 4 National Parks, 96 Sanctuaries and 3 Marine Biosphere Reserve have been created all over the country under the provisions of the Wild Life (Protection) Act, 1972 to conserve marine life including coral reef. The Wildlife Crime Control Bureau has also been set up to strengthen the enforcement of law for control of poaching and illegal trade in wildlife and its products.

Suggestions

Throughout the country, the mangrove areas are being subjected to various threats. Their survival is being threatened by felling, grazing, reclamation, urban development, industrialization and mining. Thus effective programme and regulated management plans with community participation is the pre-requisite for the protection and maintenance of this Bio-shield. This will provide the human genre a safe coastal life and economic prosperity at present and ensure for the future.

▶ Create a Global Mangrove Fund to support "climate resilience" actions that conserve and restore mangroves, and protect the carbon

stored within them;

▶ Encourage mangrove conservation and restoration through carbon credit markets such as REDD+, the "Bio-Rights" mechanism and corporate and private sector investments;

▶ Promote economic incentives such as Payments for Ecosystem Services as a source of local income from mangrove protection, sustainable use and restoration activities and ensure beneficiaries of mangrove services can find opportunities to invest in mangrove management and restoration planning;

▶ Explore opportunities for investment into Net Positive Impact biodiversity offsets by the corporate and business sectors as a way to finance the protection and sustainable use of mangroves.

Research and Development

The Indian Council of Agricultural Research has set up a number of gene banks for ex situ conservation under the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, National Bureau of Animal Genetic Resources (NBAGR), Karnal, National Bureau of Fish Genetic Resources (NBFGR), Lucknow, and National Bureau of Agriculturally Important Microorganisms (NBAIM), Mau. A large number of microorganisms of agricultural importance also form a vital part of the diversified Indian agricultural ecosystem.

The Department of Biotechnology (DBT) has been implementing focused programmes on biodiversity conservation through biotechnological interventions since 1991, inter alia by developing techniques, tools and technologies for ex situ conservation. Many tissue culture protocols have been developed for regeneration of endangered and threatened species. The DBT has established a national facility "Laboratory for conservation of species" - LaCONES, at Hyderabad jointly with the help of Central Zoo Authority (MoEF), CSIR and Andhra Pradesh Government for the conservation of endangered animal species like tiger, lion, black buck, vulture, etc.

India has all along shown deep commitment for biodiversity conservation and sustainable development and has responded effectively to relevant international treaties and conventions. Partnerships and cooperation in different sectors have further strengthened and consolidated India's efforts in cross-sectoral integration of biodiversity considerations. Among others, the sectors and programmes include: i) plant, animal, human and microbial genomics (joint centres in biotechnology with France, Germany, Indo-ASEAN Institute of Biotechnology, Indo-ASEAN Biotechnology Network); ii) International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi (an autonomous UN organization); iii) cooperation with

Ecology and Environment

● According to a study conducted by Indian Council of Agricultural Research and department of space, degraded and wasteland in India cover 120.4 million hectare (Mha). Around 93 Mha land is affected due to water erosion and 11 Mha due to wind erosion.

● According to a wasteland map published by the Union Ministry of Rural Development in association with ISRO, of the 191.79-lakh hectare geographical area of Karnataka, 13.03 lakh hectare or 6.8 per cent of the area was identified as wasteland.

Consultative Group on International Agricultural Research (CGIAR) centres for development of high quality seed material of some crops; iv) partnership building through FDAs and JFMCs, partnerships with industries; v) CSIR Strategic Alliances; vi) new initiatives in agriculture sector to promote agriculture research and education through collaboration with a large number of countries; vii) promoting investment in coastal ecosystem conservation with IUCN; viii) wildlife protection and care with USA; and ix) collaboration with GEF through wide ranging twelve on-going projects.

Wasteland

According to a study conducted by Indian Council of Agricultural Research and department of space, degraded and wasteland in India cover 120.4 million hectare (Mha). Around 93 Mha land is affected due to water erosion and 11 Mha due to wind erosion. About 6.74 Mha is under salt affected soils and 4.36 Mha forest area is under accelerated erosion due to shifting cultivation. Uttar Pradesh is the worst affected covering 54 per cent of TGA (total geographical area), followed by Madhya Pradesh (44 per cent), Karnataka (41 per cent) and Jharkhand (40 per cent). Globally, about 1,900 Mha land suffers from various degrees of land degradation, the study finds. Land degradation is continuously converting the arable land into degradable lands.

According to a wasteland map published by the Union Ministry of Rural Development in association with ISRO, of the 191.79-lakh hectare geographical area of Karnataka, 13.03 lakh hectare or 6.8 per cent of the area was identified as wasteland. On a national scale, of the 3166.41-lakh hectare geographical area, 467 lakh hectare (15 per cent is categorized as wasteland) was identified as wasteland. In Karnataka, Bellary district has the maximum wasteland (1.33 lakh hectare), followed by Belgaum (1.10 lakh hectare) Gulbarga (99,400 hectare) and Chitradurga (93,500 hectare). Bangalore Urban district has the least (9,000 hectare), followed by Kodagu (11,000 hectare) and Mysore (11, 500 hectare). Wasteland in Karnataka reduced by 1.43 lakh hectare between 2005-06 and 2008-09. In 2005-06, Karnataka had 14.43 lakh hectare of wasteland while in 2008-09, it came down to 13.03 lakh hectare. The reduction in wasteland is because of an increase in cropland and forest plantation in scrub and rocky areas.

The government classified the wasteland into 23 categories including water-logged and marshy land, land with scrubs, saline land, sands, degraded land under plantation crops,

land affected by salinity, mining wasteland and industrial wasteland.

In fact, states like Maharashtra, Madhya Pradesh, Rajasthan, Jammu and Kashmir, Andhra Pradesh and Himachal Pradesh have a significant percentage of wasteland, which could be exploited for developmental projects. Rajasthan tops the chart (84 lakh hectare) with 25 per cent of its geographical area being wasteland, accounting for 18 per cent of the wasteland in the country. Delhi does not have an inch of wasteland. In a sharp contrast, states like Punjab, Goa, Haryana, West Bengal and Kerala hardly have wasteland. In Haryana, 5 per cent of the land is wasteland, followed by Punjab (2 per cent), West Bengal (2.2 per cent) and Kerala (6.3 per cent).

Deserts, ravines, snow-clad areas and uncultivable land are among wasteland that abounds across states and which a section of political leaders and activists insist should be preferred for acquisition to stop displacement of people and waste of fertile land.

Rajasthan tops the chart with 25 per cent of its geographical area being wasteland, accounting for 18 per cent of the wasteland nationally. Delhi stands at the bottom of the pile with not an inch of wasteland. In between, there are states which are blessed with little or no wasteland and those like Jammu and Kashmir which have 75 per cent of its area as wasteland.

As per the figures, the scope for using wasteland is high in Maharashtra, with 12 per cent of its area being waste. At 8 per cent, it is fourth among states with high share of wasteland nationally. Andhra has 13.6 per cent area that is wasteland. Both the states have high demand for land for industry and development projects while they also have a thriving economy.

Odisha, on the other hand, has 10 per cent of its land as waste. The state has high demand of land for industry and is having to cope with protests over key projects in which fertile and inhabited land has been allotted to firms. Jharkhand has 14 per cent of its area as wasteland and Chhattisgarh has 8.5 per cent. However, both have a mere 2.5 per cent share of wasteland nationally. In sharp contrast, states like Punjab, Haryana and Kerala have virtually no wasteland. While Haryana has 5 per cent of its land as waste, Punjab has just 2 per cent and Kerala 6.3 per cent.

Since 1985, we have had a National Wastelands Development Board (NWDB). Plus, there is a centrally-sponsored scheme, Integrated Wasteland Development Programme (IWDP). Government has claimed that 1,500 million hectare wasteland has been made cultivable in the last decade under the Integrated Wasteland Development Programme (IWDP). According

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● The government classified the wasteland into 23 categories including water-logged and marshy land, land with scrubs, saline land, sands, degraded land under plantation crops, land affected by salinity, mining wasteland and industrial wasteland.

● Integrated Wastelands Development Project (IWDP) Scheme is under implementation since 1989-90, and has come to this Department along with the National Wastelands Development Board. The development of non-forest wastelands is taken up under this Scheme.

to the data provided by the government, Assam was given the maximum funds under IWDP in 2011-12 of Rs 4.05 crore, followed by Himachal Pradesh with Rs 3.83 crore and Uttarakhand with Rs 2.33 crore.

Maximum development of wasteland in 2010-11 took place in Andhra Pradesh where 7.24 lakh hectare have been made cultivable, followed by Bihar with 0.88 lakh hectare and Maharashtra with 0.60 lakh hectare.

IWDP has also generated impressive man days of work. Meghalaya leads with 112.45 lakh man days, Maharashtra 42.57 lakh man days and Andhra Pradesh 22.54 lakh man days.

► The **National Wasteland Development Board (NWDB)** was set up in 1985. During the Seventh Five Year Plan, the strategy adopted by the National Wasteland Development Board emphasised more on tree planting activities rather than Community Participation for wasteland development. In the year 1992, the new Department under the Ministry Of Rural Development (now Ministry of Rural Areas and Employment) was created and the National Wasteland Development Board was placed under it.

Integrated Wastelands Development Project (IWDP) Scheme: This scheme is under implementation since 1989-90, and has come to this Department along with the National Wastelands Development Board. The development of non-forest wastelands is taken up under this Scheme. The scheme provides for the development of an entire micro watershed in an holistic manner rather than piecemeal treatment in sporadic patches.. The thrust of the scheme continues to be on development of wastelands.

► In 1989 out of 120 million hectares: (a) 40 million hectares has been identified as forestlands and (b) Nearly 80 million hectares has been identified as is non-forest wastelands.

► Government has taken a number of steps to promote wastewater management.

► Submerged Aerated Fixed Film Reactor (SAFF) has been introduced by the wastewater management division of Thermax in place of what is termed as the activated sludge process. SAFF has various advantages: (a) lower power requirement; (b) less maintenance; (c) low operating cost; and (d) reduction in the overall volume of the plant.

► Reverse Osmosis is a highly advanced recycling system. **Common Effluent Treatment Plants (CEPTs)** have a number of problems:

(a) There is significant variation in the composition of the effluent discharged by the industrial units; (b) The problem is compounded because many of the users do not give the primary treatment that is required before charging wastes into the common discharge line; (c) This

pre-treatment is technically necessary; (d) Improper planning at the design stage; (e) No adequate training and it is a long drawn process; and (f) For SSIs, it is very costly.

Integrated Watershed Management Programme (IWMP) is a modified programme of erstwhile Drought Prone Areas Programme (DPAP), Desert Development Programme (DDP) and Integrated Wastelands Development Programme (IWDP) of the Department of Land Resources. This consolidation is for optimum use of resources, sustainable outcomes and integrated planning. The scheme was launched during 2009-10. The programme is being implemented as per Common Guidelines for Watershed Development Projects 2008. The main objectives of the IWMP are to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water. The outcomes are prevention of soil erosion, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table. This enables multi-cropping and the introduction of diverse agro-based activities, which help to provide sustainable livelihoods to the people residing in the watershed area.

The salient features of IWMP are as below:

(i) Setting up of Dedicated Institutions with multi-disciplinary experts at State level - State Level Nodal Agency (SLNA), District level - Watershed Cell cum Data Centre (WCDC), Project level - Project Implementing Agency (PIA) and Village level - Watershed Committee (WC).

(ii) Cluster Approach in selection and preparation of projects: Average size of project - about 5,000 ha.

(iii) Enhanced Cost Norms from Rs. 6000 per ha. to Rs.12,000/ha. in plains; Rs.15,000/ ha in difficult/hilly areas.

(iv) Uniform Funding pattern of 90:10 between Centre & States.

(v) Release of central assistance in three instalments (20 per cent, 50 per cent & 30 per cent) instead of five instalments.

(vi) Flexibility in the project period i.e. 4 to 7 years

(vii) Scientific planning of the projects by using IT, remote sensing techniques, GIS facilities for planning and monitoring & evaluation (viii) Earmarking of project funds for DPR preparation (1 per cent), Entry point activities (4 per cent), Capacity building (5 per cent), Monitoring (1 per cent) and Evaluation (1 per cent).

(ix) Introduction of new livelihood component with earmarking of project fund under Watershed Projects i.e. 9 per cent of project fund for livelihoods for asset less people and 10 per cent for production system & micro-enterprises

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● National Land Records Modernization Programme (NLRMP) meant to usher in a system of updated land records, automated and automatic mutation, integration between textual and spatial records, inter-connectivity between revenue and registration, to replace the present deeds registration and presumptive title system with that of conclusive titling with title guarantee.

