

Recreational use value of Chandigarh city's urban forestry

Forests provide a range of benefits (both market and non-market) to the society. These non-market benefits (NMBs) or intangible benefits include open access recreation, public amenity and landscape benefits. Urban forests or urban greens are one of such resources, which are responsible for various environmental, social and educational benefits to the human society. Pressure of ever-increasing human and traffic population is not only telling upon cities' infrastructure but also on green belts of these big cities. Certain unscrupulous elements in the society always try to grab such green open spaces, especially in developing countries, for creation of concrete jungles. This happens because NMBs of such areas are not correctly valued and not fully incorporated into cost-benefit analysis of different developmental projects and into decision making on resource allocation. In this way there always remains danger of diverting these areas for other so-called development purposes and in the end, the societal welfare is not maximized. Moreover, urban development projects often decrease the amenity values of green spaces, which should be taken into consideration in planning. Therefore, quantitative information on residents' valuations attached to urban forestry is needed for assessing urban land-use. Keeping these facts in view, an attempt was made to quantify the recreational use benefits of urban forestry of Chandigarh city of India, which has been created after the country's independence in 1947 and known for its urban forestry in India.

In our country, very little work has been done on quantification of recreational use value of forest resources. Basically, these types of studies have been restricted so far to only few National Parks and Sanctuaries. Studies are not available on recreational use value of urban forestry of a big Indian city. Tree plantation and landscaping has been an integral part of the Chandigarh city's Master plan. The most fascinating feature of the city's landscaping is perhaps the tree plantation along avenues, open spaces, green belts and around building complexes. A number of beautiful avenues with conspicuous tree species, well-wooded forests along the periphery of city, Sukhna lake against the backdrop of lake reserve forest and green belts running across the length and

breadth of the city enhance recreational and aesthetic value of the whole city. The total forest cover is 32.42 sq. km, which forms 23.50% of the overall geographical area. The green spaces like 1900 numbers of small and big parks/gardens maintained by the Municipal Corporation, Chandigarh; green belts, road-avenues, etc. are in addition to this forest cover of 23.50%. Thus the green cover of the city is more than 33% of its area. The meandering Leisure Valley with its myriad colours and texture of its trees and flowers, attract not only city dwellers but tourists and other city-planners also. On the whole, the city gives the impression of a luxuriant garden. A few majestic ornamental trees, which have the capacity of attracting an environmentally conscious tourist's attention because of other impressive foliage/flowers in the city, include *Chukrasia tabularis*, *Ficus benjamina*, *Magnolia grandiflora*, *Pterospermum acerifolium*, *Mimusops elengi*, *Polyalthia longifolia*, *Putranjiva roxburghii*, *Schleichera oleosa*, *Swietenia mahagoni*, *Terminalia arjuna*, *Barringtonia acutangula*, *Millettia ovalifolia*, *Jacaranda mimosifolia*, *Lagerstroemia thorelli*, *Cassia javanica*, *Lagerstroemia rosea*, *Delonix regia* and *Koelreuteria apiculata*.

The present study¹ was designed and conducted during 2002–03, mainly to find out use value of urban forests/parks of the Chandigarh city from the point of view of city's residents and tourists visiting the city. Outside India, a limited number of references have been found when recreational benefits of urban forests/wooded areas/parks have been quantified in monetary terms. During the last three decades a number of valuation methods have been developed to derive monetary measures of the value of the changes in the quality or quantity of unpriced goods or services or to place monetary value on their recreational benefits. Two methods, i.e. Travel Cost Method (TCM) and Contingent Valuation Method (CVM) were used as these are universally regarded as proper techniques for estimating recreational value of various non-market goods/services. Zonal travel cost method was used on the tourists visiting the city and contingent valuation method (open ended) was used on the residents of the city.

Due to comparatively clean and green environment of the city, many people are being attracted to this city to permanently settle down here. This was asked from the respondents, i.e. what was the percentage contribution of green cover of the city, prompting them to select Chandigarh as a place of work or as permanent residence. While deciding about this percentage contribution (equivalent to marks out of 100), they were to consider employment opportunities, educational facilities and other infrastructural and entertainment facilities available in the city, competing with the green cover of the city. City's parks, gardens, ornamental trees and green avenues were found responsible to the extent of 55.65%, in attracting people to reside or work permanently in the city. The other factors like employment opportunities, educational facilities, etc. together account for the rest of 44.35%.

The mean willingness to pay (WTP) for the betterment of existing green landscape features and for creating new parks/gardens on the part of each reasonably earning family residing in the city has been found to be Rs 153 per year for a



A landscaped traffic roundabout.



