Oswal, P., Patwardhan, A., Sahasrabuddhe, K., Mahabaleshwarkar, M., Nalavade,S. and Ghate, U. "Assessing Ecosystem Health Indicators In Pune City, India" in Martin J. Bunch, V. Madha Suresh and T. Vasantha Kumaran, eds., *Proceedings of the Third International Conference on Environment and Health, Chennai, India, 15-17 December, 2003*. Chennai: Department of Geography, University of Madras and Faculty of Environmental Studies, York University. Pages 315 – 321.

ASSESSING ECOSYSTEM HEALTH INDICATORS IN PUNE CITY, INDIA

Patwardhan, A.*, Sahasrabuddhe, Oswal, P*., K. **, Mahabaleshwarkar, M. **, Nalavade,S. and Ghate, U[#].**

Abstract

Assessment of ecosystems and human health of Pune City, Western India (18°32'N and 73°46'E) has been underway since the year 2000 with the purpose of developing a blueprint for sustainable development based on "wise" principles. Ecosystem health has deteriorated on the parameters of Biodiversity (10-30%), Carbon emissions (25-40%) and Water quality with a subsequent increase in health related problems by 10-20 % both because of changing food habits and deteriorating quality of available resources. This, coupled with a 56 % increase in human population and 50 % increase in aerial expansion over last decade has overstressed the available resources such as water and energy. Pollution, uncontrolled harvesting and introduction of exotics seem to be threats to the biodiversity, while misuse of resources and changing cultural trends such as over reliance on table work with an improper food regime, can be attributed as precursors of health related problems. A sustainable development plan requires mass participation, and recorded past evidences based on 'Wise Ecosystem Principles' through encouragement of Low External Input Sustainable Activities (LEISA) to reduce high 'Ecological Footprint' as we are proposing.

Introduction

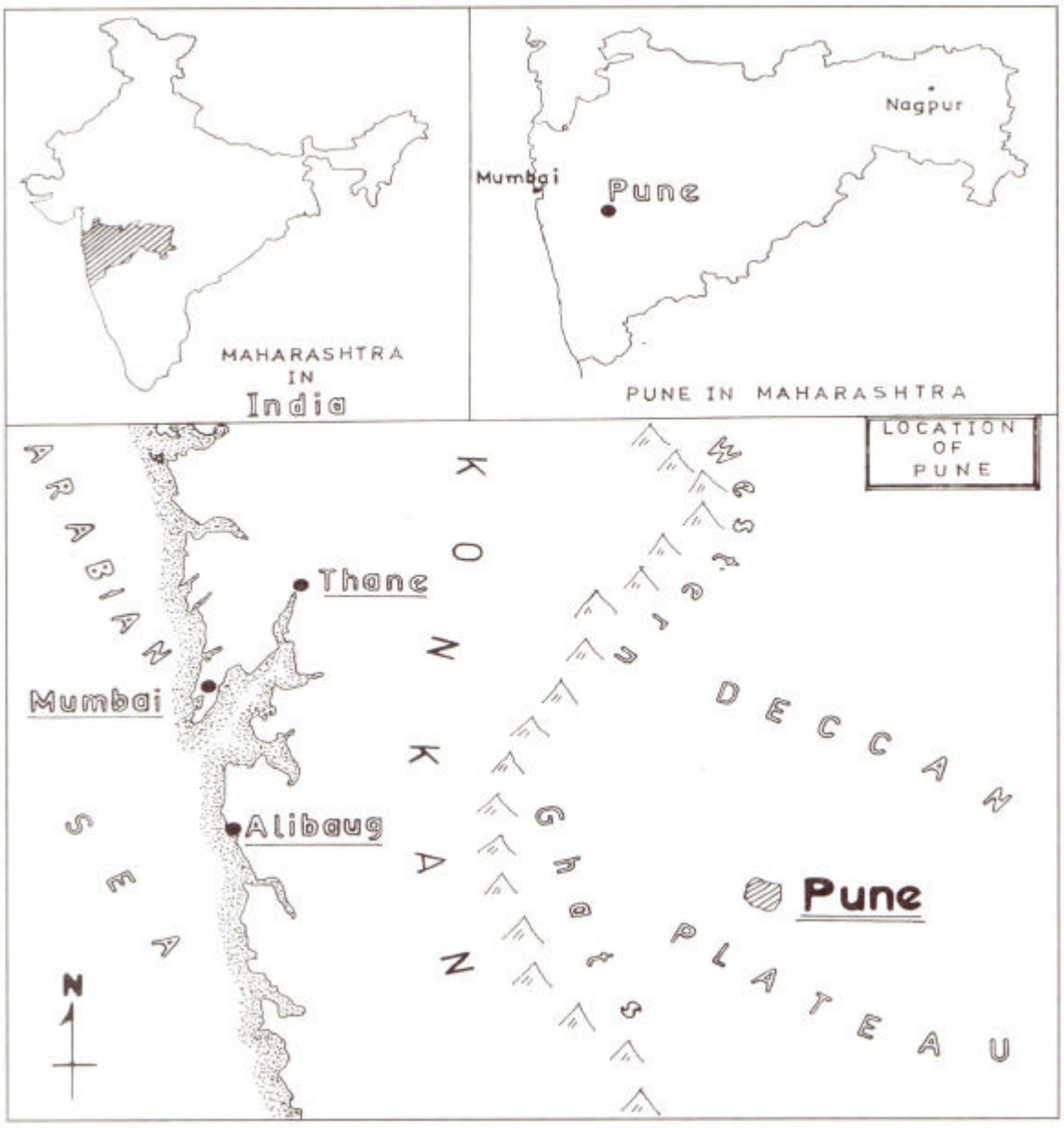
Urbanization has been identified as one of the most important factors responsible for deterioration of ecosystem health as proven by various case studies worldwide (10, 5). Also, urban areas are high resource consuming centers as indicated by their high ecological footprint (11). Characteristic disease composition in humans is associated with process of urbanization. Currently Pune enjoys the status of being 7th industrially ranked city of India (4).