(x) Delegation of power of sanction of projects to States.

National Land Record Modernization Programme: The Land Reforms (LR) Division was implementing two Centrally Sponsored Schemes viz.: Computerisation of Land Records (CLR) and Strengthening of Revenue Administration and Updating of Land Records (SRA&ULR). Later on 21st August, 2008, the Cabinet had approved merger of these schemes into a modified Scheme named National Land Records Modernization Programme (NLRMP). The main aims of NLRMP are to usher in a system of updated land records, automated and automatic mutation, integration between textual and spatial records, inter-connectivity between revenue and registration, to replace the present deeds registration and presumptive title system with that of conclusive titling with title guarantee.

The NLRMP has 3 major components - (a) Computerization of land record (b) Survey/re-survey (c) Computerization of Registration. The District has been taken as the unit of implementation, where all programme activities are to converge. It is hoped that all districts in the country would be covered by the end of the 12th Plan period except where cadastral surveys are being done for the first time.

Types of Wastelands:

The real trouble though is the lack of a consolidated and well-settled land records bank. Community lands, often classified as wastelands on revenue records, and therefore, doesn't represent a true picture. Only 9 of the 35 states and union territories are working on an integrated database at the moment. Having the database would be just the beginning, sorting out disputes and reviewing ownership is the real battle ahead.

(a) Cultivable Wasteland: Surface water logged, laterite and saline lands; (b) Uncultivable Wasteland: Land Rocky lands, snow capped mountains.

▶ There are over 87 million hectares of agricultural land prone to degradation by severe erosion.

National Wasteland Atlas 2010, prepared by Indian Space Research Organisation (ISRO) in coordination with the Land Resources Department was released. Wasteland mapping has the potential to change the food security scenario in the country. In the atlas, wherein data is based on 2005-06 situation, an estimated 47.24 M ha land have delineated as wasteland which is 14.91 per cent of the country's total geographical area.

The 11th Five-Year Plan document said, "as per the 25-year perspective plan of the Planning Commission (1997), 88.5 MH was to be devel-

oped under watershed programme by the end of 13th Plan. Of the above, 22.2 MH has already been developed during 9th and 10th Plan through a watershed approach. The major thrust in the 11th Plan must be laid on developing untreated area in Desert Development Plan (DDP) and Drought Prone Areas Programme (DPAP) blocks and watershed development projects of the ministry of agriculture. In addition, special attention is to be devoted to developing villages where groundwater is overexploited."

The agriculture department of Assam has identified farmers in each of the nine districts who would cultivate jatropha – called 'bhot era' in Assamese – on about 137.4 hectares of land. The department has roped in the Medicinal and Aromatic Plants R&D Centre of the North-eastern Development Finance Corporation (NED-Fi) to provide training to the farmers.

Nonetheless, grasslands are often mistaken for wastelands. It is wrongly perceived that the tangible (or direct) benefits society receives from grasslands are few as compared to what it receives from croplands or forestlands and hence, grasslands are given lesser importance and attention than croplands and forest lands.

A direct benefit from grasslands as perceived by society is providing fodder for cattle. But other intangible benefits like an increase in ground water level, prevention of soil erosion, and harbouring a variety of birds, and insects are not easily perceived. In many cases, grasslands are converted either into agricultural lands by ploughing and treating the land with chemical fertilisers, or into forest lands by planting fast-growing exotic species.

National Atlas Report 2012

The country's wasteland declined more than 5 lakh hectare during 2005-2008, a national wasteland atlas has noted. The atlas prepared by the National Remote Sensing Centre under the Indian Space Research Organisation has stated that wasteland during 2005-08 declined by 3.2 million hectare while increase in wasteland was to the tune of 2.7 million hectare.

The most of the decline in wasteland had been due to use of land for industrial purpose, creation of plantation cover and land being used for agricultural purpose, the atlas prepared for the department of land resources under ministry of rural development has noted.

The atlas also indicate more than 13,769 hectare of wasteland has been used for industrial purpose with states such as Karnataka (2965 h), Gujarat (2319 h), Rajasthan (1638 h), Tamil Nadu (1537 h) and Andhra Pradesh (1087 h) have been leaders in using wasteland for setting up industries.

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● The new NDA government is preparing a cabinet note to utilise wastelands for setting up industries through innovative business approach. There are huge chunks of wasteland available that can be utilised for setting up some edible oil or non-edible oil industries.

been taken up under plantation with Karnataka, Kerala and Andhra Pradesh have been leaders in creating 'green cover'.

The atlas also reveals that 1.3 million hectare of wasteland have been used for agricultural activities with states such as Rajasthan (0.5 mh), Gujarat (0.2 mh), Bihar (0.1 mh) and Jharkhand (0.1 mh) are the leading states.

The atlas say that the area under the wastelands have declined states such as Rajasthan, Mizoram, Manipur, Gujarat, Bihar, Karnataka, Andhra Pradesh and Uttar Pradesh. However during the 2005-8, a slight increase in wastelands areas were recorded in the states such as Jammu & Kashmir, Meghalaya, Nagaland, Uttarkhand.

During the last exercise of mapping wastelands using multi-season satellite data of 2005-06, land resources department had finally adopted a classification system with 23 categories of wastelands.

Potential: Wastelands in Karnataka can generate at least 50,000 MW of wind energy with turbines fitted at a height of 80 metres, according to a study by the Centre for Study of Science, Technology and Policy (CSTEP). The need of the hour is to adopt forward-looking policies. The report is more authentic as Geographical Information System (GIS) has been used to map out wastelands as well as to identify areas rich in wind potential. Scrub forest lands are another area, where we can tap wind energy efficiently.

The new NDA government is preparing a cabinet note to utilise wastelands for setting up industries through innovative business approach. There are huge chunks of wasteland available that can be utilised for setting up some edible oil or non-edible oil industries. The new government has set its eye on a recast of the country's land-use policy to make it more scientific and minimise displacement, much along the lines of the Gujarat model that enabled rapid industrialisation, by offering wasteland for development.

The wasteland data of India was last updated in 2011. The idea is to verify the updated wasteland atlas with states, which will prepare a comprehensive survey and documentation of the area, its use, titles and all related information to determine its potential. This information about the wasteland areas in each state will be made available to investors looking for greenfield expansion. Of the national land area of about 3,166 lakh hectares, 467 lakh hectares, or 15 per cent, is wasteland, including uncultivable land.

According to the Department of Land Resources under the Ministry of Rural Development, Government of India, around 55 million and

28 million hectares of wasteland is available in the states of Rajasthan and Gujarat respectively. Both locations offer ideal conditions for Concentrating Solar Power (CSP). The government has recently announced a 4 GW solar park at Sambhar salt lake which will be developed by the state owned Hindustan Salts Limited. This gives an example of how barren land can be used to develop multi-GW solar parks.

The Rajasthan-based Centre for Jatropha Promotion and Biodiesel has been working towards scientific commercialisation of non-food biodiesel trees/crops like jatropha for years. It has already identified 200 districts in 19 states to grow the "miracle plant" on the basis of availability of wasteland, rural poverty ratio, below poverty line census and agro-climatic conditions suitable for jatropha cultivation.

Waste Water Management

The Prime Minister, Narendra Modi, has outlined a vision for solid waste management and waste water management in 500 urban centres across India, through the PPP model. This would enable cleanliness in towns and cities, while facilitating ample water supply for agriculture to the nearby rural hinterland.

The draft National Water Policy 2012, adopted by the National Water Resources Council on 28th December, 2012, has recognized the importance of waste water management. The Policy, inter-alia, recommends that 'recycle and reuse of water, including return flows should be the general norm' and that 'recycle and reuse of water, after treatment to specified standards, should also be incentivized through a properly planned tariff system'. Ministry of Urban Development has also formulated the Service Level Benchmarks which recommend 100 per cent treatment of waste water.

Government of India is participating in the global consultation process launched by the United Nations Human Settlements Programme (UN-HABITAT) on Wastewater Management and Water Quality to build consensus around key water challenges related to the post-2015 Development Agenda.

▶ Government has made a number of steps to for waste water management.

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● The Cabinet Committee on Economic Affairs has approved the launching of a new Integrated Processing Development Scheme (IPDS) with a total cost of Rs. 500 crore during the 12th Five Year Plan and to establish four to six brown field projects and three to five green field projects addressing the environmental issues faced by Textile Processing Units.

(a) There is significant variation in the composition of the effluents discharged by the industrial units; (b) The problem is compounded because many of the users do not give the primary treatment that is required before it is discharged into the common discharge line; (c) This pre-treatment is technically necessary; (d) Improper planning at the design stage; (e) No adequate training and it is a long drawn process; and (f) For SSIs, it is very costly.

► Some of the industries that constitute the sources of the most toxic effluents, such as sugar industries, distillery units, etc, bypass waste water management norms using their political lobbies.

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The eligible projects under the scheme would cover the following:

(i) Common Effluent Treatment Plant (CETP); (ii) Captive power generation on technology preferably renewable / green technology; (iii) Infrastructure such as storm water management, necessary roads and pipelines for water & wastewater and (iv) Facility for testing and R&D centres.

The Scheme will facilitate the textiles industry become globally competitive using environmentally friendly processing standards and technology and create new processing parks. This scheme will support the upgradation of existing processing clusters/centres specifically in the area of water and waste water management and also encourage research and development work in the textiles processing sector.

Coastal Area Ecosystem

Coastlines are supporting fragile ecosystems - mangroves, coral reefs, sea-grass and seaweeds. The shore is the place where sea and land meet. Geographers, geologists and biologists unanimously acknowledge the unique properties of coastal zones as the contact zone between the lithosphere and the hydrosphere. This interface is represented on geographic maps as a thin coastline. This line, also known as the shoreline, is a good example of the statistic approach to shore study. Actually, the interface is a dynamic system. The size, boundaries and shape of this system constantly change under the influence of different factors - both natural and anthropogenic. In order to take into account

coastal dynamics it is more appropriate to use the term coastal area, or zone rather than "coastline". Within the coastal zone some areas are characterized by intensive interaction between water and land (beaches, marshes, mangroves, wetlands, coral reefs), while in other ones the interaction is not so pronounced (rocky shores, glacier edges) It is extremely difficult to define precisely the area within which this interaction takes place. The situation with estuaries is even more complicated. They influence the coastal area so profoundly that in dealing with a number of practical and scientific problems one needs to consider the whole catchment basin of the river as a coastal area. The presence of a gradient of transition that is a smooth transfer from sea to land and vice versa, significantly complicates the delimitation of the coastal zone - an operation that is essential for planning, zoning, mapping and other management activities. It should be mentioned, that generally speaking, delimitation is an activity peculiar to human beings who pursue practical aims, but not at all to Nature. Any border depicted on a map is always conditional and relative. So delimitation depends to a considerable degree on specific goals and particular cases.

The natural ecosystem forms the "body" of the coastal zone, which represents an object of planning. The ecosystem is a biotic community (biocenosis) that interacts with its abiotic environment (biotope) in a sustainable manner over a long time-span. The biotic community and the biotope mutually influence each other through the continuous exchange of energy, information and materials. Basic properties of ecosystems are their ability to produce biomass and to be self-sustaining.

Shore and coastal biotopes are extremely diverse. Nevertheless, to a first approximation, they can be divided into eleven basic types. These types can be sub-divided into either primary or secondary coasts. Primary coasts are coasts that have not undergone significant change under the influence of abiotic or biotic factors since their formation. Their properties are determined by erosion and sedimentation (accumulation of sediments coming from land) and by volcanic and tectonic activity. Secondary coasts are those that have been formed under the influence of hydrodynamic processes (abrasion, accumulation of sea-transported sediments) and the vital activity of marine organisms.

Coral reefs and mangrove swamps are well-known examples of biogenic coasts. These ecosystems are not typical of the shores of Russia, but some biogenic reefs formed by bivalve molluscs and sponges occur near the Kurile Islands.

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Some natural biotopes have been transformed by, often imprudent, human economic activities to such a degree that they cannot be classified as any of the types mentioned above. They are called anthropogenic shores, that is, shores transformed by human activity. Based on these classifications a manager can obtain important background information concerning the degree of appropriateness of various shores for various purposes. For example: secluded lagoons, fiords and straits between islands within archipelagos may be used for fish-farming; flat sand shores are ideal places for public beaches; building port facilities on skerries (small, rocky islands too small for habitation) is not advisable as navigation between numerous skerries along complicated fairways is risky and difficult.

