PRESENTATION: ORAL

D1-PI-A-**1**

Current status and perspectives of biodiversity in Tokyo, Japan

Tetsuro Hosaka*[1], Shinya Numata[1], Takayuki Arima[1]

Tokyo, the capital of Japan, is one of the largest cities in the world. Administrative area of Tokyo Metropolitan government covers the 23 special wards of Tokyo in the eastern part, 26 cities in the western part (Tama) and the two outlying island chains (Izu and Bonin). Despite Tokyo being relatively small in area (2,183 km2), it still holds rich biodiversity that requires conservation efforts. We review the current status of natural environment and biota (especially, flora of vascular plants and mammalian fauna) and discuss the perspectives of biodiversity conservation in Tokyo. There are three major landscapes in Tokyo: urban landscape, "Satoyama" landscape comprised of secondary forest and agricultural land, and oceanic island landscape. Different landscapes support different habitat specialists. From Tokyo, 4,323 species of wild plants and 51 mammal species were reported, which is equivalent to 49% and 21% of total number of species in Japan. Particularly in the Izu and Bonin islands, the percentage of endemic species was high (e.g. 67 % of vascular plants in the Bonin islands) though species richness is relatively low. Three principal pressures, habitat disturbance by human activities, abandonment of agricultural landscape management and invasive alien species, are major factors in biodiversity loss in Tokyo and their significance is different among landscapes. Anthropogenic habitat disturbance was severe in Satoyama landscape during 1950-1970 but slows down in these few decades. Instead, abandonment of management of fuelwood forest causes alternation of vegetation from deciduous broad-leaved forests to evergreen broad-leaved forests, and results in habitat loss for species adapted to deciduous broad-leaved forests in Satoyama landscape. Invasive alien species are commonly found in Tokyo and are particularly serious threats to endemic species in oceanic islands. On the other hand, some native species, such as wild bores and raccoon dogs, which once disappeared from urban area by 1970s might back and inhabit in urban area recently. This may be an outcome from intensive conservation projects and actions by government and publics. However, such re-expansion of wildlife habitat into human inhabiting area causes newly emerging problem, human-wildlife conflict in urban area. Since almost all of the natural landscape is under anthropogenic influence in Tokyo, public understanding of biodiversity value and their participation in conservation action are keys to draw up framework of urban planning for sustainable management of biodiversity.

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D1-PI-A-**2**

Species-Area-Relationships of Urban Areas

Peter Werner*[1]

The positive link between the number of plant species occurring and the number of inhabitants or area size of cities was already noted early on (Celesia 1997, Sukopp & Wittig 1998). The number of inhabitants and the area size correlate closely, although at different levels on the various continents. Inhabitant number and area size are dependent variables, but reflect two key factors of species richness: First, cities are centres of intentionally and unintentionally introduced species and this is linked to the number of inhabitants; second, the quantity of habitats grows in step with growing area size. The above-mentioned synoptic studies have also shown that for vascular plants the species-area curves of cities are at a higher level than those of rural, cultural landscapes used for farming or forestry.

Nevertheless, the positive correlation between species richness and city size is a gross simplification (Werner & Zahner 2009) and it is not clearly recognisable if that prediction is true for each geographical situation or for each type of cities. There is a lack of investigations studying species-area-relationships of cities sophistically.

To get a better understanding of the species-area-relationship of cities three different types of data sets were used to analyse the species-area-relationship of several clusters of cities. The data sets are:

1. Published and unpublished data of German cities, particularly gathered in the context of urban biotope mappings, and of other cities in Europe, especially in Central Europe.

2. Data reported by cities which took part in the competition “European Capital for Biodiversity”. In that competition the contributing cities were asked to give some information about the number of species of five taxonomic groups.

3. A global set of data which were reported to the CBI expert group by cities which implemented the City Biodiversity Index (CBI).

Particularly with respect to the vascular plants, the presentation will demonstrate the various species-area-relationships of the several city clusters and the results of the analysis of that data. The results reveal that not all city clusters represent a positive correlation between species number and city size. Discussing the results, some explanations for the variety of species-area-relationships of cities will be presented.

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D1-PI-A-**3**

Plant Diversity of Municipal Waste Dumpsites - Deonar and Mulund, Mumbai

Amita A. Dalvi [1,2], Satish A. Bhalerao[1]*, Shivani S. Dhage [2], Rakesh Kumar[2]

The aim of the present study is to investigate the species composition and diversity around two local dumpsite areas. The systematic vegetation survey was carried out using standard quadrate method and various phytosociological parameters such as relative density, relative frequency, relative dominance and importance value index (IVI) were computed for each species. These parameters facilitate easy identification of tolerant or resilient plant species having ecological potential to meet the challenges of disturbed environment. Simpson's diversity and Sorensen's similarity index were also calculated to find the heterogeneity and similarity between two selected study areas. During vegetation survey, a total of 43 plant species belonging to 20 families were identified from study areas. At both the sites the Euphorbiaceae constitutes major portion of vegetation followed by Amaranthaceae and Poaceae. The *Ricinus communis* was predominant species found around both the dumpsites. However, *Alternanthera sessilis*, *Cleome burmanni, Cleome viscosa,Cynodon dactylon, Cyperus rotundus, Euphorbia hirta and Ipomoea carnea* were co-dominant species. This research paper concludes that being the dominant species around multi-contaminated environment, *Ricinus communis* can be subjected to further experimental trials to explore its phytoremediation potential.

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D1-PI-A-**4**

A Study on Domestic Gardens and Insects in an Urban Environment

Madhumita Jaganmohan*, Lionel SujayVailshery[1], Harini Nagendra[1]

Domestic gardens hold great significance for biodiversity support in cities, such gardens may play a vital role in maintaining biodiversity in urban areas. This paper assesses the diversity and distribution of vegetation along with the insects present in urban domestic gardens. There is a need for assessing the biodiversity of such rapidly expanding city such as Bangalore where the loss of biodiversity is very drastic with urbanisation. The city was considered the garden city of India, and is famed for its greenery, with a predominance of residential homes with gardens. Now the second fastest growing city in India, with a population of over 7 million, apartments and multi-family homes are gradually gaining popularity, with expansion of built area within residential boundaries, and a gradual shrinking of garden area in many locations. The administrative boundary of Bangalore, i.e. the Bruhat Bengaluru Mahanagara Palike (BBMP) boundary, was used to circumscribe the study area. The BBMP boundary consists of 198 administrative sub-units or wards within the BBMP, of which 25 wards were randomly selected for study. Within a ward, the geographic center was located, and two domestic gardens located nearest to the ward center were selected for sampling. A total of 160 trees from 25 species, as well as 117 species of herbs and shrubs and insects from 11 orders were encountered in 50 households of the sampled area. A high proportion of all the plant species encountered in the gardens was used for ornamental and as food or has medicinal properties, and/or religious significance. The majority of residents had close interactions in terms of garden maintenance. These gardens were found to be rich in both floral and insect diversity and this needs to be preserved in dense urban areas. The results of this study will provide a comprehensive description of plant and insect diversity and distribution in urban domestic gardens which can be very important for understanding the importance of gardens not only for vegetation but also to support a large variety of insect population.

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D1-PI-A-**5**

Cities as Global Biodiversity Hotspots

Madhusudan Katti*[1], Charles Nilon[2], Myla Aronson[3], Frank La Sorte[4], Mark Goddard[5], Christopher Lepczyk[6], Paige Warren[7], Nicholas Williams[8], Sarel Cilliers[9], Bruce Clarkson[10], Cynnamon Dobbs[8], Marcus Hedblom[11], Jip Louwe Kooijmans[12], Ian MacGregor-Fors[13], Ulla Mörtberg[14], Stefan Siebert[15], Peter Werner[16]

Over half of humanity now lives in urban areas, which cover <3% of Earth's terrestrial surface. Cities are widely perceived as concrete jungles of limited conservation value and little is known about the global patterns and drivers of urban biodiversity. An increasing body of literature documents patterns of plant and bird species diversity within a number of cities, but relatively few studies have compared these patterns across cities at regional or continental scales. It is often suggested that urbanization are also drives global biotic homogenization, with urban floras and faunas being dominated by relatively few cosmopolitan "weedy", invasive, or commensal species occurring in most cities. We convened an NCEAS working group of researchers from cities worldwide to develop a synthesis of urban ecology using a comparative approach. We asked the overarching questions: "What makes an urban biota 'urban'?" and within that, "Are the patterns of urban biota and the processes that shape them the same across the world's cities?" We identify a hierarchy of filters that determine patterns of urban biodiversity: 1) regional scale biogeographic context, 2) metropolitan scale urban intensification, and 3) local scale socio-economic/cultural factors. Here we show, using the largest global database (147 cities) compiled to date, that cities house a significant proportion of the world's bird and plant diversity. Of the world's total known species, at least 20% of birds and 5% of vascular plants occur in cities. Contrary to global homogenization concerns, cities tend to contain unique assemblages of species. The majority of urban bird (94%) and plant (70%) species are native. Only a small number of plants and birds are cosmopolitan, Columba livia (rock pigeon, in 94% of cities) and Poa annua (annual meadow grass, in 96%) being the most common. Urban species richness is predicted primarily by anthropogenic features related to population size and land-cover characteristics. The proportion of urban non-native plants is predicted equally by both non-anthropogenic and anthropogenic factors suggesting their prevalence is not determined exclusively by human activities. While birds and plants exhibit

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different patterns, overall we see that cities are richer in species and more unique than generally expected, and contain a considerable proportion of global biodiversity.

Our study represents the largest current urban global database of multiple taxa, but some areas remain underrepresented, highlighting the lack of systematic studies in most cities. There is an immediate need for better compilation and monitoring of urban biota in areas of high regional biodiversity, such as tropical cities. Cities within the developing world exhibit rapid growth and increasing stress on local natural resources. Understanding the biodiversity in these regions is paramount to reconciling human development with the maintenance of biodiversity and ecosystem services. Conservationists are increasingly concerned that urbanization weakens the connection between people and nature. Our results highlight that cities can support both biodiversity and people, and retain a high potential for sustaining these connections. Despite worldwide biodiversity loss, cities are not depauperate concrete jungles but can play a critical role for biodiversity conservation, restoration and community education.

D1-PI-B-**1**

Urban Agricultural Plots and Vulnerability of Urban Ecosystems and Biodiversity

Kurt Thomas*[1]

Landform diversity – a basis of urban ecosystems and biodiversity

Biodiversity and urban green areas, mainly forest-like ones, fulfil important services for a better environment and human health. The natural biodiversity depends on landform diversity (figures, photos). The complementary elevation-depression forms of land surface are shown (figures). The main characteristics of landform are:

(i) altitude difference of an area, e.g. a watershed;
(ii) relief roughness (frequency of complementary elevation - depression forms). The natural landform should be protected in urban areas for specialized land use:

Elevations, ridge areas: dominant elevated free open space areas of drier vegetation complexes, for viewing over town; upper parts of elevation network for single public buildings and drier vegetation gardens.

Lower depression areas: network of green belts in cities with natural indigenous vegetation, e.g. river forests near depth lines, streams.

Landform diversity – a basis of landscape and urban planning and design

Agricultural areas are "islands" within built-up areas, residential areas; or they are stretching from peri-urban areas like "tongues" into central built-up areas of cities and conurbations. Agricultural plots for food production have generally less volumes of living biomass with less bio-climatic effectiveness for human health, e.g. for clean air compared to (remaining) forests. Green spaces and urban vegetation areas may not in all cases mitigate pollution and human health problems. Agricultural areas of communities are often mini plots inside cities. They often need lots of pesticide spraying during vegetation periods. Examples are given by mini vineyards inside cities close to residential areas (in Central European cities with cooler climate compared to southern wine fields). Also in mini plots will be introduced more and more "modern" technology (large machine systems, developed for agricultural regions outside cities; extensive pesticide use by spraying with motorized spacious spraying machinery, often spraying up to 100 meters high and wind-dispersed and drifting kilometers over residential areas (examples). Under vines are very often only bare ground areas. The rich plant species community in a layer of herbs and grasses of former vineyards in the preindustrial era disappeared in the industrial urban mini plot agriculture (table plant species list). Such intensively used vineyard mini plots can also show other environmental problems, like extremely low biodiversity through herbicide use and mechanical measures, strong water erosion and wind erosion and "desert-storm"-like soil clouds by tillage after dry weather.
Such tendencies may also be valid for other agricultural food production inside cities.

Urban landscape planning

We could in practice much do to avoid unnecessary implications on the environment, also in respect to air pollution. We should realize distance zones through land use planning inside cities between mini agricultural plots and living houses, preferably with dense tree hedgerows.

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Attention should be paid in the entire urban planning process to landform diversity, its conservation and avoidance of man-made decrease, e.g. by filling up natural (and semi-natural) depressions for gaining plane areas. If possible - do not level erosion depressions / valleys with their different sites and high biodiversity!

D1-PI-B-**2**

Urban Ecosystem Vulnerability and CRZ Violations: Fishing Communities and their Sustainability Implications

Hemant Kumar Chouhan*[1]

Coastal Regulations in India are traced back to the UN Conference on Human Environment, held in Stockholm in 1972. The Environment Protection Act 1986 was enacted to implement India's commitments as a signatory. The Coastal Regulation Zone (CRZ) Notification of 1991 was made under the provisions of the EPA in order to protect coastal environments, and social and livelihood security of fishing community.

This paper assesses the effects of CRZ rules and violations in the Mumbai Metropolitan Region, which has experienced tremendous growth due to rapid industrialization and urbanization. This process has led to destruction of mangroves and other important species of fish which play a crucial role in sustaining coastal ecology and urban biodiversity; high population density and uneven growth have exacerbated adverse environmental and socio-economic consequences. The *Koli* (fishing community) in this region faces huge problems of survival and sustenance in small-scale fishing, due to rampant commercial fishing by big trawlers and large scale dumping of waste material by industries into the sea. In small but significant ways, fishing communities through their traditional commons based resource management and livelihood systems protect the coastal ecology and help cities in reducing their carbon footprints.

On the basis of primary field research in Cuffe Parade, Mahulgaon, Shivri, Bhandup, and Chimbai, Methodology was followed for Study, Structured / Unstructured Interview (Cooperative Society, Household Survey), Focus Group Discussion (FGD), Data Collection (through secondary sources), Literature Review. This paper attempts to assess CRZ Violations taking place on coastal areas, and is causing damage to the coastal ecology. The research specifically focused on particular fishing related activities and spaces - jetties, parking of boats, access to sea, weaving and drying of nets, landing grounds, drying and cleaning of fish that are more affected by encroachment of sea shore area and by CRZ rules violations. It evaluates the action taken by MCZMA and BMC while implementing rules and making ICZMP for management of marine environment. It raises broader issues relating to the contradictions and complementarities involved in ICZM plans vis a vis management of biodiversity, within a larger context of rapid urbanization and demands for real estate growth. The paper argues that urban biodiversity management requires clear valuation of the long term ecological and socio-economic benefits of sustenance of coastal ecology and related livelihoods.

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D1-PI-B-**3**

Biological Invasions in Urban Areas: Towards an Integrated Research Framework, Management Strategy and Policy Agenda

Anzar Khuroo*[1], Zafar A. Reshi[1], Irfan Rashid[1], Akhtar H. Malik[1], G. H. Dar[1]

In the present-day world, biological invasions are recognized as one of the main drivers of global environmental change. Broadly, the impacts of biological invasions - a negative externality in the parlance of ecological economics - include the loss of biodiversity, impairment of life-supporting ecosystem services, hazards to human health and agents of biosecurity threats.

During the recent times, globalisation of world's economy along with a rapid pace of urbanisation have made the urban areas as the hub of trade, travel, transport and a plethora of production activities. As an outcome of this, urban areas are fast emerging as the primary centres of alien species introductions; and in many case the naturalisation and invasion of these species. Thus, urban areas serve as the stepping-stone for the invasive alien species, and their subsequent spread to the peri-urban, rural and natural landscapes in a particular region.

Given the ill impacts of invasive species on ecology, economy and health, which in turn have serious consequences for the conservation of urban biodiversity and sustainable provision of ecosystem services to the burgeoning urban population, initiation of research, management and policy efforts on biological invasions in urban areas merits immediate global attention. It is in this context that we here propose an integrated research framework, management strategy and policy agenda, which can be helpful in scientific understanding and management of biological invasions in urban areas.

The research framework attempts a step-wise synthesis of crucial information on the alien species occurring in urban areas: origin and native distribution range, pathway, vector(s) and purpose of introduction, residence time, traits of species invasiveness, drivers of habitat invasibility, and ecological and economic impacts. Linking research insights to management tools, the management strategy outlines a holistic model incorporating prediction, prevention and prescription options. The policy agenda underlines the urgent need for regulation of introduction pathways and invasion corridors, prioritization of the worst invasive species, shifting towards alien biota-centric approach, looking beyond the political borders, forging interdisciplinary collaboration, launching of an information network, enacting legislative measures and generating public awareness.

Although the synthesis has been drawn from the research and management expertise gained while working on plant invasions during last one decade, it can be employed for studying the biological invasions by other organisms (e.g. animals, microbes) with specific modifications. Hopefully, in an era of global environmental change, adoption of such an integrated research framework, management strategy and policy agenda in urban areas can help in meeting the challenge of sustainable urban development.

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D1-PI-B-**4**

Life of Bees in Human Dominated Ecosystems

Sivagnanam Chandrasekaran*[1], N. Arun Nagendran[2], S. Saravanan[1], J. Joyson Joe Jeevamani[2] and B. Kamalakannan[2]

Bees are the generalist pollinators and vital for any ecosystem's sustainability. However the bee population is in the declining trend in many parts of the world due to various anthropogenic activities. The economic loss due to bee population decline in United States and Europe is more than billions of dollars. More than 70 important crops are pollinated by the bees. This important service provider is under severe threat due to our ignorance in front of coffee/ juice centres. Our report on the foraging shift of honey bees towards disposed paper cups and subsequent death was published in *Current Science* (Vol. 101, 2011). Further study was carried out in 7 cities of Tamilnadu to assess the life of bees in the human dominated environment. We recorded bees' visitation in different sites such as fruit juice centres, cane juice centres, flower markets, coffee bars, etc. Bees are attracted because of different floral cues such as colour and odour in the flower markets. Residual sugar available in commercial centres (juice centres, coffee bars) attracted the bees as foraging sites. Such foraging shifts are making the life of bees highly risky. We recorded the following intentional activities of shopkeepers to drive out bees: i) pouring of hot water, ii) putting fire over waste bins, iii) beating bees with broomsticks. Besides, a considerable number of bees are trapped in beverage remains of thrown cups in the waste bins maintained by shopkeepers. Due to these anthropogenic activities 30-600 bees/day are killed and this number depends on human population size, location of sites, mode of control and nature of foraging materials. This foraging shift from usual mutalistic relationship (flowers - pollinators) to non-mutualistic association (sugar residual – pollinators) is a dangerous move and this may lead to collapse of entire ecosystem stability in the urban and semi urban ecosystems. Einstein correctly pointed out that the human race cannot sustain without bees. Therefore, it is urgent to conserve bees in the urban ecosystem by creating awareness among the stakeholders, promoting conservation activities of bees and through new rules and regulations. We should not see bees as group of insects but as "life supporting" service providers.

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D1-PI-B-**5**

Habitat and Matrix Effects on Urban Biodiversity: A Meta-Analysis

Joscha Beninde*[1], Veith Michael[1], HochkirchAxel[1]

The search for determinants of urban biodiversity has a long history. Subsequent to a frequent observation of changes of biodiversity along rural-urban gradients the focus shifted more to the explanatory power of individual factors responsible for patterns of urban biodiversity. In most cases both local habitat factors and factors characterizing the surrounding matrix have been studied. We here present a systematic review and meta-analysis of factors determining urban biodiversity. The systematic review of literature was conducted using ISI Web of Knowledge with the following term combination: (1) urban*, town*, city or cities; (2) biodiversity, species richness or diversity; and (3) species, taxa or taxon. The search aimed to include all relevant literature and exclude unnecessary literature in as many cases as possible. In total the criteria were met by 3,276 publications. The survey of this body of literature yielded more than 150 studies that provided all of the following prerequisites and constitute the basis of the meta-analysis: (1) sampling sites in an urban setting; (2) a list of all factors employed, habitat as well as matrix; (3) data analysis assigning single factors different significance levels or explanatory power for biodiversity; (4) text written in English or German. Combining all studies, over 2000 factors were registered, many representing typical and frequently employed factors for sites, such as perimeter:area ratio, disturbance level or measures of vegetation structure, while in other cases more special factors were consulted, relevant only to certain localities, e.g. depth of snow, or relevant only to certain taxa, e.g. specific resource or nesting demands of the taxa under consideration. For the meta-analysis we re-grouped factors and tested them for significance across studies. Our results identify those factors of habitat and matrix that are most relevant across taxa and thus have to be considered most important for urban planning and city design, assuming a common aim for elevating levels of biodiversity in the urban landscape. If the results are implemented in initial stages of planning, urban structures can be designed to be most beneficial for all taxa and simultaneously represent a sound basis for habitat auxiliaries necessary for single species or particular taxa.

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D1-PI-B -**6**

Adaptive Climate Change Governance for Urban Resilience

Emily Boyd*[1], Juhola Sirkku[2]

Urban areas are the forefront of climate change adaptation and mitigation. Climate governance and urban discourse is often tied into a particular narrative around sociotechnical transitions and mitigation of greenhouse gases. Much of this 'frontiers' urban climate governance work focuses on the deficits of neoliberalism and technical fixes as 'eroding' social resilience at the city level, in contrast the social-ecological resilience discourse examines possibilities, avenues for change, and transformative actions through partnerships and networks with limited critical analyses of the outcomes of those actions. In this paper we aim to conceptualise adaptive climate change governance for urban resilience by bringing together the social, ecological and the technical characteristics of the urban system. We draw on the Global Urban Transitions project database and the literature to explore three interrelated questions: what is unique about governing urban climate change? Are the current transitions contributing to the emergence of adaptive governance? Can adaptive climate change governance help to build sustainable and equitable urban spaces?

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D1-PI-C-**1**

Ecological Services of Insects in Maintaining the Ecosystem Health of Mumbai

Aniruddha Dhamorikar*[1], Amol Patwardhan[2]

Nature functions in a way such that every action is associated with a reaction, and every reaction leads to a result. In our gardens, for instance, a butterfly visits a flower for nectar (action), and the plant drops its pollen dust on its body (reaction), and when the butterfly visits another flower or another plant, it inadvertently pollinates the plant (result). This symbiosis within nature is key to survival of every species of plant and animal. "Ecological services" is a term coined to define this function of nature, especially when it applies to the benefit of humans.

These "services" are provided not only in the wild, but are surprisingly important in the basic functioning of our civilizations – from pollinating our crops, to controlling the populations of other pest insects, to decomposing of organic wastes, amongst many others. Ecological services are also a significant part of the urban habitats, but are largely overlooked over the commercial services we, as residents, receive. This manuscript particularly focuses on the ecosystem services provided by some of the major insect orders present in Mumbai city district, and Mumbai suburban district, viz. Diptera, Hymenoptera, Lepidoptera (only Butterflies), Odonata, Mantodea Hemiptera, Coleoptera, and Orthoptera.

