

Sustainable production of pulp and paper in India

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Introduction

Sustainable development is development that meets the needs of the present without compromising on the ability of future generations to meet their own needs. This contains two key concepts namely, the concept of need and the limitations imposed by the state of technology and social organization on environment's ability to meet the present and future needs.

In 1980, world conservation strategy was published. Conservation is both protection and rational use of natural resources. Conservation cannot be achieved without development to alleviate the poverty and misery of people. Sustainable development depends on caring for the earth. The conservation strategy has emphasized three objectives namely.

- (i) Essential ecological processes and life support systems must be maintained.
- (ii) Genetic diversity must be preserved, and
- (iii) Any use of species on ecosystems must be sustainable.

In 1987, the World Commission on Environment and development advanced the understanding of global interdependence and the relationship between economics and environment, focussing on the need for sustainable development. The Governments adopted an "Environmental Perspective to Year 2000 and Beyond" in 1987 defining a broad frame work to guide on environmentally sound development. The three basic points of this strategy are (i) World people want to survive with a satisfactory life for all now and for future descendant. (ii) Resources of earth meet our basic and vital needs (or ensure sustainability). (iii) Ensure development benefits are distributed equally by caring for the earth.

Misuse of natural resources has come to testing earth's capacity to its limits. In past 100 years world population has grown 8 fold, and industrial production by 100 folds with major impact on environment in terms of diminished capacity of earth to support human and other life. In less than 200 years, earth has lost six million km² of forest. The sediment load from soil erosion has risen 3-fold in major river basins and 8 fold in smaller and more intensively used ones, water with-drawls have grown from 100 to 3600 km³ a year. Atmospheric systems have been disturbed, threatening the climatic changes. Since mid-18th century, human activities have lead to more than doubling methane in atmosphere, increased CO₂ concentration by 27%, ozone layer is disturbed. Most astonishing is that 5.3 billion people now on earth are using already 40% of most elemental resources.

Yet the paradox is that a large proportion of world population is poor. One in five does not get enough food, 25% are without safe drinking water, millions of children die every year due to malnutrition and preventable diseases.

The earth is over taxed. Global population cannot stabilize at less than 10 or 12 billions. Calamitous ways of life must change to living sustainably. There is a need to promote and perfect an ethic for living sustainably. A new kind of development is necessary, coupled with significant changes in attitudes and practices.

Principles of Sustainability

The principles of a sustainable society is accepting the harmony with nature. The founding principles for

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providing the ethics for sustainable society are nine as listed below :

- (i) Respect and care for the community of life.
- (ii) Improve quality of human life.
- (iii) Conserve the earth's vitality and diversity (i.e. conserve life support systems, conserve biodiversity, ensure that uses of renewable resources are sustainable).
- (iv) Minimize the depletion of non-renewable resources.
- (v) Keep with in the earth's carrying capacity.
- (vi) Change personal attitudes and practices.
- (vii) Enable communities to care for their own environments.
- (viii) Provide a national frame work for integrating development and conservation.
- (ix) Create a global alliance.

The need is to build practical strategies for sustainable living and development. This requires many actions. Those actions which have a relevance to industrial production, particularly pulp and paper are listed in annexure-1. This includes the nine areas listed above besides such sectoral areas like energy, industry and business, human settlement, farm and range land, forest lands, fresh waters, oceans and coastal areas.

Global Scenario of Pulp and Paper Industry

Pulp and paper industry has been considered as a basic industry and it's per capita consumption has been used as an index of development. India with a per capita consumption of about 2.5 kgs. paper & board and about 0.5 kg. newsprint is one of the lowest per capita consuming countries. There is a need to increase the per capita consumption in India. The total world production of paper and board was 224 MT with nearly 189 MT coming from developed countries. The industry is expected to grow to 317 MT by 2000AD. The distribution of world pulp production in 1988 is as shown in Table-1. The global mass balance is shown in Figure-1.

Table-1 Distribution of World Pulp Production (Million Tonnes)

Countries	Wood	Other fiber	Total
Developed	140.104	1.346	141.450
Developing	11.078	9.698	20.775
Total	151.183	11.044	162,225

The 1989 world production of paper and pulp was nearly 233 (238 MT in 1990) and 164 million tonnes. Of this 85% paper and 87% pulp was produced in developed countries.

