URBAN ENVIRONMENTAL RISK ASSESSMENT THROUGH ENVIRONMENTAL EDUCATION AT URBAN SOLAPUR (INDIA)

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ABSTRACT

Considering the rapid urbanization, sustained productivity of natural resources should be an integral part of any urban development policy. The biogeochemical cycles and ecosystem services link urban and rural ecosystems. It is, therefore, essential that ecologically significant habitats along urban-rural continuum be protected to secure public and environmental health. This necessitates their identification and the establishment of administrative and legal foundations for urban nature conservation in the management of urban habitats, should be established. A group of 21 pupils were specially educated in the sector of environmental impact assessment. Through robust practical experiences of EIA ecological analysis of urban habitats of urban Solapur was conducted. The study led to the identification of a total of 12 ecologically significant habitats. Nature conservation priority was rated, in the area of the habitats. Assessment led to the identification of ecologically significant habitats that made up about 25.1 sq.km. against the total urban area of 338.8 sq.km. The total urban green space falls far below the requirement of 7 m^2 required by the city planning law. The total number of plant species was estimated to be 173.

Key Words : Environmental education, Nature conservation, Sustainable development, Ecosystem, Plant species

INTRODUCTION

Environmental education is a must for every human on earth. Environmental impact assessment should be done everywhere on earth. Environmental literacy is the only weapon that leads to sustainable development. A rapid growth of human population and consumption, and ecologically incompatible land- and energy-use decisions based solely on economic considerations increasingly degrade the structure and function of rural and urban - industrial ecosystems. The resultant environmental problems include pollution of air, water and soil, losses of biodiversity and prime farmlands, and fragmentation and destruction of ecologically significant habitats. Local environmental degradation due to urbanization and industrialization, in turn, contributes to such regional and global environmental changes as climate change, acid deposition, depletion of stratospheric ozone layer, and biological invasions. Therefore, there is an urgent need for a holistic approach of urban nature conservation, particularly in rapidly urbanizing areas.

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Urban human population of the world increased to 50% in the year 2000 and is expected to increase to more than 66% by 2025[3]. Urban corridors, woodlands, greenways, parkways, parks, gardens, orchards, wetlands, are the major representatives of ecologically significant habitats in urban areas. Ecologically significant habitats provide such ecosystem goods and services as primary and secondary production, regulation of hydrological and micro climatic conditions, sequestration of greenhouse gases, shelter and protection for organisms, assimilation of wastes, pollutants and noise, integrity of habitats, conservation of biological diversity, enhancement of environmental awareness, recreational values, and biological indicators for environmental health[4]. The purpose of this study was to assess degradation of the ecologically significant habitats of the urban settlement of urban Solapur and processes by which long-term sustainability of ecosystem goods and services provided by the

habitats are secured and threatened.

The district covers geographical area of 14845 sq.kms. which is 4.82% of the total area of Maharashtra State. Out of the total area of the district 338.8 sq.kms (2.28%) is Urban area whereas remaining 14505.8 sq.kms. (97.72%) is Rural area. The urban area of Urban Solapur is located at : Latitude 17° 42' to 18° 32', and Longitude 74° 33' to 76° 54', comprises about 338.8 sq.km. against the total area of the district 14845 sq. km. The land use pattern at Solapur district is given in the **Table 1**. District Solapur is located on major road and rail routes between Mumbai and Hyderabad, with a branch line to Bijapur. Solapur is influenced by its geography and the area largely consists of plains. The south-west and north-east parts of the district are arid areas. The district enjoys an overall tropical climate with the average rainfall 545 mm, Temperature ranges between 42 °C to 13° C.

Table 1 : Land use pattern of Solapur

Sr.No.	Type of land use	Area in sq.km.
1.	Agricultural Area	11480 sq.km
2.	Cultivable not in use	380 sq.km.
3.	Non-agricultural	690 sq.km
4.	Grass Lands and Herbs	720 sq.km
5.	Forest Cover	350 sq.km
6.	Wastelands	1260 sq.km
7.	Draught prone areas	14844.6 sq.km

Source: District collectorate, Solapur, MS, India

MATERIAL AND METHODS

Environmental education campaigns were arranged at local levels. An open advertisement regarding practical training in environmental impact assessment called individuals with common interests. An overwhelming response on the first hand was the success in this regards and it compelled our objective to follow strict selection criteria.