The present paper discusses the impact of rampant urbanization on ecosystem health and comments on associated health concerns in Pune City. Ecosystem health indicators were identified by studying ecosystem services such as biodiversity and disservices such as carbon emissions. The paper also talks about the likely strategies required to prepare a blue print for sustainable urban lifestyles at various scales ranging from individuals to community organizations to policy makers.

Methodology

Introduction to study area

This study has been conducted at Pune (18^0 31' N, 73^0 51' E) which is a plateau city situated approximately 160 km south east of Mumbai, near the western margin of the Deccan plateau (map 1). It is situated at a height of 560m above the mean sea level at the confluence of Mula and Mutha rivers. The city is surrounded by hills on the west and the south.

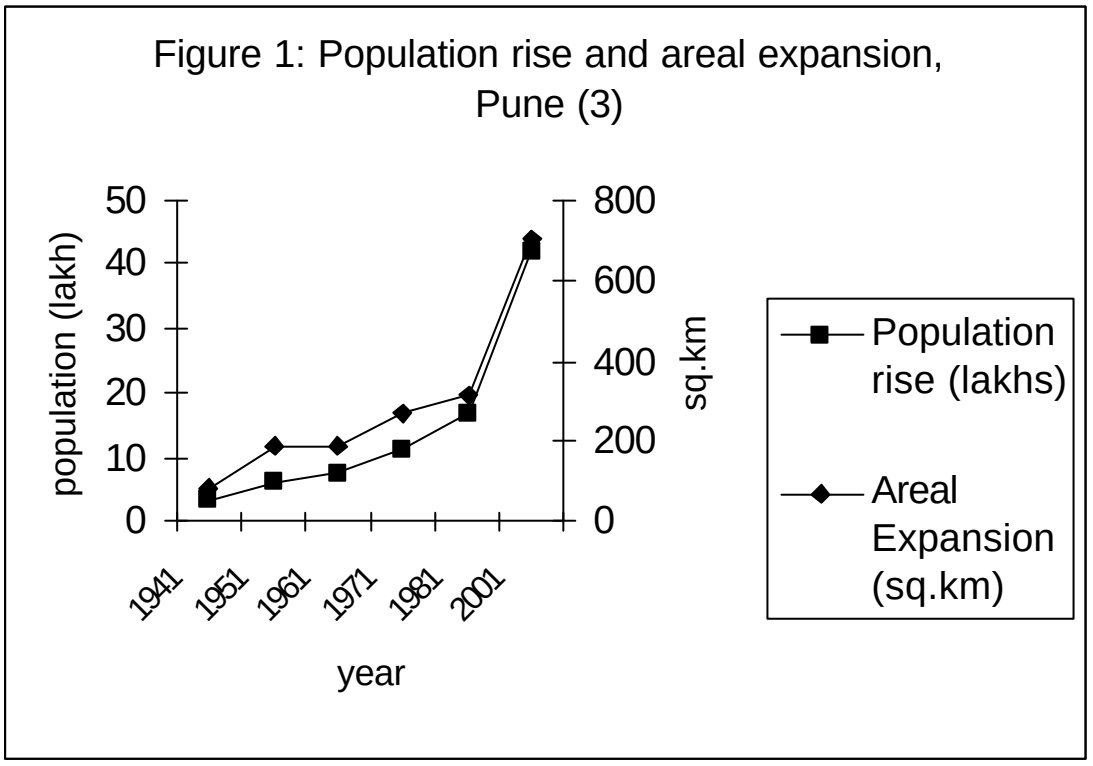


Methods

Ecological monitoring with living organisms as indicators of ongoing changes forms the most cost-effective way of better understanding the current changes in the environment (1). This approach was used to assess the biodiversity service, which was then correlated with human impact levels. Impact levels were categorized at different scales based on pollution of aquatic environments, changes in land use pattern, introduction of exotics in the environment etc. Carbon emission calculations by (9) were used as baseline estimates. Contribution of vehicular pollution to total carbon emissions was calculated. Relative diesel and petrol emissions were also looked at to explore greener options such as bio-fuels. Health implications related to escalated air pollution levels was documented by consulting semi scientific articles besides interviewing private medical practitioners. Focused interactions with medical practitioners of many pathies also provided the insight to health hazards caused because of changes in food regime and lifestyle.

Results and discussion

Population of Pune has increased by 56 % over the last decade (fig 1)



This, coupled with a 50 % increase in areal expansion (fig 1) over the last decade has overstressed the available resources such as water and energy. Area under settlement has increased 2.4 times during last 30 years. This urban sprawl is mainly at the cost of agriculture and grassland-scrub, which has decreased by 31% and 39% respectively (3). This has altered habitat and habitat characteristics with subsequent changes in biotic communities across different taxonomic groups as indicated in (Table 1). Though factors like pollution and introduction of exotic species are known to affect species composition, growing cities harbor significant biodiversity levels, a value that needs to be understood and maximized (Table 2). The impact of urban areas is felt by peri-urban and rural areas especially on account of water and electricity supply. Along with biodiversity, ecosystem health was also found to have deteriorated on the parameters of carbon emissions. Pune city emitted 7.8 lakh tons of carbon in year 2002. Vehicular pollution contributed 52 % of total carbon emissions. Tree cover of

Pune sequesters only 2-3 % of these emissions and the rest remains as atmospheric overload (9). These emissions can be curtailed down by 30% (8) with the use of greener option such as bio-diesel. A case of Pune municipal transport services was studied to explore the potential of use of bio-diesel as an alternative strategy to conventional fossil fuels. It was found that to run 800 buses for 1 year, 10 % of the total Pune urban area has to be brought under oil borne tree plantation. Exploring this option has two distinct advantages, one being an increase in green cover and second being an increase in carbon sequestration potential. The oil can also be used to generate electricity in rural areas, and seed cake as fertilizer.