For a better understanding of their services, they are classified into two parts based on the services that benefit Mumbai city, viz. direct services: where the action, reaction and result occur in the city's ecosystem, and indirect services: where the services occur outside city limits, however, the city residents get benefited. Direct services can be of following broad categories, such as scavenging, pollination in context of the city's flora, decomposition of organic wastes, and pest control; and indirect services such as pollination of crops which are consumed by the city's residents, decomposition and soil nourishment, and role played by insects in the food-web as well as an indicator-species to assess the health of the ecosystems.

This manuscript further compares the ecological services provided by the insects in the city to their detrimental role in spreading of diseases, causing nuisance, and crop damage. Comparison of their values in terms of benefits and disadvantages to the city revealed that their benefits outweigh their disadvantages, and that their services are crucial for maintaining the ecosystem health of Mumbai's urban ecosystem.

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D1-PI-C -**2**

Sustainability Assessment of Urban Cooking Fuel in India and their Implications for Climate change

Punam Singh*[1], Haripriya Gundimeda[1]

The use of different fuels for cooking is one of the most important sectors for energy use in India. Cooking consumes more than one third of the total energy consumption if all energy carriers are considered. The main energy carriers used for cooking in urban India are LPG, Firewood and Kerosene. Biogas is a renewable gaseous fuel (primarily methane) and is becoming increasingly interesting as a sustainable cooking fuel alternative to the presently used non-renewable fuel resources. With a calorific value of about 5000 Kcal/m^3 biogas is an excellent fuel for heat and electricity generation and is relatively simple and economical method to produce fuel from waste. Typically, biogas programs are often justified on the basis of direct benefits and costs accruing from consumptive use by individual households, industries or communities. The non-consumptive and indirect value derived from the biogas plant providing feedstock for other processes (such as manure and waste disposal) and other benefits such as GHG mitigation (positive externalities) are also significant. National Biogas and Manure Management Program (NBMMP) providing central subsidy in fixed amounts for setting up of family type biogas plants has been under implementation since 1981-82 in India. Despite active promotion and subsidization of biogas, its usage as cooking energy resource accounts for merely 0.5% of used energy carriers in the country.

Due to negative health and environmental impacts from intensive use of firewood and kerosene for cooking, the Indian government has been actively promoting the use of LPG as a more efficient and cleaner cooking fuel.The extraction, processing, bottling and transportation of LPG results in significant GHG emissions and other environmental hazards. Also, it is accruing substantial revenue losses (about Rs.215/ cylinder) to the government on account of subsidies and the start-up costs (in connection and cooking stoves) and refill costs are significantly higher as compared to other fuel resources (such as firewood and kerosene). Therefore, biogas can play an important role as a sustainable cooking fuel and also contributing towards the reduction in landfill disposal and global warming.

The discussion about the advantages and disadvantages of different cooking fuels can only be decided if the environmental effects of cooking fuels are regarded over the complete life cycle of those fuels. The aim of this paper is to assess the sustainability of different cooking fuel alternatives from primarily an environmental point of view using life cycle assessment (LCA) tool. The results show that biogas is indeed most sustainable cooking fuel as compared to firewood, dung cake, LPG and kerosene. The annual global warming potential of the current cooking fuel mix amounts to the release of about 23 to 43 million tonnes (MT), depending on the firewood supply sources are renewable or non-renewable. Use of biomass fuel by 23.2% households in urban area contributes significantly towards the release of particulate matter (2.5 to 10 micron), largely responsible for indoor air pollution and respiratory illness. Substituting the currently used fuel mix by biogas can potentially yield about 40 to 70% reduction in GWP and 70 to 80% reduction in PM10 formation from urban cooking activities. Households using dung cakes as primary cooking fuel can be the priority target group for dissemination of biogas technology.

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D1-PI-C -**3**

Peri- Urban Forests as Refugium for Indigenous Tree Species: A Case of Ethiopia

Eyob Tenkir*[1], Mekonnen Biru[1]

To enhance the composition of indigenous tree species and make the whole mountainous area peri-urban forest of the Addis Ababa as conservation zone different stakeholders are involved in planting indigenous tree species and protecting the site from intrusion. However, this approach lacks basic information about floristic composition and natural regeneration potential of the forest, which is important for sustainable rehabilitation, and conservation of the forest. Thus, the main objective of the study is to study floristic composition and density, height class distribution of naturally regenerating woody species in 900ha mountainous land covered by exotic Eucalyptus globules tree species at the North West of Addis Ababa. Woody species at their different stage of development(germinant, seedling, sapling, tree stage) and all other species in all the 70 quadrants were recorded following altitudinal gradient and soil samples were collected to examine physical as well as chemical properties and analyzed by using Descriptive statistics and PCORD soft ware. A total of 158 species belonging to 61 families and 33 genera were identified. These species has been identified as 12 grasses, 1 epiphyte, 1 fern, 9 climbers, 3 creeping herbs, 77 erect herbs, 9 low shrubs, 24 shrubs and 21 trees. A total of 58 woody species consist of 18 trees, 34 shrubs and 6 woody climbers have been identified. The density of all the woody species in the study site is 2400 per hectare. The density at the different stages i.e. germinant, seedling, sapling and tree found to be 1898, 1850, 133, 9 respectively. Some of the rare indigenous tree species recorded was Allophylus abyssinicus, Colutea abyssinica, Hagenia abyssinica, Prunus africana and Rhus natalensis. The three species with the highest density were Myrsine africana (59/ha), Maytenus arbutifolia (46/ha) Juniperus procera (44/ha). The record shows the existence of few individuals of the species at the lower altitudinal gradients between 2650- 2700m. Prunus africana and Hagenia abyssinica were recorded in lower density (about 1/ha). The study revealed that in pri-urban forest some native woody species like J. procera show normal regenerating population at germinant, seedling, sapling and tree stage while other species need enrichment planting in ether of the stages mentioned above. However, pri-urban forest with all the drawbacks shown in the study they could play great role in conservation of endemic and endangered indigenous species.

[1] Environment Protection, Ethiopia

D1-PI-C -**4**

Satellite Monitoring of Urban forests and Green spaces in Greater Bangalore - A Comparative Study

Malini A Shetty[1], Somashekar R.K.[1]

Bangalore is experiencing unprecedented urbanization in recent times due to concentrated developmental activity resulting in the increased population and consequent pressure on infrastructure and natural resources, which ultimately give rise to plethora of serious challenges like climate change, green house effect and frequent flooding of low lying areas. In the present study vegetation distribution is studied across 8 zones of Bangalore Metro using 2010 IRS LISS III imagery. Urban vegetation being one of the major land use categories can be assessed by Normalized Difference Vegetation Index (NDVI) and Transformed Normal Difference vegetation index (TNDVI), the biophysical variables playing a significant role in one's judgment for urban Quality of Place (QOP) and is one of the important implication areas of urban image classification techniques. Both NDVI and TNDV are grey scale continuous data sets where vegetation cover is depicted as varying level of brighter patches as the shift towards darker regions of the grey due to presence of bare soil, water bodies etc., The NDVI and TNDVI transformed image is sliced into 5 classes as water, very poor vegetation, poor vegetation, sparse vegetation and dense vegetation for ease of analysis and is given pseudo color in varying shades of green (vegetation) and Red (water). Dense vegetation shows up very strongly in the imagery and areas with little or no vegetation can be clearly identified (Wilson et al 2003). NDVI and TNDVI clearly unravels the pattern of vegetation distribution across greater Bangalore. There is significant difference in vegetation distribution pattern across different zones of Bangalore Metro. Zones in outskirts of the metro area once characterized by thick plantation and forest cover now shows phenomenal decrease in vegetation when compare to zones in central metro area. Urbanization is happening at a very fast rate and at the cost of agricultural land and plantation in the outskirts of metro, which is described as NRC hot spot areas for further studies and monitoring. Urban sprawl is observed as 9% and around 177 km^2 of agricultural land has been converted into built up area in the last 5 to 6 years. This analysis using satellite imageries goes a long way to help policy makers in rapid assessment vegetation cover and its continuous depletion across the Bangalore metropolitan region. Further it depicts the importance of satellite imagery in supporting urban vegetation cover inventories and in establishing automatic systems for inventory updates as well as vegetation monitoring. This role is especially important in metropolitan areas where the inventory has to cover thousands of square kilometers.

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D1-PI-C -**5**

Legal Concerns of Invasive Alien Species: Challenges and the Way Forward

Kumar Abhijeet*[1]

The Invasive Alien Species (IAS) is the second major threat to biodiversity after loss of habitat. The introduction of alien species to ecosystem has carried a heavy price tag, especially in terms of loss of biodiversity and environmental and natural resource damage. Studies have revealed that IAS has altered the forest structure and diversity in many parts of the Country rich in biodiversity. It has not only witnessed economic loss but also displacement and, in some cases, extinction of hundreds of indigenous species.

This research paper is divided into four parts. The first part will discuss the need for legally backed approaches to Invasive Alien Species and challenges in legislating. The second part will be brief review of the existing major international instruments. It is not intended to be a complete study of all the existing international instruments. The third will throw a light on the Indian legal approach to IAS. The last part is the way forward for India.

Article 8(h) of the Biodiversity Convention imposes an obligation upon parties ''to prevent the introduction, control or even eradication of those alien species which threaten ecosystems, habitats or species''. These invaders could be plant, animal or microbial species. The biological invasion is degrading ecosystem, threatening public health, and costing. The increased opportunity for trade, tourism and travel between nations has facilitated the species to cross their geographical barriers. IAS possesses the power to modify all the major ecosystem processes in the way, which suits them best. They are known to alter soil biota, geomorphology and hydrology of the area in which they survive. Environmental, economic, social and public health impacts that are seen as insignificant in the short term can be extremely serious in the long term.

Legally backed approaches to IAS are fragmented and piecemeal at domestic level. Though the accidental entry of the IAS cannot be overruled but the bulk was deliberately introduced. The intentional introduction of such species often has legitimate economic and social concerns, which complicate its combating. From legal point of view, the pollution associated with biological invasion is much harder to tackle than more familiar types of pollution. The basic difficulties in legislating includes

• Problems in predicating which alien species and in what point of time may become invasive.

• The various intercontinental pathways and entry points.

• Gaps in data on native species.

• Lack of objectivity in determining the risk

• Low political or public awareness.

• The range of production of trade activities that depend on or involve alien species;

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There are many international and regional binding agreements and voluntary guidelines that regulate the IAS but a comprehensive approach at international level is still lacking.

There has not been much strategic approach to IAS in India and is under-represented in national environmental or biodiversity planning process. Some of the states have adopted their own measures to counter IAS but an exclusive national legislation or policy is still a distant dream.

IAS is a global issue that requires collaboration among the governments, economic sectors and non-governmental organism and international institutions. Alien Species issues have long had relatively low visibility at policy – making level. National framework tends to be much stronger on preventing and eradication of IAS. Realizing the richness of biodiversity in India, it is high time to have a legally backed national instrument on IAS.

D1-PII-A-**1**

Trends and Patterns of Land Use Change and Urbanization in India: Implications for Food and Ecological Security

Geetika Rathee*[1], Bhagirath Behera[1]

Land is a crucial natural resource on which countries' socio-economic development depends critically. It provides a plethora of opportunities for a society to undertake a variety of economic activities along with important life sustaining ecosystem services that promotes human well-being. Given the finite supply of land resources, sustainable use and management of land resources is critical for achieving higher levels of well-being of people of a country. Over last several decades India has experienced a sea change in its land use owing to growing economic activities and population. Therefore, it is important to understand the patterns of land use changes and their likely implications on food, social as well as ecological security. The objective of this study is to examine the trend and pattern of land use changes in Sonipat district of Haryana state, and its implications for food security and other economic and environmental consequences. Sonipat is a part of National Capital Region and lately much changes pertaining to land use has occurred in the place. In particular, the paper examines the changing pattern of land use in the context of rapid urbanization in Sonipat that largely resulted in shifting of lands from agriculture to non-agricultural use which has serious implications on food as well as ecological security of the country. As a result of changing socio-economic and ecosystem structures due to change in land use pattern with the expansion of NCR, the present study has attempted to investigate the changes in the trend of human behavior in terms of disruption of social cohesion which was existed before; people's orientation towards money-mindedness that forces them to indulge in violence and crime in town under the influence of the metamorphosis. The paper uses the land-use classification data, temperature and rainfall pattern and crime lodging of the district over time to study the implication of change in land use. The change in land area under agriculture and non-agricultural uses is significant in relation with urbanization which can have cascading effects on food security. Recent trends of expansion of urbanization in small towns in the vicinity of metropolitan city has resulted in the rise in land prices prompting farmers to sell the agricultural lands, which has clearly reflected in the changing land use patterns. The study finds that the villages has witnessed rise in crime activities in the wake of large-scale land sale which is major diversion in making village and rural life prosperous and safe. Also, the analysis of temperature and rainfall pattern of the region is a concern from environmental perspective. The ecology of the land has been greatly transformed due to the current pattern of urbanization of the district. This phenomenon is not limited to the district, a quick overview of the data pertaining to land use under agriculture and non-agricultural activities shows similar patterns and trends. Growing population and declining land under food grain raises a big question mark upon food security of the region as intensive cultivation is likely to have serious problems of land degradation and depletion of irrigation water and, hence, may reduce productivity in the long run. Therefore, there is an immediate need on the part of the government to adopt land use pattern that leads to holistic development and sustainable urbanization.

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D1-PII-A -**2**

Differences in Land and Resource Use between Privatized and Non Privatized Lakes: A Case Study of Bangalore

Hita Unnikrishnan*[1], Harini Nagendra[1]

The Indian city of Bangalore has been known in the past for its extensive network of lakes which formed the water lifeline of the city. Today, many of these lakes have disappeared giving way to the pressures of development and urbanization and the remaining lakes are also in a sad state of decay. The city being the second fastest growing one in the country has seen a massive decline of its water bodies and green cover over the last decade. The presence of numerous lakes formed a massive managerial problem and in 2002, the Lake Development Authority (LDA) was formed as the nodal agency dealing with the management of lakes within the city. In 2002, the LDA undertook an ambitious plan of privatizing lakes within the city. Despite facing massive opposition from members of the civil society, environmentalists and NGOs, four lakes were leased over to private investors for management, of which one remains embroiled in a legal quagmire.

This paper examines the differences in land use and resource use around these lakes by comparing three privatized and three non privatized lakes in the city. Land use patterns seen within a hundred meter radius around each lake have been mapped and contrasted with historical land use patterns based on a Survey of India toposheet of the 1970s. Comparisons have been made across the privatized and non privatized categories of lakes. In addition, the categories of lake users have also been mapped and compared against each of the categories.

It has been observed that the non-privatized or government managed lakes support a greater diversity of traditional livelihood and non livelihood based uses than the privatized lakes. Also, greater pressures of urbanization are observed along the privatized lakes that were part of this study.

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D1-PII-A -**3**

Industrial Cities and Pre-Industrial Landscapes: a Long Term View of Urban Settlement Patterns and Ecosystems in Southeast Asia

Scott Hawken*[1]

Many of Southeast and East Asia's emerging urban territories are located within riverine agricultural ecosystems such as those of the Yangze, the Pearl River, the Irrawaddy, the Chao Phraya, the Red River, and the Mekong. Pre-industrial societies comprehensively altered extensive areas of these riverine landscapes to form artificial wetlands suitable for the cultivation of rice. The agricultural wealth created from these regions formed the economic foundations of powerful pre-industrial societies. In strategic locations these artificial ecosystems also formed the foundations of massive urban settlements such as Angkor, in Cambodia. The urban development of pre-industrial rice landscapes has important implications for the biodiversity, water quality, agriculture, quality of life, and the conservation of heritage. Most assessments of the design of cities, and/or ecosystems, use short-term ecological data or satellite imagery spanning only a few decades. If such landscapes are to sustain cities and biodiversity on a long-term basis, a spatial understanding of emerging and past environments is necessary to safeguard the cultural and ecological heritage of these urban and agricultural territories.

This paper uses the latest research from Cambodian, French and Australian collaborative teams, to present a novel case study of Greater Angkor, located in the Tonle Sap basin, within the Mekong's regional ecosystem. The case study covers more than two thousand years, stretching from the first millennium BCE, to the medieval period and the present day. A series of original detailed maps depicting features recovered from remote sensing imagery, form the basis of the case study showing how the ricefield landscape was an integral part of the urban landscape of Angkor. Greater Angkor was a vast low-density urban complex, which lasted for half a millennium, as has been pointed out since the early 21st century by Fletcher and Pottier. Through revealing the spatial relationship of hydraulic infrastructure, agricultural systems, and administrative and settlement features, the maps illustrate how various societies have interacted with ecosystems at different points in time and during different climatic events. Such spatial analyses demonstrate the close integration of urban and rural systems and shed light on modern urban configurations such as desakota.

New urban territories in Asia demonstrate a complex and comprehensive intermixing of rural and urban spaces creating what McGee has described as desakota environments. Generally studies of the global shift to urban ways of living overemphasise the distinction between urban and rural areas. Long-term studies such as the one presented in this paper, illustrate the complex interactions of such urban and rural systems back over a thousand years or more. Such studies form the basis for development proposals that go beyond today's policy documents that frequently assume rural and urban spaces are homogenous and exist as distinct, discrete spaces. Desakota environments integrate critical ecosystem elements, such as stream and river easements, that are vulnerable to climatic events but also that hold promise for managing urban growth in a sustainable way. Urban policies need to recognise the diverse functions of desakota landscapes, and identify ways they can contribute to the health and wealth of these urban riverine regions in a more industrial, and climatically uncertain, future.

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D1-PII-A -**4**

Land Use Changes Due to Improper Meddling with Nature's Resource and Its Influence on Biodiversity Conservation

Pranab Pal*[1]

Presently deprivation of environment is under the demands for economic resources due to growing human population paucity and average temperature change. The human Population is overusing usual resources and transforming inhabitant environments into human dominated landscapes. The environment impacts of human activities are willingly evident, causing remarkable changes are in patterns of variety work, great quantity and assortment in various ecosystems. All usual area, swampland and dissimilar forest areas are the main habitats of Biodiversity ecology and atmosphere situation of some area are copious reliant on the standing of Biodiversity. It was predictable that 20-30 million variety may be exists in the globe. According to specialist more than 16,000 plant and animal species are currently endangered with disappearance. However the populations of biodiversity are declining day by day and a number of species have already become extinct from the natural world. Climate change is one of the largest part vital factors of ecological changes which are causative to the massive global biodiversity loss by creating whirlwind, Drought, Heavy rainfall, Flood, ice melting sea level growing etc. Earth is warming at an abnormal rate and confirmation of warming is nearby in diverse forms, that is reflected by the temperature proceedings. Global warming is also well thought-out to be a main danger to global biodiversity. The majority of the ecological changes and environment destructions are creating by the ingenuous and unintended human interventions. Environmental changes are occurrence in diverse geographical areas suitable to landslides, trembling, erosion, siltation of riverbeds, salinity rising in soil and water. There is compromise among with the world researcher that the source for raise in full of atmosphere CO2 and eventually for earthly warming is form creature behavior. In India, about 9.38 million ha area is unavailable by salt –pretentious soil out of which 5.50 million ha is saline soil and rest of 3.88 million ha is alkaline soil. Biodiversity loss has turn into a most important reason of apprehension as a outcome of large scale ecological poverty. This motive of trepidation is further forced by the environment loss, habitat destruction, over utilization, preface of exotic species, turbulence and diversity of factors. Even though Indian having 670 Protected area including 102 National park, 515 wildlife sanctuary, 49 Conservation Reserves and 4 Community Reserves, there has been a decline in diverse wildlife species. There have been radical changes in land use around protected areas. These are generally being used intensively for developmental purposes, thus upsetting biodiversity. The scope and category of land use straight affects flora and fauna habitat and thus impacts local and worldwide biodiversity. Land alteration is the on its own most source of disappearance of worldly species. We are at present bringing up the rear species at sandwiched between 100 and 1000 times the normal rate, and more or less all of this augment is caused by humans. Even as hunting and environment damage engage in recreation a most important element, climate change and the troubles it causes such as elevated temperature, varying precipitation and extreme weather, have the condition more grave. Almost 50% of the land is windswept and robbed of its fertility. The level of damage made to the world's biological diversity and eco-system cannot be assessed. Our renewable and non-renewable resources are being disturbingly worn out appropriate to growing population pressure affectation intricacy to deal with danger to upcoming generation. Therefore, there is a burly require to talk about corrective actions to keep our potential approach and ecological management.

[1] Wildlife Institute of India, India

D1-PII-A -**5**

Benefits of Urban Green Biomass to Mitigate of Climate Change

Ujjal Adhikary[1], Debabrata Lahiri*[2]

Introduction:

Urbanization is the most vital cultural activity by human being on earth surface from the last half of past Century. Urbanization is the signification of modern civilization. Urbanization is also the process of environmental degradation. Urbanization and climate change is a co-related phenomenon (mainly the urban micro-climate). Without destruction of green biomass, urbanization is impossible. Green biomass have the capability to mitigate the climate change through absorbing the green house gases, controlling the surface run-off & infiltration of water.

The percentage of population living in urban area in India has been 31.16 percent (Census report 2011) as compared to rest of the world (22.00 percent) and also the rate of urbanization (rate of urban area increase) in India around 2.00 percent in 2011. Increasing in urbanization has been a worldwide phenomenon in developing countries, like India, Srilanka, Bangladesh, Nepal, Indonesia etc. While the causes of urbanization has been mainly migration from rural to urban area in search for work and livelihood and for this purpose increasingly destruction of green patches of land such as tree cover and water bodies which have been the destabilizing the climate.

Impact on climate in terms of change in urban areas not been different from rural areas as the ultimate effect on climate has been on change in temperature, rainfall pattern and some where rise in water level of nearby rivers due to heavy rainfall cusing inundation. For such change in climate parameters has been increase in population, human settlement etc. Due to increase in human settlement due to increase in number of houses tree cover and water bodies have been reducing day by day in urban areas. Reduction in tree cover and water bodies have been more prominent in small towns (municipalities) where expansion of habitation has occurred in a hapazard manner without giving due importance to urban planning.

Objectives:

The following are the objectives:

i) To study the extent of increase in population;
ii) To study the extent of destruction of trees and water bodies;
iii) To study the chages in temperature and rainfall pattern;
iv) To study the occurances of flood and inundation due to urbaisation.
v) To study the changes in property registration along with their values in Ghatal municipality;
vi) To study the benefits and costs of reduction in water bodies due to urbanization (sample survey – type of costs incurred by loss of water bodies – loss in crops, fisheries, (market valuation), ecosystem & biodiversity.

Research questions

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[2] Rural Development Centre, Indian Institute of Technology Kharagpur

The following are the research questions:

i) Whether climate changes have been due to increased urbanisation?
ii) Whether urbanization destroying the green biomass or water bodies?