The broad range of various coastal biotopes contributes to the formation of extremely diverse biotic communities within coastal zones. Different combinations of biotopes and biocenoses produce a virtually infinite diversity of coastal ecosystems. In the most general form, however, they may be classified as follows: (a) estuary; (b) river delta; (c) marsh; (d) wetland; (e) coral reef; (f) rocky littoral; (g) glacial; (h) muddy beach; (i) sand-dune; (j) mangrove swamps; (k) coastal forest. In addition to shore morphology and bottom relief, the major contributing factor to the formation of a coastal ecosystem is the bottom type. Bottom types are usually classified as belonging to one of two basic groups – hard (rocky, stony) and soft (muddy, sandy) The main characteristic of a hard bottom is its ability to serve as a firm substrate to which various organisms (seaweed and animals) can attach themselves. So, a kind of “underwater jungle” with a high degree of biodiversity can develop. Soft bottomed coasts are not so convenient for the development of biotic communities. Usually they are inhabited by organisms which bury themselves in the ground (“infauna”) The essential difference between a muddy and a sandy bottom is that the former is formed by silting (that is, by constant hydrodynamic mass transfer), while the latter consists of smaller fractions and testifies to stable sedimentation in zones with calm hydrodynamic conditions.

The biotic communities of the coastal zone are characterized by maximum biological productivity in comparison with other ecosystems. On average, potential biological productivity (protein per unit area) is 20 times higher along the continental shelf than on land. The coastal zone is an area of maximum concentration and diversity of species; more than 80 per cent of marine biomass is located within the coastal zone. The coastal zone houses a unique and

significant genetic pool. Anthropogenic factors often play a decisive, limiting role in sea coasts. Intensification of anthropogenic pressure often has disastrous effects, that is, leads to irreversible changes and makes it impossible for human beings to survive in the resulting disturbed environment.

The sustainability of the coastal zone depends on the diversity and structure of its biotic communities. Coastal vegetation (“macrophytes”) and colonies of benthic invertebrates (shellfish, barnacles, bryozoa, sponges, polychaeta, coral polyps) contribute to coastline stabilization. Analysis of shore washout problems clearly shows the important role of biotic communities. Sustainability implies not only preservation of structure, but also maintenance of a certain quality of the environment. Coastal areas (contact zones of sea and land) serve as a marginal filter – one of the basic ecological filters of Earth’s biosphere.

Anthropogenic factors that negatively affect the normal functioning of coastal ecosystems or even make this functioning impossible may be characterized as anthropogenic disturbances. Anthropogenic disturbances may be divided into two categories: “technogenic”, those resulting directly from the use of machinery and “technoplagenetic”, insidious disturbances whose mechanism of influence on natural processes is obscure and difficult to understand. The latter includes the introduction and acclimatization of fish species and fisheries.

India having large coast line and unique ecosystem on its coastal area, a number of steps have been taken to conserve them and avoid hazardous activities. Coastal Area Ecosystem (CAE), particularly a sensitive eco-zone is an “interface zone” where land meets the sea. It is therefore, dynamic and non-static in its geophysical and chemical parameters. It has the highest primary productivity on the planet. Being the tail-end ecosystem, it receives all the negative externalities of the terrestrial pollution. The importance of the coast can be gauged more precisely if we look at its place in the overall classification of the physical divisions and relief features of the Earth. The principal divisions of the earth are air, water and land. Technically, we can recall them as atmosphere, hydrosphere, and lithosphere. The major relief features of the earth comprise continental masses and the ocean basins.

Coastal features are varied and display a sharp contrast between the western and the eastern segments. Wide variations in coastal features are conditioned by geological factors such as the rock type, and their composition, structure/tectonics and the dominant process of degradation or aggradations, besides wave and wind

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action, and vegetation.

The Minister of State for Environment & Forests has announced Coastal Regulation Zone (CRZ) Notification, 2011 and Island Protection Zone (IPZ) Notification, 2011. This replaces the CRZ Notification, 1991. In addition, for the very first time an Island Protection Zone Notification, 2011 is being notified and published covering Andaman and Nicobar Islands and Lakshadweep.

Both these new Notifications reconcile three objectives: (i) protection of livelihoods of traditional fisherfolk communities; (ii) preservation of coastal ecology; and (iii) promotion of economic activity that have necessarily to be located in coastal regions. Apart from codifying the 25 amendments that were made to CRZ Notification, 1991 between 1991-2009, the CRZ Notification, 2011 has several new features, like:

1. It has special provisions for Goa, Kerala, Greater Mumbai and critically vulnerable coastal areas (CVCAs) like Sunderban Mangrove Area, Chilka and Bhitarkanika (Orissa), Gulf of Khambat and Gulf of Kutchh (Gujarat), Malwan (Maharashtra), Karwar and Kundapur (Karnataka), Vembanad (Kerala), Coringa, East Godavari and Krishna Delta (Andhra Pradesh), Gulf of Mannar (Tamil Nadu).

2. Clear procedures for obtaining CRZ approval with time-lines have been stipulated along with post-clearance monitoring and enforcement mechanisms.

3. Water area upto 12 nautical miles in the sea and the entire water area of a tidal water body such as creek, river, estuary, etc would now be included in the CRZ areas, without imposing any restrictions of fishing activities.

4. The concept of a Coastal Zone Management Plan (CZMP), to be prepared with the fullest involvement and participation of local communities, has been introduced.

5. The concept of a hazard line to be demarcated over the next five years has been introduced to protect life and property of local communities and infrastructure along coastal areas.

6. Measures have been put in place to combat pollution in coastal areas/coastal waters.

7. The shorelines would be mapped through time-series satellite images with no foreshore development being permissible in high-eroding areas.

8. The "no development zone" is being reduced from 200 metres from the high-tide line to 100 metres only to meet increased demands of housing of fishing and other traditional coastal communities.

Therefore, recommendations of an expert committee headed by scientist MS Swaminathan

have been incorporated in the new norms. The committee has recommended that the government should enact a law along the lines of the Forest Rights Act to protect the traditional rights and interest of coastal communities. Such a law is currently in the draft form and has been put up for public comments.

Initiatives for sustainability

▶ On the landward side, there is need for a setback area of at-least 500 meters from the high tide line that should be deemed as "non-development green zone" which should be envisaged as a playground for the sea.

▶ The no development green zone can be suitably transformed into a bio-shield using vegetation or tree cover that is appropriate for the specific site mangrove, beach grass, casuarines.

▶ The sea gives and takes in the natural course of her being. It is in human interest that we learn to respect her vicissitudinous nature. In this light the rationale of **Coastal Regulation Zone (CRZ)**, should be seen and should not be considered as a restriction on development activity.

▶ There should be a **Littoral Regulation Zone (LRZ)**, an area of the sea about five kilometers from the shoreline, for exclusive access rights of fisher folk who use conventional fishing boats and within this a two kilometer belt from the shoreline should be exclusively reserved for those using non-mechanized fishing means.

▶ In this LRZ the sedentary marine resources such as sea grass, sea weeds, corals and marine fauna should be nurtured preferably with community participation.

▶ The possibility of setting up Marine Protected Areas (MPAs) and Marine Extractive Reserves (MERs), where controlled harvesting of the resources is undertaken under community supervision may be envisaged.

Management of Coastal Zones

The MoEF had constituted an expert committee under the chairmanship of Prof. M.S. Swaminathan in July, 2004, to review and make recommendations with regard to implementation and amendments if necessary, of Coastal Regulation Zone Notification, 1991. The Expert Committee submitted its report alongwith recommendations, which were accepted by the MoEF in April, 2005. The major recommendations include:

1. Implementation of Integrated Coastal Zone Management Plan rather than uniform regulatory approach.

2. Development along the coastal stretches based on the vulnerability of the coast, taking into account the natural and manmade hazards.

3. Inclusion of the ocean zone for regulation.

4. Setting up of an Institute for Coastal Zone

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● The alarming depletion in the population of Sea Cucumber, also known as earthworms of sea, due to pollution, illegal fishing and over-exploitation can endanger marine eco-system in Bay of Bengal and Indian Ocean. Sea Cucumber, or Holothurians, are marine animals with a leathery skin and an elongated body. They are found on the sea floor.

● The sea cucumbers play an important ecological role in nutrient cycling, bio-turbation process in marine benthic communities and contribute to the oxygenation of the upper sediment levels.

Management to address the policy and legal issues.

5. Abatement of the pollution of coastal areas and marine waters in a time-bound manner.

6. Identification and mapping of the coastal eco-sensitive areas such as mangroves, corals, and turtle breeding areas.

7. Development of coastal bio-shield.

The MoEF has initiated steps for implementing the above recommendations which include:

1. Preparation of a national action plan for control of pollution of coastal waters from land based activities.

2. Pilot scale studies for demarcation of vulnerability line along identified coastal stretches through scientific organizations namely, Survey of India, Dehradun, Space Application Centre, Ahmedabad and Centre for Earth Science Studies, Thiruvananthapuram.

3. Seeking technical and financial assistance from multilateral agencies for implementing the recommendations pertaining to mapping of ecologically sensitive areas along the coastline, control of pollution in the coastal waters from land based activities and capacity building and institutional development.

Threats:

The alarming depletion in the population of Sea Cucumber, also known as earthworms of sea, due to pollution, illegal fishing and over-exploitation can endanger marine eco-system in Bay of Bengal and Indian Ocean. Sea Cucumber, or Holothurians, are marine animals with a leathery skin and an elongated body. They are found on the sea floor. Around 1,450 species of Sea Cucumbers found in the marine system worldwide, 173 are found in India. Out of them, 16 species have been identified as economically important. The creatures feed on algae, little aquatic animals, or waste materials. They break down these consumed particles into even smaller pieces, which act as food for bacteria and other marine creature and then recycle them back into the ocean ecosystem. The sea cucumbers play an important ecological role in nutrient cycling, bio-turbation process in marine benthic communities and contribute to the oxygenation of the upper sediment levels. The sea cucumbers play an important ecological role in nutrient cycling, bio-turbation process in marine benthic communities and contribute to the oxygenation of the upper sediment levels. The extinction of these marine creatures will reduce overall productivity of coral reefs. These marine animals have huge economic significance pharmaceutically and as a gourmet food item.

An unprecedented boom in hydropower dam construction underway primarily in developing countries, such as India, could reduce the

number of the last remaining large free-flowing rivers by about 20 per cent and pose a serious threat to freshwater biodiversity.

Survey: Claimed to be the first of its kind initiative in the country, a marine biodiversity map of Kerala's coastline is being prepared by the State Biodiversity Board to create a databank of marine ecosystems and traditional knowledge of the fisher folk community. The procedure to map another 50 km stretch between Thiruvananthapuram and Kollam has been already started.

Coral reefs

The Indian reef area is estimated to be 2383.87 sq. km. Coral reefs are the skeletons of stony coral polyps cemented together. Coral reefs form the most dynamic ecosystem, providing shelter and nourishment to marine flora and fauna. They are the protectors of the coastlines and the coastal populations mostly depend on the coral reef ecosystems wherever they are present. The term 'coral' has been used to describe a variety of invertebrate animals of the Phylum Cnidaria including hard and soft corals. However, 'coral' is most often used as the common name for hard corals of the Order Scleractinia.

Coral reefs are shallow water, tropical marine ecosystems which are characterized by a remarkably high biomass production and a rich faunal and floral diversity perhaps unequalled by any other habitat. Corals require certain conditions to occur and can flourish only in relatively shallow waters, exposed to direct sunlight, with optimum temperature of 23-25°C and free from suspended sediments. Zoological Survey of India has been undertaking studies on the serious threat to coral colonies only of Palk Bay continuously for more than a decade. Study initiated in 2010-11, monitoring assessments for which were carried out in 2013 confirm that there is reduction in the live coral cover and increase in rubbles, macro-algae and calcareous algae which indicate continuing degradation of these reefs.

The Government seeks to protect, sustain and augment mangroves and coral reef in the country by both regulatory and promotional measures. Under the regulatory measures, the Coastal Regulation Zone (CRZ) Notification (2011) and the Island Protection Zone (IPZ) Notification 2011 regulates the development activities along the Sea coast and tidal influenced water bodies. The mangroves and coral reefs areas are categorized as ecological sensitive areas (CRZ-I) where no new constructions are permitted except projects relating to Department of Atomic Energy; pipelines, conveying systems including transmission lines; instal-

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● As per the recommendation of the National Committee on Mangroves and Coral Reefs, the four major coral reefs areas identified for intensive conservation and management are: i) Gulf of Mannar, ii) Gulf of Kutchch, iii) Lakshadweep and iv) Andaman and Nicobar Islands.

lation of weather radar for monitoring of cyclones movement and prediction by Indian Meteorological Department and construction of trans harbour sea link and without affecting the tidal flow of water. To enforce and implement the CRZ and IPZ Notifications, the Ministry of Environment and Forests has constituted the National and State/UT level Coastal Zone Management Authorities. Coral reefs are known as the "rainforests of the sea." Even though coral reefs occupy only 0.1 per cent of the sea, one-third of all known marine species live on them. About 1km of seagrasses absorbs approximately the same carbon-dioxide (CO) as 50km of tropical forests.