A peer of 21 was ultimately finalized and was trained for the required aspects. We were successful in achieving our goal of the EIA at local level. The study area included urban Solapur area that was surveyed for understanding the phytogeographical domain and the dominant vegetation of the study area. In the course of field observations, the following variables were taken into account in the

identification of ecologically significant habitats of Urban Solapur : location; topography; spontaneous and planted vegetation; actual land use; areal extent; site age; species richness; abundance, cover, sociability, stratification and tallest tree of vegetation; and rarity. Urban habitats were sampled through the representative quadrats to obtain values of species cover-abundance and sociability according to the Braun-Blanquet's scale. Rarity, stratification, areal extent, site age, and species richness were measured based on a standardized scale ranging from 0 (least possible value) to 5 (highest possible value). The variables in the rating of ecological significance and conservation priority of urban habitats were of equal weight. Value of ecologically significant urban habitats to the explanatory variables of rarity, stratification, area, site age, and species richness were calculated according to the methodologies for ecological study and vegetational analysis[2].

RESULTS AND DISCUSSION

Ecological assessment of habitats of the urban settlement of Urban Solapur and its surrounding revealed a total of 12 ecologically significant habitats composed of human-managed and semi-natural ones **(Table 3)**.

**Table 2 : Comparison of ecologically significant habitats
(Year-1998 and 2006)**

Habitat Type	(Semi) natural		Degradation (%)
	1998	**2006**	
Tallest Trees (m)	12	10	-24
Total woody cover (%)	13	9	-31
Planted vegetation (%)	46	39	-15
Spontaneous vegetation	17	12	-29

Explanation : - negative index, + = positive index.
Calculated using Braun Blanquet methods of vegetational analysis (1932)

Table 3 : Ecological description of habitats in urban Solapur

Ecological description	Type of habitats	Land in sq.km.
City Parks/Gardens	Semi natural	3.2
Social forestry area	Natural + Semi natural	6.2
Professional High Schools	Human Managed	2.5
Cemeteries	Semi natural	1.2
Orchards	Human Managed	3
Vacant spaces	Semi natural	5
Railway sides	Human Managed + Semi natural	0.5
Bird sanctuary area	Human Managed + Semi natural	3
Private ecological habitats	Human Managed	0.5
TOTAL area in sq.km. =		25.1 (7.4% of total urban area)

Source : District collectorate, Regional Director of forestry, Institutional Authorities, District Commissioner

Ecologically significant urban habitats made up about 25.1 sq.km. (7.4%) of the total urban area. Parks, gardens, reserved areas, bird sanctuary, cemeteries, and horticultural land received the highest ratings for nature conservation priority. Species richness of urban Solapur was estimated to be 173 out of which woody and non-woody species were 77 and 96, respectively. Prevailing semi-arid conditions make the ecosystems extremely vulnerable to and unable to recover from drastic human-induced disturbances unless preventive and mitigative measures are taken against the threats to their present and future well-being.

The explanatory variables of species richness, rarity, and area were of great importance in accounting for variation in conservation priority of the urban habitats. According to the studies there were strong positive relationships between species richness and rarity, and species richness and stratification. The positive relationship between species richness and stratification revealed that an increase in the stratification of vegetation as in the successional development assists in the sustainable management of the urban habitats. Planting of indigenous species decreases uses of biocides, irrigation and fertilizers, and the establishment chance of invasive species, thus lowering maintenance costs of the urban habitats. Indigenous species also supply food sources for wildlife, and hence, is more amenable to sustaining wildlife than exotic species.

- Misuses, overuses, and incompatible uses of land and water resources, with the resultant environmental impacts on urban and (semi)natural habitats of Urban Solapur were studied. Urban sprawl of urban Solapur has resulted in an irreversible loss of productive horticultural lands, orchards and vineyards. Remnants of these agricultural lands along highways have been adversely affected by the accumulation of heavy metals in soils,

and air pollution caused by heavy traffic. Thus, the resultant decrease in agricultural productivity and produce quality has impaired public health and economic well-being. The usage of agricultural and natural forest areas to provide urban residential areas have resulted in the losses and degradation of steady-state ecosystems at urban Solapur area. This has caused the losses of such important ecological functions as the prevention of soil erosion, flooding in some areas, and purification of water, soil and air, and the provision of recreational and aesthetical values, and biodiversity. The Remainders of woody plants together with shrubs should therefore be protected for the sustained biogeochemical maintenance of ecosystem goods and services that satisfy local human needs for the present and future generations. The environmental interactions among major land uses at urban Solapur area with reference to the - land use and its environmental impact, environmental impact on land use and land use affecting as well as being affected adversely, were also studied with regards to the facts recorded at urban Solapur **(Table 4)**. The most alarming findings comparing the ecological status in the year 1998 and 2006 - is that in the (semi) natural areas areas we recorded a decrease in :