Data:

To analyse the effect of urbansiation on climate changes the following of data has been collected:

i) Changes in population over decades;

ii) Increase in number of human settlements depicted by number of registration of houses at the municipality;

iii) Ward wise decrease in water bodies in the municiplaity;

iv) Number of saplings tree either distributed or sold by the forest department as a proxy of destruction in number of trees;

v) Incidence of flood or inundation in the municipality.

All these data would be collected on time series basis and whee ever no possible sample survey would be resoted to.

Model:

The collected data is analysed through correlation and regression.

D1-PII-B-**1**

Urban Agriculture, a Tool for Biodiversity Conservation and Climate Change Adaptation

Neeraja Havaligi*[1]

Urban agriculture fills the gap between urban food demand and supply. It serves as a source of livelihood and sustenance, plays a central role in community development and provides innovative ways for efficient use of natural resources. Urban agriculture contributes significantly to urban ecosystem and community services. Urban agriculture is influenced by diverse microclimate conditions, cultural practices and local natural resources. Hence, urban agriculture provides a niche opportunity to study and document urban agrobiodiversity and can be a potential tool for city planning and development policies, especially to address biodiversity conservation and climate challenges. Unfortunately, with few exceptions, public planning and policy makers ignore urban agriculture where it can make significant impact.

Urban agrobiodiversity is a potential tool for biodiversity conservation and climate change adaptation. However, it has not been systematically quantified and identified for its potential on those lines within the urban agriculture community, biodiversity conservation practitioners, climate change specialists and urban planners. Identifying this role will be an add-on to ensure urban food security, sustainable urban planning and design and to meet the local and global challenges of biodiversity loss and climate change.

This paper consists of three parts. The first part consists of a systematic review of influences of microclimate and cultural practices on crop growth, yield, adaptation and related parameters. The review will present an insight to interlinkages between these parameters in context of urban agriculture. It will identify existing knowledge, gaps, lessons and challenges to translating these interlinkages into designing urban gardens and green spaces and in retrofitting urban plans and policies.

The second part of the paper will focus on the urban agriculture online directory/tool developed to identify and measure urban agrobiodiversity and urban agriculture practices. Surveys and interviews of urban agriculturists and officials involved in developing city plans and policies will provide an insight of their views the potential role of this online tool on existing and projected opportunities and programs designed for urban agriculture, natural resource management and climate change.

The third part of the paper will make a case for urban agriculture as a tool in urban planning and development, biodiversity conservation and climate change adaptation interventions in cities. The paper will illustrate the role of urban agriculture online resource (under development) as a design tool for urban natural resource management plans and economic development plans to support community resilience to climate change.

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D1-PII-B -**2**

The "Cumulative Emission Budget Approach": An alternative mechanism for carbon trading and its potentials for low carbon development in India

Harald Kaechele [1], Kathrin Specht*[1], Amjath Babu[1], Tharayil Shereef[1]

Current global climate policy architecture does not aim at stabilizing the greenhouse gases concentration in the atmosphere that may achieve the proclaimed 2°C guard rail. Given the scientific evidence that the warming effect of green house gases, especially CO_2, is insensitive to the timing of their emissions but only to the aggregate emissions, realistic policy instruments have to address their cumulative emissions instead of emission rates or concentration targets. An alternative approach that targets such an outcome is the "Cumulative Emission Budget Approach" put forward by the German Advisory Board of Global Change (WBGU). Instead of fixing individual country targets, a common aggregate emission budget is proposed. WBGU argues for per capita distribution of the carbon budget and universal participation of all nations. The approach visualises sharing of the carbon budget (750Gt CO_2) equally to every human, which gives an annual budget of 2.7 t CO_2 per capita until 2050. Depending on the current per capita emissions of each country, three broad categories of emission pathways can be proposed, given a treaty based on the budget approach. The objective of this research work is to further elaborate the approach, to investigate its flexibility instrument i.e. carbon trading and its potentials for low carbon development in India. Given the fact that the current per capita emissions in industrialized countries largely exceed the per capita allowance (2.7 t CO2 per year), the purchase of emission rights from nations having surplus budgets could allow their cost effective transition to decarbonization of the economy. In contrast to many existing trading arrangements based on grandfathering of pollution permits that tends to benefit the heavy polluters, the least polluters are rewarded under the WBGU approach.

The results of the analysis show, that India is the country with largest tradable surplus in the world, reflecting its low emission per capita and large population. In 2008, India emitted roughly 1.5Gt CO_2 which was 1.7Gt CO_2 below its WGBU budget of 3.2Gt CO_2. It means the country could sell the surplus CO_2 emission and substantial funds could be generated by trade of permits. Even though India is one of the lowest emitters in the world in per capita terms, individual carbon emissions within India differ, though this fact is little reflected in the literature and the climate policy discussion. A deeper understanding of the national inequities in energy use reveals that the buffer budget stems from the poor. The selling of the rights could support the transition of the recipient nations and support a low carbon growth of the economy. One critical issue is that the overall demand of carbon credits exceeds the supply. Carbon trading as proposed under the WBGU approach can be seen as a supportive element, but needs to be accompanied by further decarbonization strategies.

To conclude the WBGU approach can be understand as a political instrument for mind-setting, which promotes the idea of climate justice among the nations. Calculating tradable CO2 permissions might become a powerful instrument which supports the recipient nations in their rationale to receive transfer payments, but cannot replace decarbonization efforts.

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D1-PII-B -**3**

Observation of Biodiversity, Climate Change and Mitigation in Tbilisi's Environs

Manana Devidze*[1]

Tbilisi is located in the South Caucasus at 41° 43' North Latitude and 44° 47' East Longitude. The city lies in Eastern Georgia on both banks of the Mtkvari River (internationally called Kura River). The elevation of the city ranges from 380–770 meters above sea level and has the shape of an amphitheatre surrounded by mountains on three sides. The city stretches 33 km along the Mtkvari River and covers an area of 372 square km.

The river divides the city into two parts, with the left side of the city exceeding the right in both territory and population. The mountains, therefore, are a significant barrier to urban development on the right bank of the Mtkvari River. The relief of Tbilisi is complex. The diversity of Tbilisi's relief is the result of its geo-morphological structure. The relief has been strongly transformed by anthropogenic impacts over the centuries. Among natural-tectonic events and processes are landslides, mudflows, erosion and floods. The principal factors hampering the development of Tbilisi and damaging city infrastructure are landslide-gravitational events and mudflows, historically taking place on the basin slopes.

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D1-PII-B -**4**

Tackling Black Carbon Pollution from Agricultural Fires: The Case of Punjab

Ridhima Gupta*[1]

One of the key environmental problems facing South Asia is a layer of air pollution, known as the Atmospheric Brown Cloud, that covers large parts of the region. Much of this pollution is caused by farmers burning agricultural field residue. This pollution has a significant negative impact on people's health and on regional climate and crop output. This study from India's Punjab region looks at the factors that drive field residue burning. It also assesses the potential of new technology to address the problem. I find that the use of coarse (as opposed to Basmati) varieties of rice increases the likelihood of farmers burning biomass. Most importantly, I find that technology exists that would let farmers plant their crops without having to burn residue. This technology is known as the Happy Seeder. This machine plants seed into loose residue, making burning of residue unnecessary. A comparison of the Happy Seeder with conventional practice shows that the new technology does not increase field preparation costs or alter crop yields. The technology could therefore provide a real solution to the residue burning challenge. I conclude that farmers will be slow to adopt the Happy Seeder technology since it has no strong advantage or disadvantage from the viewpoint of profits. However, I find that for the society at large the Happy Seeder technology is a highly cost-effective intervention. Thus, the state has a role to play in promoting the machine in order to reduce residue burning, the costs of which are mostly external to the farmer.

[1] Indian Statistical Institute Delhi, India

D1-PII-B -**5**

Influence of Subdivision Design and Conservation of Open Space on Annual Carbon Sequestration Rates

Richard Vaughn*[1], Mark Hostetler[1], Francisco Escobedo[1]

Cities are increasingly trying to offset carbon emissions and residential subdivisions are a major source of such emissions. Compact or clustered subdivision designs have the potential to improve carbon storage and sequestration rates through the conservation of open space and the conservation of existing trees found on built lots. However, very few empirical studies estimate how different designs and tree conservation strategies impact the carbon footprint of residential developments. Using a 1,778 acre development site that has been approved for 1,890 units (near Gainesville, Florida), we estimated the carbon storage and sequestration rates of different hypothetical site designs and tree conservation strategies. Current land development regulations limited where homes and roads could be built, and this equaled about 61% (?) of total area. The developer, though, could distribute the built lots and roads throughout the site or strategically limit it to certain locations. Our objective was to determine which site designs could maximize carbon sequestration rates and storage given the number of homes that could be built on the site and other regulatory limitations. From 88 random stratified plots, we measured tree species, sizes, and abundance in three different land cover categories found on the development site. Land cover categories consisted of:

1) hydric, areas of forested and non-forested palustrine wetland,

2) mesic-hydric, containing mixed hardwood-pine forests, hardwood hammocks, and pinelands, and

3) xeric-mesic, land dominated by oak scrub and mixed pine/oak/hickory forest. Tree data collected from these regions were entered into the USDA Forest Service Urban Forest Effects (UFORE) model; i-tree's ECO software system was used to estimate predevelopment carbon storage and sequestration rates. ArcGIS was then used to compare the impact, on baseline carbon rates and storage capacity, of several different site designs and tree conservation strategies for the development. We found that carbon sequestration rates and storage were highest in the hydric land cover category and somewhat lower in mesic and xeric categories. This data while helpful in determining which vegetative areas should be conserved did not identify areas where construction should take place. Focus was then shifted to analyzing the storage and sequestration rates by age of the vegetation. Using Pearson's correlation model, older-aged trees sequestered relatively more C ($r = 0.554$) and stored more C($r = 0.659$) were also detected. By placing home lots in different areas across the site and retaining various densities of trees on built lots, we found that carbon sequestration and storage could be dramatically improved if the developer chose one design and tree conservation strategy over another. Increase in the storage and sequestration capacity ranged from 14-33 percent, depending on where the built lots were placed. The build scenario that focused on maximizing carbon storage by preserving the oldest and largest trees provided the greatest benefit to offsetting emissions followed closely by the scenario focusing on the combination of carbon storage and preservation of open space. Exact numbers will be presented and potential conflicts with economic and other ecological goals will be discussed. Results from this study will help planners and developers to maximize carbon sequestration rates and storage, while

[1] University of Florida, USA

balancing economic constraints and accommodating other environmental goals such as water, energy, and biodiversity conservation.

D1-PII-C-**1**

Ecological Restoration of the Riverbank in Urban Area in Japan - the Design Process of Fishways? And Surrounding Areas

Keitaro Ito*[1], Yamaguchi Eihiko[1], Yuji Shin[1], Kosuke Ide[1]

It is an important issue how to design open and semi-natural space in urban area for urban biodiversity and ecological education. Because there has been rapid decrease in the amount of open or natural space in especially in urban area in Japan due to the development of housing area. Thus, preserving these areas as wildlife habitats and spaces where children can play is a very important issue nowadays. We are working on the projects and designing urban park, nature rehabilitation in urban river bank, school garden, forest park and so on.

In this conference, mainly, I would like to show you the project to design a fishway and surrounding areas (aprox. 300m long) in Asiya town in the south of Japan started in 2008. The aim of this project is to create an area for children's play and ecological education that can simultaneously form part of an ecological network in an urban area. Process planning and Multi-Functional Landscape Planning (MFLP) has been used for this project (Ito et al. 2003, 2010). Process Planning would appear to be well suited for a long-term project such as nature restoration site. MFLP is thus considered suitable for the planning of a project which takes a long time to become established.

Forman(1995) discussed habitat fragmentation and how it occurs naturally as well as being a result of human activity. At this study site, habitat fragmentation has already been caused by the development of housing projects. If we create a green space with high biodiversity in an urban area, it will serve as a stepping stone for species dispersal. Therefore, it would be very important for the landscape planners to consider “landscape” as an “Omniscape” (Ito et al. 2010, Fjortoft & Ito, 2010, Numata 1996, Arakawa, 1999) in which it is much more important to think of landscape planning as a learnscape, embracing not only the joy of seeing, but also exciting the five senses as a whole.

[1] Kyushu Institute of Technology, Japan

D1-PII-C -**2**

Mapping São Paulo City's Biodiversity: Educational and Technical Proposal

Yuri Rocha[1]*, Patricia Prado[1], Felipe Pinto Sobrinho[1]

Introduction

The Cultural Biogeography aims to study the effects of man on the biota and the distribution of organisms on temporal and spatial scales. These effects may involve destruction, alteration, and degradation of ecosystems at various levels of intensity; extinguish, dispersing or introducing of alien species; genetically modifying plants and animals (GMOs), etc. Ellis and Ramankutty (2008) have proposed the term "anthropogenic biome" which shows the mapping of human action on different biomes, and how much the natural planetary biomes were transformed by this interaction, considering the distribution of flora and fauna in these so called anthropogenic biomes. Cultural Biogeography can be divided into Agricultural Biogeography and Urban Biogeography (Simmons, 1982). The quantity and size of cities have been increasing after the nineteenth century, causing intense changes on the natural environment. This situation becomes an emergence for the urban environments that are normally characterized by lower biomass production when compared with natural ecosystems. Thus, Urban Biogeography targets to study the distribution of plants and animals adapted to those urban environment. The techniques on biogeographical studies produce information about living beings and the physical environment they interact with. Also Biogeography contributes to the definition and understanding of organisms' geographical distributions in spatial-temporal scales. The techniques used to study the fauna, flora and the physical environment in biogeographical studies come from Geology, Geomorphology, Climatology, Hydrology, and Pedology. For example, geomorphologic studies involving orientation of slopes, pedological studies with sample collection of soil, and climate with record rainfall data are fundamental to correlate these characteristics of the physical environment with the distribution of plants and animals (Rocha, 2011). The biogeographical studies of fauna and flora are need improvements in its data collection, especially about the relationship of geographical distribution, etiology, phenology; associations and co-evolution of animal and plant habitats, including diets of animals, pollination, and seed dispersal. Therefore, there are no exclusively biogeographical techniques but associations of interdisciplinary approaches. Although the techniques come from different areas, they are used to identify territorial units with the living beings. Thus, the information generated by technologies should have meaning and geographical value (Meaza, 2000), especially if technologies are appropriate for the spatial-temporal scales of the biogeographical research. São Paulo, the capital of São Paulo State, Brazil, is one of the largest cities in the world (11,244,369 inhabitants) and the center of the largest metropolitan area in South America. This urban growth in the region of the Atlantic Rainforest led to a major transformation in the natural landscape to a very unique cultural landscape. São Paulo City presents native flora and fauna, which have managed to adapt to the natural transformation, and also the exotic species that were introduced by their cultural, aesthetic and ecological values. Therefore, the biodiversity of the city of São Paulo is certainly smaller than the original and its knowledge is essential for planning and management. The first step is to map the areas where plants and animals are distributed geographically.

Aims

This educational and technical project aims to identify and mapping species of trees, shrubs, epiphytes, insects, birds, reptiles, amphibians, and mammals, to study and quantify species each

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year, resulting in a well establish a database. The first part of the study is to map the distribution of native and exotic species of plants and animals.

Results

Since 2010, this technical and educational proposal was initiated with my undergraduate students from the "Biogeography" course (Geography majors of the University of São Paulo) in order to train students to identify species of animals and plants found around their neighborhood. Species were mapped as individuals by the Google Maps tool. Data collected by students were systematized and presented together in order to have a diagnosis of species, their frequency and how they are distributed, generating a mapping of urban sampled and biodiversity. To perform this activity, students were given instructions by a field guide to observe aspects of the environment and plants, such as: height, habit's features, type (herbaceous, shrub, tree); canopy size; proportion of shade (for trees); phenology (flowering, fruiting, seed dispersal, leaf fall), colors of the leaves, flowers fruits, and seeds, including quantity of the species in the study area. Also, if species were common or rare; interaction with other living organisms (epiphytes, parasites, animals, etc.); presence of built elements (buildings, sidewalks, walls, etc.), and death plants. They used "scales" (with a pen, for example) to compare with sizes. Regards to animals, students observed: behavior (nocturnal, diurnal); interaction with vegetation; eating habits; frequency of observations during the time of field activity; coloring of fur, feathers, etc.; presence of feces, footprints, nests and other signs. Animals were also photographed. During the two years period of studies using this technical and educational proposal (2010-2011) students have identified and mapped dozens of species of trees, shrubs, epiphytes, insects, birds, reptiles, amphibians and mammals. Project will be continue for the next years, expanding the study area, and improving the number of species in our database. Data collected by only one of students (Table 1) are systematized and presented together in order to have a diagnosis of species, their frequency and how they are distributed. Our resulted map presented the Urban Biogeography and biodiversity found at São Paulo City.

Table 1. Sample of the plants and animals found by only one of students of 2010 at *Iquiririm* Street (23º34'12.04"S, 46º43'49.86"W - 23º34'18.26"S, 46º43'48.62"W), São Paulo City, Brazil.

Plants	
Popular name	**Scientific name**
Amoreira	*Morus nigra*
Primavera	*Bouganvillea spectabilis*
Espada-de-São Jorge	*Sansevieria trifasciata*
boldo	*Plectranthus barbatus*
Ameixa-amarela	*Eriobotrya japonic*
Coroa-de-Cristo	*Euphorbia milli*
Sibipiruna	*Caesalpinia pluviosa*
Animals	
Popular name	**Scientific name**
Formigas	*Atta* sp.
Abelha	*Apis mellifera*
Maritaca	*Pionus maximiliani*
beija-flor	*Hylocartis cyanus*
Sapo-cururu	*Bufo marinus*
Pombo	*Columba livia*

Conclusions

Although this proposal has been applied to undergraduate students during a two years studied period (2010-2011), results have been very productive because they showed great interest, devotion and excellent learning about Urban Biogeography of São Paulo City. This project constitutes an educational and technical practice that can be used in the professional future of these students, especially when they apply to work as teachers. It was a simple proposal, but totally viable in terms of time and financial support, extremely efficient to increase knowledge about Urban Biogeography and landscape, but more important generating rich information about surviving species in metropolitan areas.

References

Ellis, E.; Ramankutty, N. Putting people in the map: anthropogenic biomes of the world. *Frontiers in Ecology and the Environment* 6 (8): 439-447, 2008.

Meaza, G. *Metodologia y prática de la Biogeografía*. Barcelona: Ediciones del Serbal, 2000.

Rocha, Y. T. Técnicas em estudos biogeográficos. Ra'e ga (UFPR), v. 23, p. 398-427, 2011.

Simmons, I. G. Biogeografía natural y cultural. Barcelona: Omega, 1982.

D1-PII-C -**3**

The Importance of Public perception of Nature in realizing Ecological Landscape Planning in Tropical Cities

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Ecological landscape planning has often been touted as a landscape-level solution to biodiversity conservation and provision of ecosystem services in an increasingly urban world. Despite presenting this unique opportunity, the creation of ecological landscapes in the city requires that planners tackle not only environmental issues but social issues such as the facilitating of public acceptance towards more naturalistic habitats (and biodiversity) in urban areas. Green-spaces in urban areas are varied in form, ranging from manicured parks to pockets of unmanaged secondary vegetation (Özgüner, 2001), all of which vary in their degree of public acceptance and richness of their ecological function.

In relation to studies on ecological landscape planning, research on public preference on landscape types in urban areas have been few in comparison, with an almost total focus on landscape perception in temperate or sub-tropical countries. However, due to the difference in landscape types present in temperate/ subtropical and tropical regions, ecological landscape planning solutions presented in the formal two settings need to be revised for tropical urban areas.

This research is centered on quantifying the public perception of nature in relation to landscape planning in Singapore, a highly urbanized city in which ecological landscape planning movements have just begun to take root. This study thus functions as a case study towards the social acceptability of integrating ecological landscapes into highly urbanized environments.

Results indicate that landscape preference tended towards manicured/ aesthetic landscapes despite an overall tendency towards nature preservation which is best achieved in naturalistic habitats. However, specific education in ecology as well as increased opportunities at first-hand experience in natural areas were found to be factors which could influence landscape choices to encompass more naturalistic habitats in urban areas. As such, it is proposed that applying conventional ecological integration solutions in tropical urban areas could meet with limited success. However, increased instances at public education, coupled with the gradual insertion of naturalistic habitats into urban areas to facilitate human-nature interaction on a daily basis could be viable solutions to increase social acceptance of ecological landscape creation in urban areas.

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D1-PII-C -**4**

Environmental outreach and culture: A case study of the St. Lucia Forestry Department

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An island in the Caribbean Sea with a population of approximately 100,000 individuals and a booming tourism industry, Saint Lucia is a urban hotbed of culture and life. A mixture of urban cities, coastal fishing villages, and lush rainforests requires education and outreach efforts to take on unique forms to spread a conservation message on the island.

In 2010 we interviewed administrators and outreach personnel of the St. Lucia Forestry Department regarding their conservation outreach and education programs for island residents. We were interested in first determining how the EE Unit utilized cultural influences in transmitting conservation messages to promote environmental literacy of St. Lucian residents. Secondly, what meaning do those elements have that make them suitable for transmission of conservation messages? A grounded theory approach was used to explain and explore the process of using cultural elements as a tool for transmitting conservation messages in an outreach program. Because theories are drawn from data and not forced on the data they can provide meaningful insight into the experience of the subjects (Strauss & Corbin, 1998). We also used the North American Environmental Education (NAAEE) Guidelines for Learning to determine what elements of environmental literacy are evident in their outreach and education efforts. The NAAEE Guidelines for Learning represent a set of common, voluntary guidelines and broad outcomes for environmental education; organized into four strands, which then further express the goals for environmental literacy (Simmons 2003).

St. Lucia was chosen as a unique case study for their efforts to incorporate cultural influences in the delivery of environmental outreach and education programming. This is useful in determining how useful cultural elements are in increasing environmental literacy. In the first phase of the project, we conducted interviews and observed EEU staff as they conducted outreach programs. Administrators and outreach staff were interviewed about their conservation outreach program design protocols to gain an understanding of how they are using cultural influences as part of their outreach efforts. In the second phase of the project, we did detailed observations of outreach programs to document environmental literacy and cultural identity components. What we found is that there was a cognizant effort on behalf of the EEU staff to incorporate elements of St. Lucian culture in program delivery methods. This was for the purpose of minimizing obstacles faced in making in roads with a target audience. This method also makes a direct connection with the audience's cultural identity to instill pride in the resources native to the island. Methods they used had meaning for certain members of the population; such as communication with younger or older members of the population based in the music genre they identify with. While outreach efforts in certain communities responded better with formalized community presentations and workshops, whereas other communities responded better to informal community events where information was shared secondarily. These initial results show that using cultural elements can breakdown initial communication barriers, as well as serve as a platform to build environmental literacy.