As per the recommendation of the National Committee on Mangroves and Coral Reefs, the four major coral reefs areas identified for intensive conservation and management are: i) Gulf of Mannar, ii) Gulf of Kutchch, iii) Lakshadweep and iv) Andaman and Nicobar Islands. The Ministry provides financial assistance to the State Forest Departments of all the four identified coral reefs areas in the country for activities like monitoring, surveillance, education and awareness. Besides, the Ministry also supports R&D activities with emphasis on targeted research on coral biodiversity, its management including various aspects of pollution in these areas.

► For encouraging targeted research on both hard and soft corals in the country, the Ministry has established a National Coral Reef Research Centre at Port Blair. The Ministry has a National Committee and a Research Sub-Committee on Mangroves and Coral Reefs. In order to further focus attention on all aspects/issues related to corals in India, a Working Group of expert scientists on Strategy for Conservation and Management of Coral Reefs has also been constituted.

► Detailed guidelines for the preparation of comprehensive Management Action Plans for identified coral reefs have also been formulated by way of augmentation of existing guidelines.

► Thirty two research projects have been sanctioned and implemented to supplement the management action plans on mangroves & coral reefs.

► During the year, over 100 researchers and officers of the Coastal States have been trained in the taxonomy of marine flora & fauna, snorkeling, scuba diving and coral bio-monitoring methodologies.

Overall sceanrio: The total coral reef area in India is distributed between four major regions: (1) Gulf of Mannar, (2) Andaman and Nicobar Islands, (3) Lakshadweep Islands and (4) Gulf of Kutch.

Lakshadweep is an archipelago of 12 atolls surrounded by deep water, on the northern end of the Laccadive-Chagos ridge. In the Gulf of Kutch, there are shallow patchy reefs growing on sandstone platforms that surround 34 islands. The reefs experience high salinity, frequent emersion, high temperature fluctuations and heavy sedimentation.

In the Gulf of Mannar, coral reefs are found mainly around 21 islands between Rameshwaram and Tuticorin. Two former islands are now submerged, probably due to coral mining and erosion.

The Andaman and Nicobar Islands consist of 530 islands with extensive fringing reefs which are in good condition. Corals are also found near Gaveshani Bank about 100 km offshore from Mangalore, and several areas along the eastern and western coast of mainland India, e.g. the Malvan Coral Reef Sanctuary near Mumbai.

There are about 321 islands in the Andaman and Nicobar group, with a total land area of 8,293 sq. km. Nicobars are affected by cyclones.

Reef type: Fringing type. Corals found: Acropora, Porites, Pocillopora, Montipora, Heliopora, Tubipora and Favia.

The Lakshadweep group of 12 atolls, 3 reefs, 5 submerged banks and 36 islands form the Lakshadweep archipelago.

Corals found: Acropora species, Porites species, Diploastrea, Heliopora, Goniastrea retiformis and Lobophyllia corymbosa. Coral mining continues to be the major threat to coral reefs.

Gulf of Kutch is the northernmost reefs of India. There are about 42 islands on the southern flank of the Gulf. Branching corals like Acropora, Pocillopora, Stylophora and Seritopora are totally absent. The areas of the Gulf of Kutch are heavily silted with deposits brought in by the tides and winds.

Coral reserves in India:

1. Gulf of Mannar biosphere reserve
2. Gulf of Kutch Marine National Park
3. Mahatma Gandhi Marine National Park, Andaman and Nicobar
4. Lakshadweep
5. Rani Jhansi Marine National Park in Ritchie's Archipelago, South Andaman Islands

Currently, there are many global initiatives such as Global Coral Reef Monitoring Network (GCRMN), Global Coral Reef Alliance (GCRA), and International Coral Reef Initiative (ICRI) playing an important role in monitoring the reef zones and raising awareness in the public.

Potential Fishing Zones

Potential Fishing Zone (PFZ) forecasts are operationally disseminated to all the maritime States including the two Union Territories since 1993. An integrated approach for Potential

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Fishing Zone based on Chlorophyll & Sea Surface Temperature have been developed, validated and transferred to Indian National Centre for Coastal and Ocean Information Services (INCOIS) for operational use. Utilizing the remotely sensed data available from various satellites, ESSO-Indian National Centre for Ocean Information Services (INCOIS), provides these advisories to the fishermen on a daily basis with specific references to 586 fish landing centers along the Indian coast. This operational service is rendered by ESSO-INCOIS throughout the year except during the periods of Marine Fishing ban imposed by Government of India and adverse sea state conditions such as Cyclones, High Waves, Tsunamis, etc.

The data on Sea Surface Temperature (SST) and Chlorophyll retrieved regularly from thermal-infrared channels of NOAA-AVHRR (USA) and Eumetsat (ESA)'s Met-Op series satellites along with optical bands of Oceansat-II (India) and MODIS Aqua (USA) satellites are used for the identification of Potential Fishing Zones (PFZ) along the Indian coastline. Divided over 14 sectors - viz. Gujarat, Maharashtra, Goa, Karnataka, Kerala, South Tamil Nadu, North Tamil Nadu, South Andhra Pradesh, North Andhra Pradesh, Orissa, West Bengal, Lakshadweep Islands, Andaman Islands and Nicobar Islands - the PFZ advisories are generated for each sector in the form of PFZ Maps and text. The PFZ Maps contains information on the major landing centers, bathymetry and the location of PFZ (latitude and longitude information). Due to the dynamic nature of the ocean the fishing zones identified on the maps could shift from the marked location. Hence, to guide the fishermen on the probable shifts in PFZ, the wind speed and direction information is also incorporated on the PFZ maps. This information helps the fishermen in locating the PFZ identified in the maps even if they reach the location after a day.

Hazardous Waste Management

Hazardous waste / Chemical waste can be defined as a "solid waste, or combination of solid wastes, which because of its quantity, concentration, or chemical, or infectious characteristics may cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. The MoEF is the nodal agency for the management and control of hazardous substances like

chemicals, waste and micro-organisms. India generates roughly six million tonnes of hazardous waste per year, of which about 50 per cent goes in for re-cycling. The SPCBs/PCCs can take action as per the provisions of the Environment (Protection) Act, 1986 in case of any violation. As per the information furnished by the Central Pollution Control Board (CPCB), the amount of hazardous waste generated in the country is about 7.90 million tonnes per annum. Maharashtra (22.84 per cent), Gujarat (22.68 per cent) and Andhra Pradesh (13.75 per cent) are the top three hazardous waste generating States in the country followed by Rajasthan, Tamil Nadu, Madhya Pradesh and Chhattisgarh. These seven states together are generating about 82 per cent of the country's total hazardous wastes. As per the information of Central Pollution Control Board (CPCB), there are about 41,523 industries in the country generating about 7.90 million tonnes of hazardous waste every year, of which landfillable waste is 3.32 million tonnes (42.02 per cent), incinerable waste is 0.60 million tonnes (7.60 per cent) and recyclable hazardous waste is 3.98 million tonnes (50.38 per cent).

The State Economic Survey for 2013-14 has said that there are 6,656 hazardous waste generating industries in Maharashtra as on March 31, 2013. The state has made it mandatory to install global positioning systems (GPS) in all containers carrying hazardous waste to ensure its proper disposal. So far, 102 hazardous waste transporters have installed these systems.

In India, there are 36,000 hazardous waste generating industries, which generate 62,33,000 tonnes of hazardous wastes per annum. Fifty 50 per cent of this waste generated is recyclable, about 7 per cent is incinerable and 43.78 per cent is land disposable. Quite descriptive of the immense amount of dangerous waste being discharged by industries and the urgent and desperate need to manage it.

However, India falls terribly short on the management part with huge deficits between the amount of waste being generated and the present capacity of waste management. While 27,28,326 MTA of land-disposable HW is generated annually, our disposal capacity stands at just 15,00,568 MTA, resulting in a deficit of 12,27,758 MTA. At present, 38 TSDFs include 17 Integrated TSDF, 13 Exclusive Common Secure Landfills and 8 Exclusive Common Incinerators are available in 10, 9 and 4 States/UT respectively. These States /UT contribute about 97.8 per cent of total landfillable and 88.19 per cent of total incinerable hazardous wastes generation in the country respectively. During 2013-14, financial assistance has been provided for setting up of one TSDF for hazardous

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● During 2013-14, financial assistance has been provided for setting up of one TSDF for hazardous wastes in the country. There are 17 integrated Treatment, Storage and Disposal Facilities (TSDFs) (4 Gujarat, 3 in Maharashtra, 2 each in UP and Andhra Pradesh) having both incineration and secured landfill facilities, 13 TSDFs having only secured landfill facilities (SLFs) and 08 facilities having only common incineration facilities which are presently operational in the country.

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As per a study of The Energy and Resources Institute (TERI) titled 'Master plan study for collection, recycling and safe disposal of end-of-life mercury bearing lamps and associated electronics' supported by Electric Lamp and Component Manufacturers' Association of India (ELCOMA), the mercury released into the environment, from fluorescent lamp sector has been estimated at around 8.8 tonnes considering entire lot of Fluorescent Lamps (FLs); Compact Fluorescent Lamps (CFLs) and Fluorescent Tube lights (FTLs) and Metal Halides etc. in the year 2009.

The Ministry of Environment and Forests had constituted a Task Force to evolve a policy on "Environmentally Sound Management of mercury in Fluorescent Lamps". A Technical Committee, constituted by this Task Force, had prepared "Guidelines for Environmentally Sound Mercury Management in Fluorescent Lamps Sector". These guidelines prescribe the best practices at various levels, such as at manufacturer's level and include aspects relating to mercury consumption, process technology, raw mercury distillation, on-site storage, treatment, recycling, disposal of mercury bearing wastes and mercury spill management. The best practices at consumer's level include handling of used/broken lamps, consumer awareness pertaining to collection, transport, treatment and disposal of used fluorescent lamps.

The Ministry of Environment and Forests (MoEF) and Central Pollution Control Board (CPCB) have written to all the State Governments and Union Territories to encourage establishment of recycling units so that the fused CFLs and FTLs are properly collected and the mercury is recovered and recycled scientifically and safely.

Various Acts

The Ministry of Environment and Forests (MOEF) notified the draft Hazardous Waste Substances (Classification, Packaging and Labelling) Rules, 2011 on August 1, 2011.

The main provisions of draft **E-waste (Management and Handling) Rules 2010**, are:

1. The producer of electronic goods including household appliances, computers, toys and medical equipment shall be liable for collecting any e-waste generated while manufacturing and will have to channelize it for recycling. In

fact, the producers' responsibility will go beyond the boundaries of the manufacturing unit.

2. They will set up collection centres for e-waste generated from 'end of life' of their products in line with the principle of 'extended producer responsibility' and ensure that such e-waste is channelized to a registered refurbisher.

3. They shall also finance and organise a system to meet the costs involved in handling the e-waste.

4. The rules moot a unique serial number or individual identification code for product tracking in the e-waste management system. Dealers have to make provision for collecting used appliances. Besides registering themselves with the respective State Pollution Control Boards, they will have to submit details of the collected waste annually.

5. Even the consumers are expected to do their bit by ensuring that the electronic equipment not fit for use is deposited with the dealer or authorised collection centre.

6. Emphasising the reduction in use of hazardous substances (RoHS) in the manufacture of electrical and electronic equipment over a three-year period, the rules state that producers are expected to adhere to the prescribed minimum threshold limits to using such substances. Further, the import of used electrical and electronic equipment for charity shall not be allowed in the country, the rules state.

7. Further, the stakeholders shall be liable for any damage caused to the environment or human health including third parties due to improper handling and disposal of e-waste.

8. They shall inform the authorities of such damage and undertake to reinstate or restore the damage at their cost, failing which they shall be liable to pay the entire cost of remediation or restoration of the environment.

9. Even the consumers shall be liable to deposit the e-waste with an authorised dealer or collection centre, failing which they shall be liable to pay a fine as specified for violation of the provision.

Ministry of Environment and Forests has taken a number of steps to ensure environmentally sound management of e-waste in the country. These include:

1. The Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008, are in place for proper management and handling of hazardous wastes including e-waste.

2. The guidelines for Environmentally Sound Management of e-waste, published by CPCB, provide approach and methodology for environmentally sound management of e-waste.

3. Separate E-Waste (Management and Handling) Rules, 2011 have been notified on 12th

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● Separate E-Waste (Management and Handling) Rules, 2011 have been notified on 12th May, 2011. These Rules come in to effect from 1st May 2012. The concept of Extended Producer Responsibility (EPR) has been enshrined in these rules to make EPR a mandatory activity associated with the production of electronic and electrical equipments.