Table….1. Species composition change in Pune

Ecosystem	Taxa	Past data (no. of species)	C. 2001	Trend in last 5 decades
Terrestrial	Herbs		600	25% decline in vegetation cover, cosmetic increase in species composition
Terrestrial	Trees		350	
Terrestrial	Mammals	63	56	11% species locally extinct
Aquatic	Fishes	114	70	40% species locally extinct
	Amphibians	19	14	21% species locally extinct

Table…. 2. Biodiversity of Pune, Bangalore and Delhi (1)

GROUP	UNIT	Pune	Bangalore	Delhi
Fungi	Genus	65	--	--
Herbs	Species	600	--	--
Trees	Species	350	--	--
Aquatic insects	Family	13	--	--
Snails	Species	15	--	23
Ants	Genus	12	73	--
Butterflies	Species	105	130	50
Fishes	Species	70	40	87
Amphibians	Species	14	15	7
Reptiles	Species	50	37	25
Birds	Species	300	315	434
Mammals	Species	65	40	32

Carbon level emissions were found particularly high during episodic pollution events such as Festival occasions. During such occasions urban population is more prone to respiratory diseases. Medical practitioners report high sporadic increase in diseases like Asthma during festivals like Diwali when air pollution reaches its peak as indicated by increase in pollution levels by 40%.

Allergies due to inhalation are showing increase over the last few years. (Table 3) Among the children, the respiratory diseases like consistent cough and cold are on the rise. Air pollution along with fashion trends are the major contributors. Discussion with medical practitioners revealed that factors such as ozone layer depletion, contact with hazardous chemicals, canned food-additives, ill-defined environmental factors, increase in sour eating habits (as per Ayurveda) and fast-food eating are causative agents for skin problems. Skin problems such as sun allergies, allergies due to contact with detergents, cosmetics, diseases like Urtecaria, Psoriasis are showing their significant appearance and are on rise. Also awareness about skin diseases has reflected by an increase in the number of patients. A somewhat stable or declining trend has been noted in gastrointestinal disorders because of supply of treated drinking water to most of the urban population, increasing health consciousness and use of latest generation antibiotics.

Table…3. Human Health problems associated with Ecosystem Health changes

Ecosystem changed	Human health problems	Trend	Specialist
Air	Respiratory diseases	+++++	ENT
	Ear problems	+++	ENT
	Skin	++	Skin
Water	Skin	+	Skin
Noise	Ear	--	ENT

Scale

+: - Lowest occurrence

+++++: - Highest occurrence

Ear problems are secondary to respiratory problems in many cases as ENT specialists add. But are not common due to noise pollution. Instead noise pollution, an inevitable part of urban lifestyle and the increasing high frequency sound systems are adding to increases in irritability and mental stress which adds to heart diseases (table 4).

Table…. 4.Trends in lifestyle diseases

Lifestyle diseases	Trend	Factors affecting

Heart diseases	++++	Stress, noise pollution
Joint problems	+++	Professions, lack of proper movements

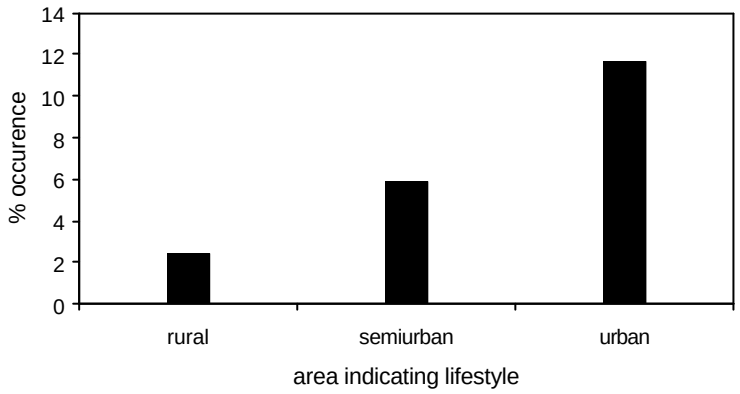
Scale

+: - Lowest occurrence

+++++: - Highest occurrence

The relation between lifestyle stresses and cardiovascular diseases has been explored by Lubree et al. (2). The lowest age at which these diseases occur is lowering very fast from 40-50 years to 25-30 years. The occurrence of type II diabetes has increased owing to sedentary professions, alcohol consumption, food habits etc along with a major heredity factor. (Fig 2) depicts that the occurrence is more in urban area as the factors causing it are prevalent there (6).