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D1-PII-C -**5**

The Soil Carbon Sequestration Potential of an Urban Area – A Case Study of Pimpri-Chinchwad Urban Area, India

Nisha Choudhari*[1], D.M. Mahajan[2], V.R. Gunale[1] and M.G. Chaskar[3]

Mitigation options for limiting the increase of the greenhouse gas concentration in the atmosphere comprise either emission reduction or removal and storage of greenhouse gases. Soil as the largest reservoirs of carbon, accounts for 2011 GtC, or 81% of the total carbon in the terrestrial biosphere Soils are an important pool of carbon that can either act as a source or sink for atmospheric carbon dioxide. Increasing soil organic matter stocks in urban ecosystems could potentially help to mitigate atmospheric changes by increasing soil carbon sequestration. Pimpri Chinchwad urban area is one of the largest industrial hubs in Asia, having more than 3000 industrial units. Most of the industries have developed green belts. The urban authorities have developed large number of gardens and parks. The present study was carried out in Pimpri-Chinchwad (India) urban area, in order to understand the soil carbon sequestration potential of this area. This area was divided into four zones viz. Residential zone, Public gardens and parks, Industrial zone and roadside, on the basis of vegetation density. Soil samples were collected from these zones at two depths, i.e. 15 cm and 30 cm, and analysed for total carbon sequestered. The soil carbon was estimated by using field study followed by laboratory analysis. The comparative account of carbon accumulated in the soil in the above stated four zones was done. For this study sampling plots of 1m × 1m were laid in perennial vegetation habitats. The soil collection sites were marked using Global Positioning System (GPS). Results obtained showed that highest amount of carbon (~ 627.3 tones/ha) was accumulated in the garden zone and the lowest amount of carbon (~196.4 tones/hector) was recorded from road side zone at the depth of 15 cm. At the depth of 30 cm highest value (~960.3 tones/ha) of carbon was recorded in garden zone while the lowest value was recorded in the residential zone (~351.8 tones/ha). The average highest value (9.64 tones/ha) of soil organic carbon recorded in the Residential area at the depth of 15 cm and at the depth of 30 cm the average highest value (13.53 tones/ha) was accumulated in the garden zone.

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D2-PIII-A-**1**

Urban Wetlands: Their Relevance & Vulnerability with Special Reference to Kochi

Anju John*[1]

Wetland is defined as land transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water" (Mitch and Gosselink, 1986). Ramsar Convention on wetlands defines wetlands as: "areas of marsh, fen, peat

land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters". They are unique systems because of their hydrologic conditions and their role as ecotones between terrestrial and aquatic ecosystems.

Wetlands provide important ecological services that contribute to watershed functions, flood attenuation, ground water recharge and discharge, shoreline protection and wildlife habitat. They are valuable as carbon dioxide sinks and climate stabilizers on a global scale. They retain water during dry periods, thus keeping the water table high and relatively stable. In addition, wetlands are important feeding and breeding areas for wildlife and play important role in supporting species diversity and hence they are often referred to as "biological supermarkets" (Mitch &Gosselink, 2000). It is estimated that freshwater wetlands alone support 20 per cent of the known range of biodiversity in India (Deepa and Ramachandra, 1999). These threatened landscapes are the last and only refuges for a wide variety of flora and fauna.Wetlands are often described as "kidneys of the landscape" (Mitch and Gosselink, 1986) due to their contributions in pollutant removal.

Kochi has a large water and wetland cover. They play a significant role in moderating the urban heat island effect. While other coastal cities such as Chennai, Kolkata and Visakhapatanam have an urban heat island intensity of over four degree Celsius, in Kochi the average is only 2.5.Valanthakadu and the banks of Vembanad Lake in Kochi housing luxuriant mangroves play a pivotal role in neutralizing the harmful effects of the newly-formed Urban Heat Islands.

The degeneration of the wetlands of Kochi can be traced to factors such as impact of sea-level rise, impact of development activities like - reclamation and creation of the Wellington Island and the shipping channel for the Cochin harbor, reclamation and bunding works in Kuttanad area for improving agricultural production in the area, construction of Thottapally Spillway and Thanneermukkom barrier etc. Sand mining, pollution &eutrophication problems, agriculture & aquaculture and population pressure accelerated the issue. The wetland area has been getting reduced at an alarming rate by the change in landuse pattern. The builtup area has increased from 18.2 sqkm to 63.20 sqkm in the last decade.

The coastal wetlands of Kochi have now become one of the most seriously threatened wetlands in India. Remedial measures in the form of policies like CRZ and proper land use planning and stringent regulations on land use are very crucial in safeguarding these precious natural resources.

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D2-PIII-A -**2**

Sustainability of Urban Water Bodies – A Tale of Two Cities

Hippu Salk Kristle Nathan[1], Borgohain Priyam Laxmi[1], Jafar K*[1]

The growth of the economy, rising urbanization, and changing life styles have influenced a large demand for all civic amenities including water in urban areas. The big cities grow at the cost of their periphery; the surrounding villages feed the city population and remain as a 'safe' place for dumping urban wastes. The process of rapid urbanisation essentially results in massive land transformation and diversified land use. These contribute to wider reaching, regional systemic changes in the urban biodiversity.

Urban activities are often connected with its water bodies. Water bodies attract informal settlements and acts as a sink for waste. The degradation of various waterbodies both within and periphery of the cities leads to water crisis. This crisis has become more severe and complex under the climate uncertainties. There is a question-mark on the sustainability of water systems in cities and cities, particularly in the developing world, are going to face the challenge of water scarcities. India is not an exception to this. Though water is renewable and seems abundant, the water that can be used for domestic purpose is very limited. For instance, the water of Powai lake and Hussain Sagar—situated in the heart of city of Mumbai and Hyderabad respectively—is too polluted to be used for domestic purpose. Increasing pollution in cities, weather extremities, and shrinking water supplies contribute to scarcity of water.

This study aims at assessing the sustainability of urban water bodies for two cities of India, namely, Mumbai and Bangalore. The focus of the study is at the supply side. Based on both secondary and primary level information, the paper does the water source profiling for the two cities from the river/water body to the treatment plant. From the population data and water supply information, per capita availability of water is assessed. The water quality data (parameters like Turbidity, pH, Alkalinity, Chlorides, T Hardness, total Coliform, and E. Coli) are studied for different reservoirs supplying water to the two cities. The sources of pollution to the water bodies are also identified. Moreover, the housing (provision of tap water in different types of buildings) and water end use characteristics of the two cities are examined to reflect on the future of water demand for both the cities.

Supply of clean, adequate, affordable water is considered as one of the most critical infrastructural services of civic bodies. Water is directly related to public health and indicates quality of life and economic and social conditions of the society. In this context this study bears importance as it gives a comprehensive evaluation of sustainability of water source of two prominent cities of India. Also, the study proposes measures for water conservation, which can foster urban biodiversity. The institutional and governance snags in the water supply are identified and corrections are suggested. The study concludes with policy recommendations to achieve a sustainable urban water supply for urban set up.

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D2-PIII-A -**3**

Watershed Management and Urban Design: An Approach to Water Urbanism

Vivekanand Tiwari*[1], Ritu Rai[1]

Watershed is a Geohydrological unit draining at a common point by a system of streams. All land everywhere is part of some watershed. A small watershed of a few hectares draining into a small stream may form larger watershed, which in turn may form part of a still larger watershed. All the combined watersheds may become a major river basin draining millions of square kilometers of land. The term watershed strictly refers to the divide separating one drainage basin from another. Watersheds of the small streams are the sub-watersheds of the watershed of the large stream.

Watershed is an integral part of urban environment which plays an important role to facilitate the various living and non living elements of urban ecosystem. On the other side it is very sensitive to the urban changes.

The increase in hard land cover within the catchment area has reduced the peculation of rain water in the ground and increased the runoff in terms of seasonal drainage. The outcome is in terms of reduction of ground water table and increase in urban floods as well as wastage of rain water as they simply get polluted and evaporated without any use. In such scenario watershed management is very much important to conserve the natural landscape not only at regional scale but also at urban scale also.

Many different concepts and approaches have been proposed along with fewer practical ways to implement the watershed management. Integration of Urban Design strategies in watershed management is very important to define the Urban Identity. Watershed development strategies and the Urban Design concepts should be in such a way so that both should facilitate each other requirements. For this particular approach the Urban Design guidelines are very important in relation with dynamic behavior of water shed region. Urban Design Proposals should respond to the site drainage for the efficient drainage planning. The localize and decentralize water catchment strategies should be the part of generic Urban Fabric. Efforts are required to incorporate the traditional indigenous knowledge of watershed management as the integral part of Urban Design which may be conceptualize as **Water Urbanism.**

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D2-PIII-A -**4**

Change in Land-use Pattern of East Kolkata Wetlands: Concern and Consequences

Debanjana Dey*[1], Sarmila Banerjee[1]

The natural gradient of the city of Kolkata is towards South-East and, therefore, the 12,500 hectare wide wetlands in the Eastern fringe of the city, popularly known as the East Kolkata Wetlands (EKW), are providing the city a unique opportunity for natural treatment of its waste water and flushing out of its excess rain water. Moreover, pond effluent based paddy cultivation and garbage based vegetable farming are integrated with fishery in a way making their production processes complementary to each other. Hence, a low-cost supply chain of fish, vegetables and other food items to the city keep its Cost-of-Living-Index (CLI) the lowest among all metro cities of India. The close interaction with nature creates a number of vocations which are inter-temporally viable as well as socially and economically sustainable. Because of this wise-use-practice EKW is a designated Ramsar site since 2002.

However, since the development of Salt Lake City and the construction of Eastern Metropolitan Bypass, the connectivity of EKW with the main city has improved and the pressure of urbanization is leading to conversion of wetlands into urban settlements. This practice is disturbing the age-old eco-balance and the eco-system based livelihood making the sewage-water-pisciculture less profitable, creating a number of new vocations related to the process of land speculation, land transfer and urban living. To protect the eco-system based livelihood a number of public interest litigations have been initiated by the Civil society and as a consequence, conversion of wetland into any other alternative form of land use has been legally barred. However, this attempt turned out to be futile in protecting the old nexus of nature-based livelihoods.

By using a detailed GIS map, this paper identifies the mouzas of EKW where the maximum conversion to urban settlement has taken place and explores the association of this change in land-use pattern with urban proximity, population density as well as size of the water body. On the basis of information collected through a primary survey it was found that over the last fifteen years the traditional livelihood pattern has been retained mostly in the mouzas having large water bodies and most of the people in this area are inclined to switch vocation. Those with better education are leaving traditional vocation faster. There was very little awareness about the benefit of this unique eco-system and almost no knowledge about the Ramsar status. Thus, the field survey documented a glaring failure of governance on the part of the authority.

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D2-PIII-A -**5**

Bangladesh Climate Change and Wetland: Bottlenecks and Conservation Approaches

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Geographic location and geo-morphological conditions of Bangladesh have made the wetlands of this country one of the most vulnerable to wetlands in context of climate change. Wetlands which occupy around 50% of the country play a crucial role in maintaining the ecological balance of ecosystems and cultural figures as well. But due to climate change and anthropogenic activities, wetlands habitat of Bangladesh is under constant threats. Drought, excessive temperature, mountain snowfields and glaciers melting, riverbank erosion, salinity intrusion, flashflood, storm surges, higher water temperatures, precipitation anomalies, coastal cyclones, seasonal anomalies and extremes are main threats to the wetland ecosystem. Enhanced UV-B radiation and increased summer precipitation will significantly increase dissolved organic carbon concentrations altering major biogeochemical cycles and also will result into the expansion of range for many invasive aquatic weeds. Generally, rising temperature will lower water quality through a fall in oxygen concentrations, release of phosphorus from sediments, increased thermal stability, and altered mixing patterns. As a result biodiversity is getting degraded, many species of flora and fauna are getting threatened, and wetland-based ecosystem is getting degenerated. At the same time, the living conditions of local people are deteriorating as livelihoods, socioeconomic institutions, and extensive cultural values as well. For conserving and managing wetlands technology, legislation, educational knowledge, action plan strategy and restoration practices are required. In order to address the human needs in the changing climate community-based adaptation approaches and wetland restoration, practices had been taken in almost every type of wetlands in Bangladesh. Therefore, Bangladesh now needs a comprehensive strategy and integrated system combining political, economic, social, technological approaches and institutional supports to address sustainable wetland restoration, conservation and the newly added crisis, climate change.

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D2-PIII-B-**1**

Occupancy Modeling of Habitat Associations of Birds Of Prey in Urban Business Parks

Jonathan Hogg*[1], Charles Nilon[1]

Through the latter half of the 20th century and into the 21st, many species of birds of prey have come to colonize urban areas. In the United States of America, various species of raptors have been found living and hunting in parks, residential areas, school grounds and complexes of business and light industrial facilities ("business parks"). It is the latter land use type that I will focus on in this study, as conservation in business parks is a growing concern due to the amount of land they occupy and their pattern of development of formerly vacant land on the fringes of urban areas. Business parks represent a sort of midpoint on the continuum of land management in urban areas between privately owned and independently managed residential parcels and publically owned spaces that are often specifically managed for wildlife, aesthetic value, and/or outdoor recreation. Conservation in business parks is a growing concern due to the amount of land they occupy and their pattern of development of formerly vacant land on the fringes of urban areas.

I am studying the use of business parks by birds of prey in the St. Louis metropolitan area. The species being surveyed for are the most common raptor species in St. Louis: American Kestrel, the Red-Tailed Hawk, the Cooper's Hawk, the Red-Shouldered Hawk, and the Mississippi Kite. Business parks are being investigated by means of call-broadcast surveys for raptors at a set of predetermined survey points. The location of the survey points was determined by querying geographic databases for business park land use and overlaying a grid of survey points on the resulting subset of parcels. Data gathered on the detection of these species at these points during the breeding season (March through August) will be used to model detection probability in urban raptor surveys, occupancy of business parks by the target raptor species, and habitat associations of raptor presence in business parks. Detection covariates will include date and time of day that surveys were performed, weather, and distance from survey point to raptor detection. These covariates will be used to construct models of raptor detection. The variables in the best-supported detection model will be entered into a further set of models with measured habitat parameters such as percentage of survey area covered by different land cover types, and diversity of land cover types. Models will be selected by Akaike Information Criterion, and model-averaged covariate estimates and odds ratios will be calculated for the parameters in the models with the highest model weight to determine which parameters most significantly contribute to variation in detection and occupancy. 155 points were surveyed 4 times each between 15 March and 3 July, 2012. Individuals of at least one of the five target species were detected in at least one survey at 94 points, and an additional 4 points had detections of unknown or non-target raptor species. The results of parameter quantification and model analysis will be presented at the conference.

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D2-PIII-B -**2**

Urban Bird Conservation in a Global Perspective

Jip Louwe Kooijmans*[1]

Half of the world human population is living is cities. With a growing number of people moving to cities, cities are expanding all around the globe. Wildlife conservation in towns is a new field of work. Conservation of urban birds can be complex, with some conflicting issues.

The BirdLife International Group on Urban Birds [BIG UB] is started to exchange knowledge and experiences on the conservation of urban birds. With this survey we try to get to three of the five goals, that were set at the kick off meeting of this working group:

- a list of activities & best practices;
- an overview of gaps in knowledge
- and a list of urban IBA's & threatened urban birds.

Information was collected with a digital questionnaire among all 124 BirdLife partners around the globe. This presentations gives an overview of the first results and can be seen as the current state of urban bird conservation around the globe and with that shows the confronting gaps in global knowledge of urban birds.

Although we know that for some species urban area's are the main habitat, still little is known. Where most people live monitoring is the weakest. For example only 1 out of 6 countries has a monitoring census for urban birds. Nevertheless between 204 – 437 bird species are indicated to have cities as their main habitat [1,9 - 4,2% of world total], of those at least 40 [9,2 – 19,6% of urban birds] are locally red listed. 16 urban bird species are on the IUCN world red list. Characteristic for the conservation issues we face in urban area's is the fact that house breeding birds are under pressure, such as Chimney swift Chaetura pelagica in the America's and Lesser kestrel Falco naumanni in several European countries. These species once benefited from urbanization, but are now under pressure from continuing urbanization.

Very few birds were mentioned as pest species, mainly from 6 bird families: Doves & pigeons, Starlings & myna's, Corvids, Gulls, Weavers [incl. sparrows], and Parakeets. In most cases these are Eurasian introductions, such as: Feral pigeon Columba livia and Common myna Acridotheres tristis. Strikingly some birds are mentioned as a pest in one country while declining or even red listed in others, like house sparrow Passer domesticus that is considered a pest in a lot of countries but is near threatened as a native in the Netherlands and Luxembourg. Or the other way around: the Java sparrow Padda oryzivora is globally vulnerable, but said to be successful exotic in the Philippines.

(BirdLife International is a global Partnership of conservation organizations that strives to conserve birds, their habitats and global biodiversity, working with people towards sustainability in the use of natural resources. We're the World's largest partnership of conservation organizations).

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D2-PIII-B -**3**

Avian Complexity of Guwahati City –A Perspective towards Urban Ecosystem Research

Chhandashree Bhuyan[1], Bhrigu Prasad Saikia[2]

It is estimated that by 2030, 60% of the global population will live in a metropolitan or urban setting. Perhaps the studies on the urban ecosystem may help understand the local intense transformations stemming from a single urban centre. Because of a spatial heterogeneity and a huge variety of environmental factors, cities are particularly species-rich habitats. The state of Assam in general and Guwahati city in particular lies in the transition zone between the Indo-Malayan and the Indo-Chinese biogeographical regions. Guwahati falls within the biogeographic zone-Brahmaputra Valley of India. It is situated in the Kamrup District which has a forest cover of 1432 sq.km.Urban ecosystems have the ability to provide "healthy" environments both for the natural ecosystems as well as for their citizens(Fitzpatrick and LaGory,2000; McMichael,2000).Urban ecosystem research in a biodiversity rich Guwahati city will be incomplete without the study of birds residing here. The present study was done to evaluate the species diversity and abundance in Guwahati city. Point count method was followed to enumerate the population of birds in different habitats in Guwahati city.

There were altogether 165 species found in the Guwahati city. There were several species found in the Guwahati city were came under schedule I, which were migratory and resident birds. The species diversity of birds in the protected area was found to high, followed by reserved forest areas, forest in the Government premises and other habitats. The abundance of the avian habitats also varies in different types of habitats. But the avian diversity and abundance of Guwahati city was found to be highly threatened by the exponential infrastructure development, encroachment in the reserved forest areas, tree cutting and other human activities. Hence there is a necessity of a urban biodiversity conservation and management plan to safeguard the urban biodiversity in the Guwahati city including the avian diversity.

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D2-PIII-B -**4**

Greater Adjutant Conservation through Community Participation in Assam, India

Purnima Barman*[1]

Greater Adjutant is the most endangered stork in the world for various IUCN Red List criteria under A2bcd+3bcd+4bcd; C2a (ii) and population is in decreasing trend (Luthin 1987, IUCN 2010). Brahmaputra valley, Assam is considered as the last stronghold for endangered Greater Adjutant and supports more than 90% of its global population. Scientific world does not have any recent collective information on the status of Greater Adjutant in its last stronghold in Brahmaputra valley of Assam. Fifteen years back the species had a population of about 600 birds in Assam out of its global population of 800. Two decades back conservationist alerted that the population of this bird is in decreasing trend and need urgent attention. Many historic breeding colonies of this colonial nesting bird are missing now and the bird is probably facing extinction threat.

The bird make their nesting colonies mainly in privately owned trees in semi urban areas and many such historical breeding trees have been cut down by owners under various circumstances. Without the support of these communities and nest tree owners it is almost impossible to save this bird from extinction threats. So, it is also important to involve local communities for any scientific information gathering effort. Doing this some innovative conservation actions might emerge from the communities / nest tree owners. In 2009-2011 a project was carried out in Kamrup district of Assam to know the key concerns and to initiate conservation activities for Greater Adjutant supported by Conservation Leadership Programme under Future Conservation Award. Greater Adjutant conservation campaign was carried out in community centeres, schools and specially with tree owners. Assamese Celebrities were roped in to boost up the moral support of the tree owners. Birds falling from nests were rescued and hand raised which were finally released in the wetland nearby the nesting colonies with awareness programmes. Livelihood mechanism with the background of this species was introduced. Villagers started developing an ownership feeling for the bird. Last year nests number increased by double then earlier survey. The nesting colony where the project worked was established as the biggest colony in Assam. In 2012 a follow up project to continue the work has been started. To prevent mortality from nest falling nets has been fixed bellow the nesting tree. A status survey is also has been planned to know the recent population in Assam.

[1] Tribhuvan University

Conserving Birds in Urban Landscape: A Case for People's Participation from Aligrah, Dist. U.P.

H.S.A. Yahya[1] and Faiza Abbasi[1]

In the post globalization development plan of India large tracts of natural habitat are being converted to agricultural and urban landscapes. The demographic and socio-economic factors in these areas have an adverse impact on the spatio-temporal dynamics of bird community and habitat. Hence biodiversity conservation in urban landscapes is extremely important. We review the bird species richness (S) and numbers (N) in different components of a small north Indian town in the densely populated Gangetic plains. It is evident the during recent years some common birds like vultures and house sparrows have declined noticeably from our environs. Although many avian species of agricultural landscape are beneficial, their future is far from secure due to various anthropogenic pressures (Yahya 1990). Even the most common House sparrow has declined to the extent of 40% during last ten years. In the present study housing areas, parks, green strips, rural urban fringe strips and green corridors were surveyed and correlated to abundance and richness scores. We conclude that home gardens and parks can sustain and develop ecological complexity to the extent that they can provide necessary biodiversity and ecosystem services across the tropics. Further, the importance of urban parks within the cities is highlighted as hotspots for biodiversity. Park size accounts for the high indicators of species diversity but fragmentation is detrimental for the populations of resident bird species specially during breeding season. As increasing the park size within cities is not achievable, habitat diversity can be increased along with resource availability by adding nest boxes, bird feeders and bird baths to the parks. Wooded streets also contribute to avian diversity, however pedestrian disturbance is to be avoided in case of streets as well as parks. Increasing habitat heterogeneity by including chunks of open, bushy and closed vegetation along with an open bank water body also contributes to species diversity. Finally, We make a case for official policy making, research and awareness.

[1] Aligarh Muslim University, India

D2-PIII-C-**1**

A Study on the Effects of Biophilic Landscape Design: Urban Beekeeping Project and Grazing of Urban Greenspace by Goats and Chickens

Yoriyuki Yamada*[1],Yuta Sone[1]

The restoration, preservation, and enhancement of biodiversity in an urban area requires not only the development and improvement of habitats and ecological networks for fauna and flora, but also the evaluation of the benefits that they provide, and the development of communication and educational programs. There are many studies that focus on the habitats and the development of ecological networks within the urban environment for fauna and flora. However, few studies focus on quantifying its ecosystem services or resolving the conflicts that may occur between urban dwellers and urban wildlife. Because urban biodiversity constantly involves people, it is essential for urban dwellers to understand why the enhancement of biodiversity is important, and to gain a correct understanding of the living creatures that come into contact.