The basic raw materials for pulp manufacture are renewable ligno-cellulosic fibrous materials besides waste paper. In developed countries mostly woods are used, while in developing countries more than 45% of pulp comes from other raw materials like bagasse straws etc. The discharge of BOD in developed and developing countries is shown in Figure-2.

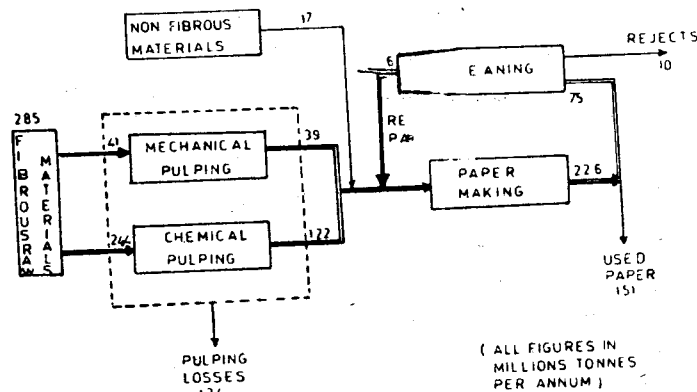


FIG.1 GLOBAL MASS BALANCE IN 1988

Ref L Webb, PPI, 33(1), 47 (1991)

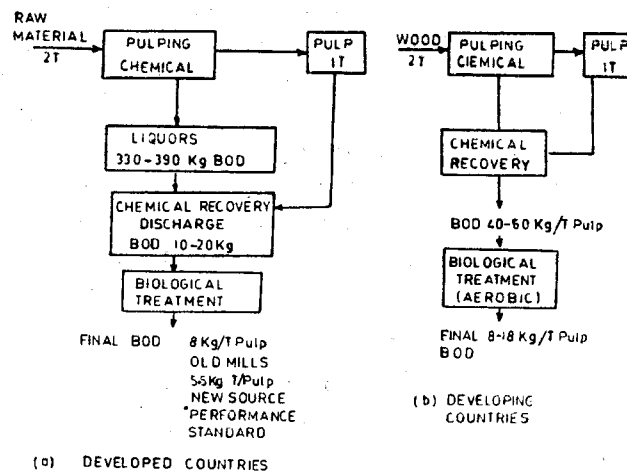


FIG 2 AVERAGE BOD DISCHARGES FROM CHEMICAL PULP MILLS WITH RECOVERY AND BIOLOGICAL TREATMENT

The basic fibrous raw material in pulp manufacture are renewable ligno-cellulosic fibrous raw materials accounting for 85 to 95% weight/weight of all raw materials (except fossil fuels). These include wood, straws, bagasse and bamboo. The wood consumption of fibrous raw materials is nearly 300 million tonnes/annum on O.D. basis. Most of the fibrous raw materials are woods, both hard and soft. The total world consumption of wood including chips from industrial wastes was more than 500 million m³ in 1984 and is likely to be 700 million m³ in 1995. Most of the pulp wood is cut and used in developed countries as shown in Table--2.

Table--2 : Round Wood Production and Utilization in 1988

	Developed Countries	Developing Countries
Total round wood production, million m ³ /year	1547	1883
Total industrial round wood,%	82.0	20.0
Pulp wood (including industrial waste). %	24.6	2.56
Other industrial uses, %	57.4	17.5
Fuel wood and charcoal, %	18.0	80.0

Ref : FAO Yearbook (Forest Products) 1988.

Forestry management in most developed countries is based on the method of sustainable yield. It is ensured that annual growth is at least equal to cut volumes. In some countries e.g. Germany, it is a general practice to make almost exclusive use of thinning material and industrial wood residues for pulp production. Such exploitations of the forests are harmonized with environmental protection techniques. However European forests are more homogeneous and therefore more readily lends itself to efficient exploitation.

In developing countries fuel and charcoal wood are the main forest commodities. Pulp wood production is negligible except in some countries like Argentina, Brazil, Indonesia, Swaziland and Tanzania. The area of natural forests in developing countries is decreasing as a result of over cutting for fuel wood, shifting cultivation and conversion of land to agriculture and pastures. In some countries like Nigeria,

mixed tropical hardwoods consisting of many species are used for pulp manufacture even though they are not suitable. There is a tendency to replace the natural forest by plantation species (like Pinus, Gmelina, Eucalyptus etc.) and to establish plantations on unused lands, and degraded forest areas. Annual yields of plantations in tropical and subtropical areas is considerably higher than in temperate zone forests. In 1985, the area of plantations was little more than 1% of total world area of closed forests, but industrial wood supply from plantations accounted for 14%. The area for plantations is expanding and the share of industrial wood in year 2000 is expected to be in the range of 19-22%. Very successful plantation programmes of Brazil are eye openers in this regard. In 20 years 6.3 million hectares of forest has been planted leading to reduction in CO₂ levels. An approximate 300,000 t/a pulp mill based on Eucalyptus needs 1.5 million cubic meters of wood per year which would mean a standing timber volume equivalent to 5 million tonnes, in terms of carbon content.