Figure 2: Life style changes and occurrence of type II Diabetes (6)



A changing food regime has been identified as one of the major causative factors of most of the diseases prevalent today. Health risks caused because of this cultural shift can be minimized if safer options like Organic/ Ethnic Foods are explored (7). This has an added advantage of lowering the environmental stresses as organically grown crops do not pollute soil or water, do not kill soil microbes or micro fauna or pests-predator insects/ birds, and no chemical fertilizers/ pesticides are required. Increasing demand for traditional crop varieties and ethnic foods and recipes would conserve those, satisfying consumers' taste; unlike unhealthy fast food/ drinks like Coke and Pizza. The other options in the same series for eco-lifestyle to better the ecosystem health and human health could be the use of Handloom Clothes which are not only good for skin health but also causes less pollution than synthetic clothes cause due to petroleum products used (7). Shifting to biomass based furniture will reduce the carbon emissions at the source thereby improving overall environment health (7).

These lifestyle alternatives practiced individually will surely add to mitigate health hazards at micro-level while supporting environment actions at policy level, which can be as follows:

1. Ward level management plans can include development of new theme parks such as meditation centers as described in Ayurveda by garden departments.
2. Promoting Bird and Butterfly attracting Plants as rooftop greenery, on the lines of now compelled rooftop water harvesting structures.
3. Conversion of abandon Stone quarries into Amphibian Parks, Butterfly Gardens, Eco-ponds, Quarry Gardens etc.
4. Preservation of original streamside vegetation wherever possible.
5. Establishing one-to-one barter system between city house and village house.

Acknowledgements

We thank all the medical practitioners representing different pathies for sparing their valuable time and experience.

Our heartiest thanks are due to Dr. Milind Watve, Head of Department of Microbiology, MES' Abasaheb Garware college, Pune for consistent encouragement.

References

1. Dixit A, S.Nalawade and G.Utkarsh (2000-01) Pune Urban Biodiversity: A Case of Millenium Ecosystem Assessment. *Journal of Ecological Society*, 13-14. pp 8-13.
2. Lubree HG, SS. Rege, DS. Bhat, KN. Raut, A. Panchnadikar, CV. Joglekar, CS.Yajnik, P.Shetty and J.Yudkin. (2002) Body Fat and Cardiovascular Risk Factors in Indian Men in Three Geographical Locations. *Food Nutrition Bulletin* 3 Suppl. pp 146-9.
3. Nalavade, S. (2000-01) Changin geography of pune urban area. *Journal of Ecological Society*, 13-14. Pp. 5-7
4. Patwardhan A, (2002) Taxoecology, Cellwall Analysis and Biological Control of Aquatic Fungi. Ph.D. Thesis submitted to University of Pune (unpublished)
5. Patwardhan A., S.Nalawade, G.Utkarsh and K.Sahasrabuddhe (2001) Urban Wildlife and Protected Areas in India. *Parks* 11(3). pp 28-34
6. Ramchandran A., C.Snehalata and V.Vishwanathan (2002) Burdan of type II Diabetes and complications and its scenario. *Current Science* volume 83, no.12.
7. RANWA (2003) Biomass Based Lifestyles and Development. *eco-ethic* The INECC Newsletter 15-16. pp 4-8
8. SuTra www.mecheng.iisc.ernet.in/sutra
9. Waran A, A.Patwardhan, U.Ghate and K.Sahasrabuddhe (2003) Urban Lifestyles and Carbon Balance in Pune: An Indian Case Study. *eco-ethic* The INECC Newsletter 15-16. pp 9-11.
10. WRI (1996) Urbanization: the challenge for the next century. *Finance Development* 33(2) pp.50.
11. WWF (2002) www.panda.org