In mega cities around the world such as Tokyo, Seattle, and London, biophilic landscape design which reduces waste or provide urban dwellers with food and many other ecosystem services has been practiced using animals such as honeybees, goats, and chickens. Raising honeybees, goats, and chickens in an urban area provides valuable chances for urban dwellers to interact with nature, but sometimes these animals are not welcomed because they are thought be dangerous or to give out a bad smell. In this paper, an urban beekeeping project, and the grazing of an urban greenspace by goats and chickens were studied as examples of biophilic landscape design. As for the urban beekeeping project, the current status of projects in Japan was researched, survey of nectar and pollen source plants of the surrounding greenspace was conducted, and the effective communication method and educational program for local residents that enhances the understanding of nature was considered. In the grazing by goats and chickens, a greenspace in a housing area in Tokyo was chosen as the site, and the management methods, effects on the vegetation, and influences to the attitudes of local residents were studied.

The studies revealed that in the urban beekeeping project, the contents of the project activities could be categorized into greening, educational, monitoring, and revitalization of local community. The majority of the project focused not only on the use of the honey, but many other activities that leads to the improvement of the local environment, and enlightens biodiversity issues. The survey of nectar and pollen source played an important role in creating a bond between the local residents and the surrounding green space. In the grazing project by goats and chickens, a fundamental knowledge of prescribed grazing in an urban greenspace was obtained, and it was revealed that the continuous grazing by goats and chickens decreased the cover of large perennial weeds including invasive alien species. In both studies, the influences to the attitudes of local residents were examined by a consciousness survey that illustrates the changes of idea before and after the project implementation. The survey revealed that the projects changed the impressions of the animals itself, and showed positive effects on local residents for raising awareness of the natural environment.

[1] Kajima Corporation, Japan

D2-PIII-C -**2**

Pilot Project for Establishment of Suburban Recreational Areas in Riparian Lands While Improving the Urban Bio Diversity

Don Mahinda Panapitiya*[1], Sunil Bandaranayake[2]

Urban areas in Sri Lanka currently have a severe shortage of recreational spaces. The impact of this problem can be seen in the rising number of Non Communicable diseases such as Diabetics, Neurosis reported in the hospitals. According to recent survey 10% of Sri Lankan population is suffering from Diabetes and it is very high around urban areas such as Gamapaha. According to Health Officials, the primary reason for this problem is the lack of recreational opportunities close to suburban areas.

Stream corridors which extend to about 10 to 20 Meters in either bank are not actively protected in Sri Lanka. The result is illegal dumping of garbage in to the river near stream corridors or illegal filling and construction. Many of the scenic stream banks have been lost during the last decades due to this problem. Stream-corridors are owned by the government. Therefore public use of this land can be considered as a fair use of the land.

Since it will be near impossible to find large areas close to suburban areas to build recreational facilities for jogging, walking, cycle riding, resting etc, narrow strips of stream banks become the only space available for this purpose. Riparian Trees planted along stream banks in developing such recreational areas increase the Urban Bio Diversity while reducing stream bank erosions and thereby minimizing silt deposition in stream causing floods. Another noteworthy feature in this exercise is that there will not be net loss in wetland space expected because required earth for bank improvement was borrowed only from the vicinity. Earth was borrowed from outside only when it is necessary to improve the surface of the jogging paths when the corridor traverses through urban areas. As such there is no major flood damage as result of the intervention. Wherever it is possible, riverine wetland ecosystems were also developed as a strategy to improve the water quality of the stream flowing through urban areas.

Community involvement specially the participation of Paddy Field Owners adjacent to the Stream Bank plays a major role for the success of the programs.. Therefore an effort is being made to introduce income generation by planting trees having medicinal values using the diverse ecological properties of the terrestrial aquatic interface of riparian lands.

The main objective of this paper is to present experience of a project which is now in progress re-configuring the riparian lands into recreational areas. About 10 KM of riparian lands have already been improved and the social acceptance as a recreational area is very encouraging. For example the average number of visitors / joggers per day for recreational activities to the first project completed adjacent to a main city called Gamapaha is around 100. Land Value of the vicinity of the project area has been increased by 50% according to a recent survey. Due to community demand,four more similar projects are now being constructed in populated urban areas in the Western Province of Sri Lanka.

[1] Richfieldlanka, Srilanka
[2] Provincial Road Development Authority, Srilanka

D2-PIII-C -**3**

UNESCO Heritage Parks as Urban Biodiversity Hotspots: Case Study of St. Petersburg, Russia

Maria Ignatieva*[1]

Urbanisation and globalisation resulted in homogenisation of urban landscapes and loosing of sense of place -"genius loci". Historical parks and gardens always play a very special role in urban landscapes because of their cultural and landscape values. Especially it concerns the most recognised monuments of park and garden art which have a status of the UNESCO WORLD HERITAGE SITES. Last two decades heritage parks in Europe are revisited and started to be also seen as highly valuable urban biodiversity hotspots. Historical parks are not only witnesses of different historical art periods but also are refuges for rare flora and fauna. They contain fragments of natural landscapes as well as unique living examples of horticultural practices and skills from last centuries. In the era of unification and using material from "global" nurseries with genetically modified plants, historical parks are unique genetic "pools" which helping to preserve national and cultural identity. We discuss the results of our research from the UNESCO WORLD HERITAGE sites in St. Petersburg (Historic Centre of Saint Petersburg and related Group of Monuments: Summer Garden, Mikhailovsky Garden, Peterhof gardens, Pavlovsky Park, Oranienbaum parks, Tsarskoye Selo etc.). This research emphasises on biological diversity, connection of certain design style to different practices of management and maintenance and the value of these heritage parks for biological conservation. Studies are based on field observation, mapping of rare plants and different types of plant communities, archive and literature research and interviews of garden keepers and landscape architects involved in the process of garden restoration. In Summer Garden recent restoration project (finished in May 2012), protection of rare herbaceous species first of all spring (vernal) plants such as Garea lutea, G. minima, G. granulosa, Anemone ranunculoides and Ficaria verna was one of the important part of restoration policy. Reconstruction of bosquets was accompanied by planting numerous species of native and exotic shrubs (Viburnum, Berberis, Lonicera) which attract wildlife (first of all birds). Nesting boxes were attached on tree trunks. Historical plant material-indigenous Vaccinium vitis-idaea has been planted in broderie parterres. Our case studies of St. Petersburg parks provide an example of how floristic and phytocoenological analyses can help identify historical and post restoration pathways of succession in plant communities.

Research of past park's management and maintenance can give a navigation also for sustainable design practices in modern green areas. One of the aims of this study is to propose the guideline for garden restoration which can be used in keeping, protecting and reinforcing particularly valuable biodiversity components of park's ecosystems. While modern urban design implements a simplified version of the British Picturesque-Gardenesque landscape architecture principles in all cultures around the world (which also ignore climatic and cultural differences), our study shows that historical parks can be a good demonstration sites of keeping regional identity and biodiversity in highly urbanised environment.

[1] Swedish University of Agricultural Sciences, Sweden

D2-PIII-C -**4**

Urban Biodiversity of Domestic Gardens along a Socio-Economic Gradient in Northern South Africa

Sarel Cilliers*[1], Siebert Stefan[1], Elandrie Davoren[1], Botha Nicola[1], Van den Berg Johnnie[1]

Private urban open spaces such as domestic gardens are increasingly regarded as important elements of the urban green infrastructure, although they are often still perceived as a luxury by urban residents and local governments. Several studies have described the ecosystem services of private green spaces, also showing the value of domestic gardens in increasing urban biodiversity. Although many of these studies have indicated that urban garden wildlife was made up by generalist, mobile and adaptable species, domestic gardens still complement the species-rich semi-natural habitats in urban areas. A number of studies have investigated the importance of socio-economics and household behavior in private urban areas and concluded that they are better predictors of vegetation cover and species richness in urban ecosystems than biophysical variables. Most of these studies were, however, conducted in developed countries.

This paper investigates the importance and extent of socio-economic aspects as drivers of urban biodiversity in private domestic gardens of a developing country. In South Africa, most settlements are characterized by a steep socio-economic gradient indicating the diversity of cultural and social groups. A large number of households are also dependent on vegetable gardens for subsistence. Recent studies on biodiversity and socio-economic aspects in domestic gardens in various types of settlements (deep rural, rural, peri-urban, urban and metropolitan) in the northern parts of South Africa provided a large dataset across various land-uses for further studies. Characterization of the socio-economic gradient was based on variables such as average monthly income per household, unemployment, household size, number of rooms in house, access to basic services and schooling status. Additional information that was collected for some of the settlements included aspects regarding human perceptions of gardens, human resources and garden management. Country of origin, invasive status, growth form, life form and specific uses of all plant species (> 1300 species in 256 gardens) were also compared. Results have confirmed the importance of socio-economics in driving plant diversity of domestic gardens. It was also shown that cultural aspects such as usefulness of species are more prominent drivers in poorer households, while aesthetics and recreation are associated with the more affluent residents. Comparison of the arthropod diversity of vegetable gardens and lawns in 44 domestic gardens in urban areas has, however, indicated that surrounding land-uses (buildings, pavements and roads, domestic gardens, parks and institutional gardens, natural grasslands, natural woodlands and agricultural areas) are driving arthropod diversity. Using the concept of ecological land-use complementation (ELC) it was investigated how gardens interact with other urban green areas which increase the habitat available for biodiversity and how it differs along a socio-economic gradient.
Integration of social aspects in urban ecological studies, including those of private open spaces, is important in terms of the conservation of biodiversity and the provision of ecosystem services, as well as the planning, management and design of urban open spaces and will lead to a sensible combination of top-down and bottom-up management approaches.

[1] North-West University, Potchef, South Africa

D2-PIII-C -**5**

Potential of Historical Monuments' Green Spaces for Biodiversity Sustenance: A Case Study of AMU Fort

Faiza Abbasi[1] and H.S.A. Yahya[1]

The Indian landscape specially, that of north-India is richly dotted with medieval era monuments like forts, mausoleums and places of worship. The Archeological Survey of India has undertaken some attention and a few are now designated world heritage sites according to the United Nations World Heritage Convention. Barring these there are numerous such monuments that are crumbling without care and the once pristine premises are under heavy encroachment and abuse. Almost essentially encompassing a garden with inter alia water bodies these have been enthused overtime with some wilderness and been inhabited by insects, amphibians, reptiles, birds and small mammals. The Aligarh Muslim University Fort was built in 13 century and now exists as a botanical garden and orchard surrounded by secondary vegetation on the ridge and secured by a moat. Owing to its accessibility and closeness to the Department of Wildlife Sciences, the biodiversity of the Fort has been studied rather regularly resulting several national and international publications as well as production of scores of M. Sc., two M. Phil and one Ph. D. dissertations. A study was conducted monitoring its avian community and habitat use at the AMU Fort from 2007 to 2011. Random bird count and occasional mist-netting was done to observe the characters of the birds and species richness curves were obtained by using the MacKinnon's method of estimating species richness. Among about hundred common species of birds found in the area Pariah kite, Common myna and Laughing dove are most frequent. Recommendations are made for further addition of water in the moat to check encroachment and increase habitat heterogeneity so that water birds are also attracted. This facility would also create some recreational avenue of the people of the locality vis-à-vis awareness for biodiversity conservation. A survey by INTACH or ASI can bring to light more such historical sites, which could be preserved for cultural and natural heritage also leading to tourist attention.

[1] Aligarh Muslim University, India

D2-PIV-A -**1**

Ecosystem Services in a Biodiversity Hotspot: Building a Case for Vegetation Conservation in the City of Cape Town

Pippin Anderson*[1], Patrick O'Farrell[2], David Le Maitre[2], Patricia Holmes[3]

Regional and global scale ecosystem service assessments have demonstrated the socio-economic value of protecting biodiversity and have been integrated into associated policy. Local government decision makers are still unsure of the applicability, return on investment, and usefulness of these assessments in aiding their decision making. Cape Town, a developing city in a globally recognized biodiversity hotspot has numerous competing land-uses. This paper presents an exploratory study on the links between ecosystem services and biodiversity conservation in Cape Town where the aim was to determining the contribution natural vegetation remnants make to ecosystem service provision. A rapid assessment technique was used. This rapid assessment had two elements. Firstly, an area weighted approach was used to attribute services to vegetation types and how these had changed through time was then assessed. Here past, present and future scenarios were explored. Secondly a distance analysis was carried out to explore proximity effects and linkages in relation to cultural services. Services for consideration were selected in consultation with management staff at the City of Cape Town. Provisioning services were found to have been most severely affected through vegetation transformation. Regulatory services were found to have been similarly affected, and these losses are more significant as regulatory services can only function in situ, where provisioning services can frequently be outsourced. The most significant losses recorded were in coastal zone protection and flood mitigation services, both of which will be placed under even greater pressure given predicted changes in climate. The role of remnant vegetation in regulating and cultural services was shown to be a significant additional consideration in making the case for conservation in the City. While the rapid assessment technique did not allow for nuanced or detailed insights, it had a number of positive outcomes. It proved extremely useful presenting a 'snap shot' of the state of ecosystem services in the broader city area, in cultivating meaningful collaboration between researchers and management staff, in serving to highlight areas where more detailed work would be valuable, and in providing a constructive space in which to take up conversations about ecosystem services and conservation forging links across the academy-practice divide.

[1] University of Cape Town, South Africa
[2] CSIR
[3] City of Cape Town

D2-PIV-A -**2**

Is there any Negative Externality of Urbanization through Developing SEZs on Coastal Biodiversity? Evidences from Mundra SEZ, Gujarat.

Tamali Chakraborty*[1], Haripriya Gundimeda[1], Vinish Kathuria[1]

The Special Economic Zones (SEZs) were established to expedite the process of economic growth of India. The motive of establishment of SEZs was mainly to attract more FDI, increase in foreign exchange reserves and promotion of exports. However, the impact of SEZs in the surrounding environment raises questions. This paper tries to answer the questions of sustainability of economic growth via SEZs in India and explore the relationship of SEZs with coastal biodiversity of India. The first section of the paper attempts to prove that there is a strong relation between urbanization and existing SEZs in India. In the second part of the paper, the challenge is to know whether urbanization via developing SEZs bring negative externality to the environment. The paper specially focuses on the evidences from the impact of Mundra SEZ on coastal biodiversity of Gujarat. Mundra area falls under Kutch district of Gujarat, India. Kutch district of Gujarat is declared as Critically Vulnerable Coastal Area (CVCA). The occurrences of loss of mangroves, migratory birds, scrub forests and fishing activities are the major concerns of Mundra area. There is an urgent need to check the actual impact of this SEZ on the coastal biodiversity as this SEZ falls under CVCA area and thus the decision makers need to pay more attention towards the sustainable use of natural resources of Mundra area.

[1] Indian Institute of Technology Bombay, India

D2-PIV-A -**3**

Urbanization and Its Impact on Anuran Fauna in Barak Valley, North East India

Mithra Dey*[1]

Urbanization is a global trend and the Barak Valley region of South Assam is also experiencing rapid urbanization. Urbanization is known to have negative influence on the flora and fauna. It also leads to alteration of habitat structure as well as quality which in turn influences distribution and survival of fauna. Barak Valley region of northeast India is a part of the Indo-Burma hotspot, which is one of the 34 global biodiversity hot spots. The region abounds in wetlands, tanks and ponds of varying sizes, streams, pools, marshes and others aquatic habitats; paddy fields and low hills. Twenty species of anurans belonging to 10 genera and 6 families were recorded, belonging to Bufonidae, Megophryidae, Microhylidae, Dicroglossidae, Ranidae and Rhacophoridae. Agriculture and tea cultivation are important economic activities. Development and expansion of urban areas is taking place at a fast rate which is accompanied by earth cutting, reclamation of ponds, pollution of water bodies and increase of traffic on roads. Road kill of amphibians and reptiles have become common due to increase in the vehicular traffic with increase in urbanization. Conversion of agricultural land into brick kilns is also a cause of habitat degradation. The amphibian and reptilian fauna inhabits diverse habitats and water availability and moisture condition influences the selection of habitat. Water quality and the structure of the vegetative community are seen to affect the survival of anurans. Ponds which served the purpose of water storage and source of water for the urban population are rapidly being filled and buildings being constructed. Disposal of waste from domestic source, car servicing centers and other small business houses are polluting the small aquatic habitats which are the breeding sites of the anurans. The paper analyses the impact of urbanization and related activities on the habitat loss and degradation and puts forward some suggestions which would help design conservation strategies for this lesser studied group of vertebrates.

[1] Assam University, India

D2-PIV-A -**4**

Conflict between Urbanization and Biodiversity Conservation: Case of Proposed BDP in Pune City

Museeb Faquih[1]

Pune is rapidly expanding spatially due to changes in land use and occupational patterns. Large number of open green spaces has taken its toll on the city in the last few years. Due to the presence of rich biodiversity in the hills, the Biodiversity Park (BDP) was proposed in the development plan 2006-2012 in order to increase and conserve the green cover of the city.

BDP is vulnerable to urban development, both in terms of squatters of urban poor and bungalows of the wealthier sections of society. 4% construction on BDP was proposed between 2009 and 2011. Environmentalists, middle class citizens led in large number an online petition-'campaign signature' to stop Government, politicians and builders to construct on hills. The aim of the study was to integrate Biodiversity park conservation and regeneration in city planning. The analysis was carried out on two lines. Firstly, it focused on the changing urbanization pattern in Pune with respect to hill ecosystem. Secondly, it explored the relationship between urban development and degenerating hills of Pune city.

Through primary survey it was found that the land use on hills was majorly divided in to two i.e. Government owned and privately owned. The land ownership and land use on studied hills namely Baner, Vetal and Bavdhan, Warje, Parvati pachgaon had a remarkable difference in land conditions where the privately owned land was greatly being degraded and also subject to encroachment. However politicians' and builders' selfish interest pose a major hurdle in the implementation of BDP. Secondly also the reluctant behavior from Municipal Corporation in implementation of BDP due high cost of land acquisition remains a major issue.

Recommendation in the form of effective governance through biodiversity management committee for implementation and management of proposed BDP was framed. The study also recommended TDR as a development tool and innovative approach for land acquisition.

[1] CEPT University, India

D2-PIV-A -**5**

Managing the Impact of Urbanization on Biodiversity: the case of Madurai, Tamil Nadu

Muniyandi Balasubramanian*[1], Dhulasi Birundha Varadarajan [1], S. Chandrasekaran[1].

Biodiversity is an important part of a complex urban ecosystem and provides significant ecosystem services. It benefits urban communities environmentally, esthetically and economically. While the development has continued, the infrastructure and urban areas being developed have substantial impact on biodiversity. Urbanization is primarily fragmenting large areas, extending it influence over the entire landscape. Even though the effects of urban sprawl. On biota have received considerable attention from the scientific community raised urbanization can create enormous stress on the environment. The extent of urban environmental impact increase not only as population grows but also as per capita demanded for resources rises. The paper examined the types of urban green space and the level of sustainability that has been achieved within its setting terms of biodiversity conservation in the midst of developing infrastructure in Madurai district Tamil Nadu state. The aim is to determine the type and spatial context of the urban green space in the study area, the number of developmental activities and managing strategies in sustaining biodiversity. The ability to maintain and make the most beneficial use of biodiversity depends on using and managing biodiversity sustainably in other activities where the production and consumption in the principle objective.

[1] Madurai Kamaraj University, India

D2-PIV-A -**6**

Industrial Waste and Urban Bio-diversity in Developing country: Mapping Aquatic Biodiversity in Nepal

Raghu Bir Bista[1]

Industrialization receives top priority in development policy in developing country. Since 1980, Nepalese Economic policy has been giving liberal gear to private and foreign investment to precede industrialization by providing non-strict environmental regulation and standard. This environment ignorance policy is effective to encourage manufacturing industry. Its socio economic implication seems to be positive but its environmental implication is negative and burdensome to the society. This is a big issue in urban biodiversity in Nepal.

This study investigates empirically the relationship between industrial waste and urban biodiversity in Nepal by using mapping method based on secondary data sources. In addition, it estimates social cost of urban biodiversity loss. Its result is positive correlation between industrial waste and urban biodiversity loss. Its social cost is interestingly significant.

[1] Tribhuvan University

D2-PIV-B-**1**

Food Security in Context of Urban Biodiversity: An Indian Dimension

Hippu Salk Nathan[1], Geetanjali Yadav[1*]

Biodiversity is a precondition for food security. Food and Agricultural Organization (FAO) of United Nations has observed conserving and using biodiversity sustainably is the key to feeding the malnourished people in developing countries. India has the maximum malnourished people in the world. The latest Hunger and Malnutrition (HUNGaMA) report by the Naandi Foundation finds as many as 42 per cent of under-five children in India are severely or moderately underweight. This finding has been described by Prime Minister as "national shame". In this context, the importance of biodiversity in Indian scenario cannot be over emphasized.

The rapid urbanization in developing countries has put pressure on biodiversity in catering to the needs of the urban area. In India, likewise the developing economies (barring the case of China) urbanization is explained by 'push' factors like rural poverty and lack of livelihood options—leading to movement of surplus rural labor to urban areas even though cities have limited growth. This can be interpreted as transfer of poverty from rural to urban areas, termed as 'urbanization of poverty' or 'over urbanization' in literature. India will add another 497 million to its urban population between 2010 and 2050. This unprecedented growth will lead to massive land transformation, where agricultural lands in the periphery of urban areas are converted to residential, commercial, or industrial use. This fall of agricultural land has put a question mark on country's food security.

The current study identifies the links between food security and urban biodiversity. The study assesses the impact on food security on account of urbanization at two levels – macro (country) and micro (city). Taking data from secondary sources, the paper examines the land use pattern in urban areas with specific reference to agricultural lands. The fall in agricultural land is coupled with increase in earth surface temperature leading to climate uncertainties manifested by weather extremities, floods, and droughts, which has affected country's food production adversely.

For micro level analysis, Bangalore Metropolitan Region is considered as a case study. Through primary level assessment, the study assesses how the food dependency of Bangalore city on the peri-urban areas and hinterlands has changed over time. The study also investigates how the changing lifestyles and food habits of city dwellers has affected the diversity in food production and supply. The roles of different stakeholders in the land management of the city with respect to agricultural lands are assessed. The paper concludes with policy recommendations for ensuring sustainability of agricultural lands, which in turn would promote the growth of urban biodiversity.

[1] National Institute of Advanced Studies, India

D2-PIV-B -**2**

Periurban Biodiversity and Ecosystem Services for Water Supply in Kathmandu City

Krishna Pant*[1]

Biodiversity that provides ecosystem services to urban people is getting degraded due to human intervention resulting into decrease in the flow of ecosystem services and reduced human welfare. Degradation of biodiversity in periurban Kathmandu is leading to an added challenge in supplying safe drinking water to the ever sprawling city. This paper examines potential of addressing the problem in quality water supply and other ecosystem services Kathmandu valley through biodiversity conservation in upstream areas. Econometric analysis using hydro-meteorological data for 16 years finds an effect of biodiversity conservation on water yield. The water service of the biodiversity is evaluated using opportunity costs of biodiversity conservation in the forest and adjoining farmlands. The results show that the biodiversity conservation increases carbon stock, water yield and water quality after a gestation period. Periurban biodiversity conservation is suggested for carbon sequestration and improved ecosystem services including water quality and quantity in urban Kathmandu.