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May, 2011. These Rules came into effect from 1st May 2012. The concept of Extended Producer Responsibility (EPR) has been enshrined in these rules to make EPR a mandatory activity associated with the production of electronic and electrical equipments. The Extended Producer Responsibility (EPR) is an environment protection strategy that makes the producer responsible for the entire life cycle of the product, especially for take back, recycling and final disposal of the product.

4. E-waste recycling can be undertaken only in facilities authorized and registered with State Pollution Control Boards/Pollution Control Committees. Waste generated is required to be sent or sold to a registered or authorized recycler or re-processor having environmentally sound facilities.

5. The Ministry is implementing a Scheme to provide financial assistance for setting up of treatment, disposal and storage facility for hazardous and integrated recycling facilities for E-waste on public private partnership mode.

6. The monitoring of Dioxin - Furan in stationary source emission at Incinerators of Treatment Storage and Disposal Facilities (TSDFs), Incinerators of organic chemical manufacturing units and Bio-medical waste incinerators have been undertaken on request of Hazardous Waste Management Division, State Pollution Control Boards, Pollution Control Committees etc.

7. Bioremediation technique is often used in curbing the problem of oil sleek, hazardous waste site reclamation, radioactive sludge removal, boosting of STP function, lake conservation, Groundwater reclamation, odour suppression, etc. In these processes, specific microbial consortia are used for application and treating the impurities. In view of quantum gap in between Sewage generation and treatment facilities, CPCB formulated the concept of In-situ treatment of sewage in open drains. The microbial consortia designed by various agencies were examined and conducted pilot studies in Ramnagar-Domora Drain of Bharatpur (Rajasthan) and AB Road Drain, Indore (Madhya Pradesh). The study revealed that in the In-situ Bioremediation stretch pollution load in terms of BOD, COD and TSS was reduced up to 50 per cent. The technology is cheaper and doesn't involve any skilled manpower, heavy machineries, electricity and other recurring cost. Other such Bioremediation projects are on-going in Budha Nala, Ludhiana (Punjab) and Bakarganj Nala, Patna (Bihar) under NGRBA/NRCD programme of MoEF.

► The following rules have been notified under the Environment (Protection) Act, 1986: (a) Manufacture, storage and import of hazardous chemicals, 1989; (b) Hazardous Wastes

(Management and Handling) Rules, 1989; (c) Manufacture, use, import, export and storage of hazardous micro-organisms/genetically-engineered organisms or cells, 1989; and (d) Bio-medical waste rules, 1998.

New rules titled Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008 have been notified superseding the earlier regulation. Recycling of e-waste and the requirement of registration for e-waste recyclers have been included under these Rules. A national strategy on hazardous wastes is being prepared to facilitate implementation of an action plan for management of hazardous waste, and to fulfill obligations under the Basel Convention on trans-boundary movement of hazardous waste, including their minimization, environmentally sound management and active promotion of cleaner technologies.

The amount of hazardous waste generated in this country is quite small in comparison to that of the USA, where as much as 275 million tonnes of hazardous waste was generated annually. However, considering the fragile ecosystem that India has (The State of India's Environment, Part I, National Overview, The Citizens Fifth Report, Centre for Science & Environment, 1999), even this low quantum of hazardous wastes (around 4.4 million MTA) can cause considerable damage to natural resources if untreated before releases. India's fragile ecosystem could be seen from the following: (a) Air pollution in Indian cities is highest amongst the world; (b) Over seventy percent of the country's surface water sources are polluted and, in large stretches of major rivers, water is not even fit for bathing; and (c) India has among the lowest per capita availability of forests in the world, which is 0.11 ha as compared to 0.50 ha in Thailand and 0.8 ha in China.

► **Hazardous Wastes (Management, Handling and Trans-boundary Movement) Fourth Amendment Rules:** To regulate management of Hazardous Wastes generated within the country as well as to regulate export/import of such wastes, the Hazardous Wastes (Management and Handling) Rules, 1989 were notified under the Environment (Protection) Act, 1986. New Rules titled 'Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008' have been notified superseding the earlier regulation. Recycling of e-waste and the requirement of registration for recyclers of e-waste has been included under these Rules. A national strategy on hazardous wastes is being prepared to facilitate implementation of the hazardous waste management and different aspects of the National Environment Policy 2006, and to fulfil obligations under the Basel Convention on Trans-boundary move-

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● The MARPOL Convention was adopted on 2 November 1973 at IMO. The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention.

ment of hazardous wastes, including their minimization, environmentally sound management and active promotion of transfer and use of cleaner technologies.

▶ Batteries (Management and Handling) Amendment Rules, 2010. The amended Rules enjoins upon the bulk users to environmentally dispose off the used batteries. Bulk consumer, in this context, means a consumer such as the Departments of Central Government like Railways, Defence, Telecom, Posts and Telegraph, the Departments of State Government, the Undertakings, Boards and other agencies or companies who purchase hundred or more than hundred batteries.

Nearly fifty percent of the total industrial output in India is contributed by the SMEs. They also account for 60 to 65 percent of the total industrial pollution. According to a report released by the Central Pollution Control Board (CPCB), Gujarat generates almost 29 per cent of the 62 lakh metric tonnes of hazardous waste generated every year. It is followed by Maharashtra (25 per cent) and Andhra Pradesh (9 per cent).

▶ The ships loaded with hazardous chemicals are not allowed into India for dismantling purposes.

The SC verdict on hazardous waste:

The Supreme Court bench of Justice Altmas Kabir and J Chelameswar has directed the central government to ban import of all hazardous/toxic wastes identified and declared to be so under the BASEL Convention. India is a signatory to the BASEL Convention, 1989 that prohibits the import of certain hazardous substances on which there is a total ban. It also imposes certain obligations on the party states to take positive measures to minimise consequences of hazardous wastes for human health and environment. It has also signed the MARPOL Convention. Under the MARPOL Convention the signatory countries are under an obligation to accept the discharge of oil wastes from ships in order to prevent pollution of the seas. The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.

The MARPOL Convention was adopted on 2 November 1973 at IMO. The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and

a new Annex VI was added which entered into force on 19 May 2005. MARPOL has been updated by amendments through the years.

The court has made it clear that according to the apex court's October 13, 1997 and October 14, 2003 orders, ship-breaking operations could not be allowed to continue without strictly adhering to precautionary principles, Central Pollution Control Board guidelines and without taking proper safeguards. Besides that the bench also asked the government to amend the rules so as to bring them in harmony with Articles 21 (right to life), 47 (Duty of the State to raise the level of nutrition and the standard of living and to improve public health) and 48A (Protection and improvement of environment and safeguarding of forests and wild life) of the Constitution.

The apex court of India has directed the Centre to ban import of all toxic and hazardous waste into the country in an ongoing case being heard for the past 17 years.

The court also asked the government to make changes in the Hazardous Wastes (Management and Handling) Rules of 1989 so that the law complies with all the provisions of the Basel Convention, to which India is a signatory. The Convention prohibits import of hazardous substances and imposes certain obligations on the party countries to take positive measures to minimise the consequences of hazardous waste on human health and the environment. A number of applications have been filed to ban entry of decommissioned ships for dismantling in India-the latest being Exxon Valdez rechristened Oriental Nicety-currently anchored off the coast of Bhavnagar in Gujarat.

The Supreme Court bench of justice Altmas Kabir and J Chelameswar, in their order dated July 6, added that the hazardous waste rules need to take note of Article 21 (right to life), Article 47 (duty of the state to raise the level of nutrition and the standard of living and to improve public health) and Article 48A (protection and improvement of the environment and safeguarding of forests and wildlife) of the Indian Constitution.

It is to be noted that the petitioner had challenged the decision of the environment and forests ministry permitting import of toxic wastes under the cover of recycling. The petitioner organisation had pointed out that the 1992 Basel convention to which India is a signatory had specified several environmentally sound management systems for treating, import and export of hazardous waste substances across the globe. The PIL alleged that despite being a signatory, India was not taking adequate steps in the management of hazardous substances.

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● The Supreme Court bench of justice Altmas Kabir and J Chelameswar, in their order dated July 6, added that the hazardous waste rules need to take note of Article 21 (right to life), Article 47 (duty of the state to raise the level of nutrition and the standard of living and to improve public health) and Article 48A (protection and improvement of the environment and safeguarding of forests and wildlife) of the Indian Constitution.

● E-waste recycling can be undertaken only in facilities authorized and registered with State Pollution Control Boards/Pollution Control Committee (PCCs). Wastes generated are required to be sold to a registered or authorized recycler or re-processor having environmentally sound facilities.

E-waste

As per these Rules, 'e-waste' means waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded. The concept of Extended Producers Responsibility (EPR) has been enshrined in these rules. As per these Rules the producers are required to collect e-waste generated from the end of life of their products by setting up collections centres or take back systems either individually or collectively. E-waste recycling can be undertaken only in facilities authorized and registered with State Pollution Control Boards/ Pollution Control Committee (PCCs). Wastes generated are required to be sold to a registered or authorized recycler or re-processor having environmentally sound facilities. The rule has provision for setting up of Collection Centre individually or jointly; or by a registered society or a designated agency; or by an association to collect e-waste. Under the e-waste rules, 2011, in case of non compliance with any of the conditions of the authorization or with any provision of the Act or the rules, the SPCB/ PCC may cancel or suspend the authorization issued under these rules for such period as it considers necessary in the public interest. The SPCB or PCC may also give directions to the persons whose authorization has been suspended or cancelled for the safe storage of the e-waste and such persons shall comply with such directions.

As per the information received from CPCB, there are a total of 98 number of registered recyclers and dismantlers having recycling/ dismantling capacity of 29,30,57 MTA for environmentally sound management of e-waste under the E-Waste Rules, 2011. With 39 numbers, Karnataka has maximum number of registered recyclers/ dismantlers followed by Tamil Nadu (19), Maharashtra (15) and Uttar Pradesh (11). Others are distributed in the States of Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Madhya Pradesh, Rajasthan, and Uttarakhand. The Import and export of e-waste are regulated under Hazardous Waste (Management, Handling and Trans-boundary Movements) Rules, 2008. Under the Rules no permission for import of e-waste has been granted during last three years by the Ministry. However, permission for export of 10,575 MT of e-waste has been granted for export of e-waste to various countries viz. Belgium, Germany, Japan, Singapore Hong Kong, Sweden, UK and Switzerland.

By 2020, emissions from the ICT sector will make for 2.8 per cent of global emissions. The

ICT sector accounts for 34 per cent of it. The country's IT capital, Bangalore, is likely to produce 57,000 tonne of e-waste by end 2014. The same is expected to increase by nearly 500 per cent by 2020. As per the report, 'E-waste management in India - The Corporate Imperative', brought out by The Energy and Resources Institute (TERI), Business Council for Sustainable Development and Yes Bank, in India, approximately 2.7 million tonnes of e-waste is generated annually. The report said that lack of awareness figures among stakeholders on the mandatory compliance requirement of the rules and the negative effects of improper handling and disposal of e-waste are alarming. It also suggests introducing new business models to treat e-waste recycling as a profitable business opportunity, rather than a single stakeholders' obligation. Since the Rules came into force from May 2012, e-waste management infrastructure has slowly been on the rise in India.

The report has suggested for a shared responsibility model in which all three primary stakeholders - the producer, the generator (households and bulk consumers), and the local regulatory body (municipality) - share the e-waste management costs.

Impact and limitations:

1. The lack of serious commercial players in the e-waste business has resulted in polluted water bodies and soil, with toxins entering our food chain.
2. More than 80 per cent of e-waste is still handled through the informal sector employing low-paid workers unaware of the safety measures needed for the work. There's no major provisions for reusing and recycling. The main challenge is to bring informal sector into the mainstream of e-waste management, he said, adding that workshops like these should be organised in many states to create awareness about e-waste management rules.
3. A meagre 3.5 per cent of Indian population is environmentally literate. India, being a geographically complex country, the task of creating awareness about e-waste is an exigent task. This effort also assumes importance as it is expected that the country will generate about 1,50,000 tonne per year of e-waste by 2020.
4. Disposal of e-waste from such electronic devices, without processing it in an environmentally sound manner may affect the human health and environment including soil and ground water. E-waste contains a variety of toxic chemicals, metals and materials such as mercury, lead and brominated flame retardants, known to cause major health and environmental damage. Lab testing of soil and water samples from the Loni and Mandoli areas of Delhi reveals high contamination of both

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● The various studies have revealed extreme negligence on part of the State Pollution Control Boards (SPCBs) on most of the tasks assigned to them by the e-waste rules. Most SPCBs have failed to carry out inventories of waste, mandated under the e-waste rules. No action has also been initiated against any of the defaulting companies by the regulatory agency.