Terraced garden.

period of five years, which converts to an annual recreational use value of city's urban forestry assets to Rs 27.50 millions at 2002–03 prices. A sample size of 2358 residents of the city and Contingent Valuation Method was used for arriving at the above estimate.

Based on a sample size of 904 tourist families and zonal travel cost method, the annual recreational use value of city's urban greenery on the part of tourists

coming to the city, was estimated as Rs 92.40 millions. Therefore, total annual recreational use value of city's parks/gardens, boulevards, green avenues, reserved forests, wildlife sanctuary and other green landscape features on 2002–03 prices, comes out approximately to be Rs 120 millions. This value suggests a keen potential role of urban greens in overall environmental conservation in polluted big cities of our country.

1. Chaudhury, P., Valuing recreational benefits of urban forestry – a case study of Chandigarh city, Ph D thesis, Forest Research Institute (Deemed University), Dehradun, 2006.

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Malaria – the cause of heartburn among scientists and funding agencies alike

On 15 September 2006, the World Health Organization (WHO) forcibly instituted the spraying of the insecticide DDT on the interior walls of homes across Africa to stop the transmission of the parasite from the *Anopheles* mosquitoes to vulnerable resident victims in endemic areas. WHO estimates that malaria claims more than a million lives each year, most of them children, with more than 300–400 million infections each year. Globally 40% of malaria infection is caused by *Plasmodium falciparum*, 50% by *Plasmodium vivax*, 7–8% by *Plasmodium malariae* and 2–3% by *Plasmodium ovale*. The major burden of this infection is borne by tropical Africa where 75% of the infection is by *P. falciparum* and is the main cause of all the mortality observed. DDT was used in the early 1950s as an insecticide to control malaria transmission but was then banned due to its many harmful consequences. In addition to affecting the central nervous system and various vital organs like the liver and kidney, there is documented evidence that spraying of DDT results in human sterility.

What has led to this reversal of strategy after billions of dollars spent on a scientific solution to a problem, existing in all probability from BC? The scientific solution is presently non-existent and might in part be used to prevent the disease – as the old adage goes – prevention is better than cure, which should be a regional government initiative. Of all the existing vaccination trials, the combined effort of the University of Oxford, Walter Reed Army Institute of Research (US), Glaxo-SmithKline Biologicals, regional Medi-

cal Research Councils across Africa and Europe and many others designed a candidate vaccine molecule which unfortunately resulted in barely 30% protection against natural *P. falciparum* infection, the main causative organism of malaria. This protection observed waned over time when assessed for its efficacy in the Gambia. However on a positive note, this protection against *P. falciparum* infection is not strain specific. The vaccine which is pre-erythrocytic named RTS,S/AS02 is assessed to be safe, immunogenic, and is made of the circumsporozoite protein fused to the Hepatitis B virus surface antigen – the first moderately successful vaccine against malaria but still not good enough for mass vaccination programmes.

The WHO has compiled a list of various candidate vaccine molecules designed, with the progress achieved in field studies. Many strategies have been employed with designs of the vaccine ranging from a single protein to multiple proteins administered on various carrier molecules as both DNA vaccines and protein molecules involving different immunization strategies and regimes. In 2005, the WHO documented that there were 94 designed candidate vaccine molecules from around the world comprising of proteins designed to immunize against various stages of the malarial life cycle. Of these, 33 had reached the stage of clinical trials involving challenge studies in both industrialized countries, where 30 candidate vaccine molecules were assessed and in endemic regions, where 13 candidate vaccine molecules were assessed. Subsequent to this enormous labour, effort and

million of dollars, now WHO recommends reverting to DDT. This, in spite of its many harmful documented effects both to the population and the environment, is still judged preventive if not protective – but fundamentally the only solution available. Where has the science or more accurately what have the scientists failed to comprehend? The responsibility for this dilemma lies not just with the scientists but also with the funding agencies as scientists are far from being infallible.

The fact that these candidate vaccine molecules resulted in no protection against the infection led to the design of using various carrier molecules such as virosomes, liposomes, and virus-like particles like Hepatitis B virus surface antigen which form 20 nm particles used in the RTS, S/AS02 vaccine, in order to effect the presentation of these candidate vaccines to the human immune system. Unfortunately there is no commendable protection against *P. falciparum* infection. The design of an efficacious protective vaccine against *P. falciparum* infection is of immediate importance and is feasible as individuals in endemic areas who suffer repeated *plasmodium* infection are eventually protected against further infection.

The design of vaccines against many pathogenic infections like Hepatitis C, HIV AIDS, chronic viral and respiratory infections, pneumococcal infections, rubella, tuberculosis, cancerous and neurodegenerative diseases are also proving elusive. Perhaps the problem lies with a lack in the basic understanding of the human immune system. The major cell involved in the presentation of these candidate vaccine molecules is the den-