[1] Market Research and Statistics Management, Department of Agriculture, Nepal

D2-PIV-B -**3**

Recreation in Pollution: Hussain Sagar Lake in Hyderabad

Prajna Paramita Mishra[1]

Hussain Sagar is a beautiful lake joining the twin cities of Hyderabad and Secunderabad. It was constructed to meet the irrigation needs of old Hyderabad. Later, the lake was converted as a drinking water source. Over many years this lake has been in news not because of its beauty but pollution. The lake area has shrunk due to encroachments over the years. In addition to this the lake water got polluted severely due to continuous discharge of untreated domestic sewage and toxic industrial chemicals for several years. The Hyderabad Metropolitan Development Authority is trying to restore the lake. The failure to reduce pollution is partly because of the high cost involved. To find out whether the costs are economically motivated, emphasis must be given to obtain benefits from reduced pollution.

Though number of studies has been done to study pollution in the Hussain Sagar Lake, not a single one has studied its impact on the recreation behavior of visitors. With this background the specific objective of the paper is to estimate the recreational benefit that may result from controlling water pollution in the lake. A number of recreational studies using Travel Cost Method (TCM) and Contingent Valuation Method (CVM) have been conducted to study how change in water quality changes individual behavior reflecting improvements in welfare. Most of these studies are concentrated only on on-site sampling. This study is different from other one as it has included also the offsite respondents.

This study survey a sample of general population of the twin cities, including offsite respondents (those who have not visited the lake during last 12 months). A combined revealed and stated preference method is used to obtain data based on particular quality improvement in and around the lake. This will help to know why people are not visiting, is pollution a reason and what types of improvements they would like to see. The study used a Poisson model to estimate the value visitors place on recreation. It estimated an annual average consumer surplus of Rs. 10,334. Policy makers can use these estimates to find out whether there is benefits of reducing pollution and whether the costs involved are economically justified or not.

[1] University of Hyderabad, India

D2-PIV-B -**4**

Vulnerability of Population Exposed to Groundwater Arsenic Contamination in Bihar

Barun Kumar Thakur*[1], Vijaya Gupta[1], Utpal Chattopadhyay[1]

Bihar, along with the state of West Bengal, in India is facing an acute problem because of arsenic contamination of groundwater. The objective of this paper is to estimate the population exposed to vulnerability due to groundwater arsenic contamination. This paper is based on secondary data and has been conducted for seven blocks of three districts namely Bhojpur, Buxar and Patna of Bihar state, India. We have used an integrated arsenic vulnerability index based on demographic, economic, physical and social characteristics. Demographic characteristics are comprised of population density, annual growth rate of population, and population at risk due to contamination of water. Economic characteristics include agricultural dependency, income and other variables. Social characteristics are based upon literacy rate, awareness and spread of institutional set up while physical characteristics include number of vulnerable habitations at risk. The vulnerability index is also based on low, medium and high exposure on the basis of concentration of arsenic contamination. Excess of arsenic in drinking water leads to both primary and secondary health impacts in the long run. It leads to skin diseases like Arsenicosis, Melanosis, and Keratosis in primary stage and different kinds of cancer in secondary stage. The data is based on secondary information, census 2001 and national habitation survey 2003. The lab testing reports on arsenic contamination level have been collected from the Department of Drinking Water Supply, Government of India. The results reveal that Maner is the most vulnerable block to arsenic contamination where 55,228 (28.57 per cent of the total population) persons are prone to arsenic contamination. In Maner block, 6 panchayats, 14 villages and 24 habitations are more vulnerable to the arsenic contamination. In other blocks, percentage of arsenic vulnerability are in the range of 10- 25 percent of the population. Appropriate mitigation and adaptation strategies are yet to be undertaken in the area at large level.

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D2-PIV-B -**5**

Regenerative Urban Ecosystems: Role of Greywater, Rainwater and Urban Agriculture for Urban Water and Food Security

Neeraja Havaligi*[1]

Urban Agriculture is gaining popularity as a tool for urban food security, sovereignty and for efficient management of urban natural resources. However, this does not identify constraints to water availability, a critical determinant for success Urban Agriculture. Urban Agriculture is largely dependent on freshwater supply that often travels great distances, expending energy before it reaches the end user in the city. This is especially true in countries like the USA where freshwater is the primary water source for urban agriculture. With increasing unpredictability of rainfalls and resultant water shortages, water needs of Urban Agriculture vie with growing needs of urban population for the same fresh water resources. As the practice of Urban Agriculture increases, its management through urban planning and policymaking process for water and other regenerative practices (e.g. composting) associated with food production becomes more critical.

This study consists of three parts. The first part is a systematic review of the potential role of rainwater harvesting and greywater reuse in urban agriculture. The review will include aspects of urban planning and policies and concerns on safety to community and ecosystem health, which are critical for Urban Agriculture, rainwater harvesting and greywater reuse to take root in urban communities. The second part focuses on results from a residential greywater use survey conducted in California. The survey reflects on multiple aspects of greywater reuse, including the different greywater systems used, installation and maintenance cost, ROI, effect on soil characteristics and quality and record physiological growth response in plants. The third part will project the water use efficiency (WUE) resulting from use of greywater and rainwater as water resources from plant physiology point of view.

Results of this study will be threefold: 1. Provide a valid argument for use of greywater and rainwater harvesting as tools in urban planning and development in the context of urban agriculture. The study will bring out the role of the three interlinked and regenerative resource use tools mentioned above, in climate action plans designed for cities in the USA. 2. Illustrate water use efficiency in context of greywater and rainwater harvested used in Urban Agriculture. 3. Provide examples of policies and financial incentives that have been successful in promoting use of these regenerative tools in urban natural resource management. The study will illustrate lessons learnt in capacity building at the community and city level and project potential economic returns from regenerative urban ecosystems.

This paper advances the knowledge the potential of urban ecosystems and its resource management. The argument for use of greywater in Urban Agriculture based on the projected productivity of greywater in terms of water use efficiency is a novel approach. This work also adds to existing but minimum literature of public policy, public health and zoning issues that determine grey and rainwater use for Urban Agriculture. By identifying the regenerative ecosystem services of greywater, rainwater and urban agriculture and by illustrating their interlinked roles in urban planning and development, especially in local climate action plans and in supporting local jobs and markets, the paper provides a practical application of this research. The results are applicable to similar geographical areas, and lessons from this study can support greywater reuse and rainwater harvesting for Urban Agriculture.

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D2-PIV-C-**1**

Why Culture and Traditions Matter in Local Policy Making for Biodiversity and Ecosystem Services

Raquel Moreno-Penaranda*[1], Unnikrishnan Payyappallimana[1], Wanyu Shih[1]

When managing the ecosystems of cities, local authorities are usually challenged by conflicting sectoral interests and a lack of a common vision regarding what kind of biodiversity to protect and what kind of ecosystem services to prioritize. According to the Convention on Biological Diversity (CBD), three broad dimensions are to be taken into account with regard to biodiversity management: conservation, sustainable use and equitable benefit sharing. Some progress has been made to date vis-à-vis the establishment of targets and mechanisms to attain the goals of the CBD at the national level (for example with the so-called National Biodiversity Action Plans or NBSAPs). Yet still much needs to be done for the specific case of cities, as urbanization imposes further challenges to effective local ecosystem management. Current efforts towards the development of Local Biodiversity Action Plans (LBSAPs) could help local authorities defining clear goals and establishing functional strategies for effectively managing their biodiversity. Yet clashing sectoral interests and the fact that the relationship between cities and biodiversity is a complex multifaceted phenomenon for which scientific knowledge is still highly fragmented jeopardize the success of local actions for biodiversity. In this paper we look at urban ecosystems from the perspective of natural resources management systems (NRMS) in order to define key messages for decision makers on conservation and sustainable use of local biodiversity resources. As an extensive body of literature on NRMS shows, the sustainability of these systems – and thus of the biodiversity they contain—is often critically connected to specific traditional use patterns and management practices, hence deeply linked to cultural and behavioral aspects. The presence of certain species and landscapes, the specific uses of local biodiversity resources (for food or healing purposes, for example), or the kind of recreational and spiritual benefits provided by local ecosystems, are all intimately linked to local traditions, taste and preferences. The NRMS approach can help local governments to clarify what are the mechanisms underlying biodiversity trends in the locality, while highlighting which stakeholder groups are key for achieving their sustainable use. Several local initiatives inspired by traditional uses and local practices in sustainable use of local biodiversity are examined in different cities and countries. In Japan, the case of policies in support for traditional forest and agricultural products in Kanazawa city; home gardens in Kerala, India; organic farming conversion in peri-urban settlements of Sao Paulo city, Brazil; and innovative strategies for rebuilding the relationship between restored lands and local communities in Durban, South Africa. Cases highlight the importance of including cultural and traditional use considerations when designing local strategies for biodiversity in order to ensure that they generate local ecosystem services in a sustainable, equitable way. Moreover, lessons are drawn from the cases concerning opportunities for identifying win-win solutions combining different sectoral agendas and policies in local decision-making.

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D2-PIV-C -**2**

Urban Natural Resources Management for Biodiversity and Ecosystem Services: Lessons from Forestry and Agricultural Policies in a Japanese City

Raquel Moreno-Penaranda*[1]

In a rapidly urbanizing world where cities are consolidating as centers of socio-economic development while voraciously consuming an increasing share of the world's natural resources, two crucial yet interrelated issues remain unresolved. First, how to make cities more sustainable so urban ecological footprints can be reduced and hence some drivers of global environmental change, from biodiversity loss to climate change, overturn. Second, how to make modern cities more livable, so urban dwellers can fully enjoy the benefits of local ecosystems and biodiversity, from access to green (and blue) space for leisure and spiritual comfort to local foods or fulfillment of cultural needs. This study explores the challenges and opportunities for cities to address global sustainability goals and local wellbeing concerns in a synergic way, by using a case study in the Japanese city of Kanazawa.

The paper looks at the potential of local governance mechanisms for designing instruments that can lead to enhancing urban ecosystem services and biodiversity for increasing both sustainability and local wellbeing. Interviews and secondary data collection from existing experiences at the government and stakeholder level suggest that the concept of bio-cultural diversity can contribute to the operationalization of such instruments, as it connects preferences, values and practices relevant to the sustainable use of nature's goods and services at different scales – from local wellbeing to regional/global sustainability. For instance, food culture is found to be linked to appreciation for some locally grown traditional varieties of vegetables, which in turns generates interest in revitalizing sustainable local food production-consumption networks that are helping to preserve local agro-biodiversity. Likewise, policy stimulus for the renowned –yet currently declining—local crafts and traditional architecture industry implemented alongside native forest restoration programs are revitalizing local forestry while protecting valuable tree species and their ecosystems (and hence all the associated ecosystem services provided at the local, regional and global level). Yet numerous challenges for materializing such win-win approaches exist, from the planning to the implementation level, and include financial, regulatory, and behavioral aspects. The paper draws lessons from the Kanazawa case which can be relevant to cities confronting the challenge of addressing sustainability and local wellbeing simultaneously, in Asia and beyond.

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D2-PIV-C -**3**

Organizational Sustainability: The Case of Handcrafts Micro-Business in Southern San Sebastian, Jalisco, México

José Vargas-Hernández[1]

This paper analyzes sustainability and efficiency of organizations committed to the exploitation' activities of *tule Thypha spp* at Zapotlán's Lake taking into consideration the socioeconomic and environmental impact in the municipalities of Gómez Farías and Zapotlán el Grande. The initial hypothesis departs from the consideration of the scarce social capital of organizations that limits development's sustainability. The research method employed is the ethnographic, complemented with field work supported by informal interviews, documental and bibliographic research. The hypothesis of this research is proved empirically and confirms similar findings by the research conducted on the mainstream theory of social capital and its implications on economic development. The outcomes of the application demonstrate that the drama of economic efficiency and sustainable development of micro-business is tied to constrain of social capital. This finding has implications for the design and implementation of economic and social policies oriented towards the improvement of economic growth and sustainable development.

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D2-PIV-C -**4**

Between Gray and Green. Biodiversity, Ecosystem Services and Urban Management: Three case-studies in Colombia

Juana Mariño[1]*, Maria Mejia[1]

Some of the Convention on Biological Diversity (CBD) major statements have emphasized the need to create information systems to support decision making process, understanding "communication" in a broader sense –beyond the generation and diffusion of information. Also, certain CBD specialized committees have addressed the importance of empowering local authorities, in order to adopt global decisions in local contexts through flexible, adaptive and multi-criteria strategies.

Aligned with both considerations and also in response to national environmental evidence and ongoing economic development main projects; this research aims to incorporate Biodiversity (BD) and ecosystems services (ESS) guidelines into city-region management, carried on three case-studies in which geographical, socio-ecosystem, political and economic differences are determinant.

The project focuses on the following complementary fields of knowledge: (i) research on BD and ESS, (ii) public policy decision-making, and (iii) social appropriation strategies as follow-up mechanisms. Furthermore, this research lead by the Policy Program of the Alexander von Humboldt Research Institute on Biological Resources (IAvH for its acronym in Spanish), proposes multi-scalar approach: (i) environmental management within urban fabric itself; (ii)city-nearby ecosystems interactions, and (iii)the impact of the city-system on national ecosystem network.

In order to achieve the scope of this project, it is necessary to establish alliances with environmental authorities, territorial entities and academic-research centers as it is evidence in the three case-studies described in this research paper.

On its preliminary stages, this research has achieved the following results: (i) Conceptual and methodological framework address in general outlines of the BD/SES/city-region interactions. The National Policy for the Comprehensive Management of Biodiversity and Ecosystem Services (PNGIBSE), adopted on July 2012 by the government of Colombia, provides a legal framework for promoting BD and ESS management within human-nature interaction. Traditionally biodiversity management has been focused on conservation strategies and the promotion of protecting areas. Today through incorporating and promoting conceptual innovations our initiative validates the national policy as framework to rationalize research in this field: BD&ESS and city-region context; (ii) Identification and characterization of three case-studies based on national environmental and social evidence and taking into account their representativeness in terms of BD/SES/city-region interactions in Colombia; (iii) Established alliances with environmental authorities, territorial entities and academic-research centers in the three case-studies. Currently, different policy instruments are still being negotiated for each of the specific three cases addressed, in order to take into account all of their particular needs and governance conditions in terms of BD, ESS and urban management capabilities.

During designing and formulating the conceptual framework of this applied research, the IAvH has identified a set of preliminary criteria that is relevant to achieve scientific outputs in line withlocal policy demands.

- Public policy itself is analyzed and considered as an entire field of study.

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- To impact decision making process, it is necessary to identify and prioritize policy instruments that are easy to rethink and to re-define.
- Once policy instruments have been prioritized, research process would become clear in terms of which scientific information is needed to guarantee its impact.
- While selecting different study cases, universal patterns become important references to understand the development of organizations in the future, but become insufficient criteria to understand how certain urban dynamics impact different territories in terms of BD & ESS.

D2-PIV-C -**5**

Unpacking the Barriers to the Establishment of a Green Infrastructure in Taipei City

Wanyu Shih*[1], Iain White[2], John Handley[2]

In face of multiple challenges due to environmental degradation in urban environments, increasing research has argued establishing Green Infrastructure (GI), an interconnected multifunctional green network, for improving living quality, enhancing biodiversity, and adapting to climate change (Barker, 1997; Handley et al., 2006). In urban areas, there is a tendency to integrate the concept of ecological network into open space standards for optimizing green space systems as a GI (e.g. Barker, 1997; Kit Campbell Associate, 2001). However, it is challenging in practice, as not only competitive land-use, but also existing planning mechanism might hinder the implementation of GI.

Seeking to identify key barriers to the establishment of GI in cities, this study conducted a case study in Taipei City. Principal obstacles are found in three areas, including political barriers, technical barriers, and social barriers, in the process of green space planning. The political barriers are derived from existing open space standards encouraging small and artificial green spaces; the lack of legal support of green space conservation; overriding priority on economic development; budgetary shortage on land acquisition; and divided mandates on green space planning and management. The technical barriers include anthropocentric planning that favors ornamental landscape in urban areas; inadequate ecological knowledge of planners; the lack of ecological database and biological investigation; and insufficient consultation with ecologists. On social aspects, barriers are associated with pragmatic attitudes toward the use of lands; and the fear of nature-looking environments from the public.

To address these problems, this study suggests five key strategic areas for shortening the gaps between theory and practice. Firstly, an amendment is needed to align relative regulations, policies and planning standards to the planning principles of GI. Strategic Environment Assessment is proposed as a tool to oversee the incorporation of GI concepts into existing planning mechanism. Secondly, in addition to sourcing extra funding, green space budgets can be more efficiently used by preserving existing green spaces, applying Transfer of Development Right (TDR) for saving money from land acquisition; and stopping the creation of too small green spaces that has little ecological value. Thirdly, mapping environmentally important areas for GI with scientific evidence can make planning decisions of green space conservation more defensible. Fourthly, for planning decision to be materialized, it is necessary to reinforce the role of advisory team. A 'communication loop' of planning, design, management and maintenance should be established and monitored to ensure that each part of the process informs the others. Finally, raising awareness regarding the importance of green spaces is critical to gain support from both governments and the public.

In conclusion, the establishment of a GI in a densely built city is a complicated issue. It requires multiple transformations within institutions and societies that provide institutional, technical and social support from different dimensions.

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D3-PV-A-**1**

Object Based Classification for Tree Diversity Assessment of Bengaluru Using High Resolution GeoEye Imageries

Shivani Agarwal*[1], Lionel Sujay Vailshery [1], Madhumitha Jaganmohan[1], Harini Nagendra [1]

Bengaluru is known as Green City in India. However, in recent years, developmental activities (like road widening, metro and flyover constructions) have had an adverse effect on both climate and vegetation. In the rapidly growing south Indian city of Bengaluru, here is no consistent environmental vision, in large part because basic information on the distribution and accessibility of green areas and biodiversity is lacking. Proper urban planning is required for maintaining the green spaces and spatial analysis is an effective tool for enabling planning. Object based classification with high resolution images are widely used for spatial analysis and biodiversity assessment. However, heterogeneity in tree species diversity and its distribution makes the task of assessing canopy cover and number of trees much more challenging in an urban setting such as Bengaluru. Thus it is essential to examine the potential of high resolution images using object based classification for vegetation assessment. In the present study, Pan merged GeoEye images of 0.5m resolution has been used to perform object based classification using eCognition Developer 8.7. Rigorous ground-truthing was done for accuracy assessment and for developing appropriate rule set in eCognition. The study area was divided into 150m×150m grid and 30 random grids were selected using. The study helped it estimating the number of trees, tree species and their spatial distribution. Our results showed, good correlation between object based classification and trees on ground i.e. pearson r is 0.659 (significant at $p<0.01$). Approximately 2,82,540 trees are expected in 2 km buffer area of Bangalore. We also compared the results of pixel based classification and object based classification; and found that the result of object based classification is more reliable. We also found that the number of tree is less correlated with NDVI and types of species in urban environment i.e. pearson r is 0.108 and 0.187 respectively. Ecological rules (relating biomass and NDVI to number of trees and species) do not work in urban environment because of human dominated decisions to plant trees. For example, in some areas rain trees are planted, which have high biomass and low number of trees. However, in other areas coconuts and palms are planted, which have low biomass and high number of trees. Thus, it is difficult to develop generalizable rules ret for assessing tree diversity in urban environment.

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D3-PV-A -**2**

The "URBIO" Greenspace Evaluation Tool for Sustainable Design

Katja Elsner*[1], Norbert Müller[1]

Aspects of sustainability are taken in consideration increasingly in urban design since Rio 1992 Earth Summit. The result of a recently done random test of public buildings in Germany have achieved the result that the buildings are designed and constructed consequently following aspects of sustainability, while in the opposite in the design of green spaces sustainability does not matter in general. An additionally done test of 2 international and 2 national landscape design journals following the volumes of the last 4 years supported the assumption that in landscape architecture evaluation tools as well as guidelines for sustainability are still missing.

First attempts to evaluate green spaces for sustainability were developed in Great Britain with the "Green Flag Award" (since 1996) and the United States with the "Sustainable Sites Initiative" (since 2005). But these systems are difficult in handling and expensive in getting a certification or do not concern all aspects of sustainability.

In our research we were focusing on a simple evaluation tool, which is based on a set of indicators which enable to do a rapid evaluation of green spaces including all aspects of sustainability. The aim is to sensitize landscape architects and clients for sustainable design and to improve current green spaces. The index' includes 25 different indicators and is covering the following topics: design objective, material application, usability, welcome place, biodiversity, climate/ water/ soil and maintenance/ management. At this presentation we will discuss the set of indicators and present first results of its testing phase in public green spaces in Germany.

The application of the indicators will contribute to support urban biodiversity and is therefore named URBIO greenspace evaluation tool.

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D3-PV-A -**3**

A GIS Based Framework for Evaluating and Planning Sustainable Urban Green Spaces

Dhanapal G*[1], David Gallacher[1]

The scope of this paper is to present a framework on planning sustainable urban green spaces using GIS as a tool, we have developed this framework and have tested it in planning sustainable green spaces in urban planning projects, we hope that this framework will provide as a suitable guide to urban planners in planning sustainable green spaces.

A key indicator of sustainable urban development is the quality and quantity of a cities green spaces. Planning green spaces that meet social and ecological needs of the city are required to promote urban sustainability. Though there are many research works on planning urban green spaces, a comprehensive framework that helps urban planners design sustainable urban green spaces is yet to be developed,, which is important in the present century that is witnessing rapid urbanization associated with loss of biodiversity and decreased per capita availability of green spaces .

The important characteristics of green spaces relating to sustainability comprise; Quantity (what percentage of the urban area is filled with green space?), Quality (can the green space improve urban biodiversity and provide better ecosystem services?) its Connectivity (how much of green space is connected?) and Accessibility (how much population has access to green space?).

An Ecologically sustainable urban green space not only provides basic ecosystem services for the city but also sustains and enhances urban biodiversity, Landscape ecology principles, which is based on three aspects; Patches, Corridors and Matrix have been successful in planning ecologically sustainable landscapes. Patches are single continuous area of green space like parks, gardens etc. Corridors are connections among patches like riverine buffer zone, street scapes. While patches forms the basic structure on which urban ecosystem services are depended, corridors facilitate the flow of animals, energy, minerals, water and other elements across landscape. The spatial arrangement of patches and corridors forms the landscape matrix, appropriate matrix is required to form sustainable urban forms.

The social aspect of open spaces in urban sustainability deals with accessibility to open spaces and availability of open space per capita or 1000 population

In this paper, we describe an integrated GIS based framework that helps to evaluate and plan urban green spaces. The framework is based on principles of landscape ecology and measures key indicators (patch quality index, connectivity index and social accessibility index). The paper describes on evaluating the key indicators and plan green spaces that meets the ecological and social aspects of urban green spaces.