Waste paper is an important raw material in paper production and world waste paper recovery in 1989 was 80.37 million tonnes and consumption 79.57 MT i.e. a utilization rate of 34% and a recovery rate of 35%. World consumption of waste paper in 1990 was 85 MT. Waste paper consumption by year 2000 will be about 130 MT. Less waste paper is utilized than is discarded and partly it is incinerated. Less than 40% waste paper is actually collected. The highest waste paper utilization rates in fiber furnish is recorded in the Netherlands, Denmark and U.K. where it has reached a figure of 60% in 1990. In Asia in many countries waste paper utilization is about 50% and in Republic of Korea it is about 70%. Utilization of waste paper is ecologically desirable as it lowers refuge, extends the life cycle of carbons in waste paper fibers. In countries with shortage of fibrous raw material resources, waste paper processing will prevent over cutting of forests. It also reduces energy demand significantly. The BOD discharges in mechanical waste paper processing is about 15-20 kg/t and COD about 40 kg/t. of waste paper processed. In deinking emissions of BOD is 15-40 kg/t and COD is 50-90 kg/t. Losses in repulping waste paper are about 13-14%.

The world waste paper consumption is expected to rise from 32.8% in 1988 to 41% in 2001 or an increase in waste paper consumption by 45 million tonnes to

130 MT between 1990 and 2001 MT. In countries like North America waste paper use will grow sharply in liner and medium and perhaps in Newsprint. The levels in liner and medium will grow from 25% in 1988-89 to above 40% by 2001 in U.S. In Asia utilization rate is already high for these grades and no major increase is expected. In newsprint, Asia will achieve 50% waste paper content by 2001. Waste paper use in cartons and boards will be more than 90% (Japan is virtually 100% already) and in tissue around 80%. Only in printing and writing is the rate much lower and is as given in Table-3.

Table-3 : Utilization of Waste Paper in Printing and Writing Grade of Papers

Region	Utilization %	
	1988	2001
Japan	12.5	17.5
China	6	25
Other Asia	25	30

The waste paper utilization rates are already very high in Korea, Philippines and Thailand besides Japan and Taiwan. The trends likely to emerge in Asia as far as waste paper utilization is concerned are as in Table-4.

Table-4 : Likely Trend in Utilization of Waste Paper in Different Grades of Paper in Asia

Type	Waste paper utilization %
Unbleached corrugated, solid containers, sack kraft.	60
Newsprint and other comparable grades containing mechanical pulps.	10-30
Wood free papers	Less than 20% (46% in Philippines)

As far as China is concerned most of the new capacity planned is wood based. The plantation of Masson pine, paulownia pine, Pinus taeda and Eucalyptus will be the source of major new raw material. The felling cycles for pines range from 12-15 years. Growth rates are expected to be 10.5 m³/ha/year for

taeda and 7.5 m³/ha/year for masson pine. A number of new mills of very large capacity are planned. By the end of 1992, 90,000 hectares of Masson Pine and Pinus taeda will be planted in China.

Indian Paper industry scene

Indian paper industry is at cross roads today. New economic policy of the government will require the paper industry to catch up with the rest of the world. As a consequence the industry will be exposed to greater external competition both in terms of price and quality. Our installed capacity for paper and board rose from 1.37 lakh tonnes in 1951 to 33.04 lakh tonnes in 1992. Further there is a capacity of 3 lakh tonnes of Newsprint. The industry was centered around bamboo in sixties and switched to hardwood and bamboo slowly. Today 325 units in the country producing paper and board are distributed as under.

Table-5 : Raw Material Distribution in Indian paper industry.