The total woody cover = - 31 %,

- Tallest trees = - 24%,
Planted vegetation = - 15%,
- Spontaneous vegetation = -29%

Ecologically significant habitats have been so degraded by uncontrolled disposal of residential and industrial wastes that they have become aesthetically unpleasant and a source of bad odor. Wetlands at Solapur were drained and filled up to be converted into residential, agricultural and waste disposal areas. This has

Table 4 : The environmental interactions among major land uses at urban Solapur area

Environmental impact	Housing	Food and Chemical industry	Transportation	Disposal and& burning of waste	Burning of fossil fuels	Cropland	Recreation	Nature conservation
CLIMATE								
Aerosols	◉	■	◉	■	■	●	●	●
Air pollution	◉	■	◉	■	■	●	●	●
Noise		■	◉	■	■		●	●
SOIL								
Erosion by water						◉		●
Erosion by water						◉		●
Soil pollution		■	■	■	■	◉		●
Loss of productive soil		■	■	■			●	●
WATER								●
Pollution of surface water	◉	■	■		■	◉	●	●
Pollution of Ground water	◉					◉		●
Decline in water table	◉	◉				◉	◉	●
VEGETATION								
Loss of biodiversity	■			■	■		◉	●
Fragmentation	■			■			■	●
FAUNA								
Loss of biodiversity	■				■	◉	◉	●
Fragmentation	■							●
AESTHETICS								
Visual distortion	◉	■	■	■			■	●

Explanation : ● : Land use and its environmental impact; ■ : environmental impact on land use
◉ : land use affecting as well as being affected adversely

Fig. 1 : Location of Solapur District on the map of Maharashtra State (India)

caused such ecological services provided by the wetlands as migration routes for birds, regulation of hydrological cycle, biodiversity, and assimilation of water pollutants to be lost irreversibly. Chemical and food industries have caused a substantial decrease in water quantity and quality due to their excessive water use and disposal of untreated wastes. Ecologically improper waste disposal and vast landfills (10-20 m wide) have destroyed the aquatic life, altered natural pattern of drainage and impoverished recreational value in the wetland areas. Population of Urban Solapur increased rapidly at an annual rate of 19.2% from the year[5] (Census reports 2001). Currently, Urban Solapur has a total open greenspace of 25.1 sq.km (equivalent to 7.4% of the total city area) 3.2 sq. km of which made up public parks (equivalent to 1% of the total city area) . Per capita greenspace and public park area are well below per capita urban greenspace of 7 m^2 required by city Planning law. Although environmental law of national parks enunciates the necessity of preventive and mitigative measures towards rational uses of natural resources, there are no clear legal measures and public policies that take into account the nature conservation of urban habitats.

Mahatma Gandhi national zoo, and the lake Sambhaji are close together. The area around lake Sambhaji has been declared a bird sanctuary. Lake Sambhaji is situated in the declared bird sanctuary area (a semi natural and human managed area) in the heart of Solapur district **(Fig. 2)**. Despite the sanctuary area occupies a small area of 3 sq Km. yet it supports rich diversity of flora and fauna and is unique ecosystems. Lake Sambhaji is a major Lake of Solapur city. It is one of the magnificent avian habitats in the district of Solapur. Lake Sambhaji is a naturally occurring lake, with a surface area of 8.6 hectares, a mean depth is ... rs, and a maximum depth of 24.15 ... he volume of the lake is 54716 cubic ... ompassing a shoreline length of 1179 ...