● The EU defines this new waste stream as 'Waste Electrical and Electronic Equipment' (WEEE). As per its directive, the main features of the WEEE include definition of 'EEE', its classification into 10 categories and its extent as per voltage rating of 1000 volts for alternating current and 1500 volts for direct current.

with heavy metals and other impurities. Shockingly, even the drinking water at both the locations contained high amount of toxic metals. At Loni, some water samples reveal mercury level as high as 20 times the prescribed limit, while at Mandoli zinc level in a sample was 174 times higher.

5. According to the ASSOCHAM study on 'Earth Day', in India, about 4.5 lakhs child labours between the age group of 10-14 are observed to be engaged in various e-waste (electronic waste) activities, without adequate protection and safeguards in various yards and recycling workshops. The informal recycling industry often employs children to dismantle electronic waste. Delhi-NCR is emerging as the world's dumping yard for e-waste and likely to generate to an extent of 95,000 metric tonnes (MT) per annum by 2017 from the current level 55,000 metric tonnes per annum growing at a compound annual growth rate (CAGR) of about 25 per cent, revealed a just-concluded ASSOCHAM study.

6. A report developed by researchers at Toxics Link noted that 16 out of the 50 leading companies (31 multinational and 19 national) were found to be wanting in their role on e-waste management and fared very poorly in the ratings.

7. The various studies have revealed extreme negligence on part of the State Pollution Control Boards (SPCBs) on most of the tasks assigned to them by the e-waste rules. Most SPCBs have failed to carry out inventories of waste, mandated under the e-waste rules. No action has also been initiated against any of the defaulting companies by the regulatory agency. In fact, most SPCBs have not set up any mechanism in their respective States to monitor the collection and processing units. Many of them have not even uploaded e-waste rules on their website to educate different stakeholders.

8. Less than five per cent of India's total electronic waste (e-waste) gets recycled due to absence of proper infrastructure, legislation and framework. Almost half of all unused and end-of-life electronic products lie idle in landfills, junkyards and warehouses. Computer equipment accounts for almost 68 per cent of e-waste material followed by telecommunication equipment (12 per cent), electrical equipment (eight) and medical equipment (seven). Other equipment, including household e-crap account for the remaining five per cent.

Remedies and measures:

The countries of the European Union (EU) and other developed countries to an extent have addressed the issue of e-waste by taking policy initiatives and by adopting scientific methods of recycling and disposal of such waste. The EU defines this new waste stream as 'Waste

Electrical and Electronic Equipment' (WEEE). As per its directive, the main features of the WEEE include definition of 'EEE', its classification into 10 categories and its extent as per voltage rating of 1000 volts for alternating current and 1500 volts for direct current. The EEE has been further classified into 'components', 'sub-assemblies' and 'consumables'. Since there is no definition of the WEEE in the environmental regulations in India, it is simply called 'e-waste'.

1. Electro spinning and electro spraying are versatile techniques to produce a range of nano fibres and particles, and membranes made out of them can be used in water filtration to great effect.

2. The MoEF has taken a number of steps to ensure environmentally sound management of e-waste in the country. These include: (i) The Guidelines for Environmentally Sound Management of e-waste, published by Central Pollution Control Board, provide approach and methodology for environmentally sound management of e-waste; (ii) The Ministry is implementing a Scheme to provide financial assistance for setting up of treatment, disposal and storage facility for hazardous and integrated recycling facilities for E-waste on public private partnership mode.

3. The regulation of e-waste can only be achieved if bulk consumers of electrical and electronic equipments accept responsibility to follow the e-waste rules and channelize it through authorised collection centres or recyclers.

To facilitate e-waste management in the country, the government is implementing a scheme under which financial assistance is provided for awareness and capacity building activities relating to e-waste management. Under the 'Creation of Management Structure for Hazardous Substances' scheme, government is also setting up integrated recycling facility for e-waste.

4. Guide Foundation for Development, Hyderabad, has joined hands with Clean E-India, to try and implement safe collection and disposal methods. Clean E-India initiative was jointly launched in April 2013 by IFC, a member of the World Bank Group, and Attero, an asset management and recycling company to collect and responsibly recycle electronic waste through an approach that integrates informal waste collectors (*kabadiwallahs*) into an organised network.

Chemical Safety: The Manufacture, Storage and Import of Hazardous Chemical (MSIHC) Rules, 1989 and the Chemical Accident (Emergency Planning, Preparedness and Response) Rules, 1996 are the main instruments for ensuring chemical safety in the country. As per

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● The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty to protect human health and the environment from POPs. The Convention sought initially 12 chemicals, for restriction or elimination of the production and release. Now, the Convention covers 22 chemicals.

● In accordance with Article 7 of the Stockholm Convention on POPs, India developed a National Implementation Plan (NIP) through Global Environment Facility (GEF) funding to demonstrate how its obligations to the Convention would be implemented.

the information received from various States and Union Territories, there are 1905 MAH units in the country located in 304 districts across the country. A "GIS based Emergency Planning and Response System" for chemical accidents in Major Accident Hazard (MAH) units has been developed.

Stockholm Convention: The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty to protect human health and the environment from POPs. The Convention sought initially 12 chemicals, for restriction or elimination of the production and release. Now, the Convention covers 22 chemicals. The Convention was adopted in May, 2001 and came into force on 17th May, 2004. The Convention was ratified on 13th January, 2006 by Government of India which came in to force on 12th April, 2006. Presently, the Convention has more than 179 Parties and 152 signatories. The Ministry of Environment and Forests serves as the focal point for GEF and Stockholm Convention in the country. India has ratified 12 initially listed chemicals.

In accordance with Article 7 of the Stockholm Convention on POPs, India developed a National Implementation Plan (NIP) through Global Environment Facility (GEF) funding to demonstrate how its obligations to the Convention would be implemented. The Ministry of Environment and Forests serves as the focal point for GEF and Stockholm Convention in the country. Environmentally sound management and disposal of Polychlorinated Biphenyls (PCBs) in India has been selected as one of the first priorities of post-NIP programme.

Persistent Organic Pollutants (POPs) are organic chemical substances, that is, they are carbon-based. They possess a particular combination of physical and chemical properties such that, once released into the environment, they:

(a) remain intact for exceptionally long periods of time (many years); (b) become widely distributed throughout the environment as a result of natural processes involving soil, water and, most notably, air; (c) accumulate in the fatty tissue of living organisms including humans, and are found at higher concentrations at higher levels in the food chain; and (d) are toxic to both humans and wildlife. In addition, POPs concentrate in living organisms through another process called bioaccumulation. Though not soluble in water, POPs are readily absorbed in fatty tissue, where concentrations can become magnified by up to 70,000 times the background levels. Fish, predatory birds, mammals, and humans are high up the food chain and so absorb the greatest concentrations. When they travel, the POPs travel with them. As a result of these two processes, POPs

can be found in people and animals living in regions such as the Arctic, thousands of kilometres from any major POPs source.

Initially, twelve POPs, also called dirty dozen, have been recognized as causing adverse effects on humans and the ecosystem and these can be placed in 3 categories: (A) Pesticides: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene; (B) Industrial chemicals: hexachlorobenzene, polychlorinated biphenyls (PCBs); and (C) By-products: hexachlorobenzene; polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/ PCDF), and PCBs.

Aldrin: A pesticide applied to soils to kill termites, grasshoppers, corn rootworm, and other insect pests, aldrin can also kill birds, fish, and humans.

Chlordane: Used extensively to control termites and as a broad-spectrum insecticide on a range of agricultural crops, chlordane remains in the soil for a long time and has a reported half-life of one year.

DDT: DDT was widely used during World War II to protect soldiers and civilians from malaria, typhus, and other diseases spread by insects.

Dieldrin: Used principally to control termites and textile pests, dieldrin has also been used to control insect-borne diseases and insects living in agricultural soils.

Endrin: This insecticide is sprayed on the leaves of crops such as cotton and grains. It is also used to control rodents such as mice and voles.

Heptachlor: Primarily used to kill soil insects and termites, heptachlor has also been used more widely to kill cotton insects, grasshoppers, other crop pests, and malaria-carrying mosquitoes.

Hexachlorobenzene (HCB): First introduced in 1945 to treat seeds, HCB kills fungi that affect food crops. It was widely used to control wheat bunt. It is also a byproduct of the manufacture of certain industrial chemicals and exists as an impurity in several pesticide formulations.

Mirex: This insecticide is used mainly to combat fire ants, and it has been used against other types of ants and termites. It has also been used as a fire retardant in plastics, rubber, and electrical goods.

Toxaphene: This insecticide is used on cotton, cereal grains, fruits, nuts, and vegetables. It has also been used to control ticks and mites in livestock.

Polychlorinated biphenyls (PCB): These compounds are used in industry as heat exchange fluids, in electric transformers and capacitors, and as additives in paint, carbonless copy paper, and plastics. Of the 209 different types of PCBs, 13 exhibit a dioxin-like toxicity.

Polychlorinated dibenzo-p-dioxins (PCDD):

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● Pursuant to paragraph 4 of Article 21 of the Convention, the amendment was communicated by the depositary to all Parties on 27 October 2011. According to the risk management evaluation on endosulfan, adopted by the POPRC, endosulfan is an insecticide that has been used since the 1950s to control crop pests, tsetse flies and ectoparasites of cattle and as a wood preservative.

● Today India is the largest producer of Endosulfan and accounts for over 70 per cent of the global trade of this product. The demand to ban Endosulfan had gathered strength after cases of health problems related to its use were reported in Kasargod district in Kerala where it was aerielly sprayed on Cashew plantations.

These chemicals are produced unintentionally due to incomplete combustion, as well during the manufacture of pesticides and other chlorinated substances. They are emitted mostly from the burning of hospital waste, municipal waste, and hazardous waste, and also from automobile emissions, peat, coal, and wood.

Polychlorinated dibenzofurans (PCDF): These compounds are produced unintentionally from many of the same processes that produce dioxins, and also during the production of PCBs. They have been detected in emissions from waste incinerators and automobiles. Furans are structurally similar to dioxins and share many of their toxic effects. There are 135 different types, and their toxicity varies.

Nine new POPs: At its fourth meeting held from 4 to 8 May 2009, the Conference of the Parties adopted amendments to Annexes A, B and C to the Stockholm Convention to list nine new persistent organic pollutants (SC-4/10-SC-4/18). Pursuant to paragraph 4 of Article 21 of the Convention, the amendments were communicated by the depositary to all Parties on 26 August 2009.

A. Pesticides:

Chlordecone: Chlordecone is a synthetic chlorinated organic compound, which was mainly used as an agricultural pesticide. It was first produced in 1951 and introduced commercially in 1958. Currently, no use or production of the chemical is reported.

Alpha hexachlorocyclohexane: Although the intentional use of alpha-HCH as an insecticide was phased out years ago, this chemical is still produced as unintentional by-product of lindane.

Beta hexachlorocyclohexane: Although the intentional use of beta-HCH as an insecticide was phased out years ago, this chemical is still produced as unintentional by-product of lindane. For each ton of lindane produced, around 6-10 tons of the other isomers including alpha- and beta-HCH are created. Large stockpiles of alpha- and beta-HCH are therefore present in the environment.

Lindane: Lindane has been used as a broad-spectrum insecticide for seed and soil treatment, foliar applications, tree and wood treatment and against ectoparasites in both veterinary and human applications. The production of lindane has decreased rapidly in the last few years and only few countries are still known to produce lindane.

Pentachlorobenzene: PeCB was used in PCB products, in dyestuff carriers, as a fungicide, a flame retardant and as a chemical intermediate e.g. previously for the production of quinotzene. PeCB might still be used as an intermediate. PeCB is also produced unintentionally

during combustion, thermal and industrial processes. It also present as impurities in products such as solvents or pesticides.

B. Industrial chemicals:

Hexabromobiphenyl: Hexabromobiphenyl is an industrial chemical that has been used as a flame retardant, mainly in the 1970s. According to available information, hexabromobiphenyl is no longer produced or used in most countries.

Hexabromodiphenyl ether and Heptabromodiphenyl ether: Commercial mixture of octaBDE is highly persistent, has a high potential for bioaccumulation and food-web biomagnification, as well as for long-range transport.

Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride: PFOS is both intentionally produced and an unintended degradation product of related anthropogenic chemicals. The current intentional use of PFOS is widespread and includes: electric and electronic parts, fire fighting foam, photo imaging, hydraulic fluids and textiles. PFOS is still produced in several countries.