Raw materials base	Units		installed capacity	
	No.	% of total	lakh TPA	% of total
Forest	28	8.6	14.44	43.7
Agric residues	87	26.8	9.42	28.5
Recycled fiber	270	64.6	9.17	27.8
Total	325	100	33.03	100

Out of this 33.04 lakh tonnes capacity, 7.85 lakh tonne capacity is closed. The capacity utilization based on total capacity is 62% and actual production is 20.5 lakh tonnes. Demand for paper & board and newsprint is bound to increase. As per planning commission target, the per capita consumption of paper & board and newsprint by year 2000 will be 4.5 kg. and 1 kg. respectively or an installed capacity of 42.5 and 12.5 lakh tonnes per year respectively. The actual demand for paper as per ICICI by year 2000 will be about 37.9 lakh tonnes per year. But with new economic outlook, the demand for paper and board may be between 45-50 lakh tonnes by 2005 AD besides newsprint. The performance of the industry so far is rather weak. Many external forces have been harassing the industry. The shortages of fibrous raw material resources and energy availability are two most important parameters. Use of large quantity of fresh water and

discharge of heavy amounts of polluted waters have put the industry as a heavily polluting industry. Similarly air emissions with high percentage of TRS compounds, SO₂ and particulates from kraft paper mills is a cause of concern. The disposal of large quantities of solid wastes (sludges and ashes) has been a major problem. All the factors have made the industry environmentally incompatible. While production of paper and pulp will have to increase to meet the developmental needs, the industry has not been sustainable so far. What are the options on raw materials and other factors to make this industry grow in a sustainable manner. The answers will have to be based on utilization of sustainable raw material resources, and clean & environmentally friendly technologies.

For the current about 20 Lakh tonnes of Paper and Board production raw material imports are 5 lakh tonnes. Current usage pattern shows 39% bamboo 27% wood, 15% waste paper and 19% non-conventional resources. The waste paper to large extent is from imported sources and very little indigenous waste paper is used.

The availability of forest based raw materials is rather limited. The forests appear to be over exploited and the plantations have not made any significant contribution. It is unlikely if forest based raw materials can support more than 13-14 lakh tonnes of production of Paper Board and Newsprint put together. The availability of Bamboo and wood would be about 20 and 13 lakh tonnes by 2000 AD. Agro residues appear to be next best choice. Better collection of straws greater use of jute are two possible options. The use of straws and jute should sustain a production of 6-7 lakh tonnes against current level of 3-4 lakh tonnes. The issues will be again better collection, storage and handling of straws.

Bagasse appears a very promising alternative as India is number one producer of sugar cane in the world. In 1989-90. total area under sugar cane cultivation had been 3.4 million hectares and production of sugar was 10.988 million tonnes. The total sugar cane produced was 222 MT. in 1986-87. 85 million tonnes of sugarcane out of a total production of 182 MT (or 46.7%) went for sugar production. The availability of sugar cane bagasse at 60% level (it can

be up to 80%) and working on a surplus bagasse of 8-12% the possible paper production is shown in Table-6.

Table-6 Paper Production Possibilities From Surplus Bagasse (Million tonnes)

	1990-91	1994-95	1999-2000
Cane crushed	103.57	132.18	160.67
Availability of bagasse at 60% level	62.14	79.31	96.40
Availability of Surplus Bagasse			
at 8% rate	4.97	6.35	7.71
at 12% rate	7.46	9.52	11.57
Potential Paper Production			
at 8% rate	0.83	1.06	1.28
at 12% rate	1.24	1.59	1.93

Basis : 1 tonne pulp is made from 6 tonnes of mill wet bagasse.

At 80% availability and 12% surplus, potential for pulp from bagasse will be 25.7 lakh tonnes. This obviously would mean a tremendous effort to increase the efficiency of sugar mills to release surplus bagasse, improve bagasse collection, storage and handling facilities.

Waste paper will be another major area to look at and this sector has a potential for about 8.5 lakh tonnes of paper. Our current level of waste paper utilization should go up from less than 20% level to beyond 30% (or even 35%) level in next 8 years and to 40% level (or even 45%) level by 2005. This would mean 8.5-9.5 lakh tonnes paper by 2000 and 14-15 lakh tonnes paper by 2005. This waste paper has to be from the twin sources of indigenous wastes as well as imported wastes almost in 50:50 ratio. Currently indigenous waste utilization is rather very low. The problems in waste paper utilization will center around collection, segregation/sorting of waste paper and technology of waste paper deinking and cleaning.

The other options appear to be means of increasing yield in chemical and mechanical pulping processes.