We have proposed GIS as an useful tool in capturing the data in spatial form which helps in evaluating urban green spaces based on the set of indicators and this framework can help town planners and city administration to assess the present status of green spaces and will also help in planning additional green spaces for sustainable urban forms.

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D3-PV-A -**4**

Assessing Biodiversity for Adaptive Co-management: A Perspective of Urban Sustainability in Yokohama, Japan

Maiko Nishi*[1], Tetsuo Kidokoro[1], Aki Suwa[2], Hiroshi Kishida[2], Jose A. Puppim de Oliveira[2], Eduardo S. Brondizio[3]

Today's rapidly changing global contexts associated with economic globalization and global environmental changes calls for an adaptive approach to ecosystem management (Olsson et al., 2004). In particular, large cities with the greater population size usually have pressing demands to wisely use biodiversity and ecosystem services on a sustainable basis in addition to conserving limited or diminishing green space. Assessing urban biodiversity is a critical step to plan and act for managing cities and achieving their sustainable growth without jeopardizing the human wellbeing of future generations. An increasing number of indicators and assessment tools have been developed to measure urban biodiversity and assess the progress of conservation activities in cities (*Puppim de Oliveira* et al., 2011). However, less attention has been paid to how to incorporate those technical tools for urban biodiversity assessments most effectively into urban management and planning so as to make informed decisions and act on the findings from those assessments.

This paper aims to examine challenges and opportunities in using and applying City Biodiversity Index (CBI), including the one that has been recently developed by experts from around the world under the initiative by the Singapore National Parks and the Secretary of the Convention on Biological Diversity, and to explore a way in which such indexes on urban biodiversity can be integrated into urban management and planning. For this purpose, the study employs as a case study, the City of Yokohama, capital of Kanagawa Prefecture, Japan, which is the first largest municipality in Japan with a population of nearly 3.7 million. Through the literature review and the hearing from the local and national government officials and scholars, it analyzes the applicability, significance, implications and limitations of the CBI in the context of urban planning, strategies and policies in the City of Yokohama.

The study has identified the following possible and potential CBI's roles in promoting conservation, restoration and sustainable use of biodiversity; 1) motivating various stakeholders to recognize their connections with biodiversity and be concerned of it; 2) facilitating internal communications among different departments and sections in the local government; and 3) establishing an urban governance system as a whole to address urban sustainability particularly when the indexes are incorporated as numerical goals into plans or strategies of the city. To ensure the reciprocal connection between the CBI and the urban management and planning, however, it also suggests that it is critical to restructure or tailor the indexes, by redefining and choosing the indexes in accordance with the urban planning, strategies and policies into which they are integrated as quantitative targets and also in consideration of the specific contexts of the city.

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References

Puppim de Oliveira, J.A., O. Balaban, C.N.H.Doll, R. Moreno-Peñaranda, A. Gasparatos, D. Iossifova, A. Suwa. 2011.Cities and biodiversity: Perspectives and governance challenges for implementing the convention on biological diversity (CBD) at the city level.*Biological Conservation*. 144: 1302–1313.

Olsson, P., Folke C, Berkes F. 2004. Adaptive comanagement for building resilience in social-ecological systems. *Environmental Management*. 34 (1):75-90.

D3-PV-A -**5**

Modelling and Interactive Visualisation for Addressing the Economic, Ecological and Socio-Cultural Dimensions of Sustainability in an Urban River Landscape

Eckart Lange*[1], Gill Lewis[1], Henneberry John[1], Morgan Ed[1], Shaw Ed[1]

This study explores how the ecologic, the economic and the socio-cultural dimension of sustainability can be addressed through modelling and 3D-visualization by using the case study of the Urban River Landscape of the River Don Corridor in Sheffield, UK. It is the focus of the EPSRC-funded (Engineering and Physical Sciences Research Council UK) URSULA research project consortium (Urban River Corridors and Sustainable Living Agendas) in which a range of multidisciplinary research approaches are considered.

The physical form of the landscape has long been represented in visualizations (e.g. Zube et al. 1987). Analogue techniques such as plans, perspective drawings and physical models have a long tradition and they can be used to portray existing environments and proposed changes to them. More recent advances in computer technology have supported the development of visualization techniques for efficient use in the decision-making process in designing and planning environments (Lange, 2001; Bishop & Lange 2005).

3D models of the River Don corridor in Sheffield have been developed so that proposed 'interventions' to the existing environment can be visualized and then used in an assessment process with stakeholders. Most importantly, further to the representation of physical form, abstract information regarding the three dimensions of sustainability is represented in a visual format. The models are viewable in real-time either as eye-level walkthroughs or as 'birds-eye' overviews and are sufficiently representative of the actual areas and the interventions to allow stakeholders to assess the latter. For the visualization, Simmetry3d software is used, a design and visualization solution based on the technologies used in the computer game industry. It supports stereoscopic three-dimensional viewing and can be used to explore existing and proposed environments in the University of Sheffield virtual reality facility.

In particular the following routes for 3D visualization and modelling have been pursued, and the results in terms of addressing the economic, ecological and socio-cultural dimensions of sustainability in an urban river landscape will be presented:

- a direct interactive link to a financial appraisal system (Henneberry et al. 2011) so that the financial implications of alternative development interventions along the river corridor can be assessed.
- a link to a conceptual model addressing river functions, in particular modelling of weir functions and ecosystem services (Gill et al. 2010).

- a virtual environment which allows the integration of stakeholders in planning and design.
- an iPhone and iPad app that allows Augmented Reality representations on site showing proposed changes (Graham-Rowe 2011, Lange 2011).

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- a biodiversity education game merging ecological survey data with a 3D simulation (Morgan et al. 2011) which was tested at the "Wildlife of our Waterways" event in the Weston Park Museum in Sheffield, a major museum focusing on natural and cultural history.

References

Bishop, I. & E. Lange (2005) Visualization in Landscape and Environmental Planning. Technology and applications. Taylor & Francis, London, New York, 296 pp.

Gill, L., V. Kumar, E. Lange, D. Lerner, E. Morgan, D. Romano, E. Shaw (2010) An interactive visual decision support tool for sustainable urban river corridor management, Proceedings of iEMSs 2010, Ottawa, Canada, 1431-1438.

Graham-Rowe, D. (2011) Not in my backyard! App to spot eyesores in the making. New Scientist, Magazine issue 2806, 2. April 2011, p. 23.

Henneberry, J., E. Lange, S. Moore, E. Morgan & N. Zhao (2011) Physical-Financial Modelling as an Aid to Developers' Decision-making. In: S. Tiesdell & D. Adams (Eds.): Urban Design in the Real Estate Development Process - Policy Tools and Property Decisions. Wiley, Blackwell, 219-235.

Lange, E. (2001) The limits of realism: perceptions of virtual landscapes. Landscape and Urban Planning, 54(1-4), 163-182.

Lange, E. (2011) 99 volumes later: We can visualise. Now what? Landscape and Urban Planning 100, 403-406.

MORGAN, E., L. GILL, E. LANGE & M. DALLIMER 2011: Integration of Bird Survey Data into real-time 3D Visualization Models and its Use in a serious Game for Children. In: E. Buhmann, S. Ervin, D. Tomlin & M. Pietsch (Eds.): Teaching Landscape Architecture. Digital Landscape Architecture 2011, Hochschule Anhalt, 278-285.

Zube, E. H., D. E. Simcox & C. S. Law (1987) Perceptual Landscape Simulations: History and Prospect. Landscape Journal 6 (1), 62-80.

D3-PV-B-**1**

ZFarming: Urban Food Production in and on Buildings and Its Implications for Climate Change

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Cities consume more than two-thirds of the world's energy and account for more than 70% of global CO_2 emissions (UNFCC 2010). Therefore they can play a leadership role in decarbonisation by decreasing CO_2 emissions. Environmentally sustainable solutions for food, water, energy and transport as integrated components of city's climate change adaptation are needed. Innovative forms of green urban architecture aim to combine food, architecture, production and design to produce food at a larger scale in and on buildings in high-density urban areas. Zero-acreage farming (ZFarming) describes the non-use of farmland and therewith differentiates the building-related forms of urban agriculture from those in parks, gardens, urban wastelands, and so on. Such production types might include the installation of rooftop gardens, rooftop greenhouses, edible green walls as well as further innovative forms such as indoor farms or vertical greenhouses. The objective of this research work is to investigate which role ZFarming can play in future cities to combat and adapt to climate change.

The results are based upon the analysis of 96 documents published in accessible international resources. The results show, that ZFarming is seen as an "outside-the-box" solution which has the potential to play a strong role for greening the city and combating climate change. ZFarming brings with several potential benefits for enhancing the situation regarding climate change. Depending on specific site conditions, major potentials are found in the reduction of transport emissions, reducing the environmental impact of architecture, improving the recycling of resources and the opportunity to take pressure off agricultural land.

But dealing with and managing ZFarming is challenged by several difficulties. For some of the envisaged applications, the necessary technologies to recycle water, energy and waste need to be further developed or improved. Beside technical constraints, we found further disadvantages, as the problem of high investment costs or a lack of acceptance on soil-less growing techniques.

To conclude, ZFarming has some potential to serve as an element of sustainable urban infrastructure and to generate win-win scenarios in cities in terms of improving climate and aesthetics, providing fresh food with low carbon footprints and stimulating the reuse and recycling of resources. Nevertheless, it is still in an early stage of development and needs to overcome several technical and other constraints.

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D3-PV-B -**2**

Green Infrastructure to Reconcile Urbanization, Biodiversity and Ecosystems Services: Case Study in Rio De Janeiro, Brazil

Cecilia Herzog*[1], Ricardo Finotti[2]

The city of Rio de Janeiro has a remarkable urban biodiversity distributed in isolated Atlantic rainforest, mangroves and sandbanks ecosystems fragments among urbanized areas. The population is 6.3 million inhabitants in an area of 1.255,3 Km^2. The expansion of urbanized areas increased 36.45%, from 334 Km^2 in 1984 to 531 Km^2 in 2010. The lack of urban landscape planning leads to severe degradation with ecological, social and economic losses. Some of the most significant forest remnants are located in highly priced city expansion areas, where they are under threat of suppression to give place to new real estate developments with globalized gardens, which are usually largely covered by lawns and few mainly exotic ornamental species. According to a municipal proposition called Green Corridors, the fragments will be protected and connected to increase the multiple abiotic, biotic and cultural ecosystems services they provide, as well as enhance fauna, avifauna habitat and mobility.

This paper aims to present the case study of multifunctional urban ecological corridors that incorporate several public and privately owned parks and greenways in a coastal lagoon system located in one of the most profitable real estate development areas of the city. The existing parks and greenways were created to comply with environmental laws, and many were planned to restore mangroves and sandbank ecosystems mimicking natural floristic associations with attractive design led by the landscape architect Fernando Chacel. Those green areas play an essential role not only for biodiversity, but also for people, once they have direct contact with nature and native biodiversity and fruit trees. Many of them are accessible and very popular, where users may have a multitude of activities for all ages. They combine high ecological and social value, and should inspire garden designs. An example of best practice surrounds the Peninsula complex, a private medium and high income community, where a 3 Km long riparian corridor, was restored and converted into a multifunctional greenway fifteen years before the developer obtained the building permits. Today the complex has 10 years with more than 11.000 residents.

Native biodiversity is important in the restoration process, they offer irreplaceable ecosystems services: mangrove filters contaminants and protects biodiversity and nesting sites, thus contributes to the lagoons' recovery; sandbanks ecosystem has a high biodiversity adapted to the harsh local conditions, promotes ground water recharge, prevents and filters rainwater run-off, among other benefits.

The ecological design is an important source of inspiration for the Green Corridors plan to reconcile urbanization, multiple human uses and biodiversity conservation and restoration. It is essential to have a systemic approach of the whole watershed social-ecological challenges, based on interdisciplinary scientific knowledge and on the climate change challenges. The plan

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may constitute the framework of an urban green infrastructure and orient the real estate development, at the same time offer irreplaceable ecosystems services where people are, thus build a more sustainable and resilient urban ecosystem.

D3-PV-B -**3**

The Design and Construction of Greenways in Shenzhen

Jianchun Song[1], Hongchang Zhang[2], Xiaoming Wang[3], Cun Mei[4], Junkai Chen[5], Tao Chen*[3]

The Perl River Delta region in Guangdong province has witnessed the miracle of economic development and has turned out to be one of the densest urbanized areas in China. Meanwhile it has also been facing the ecological challenges from environment pollution and disordered urban development. Recently the planning guidelines and construction standards for the greenway network has been put forward for a more livable Guangdong.

The greenway is a linear green open space which is usually established along natural and artificial corridors such as riversides, valleys, mountain ridges, highways, railways, drainage channels and landscape roads, etc. A greenway network is formed with ecological, countryside and urban greenways connecting parks, nature reserves, scenic spots, heritages, and residences in urban, suburban and rural areas. The ecological greenways are usually over 200 meters in width and mainly in rural areas for ecological and biodiversity conservation and natural sight-seeing. The countryside greenways are generally more than 100 meters wide and in the suburban area providing urban-rural ecological connection. The urban greenways usually not less than 20 meters in width and in the urban areas such as scenic spots, parks, squares and roads of built-up areas. The construction of regional greenways including green corridor system, low-speed pathway system, transit interchange facilities, service facility system and visual identity system.

By the end in 2010 a total of 2372 kilometers of greenways has been developed by the Perl River Delta cities. Shenzhen is one of the key cities comprising the Perl River Delta region in Guangdong province. The construction of greenways started in Shenzhen in early 2010. By the end of 2011 a greenway network of 1200 kilometer has been formed including 335 kilometers of provincial regional greenways, 318 kilometers of urban greenways and 534 kilometers of community greenways. Shenzhen has paid special attention to develop the multiple functions of greenway network such as biodiversity conservation, recreation, sports and education etc., which is achieving comprehensive efficiency and becoming a prospective way towards a more livable and happier city.

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Development of Green Infrastructure through Green Streets

Ritu Rai[1*], Vivekanand Tiwari[1]

Green infrastructure is the living network of green spaces, water and environmental systems in, around and beyond urban areas. It includes trees, parks, gardens, road verges, allotments, cemeteries, woodlands, rivers, wetlands and coastal habitats.

Streets are the lungs of the city, they are also the nervous system supplying the service utilities (water, gas, electricity, Landscape etc.) which make urban life possible. These connections allow towns to work and link to the wider world. Just as much as architecture or landscape they help determine whether places are good or bad. So whatever their function, connections need to be thought of as an integral part of the urban fabric.

Past decades Gray Infrastructure has raised different community issues like Erosion of soil, clogging of rainwater on streets, heat island effect, adds to global warming.

This paper tries to identify the role of Green Streets in particular for urban areas. A "Green Street": can handle storm water on site through use of vegetated facilities; Provides water quality benefits and replenishes groundwater (if an infiltration facility); can Create attractive streetscapes that enhance neighbourhood liveability by enhancing the pedestrian environment and introducing park-like elements into neighbourhoods; Serves as an urban greenway segment that connects neighbourhoods, parks, recreation facilities, schools, main streets, and wildlife habitats; and Meets broader community goals by providing pedestrian and where appropriate bicycle access.

Green Streets can provide cost-effective infrastructure solutions to storm water management. They can be more cost effective in some circumstances than traditional storm water structures. The street should be designed to suit the activities that we would like to see Green Infrastructure provides green spaces to encourage exercise and socializing, provides a place with character and a strong identity, it allows us to access nature, and feel part of it, improves the image of a place, boosts property prices and attracts investment. Green infrastructure is often neglected. But by protecting local green spaces, integrating green infrastructure into the design of buildings and places or planning a green space network, we can weave it into the core of the places where we live.

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D3-PV-B -**5**

BiodiverCITY: How to Take Biodiversity into Account in Urban Management?

Tatiana Gadda*[1], Tamara Simone van Kaick[1]

While cities have relatively limited reliance on Biodiversity within its borders, most local policies for biodiversity conservation neglects biodiversity outside the city limits. At the same time it is in cities that most of the systematized knowledge on biodiversity is concentrated: our Universities and research centres worldwide are mostly located in urban areas. It is also in cities that most of the decisions affecting biodiversity are taken. This is the case also in the city of Curitiba.

The Technological University of Paraná (UTFPR) has launched a Studio on Cities and Biodiversity to try to identify whether the links between public policies and biodiversity conservation are strong enough to make serious contributions to biodiversity conservation within and outside the city's borders. According to preliminary results from our assessment there has been no research aiming to relate the biodiversity dynamics with the urban dynamics. The existent data are punctual and sparse – the different parts of the puzzle do not relate to each other. This gap in knowledge weakens the city capacity to make conscious decisions for biodiversity conservation.
The urbanization history, however, makes clear that there has been a suppression of the local biome and its ecological niches generating an unbalanced state which in its turn facilitates the introduction of exotic species of fauna and flora, some of which are also invasive.
The common citizen as much as public managers lack knowledge on the impacts of these unbalanced states can bring to the ecological urban dynamics. The cost to bring back these dynamics as they used to be, are high and depend on proper legislation to assist towards this direction.
The city of Curitiba is currently attempting to build the relevant legal framework to tackle biodiversity conservation more efficiently. The city is also promoting a broader understanding of the positive aspects of fauna and flora conservation within the city.

The Studio Cities and Biodiversity –Curitiba seeks to analyse the urban state of fauna and flora linked with the legal framework, public policies and social development, urban economic development, production and consumption relations, industrial ecology, urbanization and planning, urban management and governance. The knowledge being produced assist in a better understanding of the bio-urban dynamics over time in relation to public policies. The analysis may potentially show which are the actual knowledge gaps and difficulties towards the understanding required to obtain the desired biodiversity conservation strategy.
To this end the University can make contributions to help build an understanding on how to apply or how to optimize action having biodiversity interests as a central axis in public management. Therefore the University has the possibility to contribute to local management through a debate on the critical analysis of the state of the urban biodiversity and its implications for human wellbeing. It also has the capacity to collaborate in possible reorientations to better manage and conserve the urban biodiversity.

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D3-PV-C-**1**

Integrated Approach for Urban Biodiversity Management: A success Story of TCS – Yantra Park, Thane

Laxmikant Naik*[1]

Urban biodiversity is under severe threat due various developmental activities and decreasing at an alarming rate. Large landscapes in urban areas plays significant role in protecting biodiversity. TCS perceives biodiversity management as an integral part of its environmental philosophy and biodiversity considerations are integrated into Environmental Management System. Biodiversity mapping of TCS owned landholdings throughout India has been carried out and site specific Biodiversity Action Plan has been implemented for conservation & enhancement of flora & fauna within the TCS premises for protection of depleting urban biodiversity.

The present case study i.e. TCS Yantra Park, Thane (Maharashtra) spreads over an area of 13.5 acres with 36 % is open area & state of the art 10 buildings. Various innovative biodiversity conservation & enhancement programs has been successfully implemented and resulted in biologically diversified landscape. The floral diversity is represented by i.e. 168 plant species belonging to 120 genera and 96 families with 750 well grown trees. While faunal diversity comprised of 98 species. Remarkable increasing trend in biodiversity was recorded form 2007-08 to 20011-12. Biodiversity awareness programs were implemented for increasing awareness amongst employees. Effective use of biotechnology for onsite waste management has further resulted in use of organic fertilizers for landscaping.

TCS has also implemented Marine Turtle Conservation Program on participatory basis with NGO Sahyadri Nisraga Mitra along 3 coastal villages of Raigad District of Maharshtra and successfully releases 3076 hatchlings of Olive Ridely Turtles in their natural habitat.

Integrated approach for maintaining biologically diversified urban landscapes not only played vital role in ecological sustainability but also provides business sustenance through ensuring ecological services, enhance working environment, increase productivity, appreciation form clients, visitors, internal & external stake holders, shareholders, and an important part of various recognitions & awards.

Due to consistent efforts for biodiversity conservation Yantra Park has became an excellent example of successfully operating industry in biologically diversified urban landscape.

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D3-PV-C-**2**

Social and Environmental Green Evaluation System (SEGES) in Japan and a Good Practice of Sanden Forest

Kochi Tonosaki*[1], Yoshihiro Ueno[1], Naomi Komatsu[1], Kitsuro Murauchi, [2], Toshiyuki Ishikura[3]

Organization for Landscape and Urban Green Infrastructure runs an accreditation system to neutrally evaluate the activities of businesses that are actively working to green the city and are dedicated to improving the social environment at 46 sites. This system is known as the Social and Environmental Green Evaluation System (SEGES), and is recommended as a good practice in many guidelines of the National government (Third Basic Environment Plan, National Biodiversity Strategy 2010, Guidelines for private participation in biodiversity, Low-carbon urban development guidelines etc).

SEGES evaluates green spaces managed by various bodies including businesses, factories, nature study facilities and private associations. It sets out a comprehensive framework to assess from a variety of perspectives how green spaces contribute to society and the natural environment. Assessment factors comprise 3 principles and 8 general rules based on SEGES standards. The evaluators are selected specialists in environmental management and green spaces who carry out field investigations and interviews based on candidates' individual skills and capabilities. The system involves interviews with senior management to ensure that the candidates have a vision for the future that is in line with overall greenery strategy. The outcome of the assessment is then passed on to an evaluation and accreditation board that issues certificates after taking into account the results of the assessments and the interviews. The certificates are issued as badges in 5 grades. Superlative Stage: qualified after continuously accredited as Excellent Stage 3 Excellent Stage1, Excellent Stage2, Excellent Stage3: Excellent contribution to the society. Graded by score Green Stage: Potential good green space.

Green spaces in factories and business establishments not only contribute to employee intellectual productivity and relaxation, but are also regarded as part of the company's Corporate Social Responsibility (CSR) activities. Green spaces contribute to society in a variety of ways, including acting as carbon sinks for global warming, modifying the heat island effect, recharging groundwater, and serving as places to connect local communities with nature.

Sanden Forest (67 ha), a complex of manufacturing and forest areas which was opened by Sanden Corporation (Japan) and came into operation in 2002, has actively promoted regeneration and utilization of a forest 30 ha in size at its factory site consistently in accordance with the basic concept of “harmonious coexistence of industry and environment” since the start of its construction. It has gained a high reputation from local communities as evidenced by the fact that the forest was certified by Gunma Prefecture to have absorbed 537 tons CO2 equivalent. Sanden Forest’s green space also has been highly evaluated; it received the Minister of the Environment Award and Minister of the Economy, Trade and Industry Award and has been certified by the Organization for Landscape and Urban Green Infrastructure as SEGES. Furthermore, last year, the OECD (Organization for Economic Co-operation and Development) presented the Akagi Plant of Sanden Corporation in its Sustainable Manufacturing Toolkit site through which it disseminates information across the world as an exemplary case of manufacturing in harmony with nature.

[1] Organization for Landscape and Urban Green Infrastructure, Japan
[2] Sanden Corporation, Japan
[3] Sanden Facility Co., Ltd.