Tetrabromodiphenyl ether and pentabromodiphenyl ether: Commercial mixture of pentabDE is highly persistent in the environment, bioaccumulative and has a high potential for long-range environmental transport.

C. By-products: alpha hexachlorocyclohexane, beta hexachlorocyclohexane and pentachlorobenzene.

Endosulfan

At its fifth meeting held from 25 to 29 May 2011, the Conference of the Parties adopted an amendment to Annex A to the Stockholm Convention to list technical endosulfan and its related isomers with a specific exemption. Pursuant to paragraph 4 of Article 21 of the Convention, the amendment was communicated by the depositary to all Parties on 27 October 2011. According to the risk management evaluation on endosulfan, adopted by the POPRC, endosulfan is an insecticide that has been used since the 1950s to control crop pests, tsetse flies and ectoparasites of cattle and as a wood preservative. Though 84 countries have banned endosulfan, India has been resisting saying there is no conclusive proof that it affects human health. In 2011 at a world convention in Geneva, India accepted the pesticide is a health hazard and agreed to a phased-out ban with exemption for some crops.

A three-Judge Bench consisted of former Chief Justice of India S.H. Kapadia and Justices K.S. Radhakrishnan and Swatanter Kumar, in a brief order, said: "Keeping in mind various judgments of this court under Article 21 (right to life and liberty) of the Constitution and particularly keeping in mind the precautionary principle, we, hereby, direct and pass an ad

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● The text of the Rotterdam Convention was adopted on 10 September 1998 by a Conference of Plenipotentiaries in Rotterdam, the Netherlands. The Convention entered into force on 24 February 2004.

● There are 47 chemicals listed in Annex III to this Convention, which include 33 pesticides and 14 industrial chemicals that have been banned or severely restricted by two or more Parties and which the Conference of the Parties (COPs) has decided to subject to the Prior Informed consent (PIC) procedure.

interim order for immediate ban on production and use of endosulfan all over India.” The Karnataka High Court has directed the state government to pay interim relief to the 6,140 victims of endosulfan use in the three coastal districts of Karnataka, Shanbhag. The government has informed the court that there are 6,140 endosulfan victims in all the three districts viz. Dakshina Kannada, Udupi and Uttara Kannada.

Endosulfan is extensively used in India and China – both are emerging economies with large numbers of poor farmers engaged in low-cost agriculture – because it is a cheap and relatively harmless generic pesticide. Endosulfan is used extensively in cultivation of fruits and vegetables. Today India is the largest producer of Endosulfan and accounts for over 70 per cent of the global trade of this product. The demand to ban Endosulfan had gathered strength after cases of health problems related to its use were reported in Kasargod district in Kerala where it was aerielly sprayed on Cashew plantations. The state later disallowed the use of the pesticide. The Government has agreed to phase out use of Endosulfan by 2017 and all existing stock of the pesticide in the country that is past its expiry date.

Chemicals proposed for listing under the Convention: The POPs Review Committee evaluates the proposals and makes recommendation to the Conference of the Parties on such listing in accordance with Article 8 of the Convention. Currently, the following chemicals are under review:

1. Hexabromocyclododecane: HBCD is one of a group of polybrominated flame retardants, or PBFRs. It is used in expandable polystyrene foams in domestic and industrial building insulation, packaging of industrial products and bean bag fills. Other uses are as a polypropylene resin in housings for domestic electrical appliances and as a textile coating additive in blinds, baby car seats, public seating and textiles. Finished articles containing HBCD include extruded polystyrene (XPS) boards, office equipment such as inkjet printers, projectors, scanners and ceiling ventilator covers.

2. Short-chained chlorinated Paraffins: SCCPs are persistent, bioaccumulative, and toxic to aquatic organisms at low concentrations. They can remain in the environment for a significant amount of time and can bioaccumulate in animal tissues, increasing the probability and duration of exposure. Even relatively small releases of these chemicals from individual manufacturing, processing, or waste management facilities have the potential to accumulate over time to higher levels and cause significant adverse impacts on the environment.

3. Chlorinated naphthalenes: It has industrial uses including cable insulation, capacitors, gauge and heat exchange fluids, instrument seals and solvents. Polychlorinated naphthalenes (PCNs) are a group of substances based on the naphthalene ring system. PCNs - commercially produced as mixtures of several congeners e.g. Halowax, Nibren Waxes, Seekay Waxes and Cerifal Materials - became popular chemicals after 1910 but their production decreased in the late 1970s

4. Hexachlorobutadiene: It is used mainly as an intermediate in the manufacture of rubber compounds. It is also used in the production of lubricants, as a fluid for gyroscopes, as a heat transfer liquid, and in hydraulic fluids.

5. Pentachlorophenol: It is a white organic solid with needle-like crystals and a phenolic odour. The greatest use of pentachlorophenol is as a wood preservative (fungicide).

Rotterdam Convention

Rotterdam Convention: The text of the Rotterdam Convention was adopted on 10 September 1998 by a Conference of Plenipotentiaries in Rotterdam, the Netherlands. The Convention entered into force on 24 February 2004. The objectives of the Convention are: (a) to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm; (b) to contribute to the environmentally sound use of those hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties.

The Convention creates legally binding obligations for the implementation of the Prior Informed Consent (PIC) procedure. It built on the voluntary PIC procedure, initiated by UNEP and FAO in 1989 and ceased on 24 February 2006. The convention was acceded to by Government of India on 24th May 2005 and it became operative on 23rd August 2005.

There are 47 chemicals listed in Annex III to this Convention, which include 33 pesticides and 14 industrial chemicals that have been banned or severely restricted by two or more Parties and which the Conference of the Parties (COPs) has decided to subject to the Prior Informed consent (PIC) procedure. The inclusion of Pentabromodiphenyl Ether (CAS No. 32534-81-9) and Penta-bromo-diphenyl Ether Commercial Mixtures, Octabromodiphenyl ether (Octa BDE) commercial mixture, Perfluorooctane-Sulphonic Acid, Perfluoro-octane-sulfonates, Perfluoro-octane-sulfonamides and Perfluoro-octane-sulfonyls in Annex III of

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● In February 2006, over 190 countries including India acceded to the Strategic Approach to International Chemicals Management (SAICM), which is an international policy framework to foster sound management of chemicals. It was adopted by the International Conference on Chemicals Management (ICCM) on 6 February 2006 in Dubai, United Arab Emirates.

● Convention on long-range transboundary air pollution (CLRTAP): The United Nations Economic Commission for Europe (UNECE) adopted the Protocol on POPs as part of the CLRTAP (Convention on long-range transboundary air pollution) on the 24 June 1998 in Aarhus, Denmark.

● Vultures die after eating dead cattle which has been administered with the chemical. The birds of prey in Jorbeer near Bikaner, the preferred vulture habitat, are alarmingly falling prey to diclofenac despite the government ban in 2006 on the production of drug for veterinary use.

the Convention has been agreed.

SAICM: Strategic Approach to International Chemicals Management: In February 2006, over 190 countries including India acceded to the Strategic Approach to International Chemicals Management (SAICM), which is an international policy framework to foster sound management of chemicals. It was adopted by the International Conference on Chemicals Management (ICCM) on 6 February 2006 in Dubai, United Arab Emirates. Initial activities under SAICM included development or updating of national chemicals profiles, strengthening of institutions, and mainstreaming sound management of chemicals in national strategies. Towards this end, India initiated the preparation of the National Chemicals Management Profile to assess India's infrastructure and capacity for management of chemicals.

Minamata Convention on Mercury: The Minamata Convention on Mercury is a global treaty to protect human health and the environment from the adverse effects of mercury. It was agreed at the fifth session of the Intergovernmental Negotiating Committee in Geneva, Switzerland on 19th January 2013. The major highlights of the Minamata Convention on Mercury include a ban on new mercury mines, the phase-out of existing ones, control measures on air emissions, and the international regulation of the informal sector for artisanal and small-scale gold mining. The sixth session of the intergovernmental negotiating committee on mercury (INC6) was held from 3 to 7 November 2014 at the premises of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) in Bangkok, Thailand. INC6 carried out work to prepare for the entry into force of the Minamata Convention on Mercury and for the first meeting of the Conference of Parties (COP1).

Convention on long-range transboundary air pollution (CLRTAP): The United Nations Economic Commission for Europe (UNECE) adopted the Protocol on POPs as part of the CLRTAP (Convention on long-range transboundary air pollution) on the 24 June 1998 in Aarhus, Denmark. This Protocol established a list of 16 POPs substances, comprising eleven pesticides, two industrial chemicals and three byproducts. The ultimate objective of the Protocol is to eliminate any discharges, emissions and losses of POPs to the environment. Under the Protocol, the production and use of Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Hexabromobiphenyl, Mirex and Toxaphene is banned. Other chemicals are scheduled for elimination at a later stage (DDT, Heptachlor, Hexachlorobenzene, PCBs). The Protocol severely restricts the use of DDT, HCH (including Lin-

dane) and PCBs. It also requires parties to reduce their emissions of Dioxins, Furans, PAHs and HCB, and sets specific limit values for the incineration of municipal, hazardous and medical waste. The CLRTAP Protocol on POPs entered into force on the 23 October 2003. There are, at present, 36 signatories to the Protocol, including many European nations. So far, 24 of the signatories have ratified the Protocol.

Diclofenac: Vultures die after eating dead cattle which has been administered with the chemical. The birds of prey in Jorbeer near Bikaner, the preferred vulture habitat, are alarmingly falling prey to diclofenac despite the government ban in 2006 on the production of drug for veterinary use. Recently a dead Black eyed kite, a migratory bird and a Steppe Eagle were found dead in Jorbeer carcass dumping site and in the last 2.5 months, 30 birds were found dead because of the drug. "Three Critically Endangered Gyps vultures endemic to South Asia continue to decline due to the use of diclofenac to treat livestock," noted the Bird Conservation International.

After ban of diclofenac, the drug is still available in the market. Government of India banned the formulation, manufacture and import of veterinary diclofenac in 2006, but not multi-dose vials. After that, some veterinary doctors started misusing multi-dose vials of diclofenac sodium, generally of 10 ml to 30 ml meant for human consumption to treat animals illegally. The alternate pain killer, meloxicam, is expensive and not as effective making veterinarians sometimes use the ones meant for humans.

Management of Plastic Wastes: These are littered around and if not collected systematically may find their way into the drainage system resulting in choking of drains, creating unhygienic environment and causing health problems. The Ministry has notified the Recycled Plastics Manufacture and Usage Rules, 1999 under the Environment (Protection) Act, 1986 and amended them in 2003 for regulating and managing plastic carry bags and containers.

After extensive consultations with stakeholders, the Ministry has now notified the draft Plastics (Manufacture, Usage & Waste Management) Rules, 2009 and invited objections/ suggestions to the proposals contained in the draft notification to finalize the notification. The new Rules will supersede the existing Recycled Plastics Manufacture and Usage Rules, 1999 (as amended in 2003).

The ministry put forth the draft of municipal solid waste (management and handling) rules 2013 and it will come into force on the date of their final publication in the official gazette. The Municipal Waste (Handling and Management Rules) 2013 for the first time specify norms for

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● Municipal Waste (Handling and Management Rules) 2013 for the first time specify norms for the landfill debarring municipal bodies from setting them up near residential colonies, wildlife and forest areas, religious, historical and spiritual places. The new rules also make it mandatory for the municipal authority to prepare solid waste management plan as per the policy of the state government.

● The four metros are major culprits in generating such waste, with Delhi producing 689.5 tonnes a day, followed by Chennai (429.4 tonnes), Kolkata (425.7 tonnes) and Mumbai (408.3 tonnes). As 40 per cent of plastic waste is not recycled, the daily addition to untreated plastic in Delhi is estimated at 275.6 tonnes, followed by Chennai (171.6 tonnes), Kolkata (170 tonnes) and Mumbai (163.2 tonnes).

the landfill debarring municipal bodies from setting them up near residential colonies, wildlife and forest areas, religious, historical and spiritual places. The new rules also make it mandatory for the municipal authority to prepare solid waste management plan as per the policy of the state government. To deal with the menace of municipal solid waste, ministry of environment has framed rules for management and handling along with assigning clear responsibilities to all the stakeholders. Once implemented, it will become mandatory for the municipalities in the state to develop landfills and submit annual reports to state government and pollution control board. As per the new provisions it is necessary for the municipal to set up disposal facility and processing plants. The landfills should meet the standards laid down by the ministry with all environment clearances.