... Mahatma Gandhi National Zoo, has ... als and birds well nourished that provide educational and recreational amuse-ment to the people of Solapur. The Zoo has monkeys, tiger, lion, porcupine, Indian fox, crocodile, rabbits, wild cat, cheetah, Indian hare, leopard, deer, antelopes, Terrestrial and water snakes, peacock, turkey, etc. The zoo area is densely planted and also has natural woody species in the vicinity. The lake Sambhaji stands south to the zoo after an elevation and this total area is a master piece of beauty and the centre of attraction. The naturally occurring flora contains grass, scrub, woodland, semi-arid and aquatic habitat. Variety of habitats is one of the reasons of its rich biological diversity. Local people since beginning have utilized it for cattle grazing although banned several years ago.
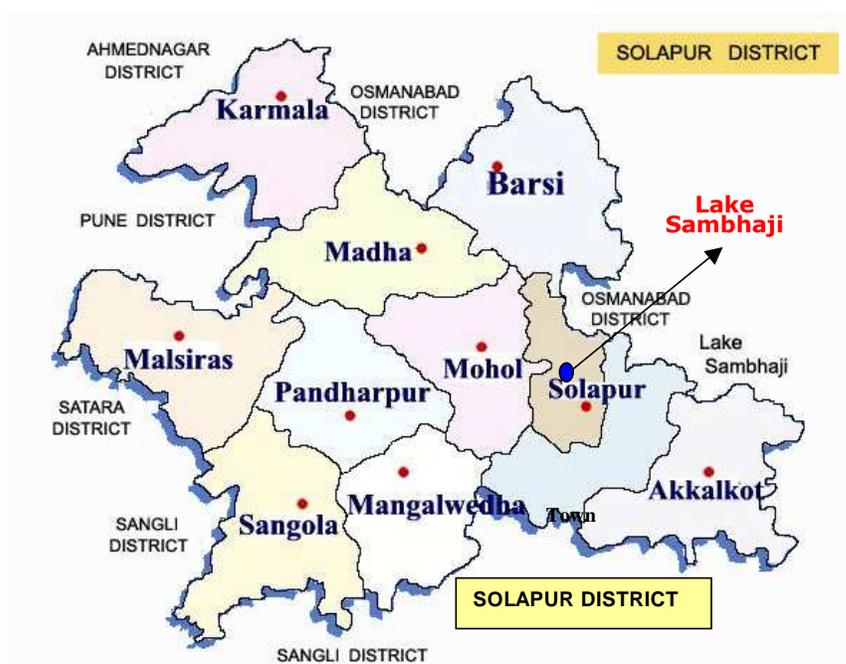
Fig. 2 : Map of Solapur District, M.S. (India)

Incidents as killing of deer's, rabbits in the surrounding and in the zoo have been recorded. Inhabitants of the adjoining area still liberally use this land for cattle grazing. Increasing anthropological activities as cattle grazing, for common resources like water, fodder, fuel wood, coupled with irregular and scarce rainfall is a major threat for the viable future of this natural area.

Given the rate and stock-limited natural resources of the world, developing sustainability requires that human activities use natural resources and generate wastes without progressively exceeding the productive, assimilative and regenerative capacities of and impairing the biogeochemical integrity of habitats wherever located. Integration of nature conservation strategies into regional and urban land use planning is an integral component of any sustainable urban development policy. It is essential that habitat links along urban -rural continuum be established and augmented in bioregional context by the identification and protection of ecologically significant habitats.

In this way, ecosystem goods and services as the ultimate source and foundation of wealth upon which the urban -rural activities depend are sustained. The identification of urban habitats and the rating of their conservation priority should be accompanied by the monitoring of spatial and temporal patterns of changes in habitats (location, magnitude, direction and rate of changes). This allows management alternatives to be adapted to dynamic environmental conditions and societal requirements. Probably the increase in ; the total woody cover (+35 %), increase in the tallest trees (+42%), Planted vegetation (+9%), indicates the impact of environmental literacy on the human managed habitats, where the estimated adult literacy rate for India has been estimated to 20%[5].

CONCLUSION

With our contemporary understanding of environmental threats, one can see now more clearly that our solutions to environmental threats are tied to our economic development paradigms. Ignorance of our global

interdependence, unsustainable population and consumption growth, distributive injustice of wealth and power, externalities, and lack of coordination for institutional regimes are the major root causes of the degradation and destruction of the environment. Since cities are the dense concentrations of population, energy-material consumption, and waste generation, urban nature conservation strategies should be developed to prevent :

(1) ecologically incompatible uses of energy, materials, lands, and species;

(2) degradation, fragmentation and destruction of habitats; and

(3) reversibly, or irreversibly inappropriate conversions among grasslands, forests, croplands, wetlands, and urban - industrial lands. Strengthening institutional conditions for the formulation and implementation of sustainable urban policy and management includes :

(1) harmonization of the free market with the objectives of participative democracy, social solidarity, and sustainability

(2) environmentally adaptive and decentralized approaches in the process of decision- and policy-making;

(3) a sound partnership among public and private sectors;

(4) a balanced investment in human, natural and man-made resources; and

(5) coordination of sectoral policies and institutions.

We have taken immediate actions as regards:-

- Recommendations to government authorities about present ecological status & self initiatives on imposing:
- Immediate check on unauthorized intruders in the area
- Penalization upon violation of the rules
- Total ban on illegal cutting of trees and its parts, fishing, cattle grazing in and around the area .

- Plantation programs with immediate effect with the help and involvement of local population.
- Gain confidence of the local population, to bring justice to the area through conservation and management activities.

ACKNOWLEDGEMENT

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