Mechanical pulping processes are mostly used in newsprint manufacture while chemical pulping processes are used for bleached and unbleached varieties. The yields from forest based materials is about 50% for unbleached varieties while it is 42-44% for bleached varieties. The figures are lower when one uses agri-residues and bagasse. The use of methods to increase yields marginally (say by 2%) will have significant level of raw material savings. At 20 lakh tonnes production of paper and board, if one assumes a 2% increase in yield, it would mean a saving of fibrous raw material to the tune of 1.5 lakh tonnes. Similarly there are certain grades of paper where conventional chemical pulp use can be changed to use of mechano-chemical pulps where yield levels are 12-15% more.

The area of bleaching needs attention to ensure bleach plant effluents do not cause major environmental damage through release of high levels of AOX. The choices are to slowly replace chlorine and hypo stages and introduce oxygen and chlorine dioxide. This must be accompanied by a conscious effort to reduce waste water discharges by greater degree of systems closure and introduction of recycle loops.

Options For Sustainable Paper Industry In India

In order to make the Indian paper industry meet the challenges and make it sustainable, number of options are available to be considered. These are listed as under :

1. Increase the forest cover by man-made plantations of suitable polycultures and increase the available forest based raw material. This required a sustained planned effort and significant investments and land for plantations.
2. All new paper units planned should be on a sustainable basis as far as raw materials are concerned. This would mean the selection of furnish should be based on attached agro-forestry produce (either by use of waste lands or by individual farmer level contracts). This necessarily would mean planning for raw materials at least 10 year ahead of pulp production for forest based materials.
3. The utilization of other agro residues will have to be improved. The agto-residue fibers include rice

and wheat straw. jute, sarkanda and many other varieties of grasses. The major issues needing attention will be their collection. Storage, handling and processing. The area of black liquor handling also needs greater care. One of the alternatives could be two street pulping with one street on agro-residues and another street on forest based materials and common processing of black liquors from both streets.

4. The area of bagasse needs maximum attention particularly with respect to release surplus bagasse. All efforts should be directed towards improved working of sugar mills to make available 10-12% surplus bagasse. Concept of replacement bgasse is not really sustainable. The other area needing efforts would be better utilization of bagasse for pulp production through improved collection, storage, handling, depithing and processing.
5. There should be certain over riding clauses on minimum use of recycled secondary fiber (indigenous or imported) in almost every mill and grade of paper (except perhaps some special grades). This requires planning towards import of good quality secondary fiber and improved indigenous waste paper collection. The country should have targets to reach 35% recycle use level by year 2000 and 45% levels by 2005.
6. Increased use of secondary fiber would require development of technology and machinery in processing secondary fibers namely deinking and cleaning besides new thrust on treatment of effluent waters from these processing units. The increased use of waste paper must bring in advantages of reduced energy and chemical consumption and reduced waste water discharges.
7. Bamboo (and to some extent pine) can be considered as the best indigenous fibrous raw material source and its exploitation should receive maximum attention to ensure its sustainability. The juvenation programmes of bamboo forests needs strength-ening from forest management point of view. For sustainability, its use in paper manufacture may have to be closely controlled. One can start looking at this material as essentially a reinforcing fiber and limit it's use to a certain upper limit. Till such time that adequate bamboo

crop is not assured, the import of pulp/chips from long fibers furnishes may have to be encouraged.

8. In order to make pulp and paper processes sustainable, it is essential that manufacturing processes are environmentally friendly and are based on clean production options. Paper industry has a poor image in this regard. The technology upgradations should then be towards reduced energy usages, increased yields, replacement of chlorine/hypo based bleaching systems, closed water cycles and more energy efficient end of pipe line treatment and greater usage of waste papers. Some of the areas of focus could be the following :

Continuous pulping processes for agri-residues.

Cold blow pulping for woods and bamboo to reduce energy consumption and control sulphur emissions.

Improved washing including use of belt washers and presses to reduce losses and increase black liquor concentration.

Introduction of Oxygen pulping/bleaching.

Reduction in use of sulphur and introduction of alkali-oxygen in pulping.

Attempts on yield improvements through selective extended delignification and use of catalysts.

Replacement of chlorine/Hypo chlorite by ClO_2 , peroxide system to make bleach plant discharges environmentally more acceptable.

Improvements in press section design to increase dryness of sheet entering the dryers.

Better design of paper machines to reduce steam consumption.

Improvements in fiber recovery systems.

Greater use of fillers in paper making.

Improvements in water recycle and systems closure. Improvements in waste water processing by use of anaerobic-aerobic system to make it less energy intensive.