Total plastic waste which is collected and recycled in the country is estimated to be 9,205 tonnes per day (approximately 60 per cent of total plastic waste) and 6,137 tonnes remain uncollected and littered. The four metros are major culprits in generating such waste, with Delhi producing 689.5 tonnes a day, followed by Chennai (429.4 tonnes), Kolkata (425.7 tonnes) and Mumbai (408.3 tonnes). As 40 per cent of plastic waste is not recycled, the daily addition to untreated plastic in Delhi is estimated at 275.6 tonnes, followed by Chennai (171.6 tonnes), Kolkata (170 tonnes) and Mumbai (163.2 tonnes). This waste is a source of continuing pollution as plastic is not bio-degradable and poisons the environment for decades. The problems, which are associated, inter-alia, with the uncollected plastic waste, include (i) choking of drains by plastic carry bags which may lead to unhygienic environment and water borne diseases, (ii) causing of illness and possible death of animals that may feed on plastics from garbage bins, (iii) non-biodegradable and impervious nature of plastics disposed on soil which may arrest recharge of ground water aquifers, (iv) presence of additives and plasticizers, fillers, flame retardants and pigments used in the plastic products which have potential to cause adverse health impact and ground water pollution.

The Ministry of Environment and Forests has notified the Plastic Waste (Management and Handling) Rules, 2011. As per these rules, manufacturing, stocking, distribution, sale on use of plastic carry bags of less than 40 micron in thickness is prohibited. These rules are uniformly applicable to the whole of the country. However, some States/ Union Territories have prescribed more stringent norms and also either completely or partially banned the use of plas-

tic carry bags within their respective jurisdictions. The State Pollution Control Boards and Pollution Control Committees in respect of Union Territories are the prescribed authorities for enforcement of provisions of these rules relating to registration, manufacture and recycling. The concerned Municipal Authorities are responsible for enforcement of provisions of these rules relating to the use, collection, segregation, transportation and disposal of plastic waste.

Sources of Hazardous Metals and Minerals Heavy Metals and Aluminium

The industrial sources of heavy metals are in various fields. Chromium (Cr) is found in Mining, industrial coolants, chromium salts manufacturing and leather tanning. Lead (Pb) is released in industries like lead acid batteries, paints, E-waste, Smelting operations, coal-based thermal power plants, ceramics, bangle industry where as Mercury (Hg) is released from Chlor-alkali plants, thermal power plants, fluorescent lamps, hospital waste (damaged thermometers, barometers, sphygmomanometers), electrical appliances etc. Arsenic (As) is found in Geogenic or natural processes, smelting operations, thermal power plants, fuel burning. Copper (Cu) from

Mining, electroplating, smelting operations, Vanadium (Va) from Spent catalyst, sulphuric acid plant and Nickel (Ni) is found in Smelting operations, thermal power plants, battery industry. Cadmium (Cd) is released in Zinc smelting, waste batteries, e-waste, paint sludge, incinerations & fuel combustion, Molybdenum (Mo) in Spent catalyst and Zinc (ZN) is released in Smelting, electroplating.

Besides the industrial sources of lead, listed above, lead exposure also occurs through gasoline additives, food can solder, ceramic glazes, drinking water system, cosmetics, folk remedies, and battery/plastic recycling industry¹. According to some work done at the DPSAR university, New Delhi many brands of cosmetics like talcum powder, lipsticks, shampoos, 'kajal' and hair colours contain heavy metals. Ash dumps from thermal power plants, contain many polluting metals and complexes, which are carried to nearby water bodies and ground water. Volatile complexes such as those from Uranium, enter the atmosphere via chimney emissions. The U content of coal may be as low as 0.2 ppm, but considering the millions of tons of coal that is burnt it is an important pollutant. In recent years the use of energy-saving CFL bulbs has gone up enormously. Thus, according to a recent report the production of CFL bulbs has increased from 19 million in 2002 to 500 million in 2010. Each bulb contains 3-12 mg of mercury. With no system to recover these bulbs and safe disposal, these can prove to be a

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● The major heavy metal contaminated sites in India, are Ranipet in Tamil Nadu, Kanpur, Uttar Pradesh, Talcher in Orissa and Vadodara in Gujarat for Chromium. Ratlam in Madhya Pradesh, Bandalamottu Mines in Andhra Pradesh, Vadodara in Gujarat and Korba in Chattisgarh are grossly polluted with Lead.

● Aluminium pollution is associated with bauxite mining. With steady increase in demand for aluminium in India, its anthropogenic pressure is increasing. India ranks sixth in bauxite mining and 8th in aluminium production. The state of Orissa is worst affected.

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Kodaikanal, Tamil Nadu, Ganjam, Orissa and Singrauli, Madhya Pradesh are heavily polluted with Mercury. Tuticorin in Tamil Nadu, West Bengal and Ballia and other districts of Uttar Pradesh is known for Arsenic pollution. Tuticorin, Tamil Nadu, Singbhum Mines of Jharkhand and Malankhand, Madhya Pradesh have copper pollution. Data of CPCB show that Gujarat, Maharashtra and Andhra Pradesh contribute to 80 per cent of hazardous waste (including heavy metals) in India.

Apart from industries, roadways and automobiles contribute substantially to the environmental burden of heavy metals since particulate matter in traffic emissions include heavy metals like lead, cadmium and arsenic. Exposure to traffic emissions, especially diesel exhaust may enhance asthma, allergen responsiveness and inflammation, leading to atherosclerotic vascular disease.

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Significant concentration of total and hexavalent chromium is observed in many wells located in the close vicinity of some of the industries in the industrial area of Ranipet, in Tamil Nadu. The sources are clusters of tanneries and other industries located in the area. The concentration of total chromium in these wells varies between 3.1 to 246 mg/L whereas the concentration of hexavalent chromium varies between 2.1 to 214 mg/L which far exceed the concentration of 0.05 mg/L prescribed under Indian Standards Specification for Drinking water quality. The ground water in these areas is therefore, severely contaminated with hexavalent chromium. Based on the detailed laboratory scale studies and techno-economic evaluation, an in-situ bioremediation (biotransformation) option was recommended by NEERI for implementation of bio-remediation of contaminated ground water in the critically polluted area' [Ref. Tamil Nadu Pollution Control Board: 'Revised Village Khanpur in Rania area of Kanpur Dehat also revealed high levels of hexavalent chromium in groundwater ranging from 1.05 to 35.34 ppm.

Fluoride: Natural sources contribute to the bulk

of environmental load of fluoride and arsenic. In India, 19 out of 35 states and Union territories have ground water highly contaminated with fluoride, with levels exceeding 1.0 mg/L and going up to 48mg/L_{4,5}.

In states like Andhra Pradesh, Gujarat and Rajasthan, 70-100 per cent districts contain high fluoride levels in food and water. Black rock salt (CaF₂) commonly used as flavouring agent in road side, as well as processed and home-cooked foods contributes significantly to the ingestion of fluoride. It contains 157 ppm F⁻. Public awareness in this regard is needed. Dental products, anti-depressant and anti-cholesterol drugs used for long term treatment are important sources of fluoride. Industries using fluoride salts/hydrofluoric acid pollute the work environment and are a source for high ingestion/inhalation of fluoride dust and fumes by the Industrial workers.

Arsenic: Pockets in West Bengal, Bihar, UP, Assam and Chhattisgarh are the major states affected by arsenic contamination of water, West Bengal being by far the worst affected. Ground water of 9 out of 16 districts of West Bengal is heavily contaminated with arsenic, affecting 26 million people⁶. In a U.P. Jal Nigam/IITR survey of 66671 samples of water from hand pumps in 20 districts of U.P., 42 per cent were found to contain > 10 ppb arsenic of which 2610 (4 per cent) had > 50 ppb arsenic. Children ingest arsenic through pica behaviour.

Bio-Medical Waste Management: The Ministry has notified the Bio-Medical Waste (Management & Handling) Rules, 1998 (BMW Rules) under the provisions of Environment (Protection) Act, 1986 for proper management and handling of Bio-Medical Waste (BMW) generated in the country. Under these Rules, the wastes generated by Health Care Establishments (HCEs) have been categorized into 10 categories and treatment & disposal methods for each of these categories of wastes have been specified. The status of implementation of these rules is being regularly monitored by the respective State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) of Union Territories.

▶ A central control room has been set up in the Ministry to deal with emergencies arising from hazardous chemicals and a Crisis Alert System has been established.

▶ Emergency Response Centres have been set up at Bhopal, Baroda, Manali and Khapali.

▶ A sub-scheme entitled 'Industrial Pocket-wise Hazard Analysis' has been in operation since the 8th Five-Year Plan. Hazard analysis studies of 37 industrial pockets have since been completed.

▶ A Public Liability Insurance Act has been en-

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● India is a Party to the Basel Convention on trans-boundary movement of hazardous wastes. The basic objectives of the Basel Convention are for the control and reduction of trans-boundary movements of hazardous and other wastes subject to the Convention, prevention and minimization of their generation, environmentally sound management of such wastes and for active promotion of the transfer and use of cleaner technologies.

● Microbial fuel cells use biological reactions from microbes in water to create electricity. The first microbe-powered, self-sustaining wastewater treatment system could lead to an inexpensive and quick way to clean up waste from large farming operations and rural sewage treatment plants while reducing pollution.

acted to provide immediate relief to the victims of accidents by hazardous chemical industries.

▶ A scheme on National Register of Potentially Toxic Chemicals (NRPTC) has been started for setting up the basic infrastructure for implementing the London guidelines for the exchange of information on chemicals in international trade, including the procedure for prior informed consent.

▶ Nine Regional Registers (RRPTC) have been set up in UP, MP, Gujarat, Kerala, HP, Punjab and Maharashtra.

▶ A National Poison Information Centre has been set up in AIIMS.

▶ The Ministry has constituted a National Waste Management Council to suggest ways and means for effective utilization of wastes generated in the country.

▶ A pilot project on Municipal Solid Waste Management has been sanctioned to the Hyderabad Municipal Corporation.

▶ A high-powered committee on hazardous wastes has been constituted to oversee the strict implementation of the rules and regulations.

▶ A notification has been issued banning import of wastes containing Beryllium, Selenium, Chromium (Hexavalent), Thallium, Pesticides, Herbicides and insecticides as well as Waste Asbestos (dust and fibre), waste containing PCB, PCT and PBB.

As per the information received from SPCBs and PCCs of Union Territories, about 4.16 tons of bio-medical waste is generated per day. There are 192 Common Bio-Medical Waste Treatment and Disposal Facilities (CBMWTFs) in operation and 29 CBMWTFs are under construction.

The Basel Convention on hazardous wastes:

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Cobalt 60: On the issue of Cobalt-60 found in a scrap market, it is to be noted that a radioactive material not covered under the Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules framed by MoEF. In fact, radioactive waste is covered by Atomic Energy Act. The Cobalt-60 was in a "Gamma Irradiator", which was bought in 1968 from Canada and was not in use since 1985. Cobalt-60 is a radioactive isotope of cobalt, which is a hard, lustrous, grey metal. Cobalt-based colours and pigments have been used since ancient times for jewellery and paints, and min-

ers have long used the name Kobold ore for some minerals.

Biological clean-up methods

Bioil-FC has proven effective in changing toxic compounds in hydrocarbons into biodegradable substances, up to complete conversion into carbon dioxide and water. Bioremediation is usually employed as a secondary treatment after mechanical collection of oil waste using different types of equipment. That first phase can mean the recovery of up to 60 percent of the spilled hydrocarbon.

Advantages:

1. The applications in Cuba and Caribbean Islands have shown effective results. It is more cost-effective than other chemical and physical process.

2. "Bioremediation" is a technique for environmental detoxification through microorganisms that break down dangerous organic waste and turn it into less harmful compounds.

3. It is least polluting and doesn't affect the eco-system.

4. It can be effectively used in cold areas like Antarctica.

5. It has ability to be used in cleaning up the acid drainage produced from abandoned coal mines.

6. Unlike chemical and physical pollution, the biological, or "passive" control. This technology involves the construction of a treatment system that is permanent and requires little or no maintenance. Passive control measures involve the use of anoxic drains, limestone rock channels, alkaline recharge of ground water, and diversion of drainage through man-made wetlands or other settling structures.

7. Microbial fuel cells use biological reactions from microbes in water to create electricity. The first microbe-powered, self-sustaining wastewater treatment system could lead to an inexpensive and quick way to clean up waste from large farming operations and rural sewage treatment plants while reducing pollution. In the new method, the microbial fuel does the work of the aerator, using only the power of microbes in the sewage lagoons to generate electricity. Researchers have developed a unique method to use microbes buried in pond sediment to power waste cleanup in rural areas. The technology could also be used in underdeveloped countries to more effectively clean polluted water.

Disadvantages: (a) Bioil-FC is that it acts only at temperatures above five degrees (Celsius). Maximum effectiveness is achieved between 25 and 35 degrees.

(b) Biological pollution removal, which on the face of it is relatively simple, nevertheless requires case by case investigations".