The aim of the technological upgradation will be for environmentally compatible clean production proce

sses for pulp and paper manufacture. The Industry will aim for greater productivity, resource recovery and recycle of both water, fiber and waste paper, Improved efficiencies in energy and environment sectors and better utilization of fibrous raw materials and money through competent man-power.

9. Finally there is a need to develop a National paper raw material policy.

The Indian Paper Industry is geared to make a confident entry into next century using the available eight years left towards a sustainable industrial development based on clean production processes. The issues of raw materials for sustainable production of paper and pulp based on environmentally friendly processes will have to be addressed on a war footing.

Suggested Reading Material

1. "Our Common Future" by World Commission on Environment and Development'. Oxford University Press, April 1987—Reprinted (1989).
2. "Caring for the Earth—A strategy for sustainable living" Published by 'World Conservation Union', UNEP and WWF. Gland, Switzerland. October (1991).
3. "Pulp and Paper, case study No. 1"—Felligi, J. & Judt, M.— Conference on Ecologically Sustainable Development—Copenhagen, Denmark Published by UNIDO, October (1991).
4. "Report on Long Term Strategic Planning for use of bagasse as raw material for paper industry"— Report of sub-committee of Development Council for Pulp, Paper and Allied Industries. N. Delhi, July (1991).
5. "Asia Pacific Pulp and Paper"—year book and directory (1992).
6. Report of the workshop on country specific activities to promote cleaner production"—UNEP workshop-Paris September (1991).
7. "Report of the conference on Ecologically Sustainable Industrial Development"—General conference of UNIDO. Vienna. November (1991).

8. Asia-Pacific Pulp and Paper" No. 5 February (1992).
9. Address of Mr. K.L. Chugh, Chairman Development Council for Pulp, Paper and Allied Industries. New Delhi-13th March (1992).

ANNEXURE-1

IMPORTANT ACTIONS REQUIRED FOR SUSTAINABLE DEVELOPMENT

1. Respecting and Caring for the Community of Life.

- Develop world ethics for living sustainably.
- Promote world ethics for living sustainably at national level.
- Implement world ethics for living sustainably through actions in all sectors of society.

2. Improve the Quality of Human life.

- In lower income countries increase economic growth to advance human development.
- Provide universal primary education for all children and reduce illiteracy.
- Develop more meaningful indicators of quality of life and monitor the extent to which they are achieved.
- Enhance the security against natural disasters and social strife.

3. Conserving the Earth's Vitality and Diversity

- Adopt precautionary approach to pollution.
- Cut emissions of SO_2 , NO_x , CO and hydrocarbons.
- Reduce green house emissions. Prepare for climate changes.
- Adopt an integrated approach to land and water management using the drainage basin as the unit of management.
- Maintain as much as possible each country's natural and modified ecosystems by protecting the best farm lands and managing it in ecologically sound ways.

- Halt net deforestation, protect large areas of old growth forests and maintain a permanent estate of modified forest.
- Use a combination of in-situ and ex-situ conservation to maintain species and genetic resources.

4. Keeping Within the Earth's Carrying Capacity.

- Increase awareness about the need to stabilize resource consumption and population.
- Integrate resources consumption and population issues in national development policies and planning.
- Develop, test and adopt resource efficient methods and technologies.

5. Changing Personal Attitudes and Practices.

- Ensure that national strategies for sustainability include action to motivate, educate and equip individuals to lead sustainable lives.
- Review the status of environmental education and make it an integral part of formal education at all levels.
- Determine the training needs for sustainable society and plan to meet them.

6. Enabling Communities to Care for Their Own Environments.

- Improve exchange of information, skills and technology.

7. Providing a National Frame Work for Integrating Development and Conservation.

- Adopt an integrated approach to environmental policy with sustainability as the over-all goal.
- Subject proposed developmental project to environmental impact assessment and to economic appraisal.
- Establish a comprehensive system of environmental law and provide for its implementation and enforcement.

— Use economic policies to achieve sustainability.

— Provide economic incentives for conservation and sustainable use.

8. Creating a Global Alliance.

— Strengthen existing international agreements to conserve life support systems and biological diversity.

9. Energy.

— Develop explicitly national energy strategy.

— Reduce the use of fuels, wastages in energy distribution and pollution from commercial energy sources.

— Develop renewable and other non-fossil fuel energy sources.

— Use energy more efficiently in home, industry business premise and transport.