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The Construction of Sanden Forest Using Neo-Natural Construction Methods and Continual Environmental Surveys

Kitsuro Murauchi*[1], Toshiyuki Ishikura[2], Shubun Fukudome [3], Kochi Tonosaki[4],

Sanden Forest (67 ha), a complex of manufacturing and forest areas which was opened by Sanden Corporation (Japan) and came into operation in 2002, has aimed at the co-existence of biodiversity and a manufacturing plant through the regeneration and utilization of forest consistently in accordance with the basic concept of "harmonious coexistence of environment and industry" since the start of its construction. Employing the "neo-natural construction methods" from the land development stage, we endeavored through the entire construction process to preserve and recover the habitat environment for decreased plants and small animals which form the base of the ecological pyramid. The construction methods began in Switzerland in the late 1970s as an environmentally friendly approach replacing the conventional river improvement methods which made rectilinear river banks. Since their introduction into Japan, they have been developed in many original ways, for example, by combining traditional stone masonry techniques that are suitable for Japanese climate.

Sanden Forest is the first industrial site in Japan developed using the ideas and techniques of Neo-natural Construction. It is characterized by the following techniques:

- Instead of constructing concrete revetments on the boundaries of developed plots, gentle slopes planted with trees were created;
- Statutory regulating reservoirs were built into biotopes to produce living space for plants and animals;
- A traditional stone masonry technique was used in the construction of the vertical side of the dam with a view to securing the continuity of ecosystems;
- When creating new forests, only tree species indigenous to the local area (potential vegetation) have been planted; and so on.

In addition, we have been conducting continual environmental monitoring surveys nearly every three years since 1998, which was before the industrial site was developed, to quantitatively understand the changes of flora and fauna species living and growing in the compound and have managed them in a proper fashion. As a result, at present, lots of great purple emperors, the national butterfly of Japan, are observed, while the populations of Japanese flagship species such as the Japanese firefly have been on the rise. Regarding animal species, four species on the Ministry of the Environment Red Data List have been confirmed.

Meanwhile, we have confirmed that the number of plant species increased from 360 before the development to 430 to date. In particular, endangered species such as the helleborine and the Calanthe can now be observed in large groups. Five plant species on the Ministry of the Environment Red Data List have been confirmed. Sanden Forest has been revived as an advanced area of biodiversity through the construction and forest development using the "neo-natural construction methods" as well as operation and maintenance based on continual environmental monitoring surveys. In consideration that these measures are effective in fighting global warming, we intend to embark on a study of organic carbon in the soil as a new research theme for 2012 onwards, thereby committing ourselves to the development of forests which will be able to contribute to both the preservation of biodiversity and the prevention of global warming.

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D3-PV-C-**4**

Forest Management and Human Resources Development at Sanden Forest through Wide-Range Cooperation with NPOs

Kitsuro Murauchi*[1], Toshiyuki Ishikura[2], Yoshinori Kobayashi[3], Kochi Tonosaki[4]

Sanden Forest (67 ha), a complex of manufacturing and forest areas which was opened by Sanden
Corporation (Japan) and came into operation in 2002, has actively promoted regeneration of a forest (30 ha) at its factory site as well as environmental education programs using the forest as teaching materials consistently in accordance with the basic concept of "harmonious coexistence of environment and industry" since the start of its construction.

As a measure to pursue these practices, we invited an incorporated nonprofit organization (NPO) to
establish the Akagi Nature School, within the Sanden Forest site in 2007. With the aim of developing human resources who can care for the environment, the NPO has conducted activities centering on four pillars, i.e. forest management ("Field"), exchanges between urban and rural areas ("Approach"), collaboration ("Collaboration") and environmental education ("Education"). The activities are called the FACE-Project, named after the initials of the four pillars.

The FACE-Project has conducted vigorous activities throughout the region, covering not only Sanden Forest but also forests surrounding Mt. Akagi and lake areas on the mountain top. The purpose of the forest management project is to teach people about the roles of and realize the values in forests by experiencing tree thinning, planting, etc. As the project's activities have gained a high reputation, the forest was certified by Gunma Prefecture in 2010 to have absorbed 537 tons CO2 equivalent. The human resources development project has, meanwhile, been hosting 5,000 children or more every year as part of school activities. Because it enables children to visit a manufacturing plant and gain hands-on experience in nature at the same time, they can learn about both the development of human resources to care for the environment and environmentally sound manufacturing. As these activities have also been highly rated by schools, a long-term (one-year) training program targeting school teachers has been repeatedly provided for more than ten years.

In order to pass the knowledge obtained through past experience along to subsequent generations, Sanden Corporation together with the Akagi Nature School is planning to publish a "Guide to Forest management" and "Grand Design for Forest Management." Moreover, with a view to further invigorating environment conservation activities across the region, it has been endeavoring to train future leaders by implementing an "Environment Guide Training Course,"

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the “Forest Certification Test,” etc. Through these activities centering on Sanden Forest, we, in collaboration with local communities, have been promoting the creation of a sustainable society.

D3-PV-C-**5**

Ecological Efficiency and Sustainable Quality for Urban Grown of Guatemalan Metropolis

Miguel Chacon*[1]

Guatemala has about 12 million people, it is a country in Central America. Guatemala City is the capital City, and it is the largest central American city. It has almost 3 million people, and they represent almost fifty percent of the total urban population of Guatemala. It was founded still under the Spanish colony in 1776 in a valley with great forested areas, and small lakes, very near volcanoes. In earlier times, the valley was the location of a mayan community near a lake Miraflores. Since 1776 the water supply source for Guatemala city's population is coming from the forested hills of Mixco and Pinula at 10 kms. Distance from the city. In addition to the parks and plazas of the original city in the historical center, there are also some public green spaces created in the beginning of XX century as influence of the garden city, including the zoological garden, and the Minerva park en the south of the city. Other Sport's centers and university campuses were introduced with green areas in the middle of XX century. However, less green public space was created and introduced in the years when the population growth and spatial expansion of the city was more significant after t the middle of XX century, when the economic activities of the city changed from colonial capital city of a country of agricultural economy, to a city of a few manufactures and commercial business. This growth had affected land uses in the forested areas due to the conurbation of other small towns, which did not have urban regulation and urban planning instruments. Housing projects have functionalist style but very small public green space included.

At the end of XX century the urban growth has metropolitan scale and it is affecting the watershed of a nearer lake named Amatitlan and the Pinos lake, both are located at 25 kms, to 40 kms of the central city. In the central areas of the city the low income public housing decreased the public space after the resettlement of very low income population derived from migration after Guatemalan internal conflict. Other areas with deep rivers have become the location of very vulnerable housing located in land exposed to natural hazards in raining seasons.

This paper addresses the need to redefine alternative criteria for urban growth that is taking place in the direction of forested areas. In addition, the land uses are jeopardizing the natural resources and the ecological services they provide to the largest population of Guatemala city and metropolitan towns. The contradictions between quality of urban life and the need for urban space will require considering ecological and spatial efficiency criteria for sustainability of city. The paper includes a review of the university experience in managing ecological reserves and urban green space in the city, as well as urban research for ecological and social sustainability and city planning and urban regulacion.

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D3-PVI-A-**1**

Urban Natural Capital: A Non-Economic Multi-Criteria Approach to Valuing Multiple Urban Ecosystem Services in the Social-Ecological System of New York City

Timon McPhearson*[1], Peleg Kremer[1], Zoe Hamstead[1]

The world is increasingly urban, interconnected and changing (Seto et al. 2011). Over the last few decades there has been increasing recognition that human population expansion and development, especially in cities, is reshaping the ecology of the entire planet (Folke et al. 1997, Alberti et al. 2003: Rockstrom et al. 2009). Given global urbanization trends compounded by climate change and other global environmental pressures, the primary dynamic that must be understood for increasing urban sustainability and resilience is the social-ecological relationships between humans and the urban ecosystems in which they live (Pickett and Grove 2009). To improve urban sustainability while also increasing resilience city planners and policymakers will have to consider how ecological resources can be strategically developed and best managed to meet the needs of urban populations.

Ecosystems in cities have been widely discussed as providing critical ecosystem services (ES) to urban residents (Troy et al. 2007; McPhearson 2011). However, research has primarily focused on economic valuation of either biophysical or social benefits of urban green space and has rarely investigated multiple ecosystem services simultaneously, which necessitates the inclusion of non-economic valuationmethods. Since cities are socially and ecologically heterogeneous across space and time, it is easy for ES assessments to overlook urban spaces of important potential combined social-ecological value. Additionally, though the spatial and functional heterogeneity of urban systems has been well noted (Jacobs 1961; Pickett et al. 2007), the interaction of various kinds of social-ecological heterogeneity in urban systems is a major open question (Pickett et al. 2008).

The objective of our research is to link social, biological, and infrastructural heterogeneity in a spatially explicit conceptual framework to understand the supply and demand for ecosystem services and as a platform for investigating patterns of social-ecological value across the urban landscape of New York City. Here, we present the first multi-criteria, non-economic ecosystem service assessment of urban land in New York City. Weincorporated land use, land cover, and other spatially referenced empirical data to assess the current ecosystem services provided by urban land and biodiversity in the city. Assessment methods included extensive literature review to develop empirically based algorithms for calculating a broad range of urban ecological values (ES supply) and social needs (ES demand). We developed a novel social-ecological matrix approach to urban ecosystem services assessment where high/low social need and high/low ecological value are assessed for each examined urban patch in the citywide landscape. Our results are summarized in acombined social-ecological value map of 1502 urban lots. We also conducted a spatial cluster analysis and found that vacant land with low ES value located in areas with high demand for ES clustered in three primary neighborhoods, resulting in recommendations of specific target areas for prioritizing urban green infrastructure investment. Our research suggests that urban areas with high ES demand and low ES supply constitute the low hanging fruit for social-ecological transformation of urban land to more resilient forms and should be prioritized in urban planning, policy-making, and management. We demonstrate how our methodological approach can illuminate combinations of ES supply and demand in the urban landscapeand uncover overlooked opportunities to improve urban sustainability and resilience.

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D3-PVI-A-**2**

Towards a Set of Urban Biodiversity Indicators for Indian Cities

Hippu Salk Kristle Nathan *[1]

The importance of cities cannot be over emphasized. The ecological and sociological footprints of cities have spread over wider areas and cities will continue to have a significant impact on the global carrying capacity of the earth. Urban areas are fulcrums of economic activities, where indicators of general health and wellbeing, literacy, women's status, and social mobility are typically higher. However, urbanization must be judged not only from a perspective of prosperity, but also from the point of view of maintaining a natural balance. City's dynamism and diversity is coupled with the fact that a large percentage of Earth's biodiversity exists in urban or urbanizing areas. Healthy ecosystems and biological diversity are vital for not only cities to function properly (as it provides water, food, fuels, fibers, clean environment, and quality of life), but also essential for minimizing climate change impact, fostering biodiversity conservation in global scale, and ensuring the survival of life on earth. In this context, it is important to assess and monitor the biodiversity of cities through indicators.

This paper develops a framework to determine a set of urban biodiversity indicators for Indian cities. Regular tracking of these indicators influences a sustainable pattern in resource allocation and use; and inspires urban societies to pursue development with inter- and intra-generational welfare. For instance, ranking of China's major cities on the basis of Urban Environmental Quantitative Examination System (UEQES) has motivated the mayors to show tremendous interest in environmental quality so that their respective city improves in ranking.

The paper does a literature review of urban biodiversity assessment worldwide, collates such indicators, and places them in urban Indian context to generate a list of potential indicators. In order to filter out final indicators of urban biodiversity from this potential list, the study uses What-How-Whom (WHW) framework, where selection criteria are organized in a value tree fashion. For scores of indicators on subjective criteria, opinions of different stakeholders are sought. The stakeholders—engaged for this purpose—are drawn from the following domain: academia, scientists, environmentalists, policy makers, civic body associates, media houses, and citizens. The overall scores of the indicators are step-wise aggregated using displaced ideal (DI) method. The DI method is used instead linear addition to overcome the limitation of imposition of perfect substitutability assumption across criteria. On the basis of the overall scores, the final set of indicators is obtained. Eventually, the study illustrates the indicators for assessing the biodiversity of city of Bangalore, India.

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D3-PVI-A-**3**

Urban Sustainability Index for India: Promoting Sustainable Cities

Koyel Mandal*[1], Kadambari Anantram[1], Vivek Venkatramani[1]

Cities will be central to India's economic future. The scale of urbanization, however, has put massive pressures on cities' resources and providing basic services, traveling from home to work and disposing of waste are already proving daunting for urban managers. In addition to this, cities are facing a host of environmental problems, from air pollution to waste water management and green space degradation. The High Powered Expert Committee for Estimating the Investment Requirements for Urban Infrastructure Services (MoUD, GoI) estimated the investment requirement for urban infrastructure for the period 2012 – 2031 at Rs. 39.2 lakh crore at 2009-10 prices. Of this, 44 percent is accounted for by urban roads and 20 percent for delivering urban services such as water supply, sewerage, solid waste management, and storm water drains. To attract investments, to be competitive, and to sustain the economic productivity of cities and towns, India needs to manage its urbanization, not only in terms of addressing basic service delivery, but also paying equal attention to environmental and energy considerations. Currently, most of the urban policies and initiatives focus on ensuring provision of basic public services for all in the cities and towns of India. Environmental and energy concerns are either viewed as "add-ons" to overall strategies driven by service delivery concerns or as a subject for conventional environmental infrastructure programming as an important routine task for cities. Given the rising cost of energy, traffic congestion, urban sprawl and related mobility costs, the vulnerability of fresh water sources, and incidences of chronic air pollution, environmental and energy considerations should become part of the core city development planning process.

The **Urban Sustainability Index (USI)** for India seeks to measure and assess the performance of Indian cities across a range of criteria. USI is as an equally weighted average of six categories - Air, Water, Built Environment, Solid Waste, Sewage & Sanitation, and Roads. All the underlying indicators used for creating the index have normative benchmarks. Thus, USI measures the sustainability performance of cities as percentage of the benchmark. The framework was pilot tested for four cities in two different states of India – Chennai and Kovai from Tamil Nadu, and Bangalore and Mysore from Karnataka. This paper presents the key findings from the index. It also provides useful insights into the performance of Tier I (Chennai and Bengaluru) as well as Tier II (Kovai and Mysore) cities and provides opportunities for learning both within and across groups. USI scores are the highest for Mysore, followed by Bengaluru. Kovai trails closely and Chennai brings up the rear. Mysore performs uniformly well across all categories. Tier I cities perform well in certain categories such as 'Roads' and 'Sewage', while they lag behind in the provision of water services and in curbing pollution of fine particles (SPM and RSPM). One area of concern across the board is with regards to solid waste management (waste generation, primary waste collection & transport to transfer station, segregation and disposal in landfills).

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D3-PVI-A-**4**

An Integrated Urban Sustainability Indicator Mix – Practicability and Implications

Pallavi Tak Rai[1]

Scope: Embarking on the journey of sustainable urban development, countries would first require, a well defined and framed Urban Sustainability Indicator Mix, comprising of indicators for an integrated, harmonious and long term environmental, economic and social development. The sustainability indicators should qualify the test of clarity, practicability, measurability, reportability, verifiability, replicability and sustainability, besides withstanding test of spatial differences and temporal variation trends. The whole idea is to be proactive instead of being reactive, when it comes to designing future cities for a better quality of life, and to prepare ourselves for a long term, sustainable, balanced and better approach to urban development. This paper is a humble endeavor, towards identifying a set of indicators to measure integrated urban sustainability, along with problem-solution approach to focus-sustainability indicators. It also attempts to test the practicability ground of these indicators, in the light of integrated townships as a means for sustainable urban development.

Objectives: Nations are now more serious and conscious about the repercussions and negative externalities associated with the reckless urban growth patterns which may lead to effects beyond recall, and they are resorting to more planned and sustainable measures, policies and practices for development. Integrated townships can be one of the means and experiment grounds, to put to use these sustainability indicators. The objective of this paper is to check the correlation between urban sustainability and integrated townships as a means to achieve the same.

Primary Results: Considering case of integrated township, it is observed that through these townships, achieving a larger goal of urban sustainability becomes more viable and simple. The Municipal corporations need to be facilitators to allow this public private partnership, work in favor of urban sustainability.

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D3-PVI-A-**5**

City Biodiversity Index for an Indian City – a Case Study

Madav Ramesh[1], Yashada Kulkarni*[1], Surabhi Mehrotra[1]

The city biodiversity index, a tool developed by the National Parks' Board of Singapore for the Convention on Biological Diversity, was used to access the biodiversity of the Indian city of Mira Bhayandar, a satellite city of Mumbai. Experiences and relevant findings of this exercise, which was conducted for the first time for an Indian city, are discussed. Results obtained from the City Index are interpreted and suggestions are listed. Feasibility of reproducing this exercise for other Indian cities is discussed.

The City Biodiversity Index consists of three components – Native Biodiversity, Ecosystem Services and Governance and Management. Each component has a set of indicators that measures various aspects of a city's biodiversity. Methods to calculate each indicator include gathering data from studying secondary sources of information such as government records, nature groups, publications and such others.

Our study showed that Mira Bhayandar is well endowed with stretches of natural areas and thus scored well in the first component of the Index. Scoring system for the second component is yet to be finalized by the organizing authority. The third component which pertains to administration and management of biodiversity of the city shows that there is scope for improvement for better biodiversity management. Thus, the city index of Mira Bhayandar showed that natural areas with biodiversity exist in the City but greater involvement of the administration is required in biodiversity matters. A Local Biodiversity Strategy and Action Plan for Mira Bhayandar in line with the National Biodiversity Action Plan can be formulated. The third component highlighted the need for better dialogue between agencies handling biodiversity.

Easy availability of secondary data is a pre-requisite for accurate and timely calculation of this Index. Feasibility of conducting this exercise for other Indian cities is checked keeping the pre-requisites in mind. Here we assert the importance of open source data and public groups present in most large Indian cities in maintaining biodiversity checklists and their indispensability in maintaining up to date records. As digitized landuse maps of most Indian Metros are available, it is possible to calculate those indicators that rely on spatial analyses. An analysis of the presence of such data for major Indian metros leads us to postulate that Indian cities have matured to undergo the process of calculating their city biodiversity index.

[1] Terracon Ecotech Pvt. Ltd.

D3-PVI-A-**6**

Assessment of Urban Sustainability index- A Case Study of Mumbai

Trupti Mishra*[1]

The development of an Economy is closely linked to industrialization and urbanization. Cities are at the forefront of global socio-economic change. Half of the world's population now lives in urban areas and the other half increasingly depend upon cities for economic, social, cultural and political progress. Cities are hubs of production, consumption, and waste generation. With the growth of city, the ecological footprints also increase as the pressure on natural resources to meet the rising demand for basic amenities.

India's urban population in 2010 was 356.38 million which is projected to be approximately 590 million by 2030, an increase of nearly 66%. The side effect of urbanization on communities is from air quality, water resources, sanitation, loss of bio diversity and waste. On the other hand the issue of urbanization and urban mobility is central to India's sustainable development agenda. In this background the emerging challenge for the policy makers is how to ensure rapid urbanization does not hinder the achievement of the sustainable goals.

This present paper focuses on constructing an Urban Sustainability Index (USI) for the city of Mumbai in order to assess the sustainability of the city on the basis of performances on key environmental indicators.USI would help in measuring the potential of city to maintain their environment in the coming decades given the various environmental resources that a city is endowed with. Dimensions of sustainability both as historical conditions and present efforts are mapped through 5 key indicators and USI would be in constructed as a composite index from these indicators. It would be an equally weighted average of five indicators: Air Quality, Water quality and Supply, Sewage and sanitation, Waste, Loss of Biodiversity.

As USI measures the sustainability performance of city, the outcome of the study would help the policy makers, regulators in evaluating the impacts, pressure on environmental resources and societal and government response for conservation and reduction of pressure on the eco system.

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D3-PVI-B-**1**

The Economics of Ecosystems and Diversity for Local and Regional Policy Making

Haripriya Gundimeda[1]

Human well-being is based on a healthy, functioning environment and we depend on nature for our well-being both directly and indirectly. The ecosystem services are poorly visible, provide benefits to everyone and their continuous availability is falsely assumed. Hence, when it comes to planning for development, other more visible aspects of development seem more pressing and decisions are often taken against ecosystems with little knowledge of the consequences. Given that ecosystems having their tipping points, restoration or alternative solutions to ecosystem services may not be possible after the system 'flips' and where possible require considerable amount of time and resources. The study "The economics of ecosystems and biodiversity" by UNEP highlights the enormous potential for securing and enhancing human well-being by taking nature's benefits into account for international, national, local, regional policy makers and for businesses and citizens.

The study "TEEB for local and regional policy" suggests a shift in focus. Economic analysis indicates that maintaining healthy ecosystems is often a better, less expensive, option. Appraising ecosystem services provides a full picture, outlining the costs and benefits of different policy options and highlighting the best local strategy for enhancing human well-being and economic sustainability. Considering the value of nature in local policy making can help save on future municipal costs, boost local economies, enhance quality of life and secure livelihoods. The approach also helps tackle poverty as it discloses the distribution of scarce and essential resources and services upon which people depend. The study show-cases how decision makers can promote local development by explicitly considering nature and the services it provides for human well-being. The study also explores how biodiversity and ecosystems are impacted by climate change and how a resilient environment can help mitigate the impacts or adapt to them

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D3-PVI-B-**2**

Preference Heterogeneity and Willingness to Pay for Native Tree Species in an Urban Park

Kentaro Yoshida*[1], Tomoki Nakanishi[2], Asami Nishiura[1]

Parks are important for the conservation of biodiversity and ecosystem services in urban areas. Usually, the tree species planted in the parks are likely to be chosen in terms of landscapes and ease of park management. MOEJ enforced Alien Species Act in 2005.Although the act targets mainly at prevention of invasive alien animals, after enforcement of the act even planting trees and glasses in the parks and along the road side are thought to be invasive. Gardening companies started to consider planting native tree species instead of alien or introduced species from different areas of Japan. Several cities started to introduce native tree species for park design. However, planting trees, flowers, and glasses have a long history of using imported and improved varieties. If people have a strong preference for non-native species, it would be difficult to plant native species. In order to implement the native-species–based park design, it is required to demonstrate that the value of native speciesis higher than that of non-native species.

This study examined the benefits of park design allocating the green space including native species area using choice experiments. In order to elicit preferences for native tree species, we conducted a questionnaire survey of residents living within a walking distance to Negishi Forest Park in Yokohama City. Several green spaces in the park were classified into lawns for recreation, forests for recreation and relaxation, and forests for wildlife conservation. These attributes were presented to respondents with graphical and text information as a choice set. The attributes of a hypothetical local green space conservation tax and a percentage of native trees within the forest area were presented with text information. The local tax was hypothetical one but the City of Yokohama has implemented Yokohama Green Tax since 2009. The hypothetical tax scenario used in the questionnaire was adequately realistic and well-known to the residents of Yokohama.

We applied two analytical methods, a mixed logit and latent class logit model, to incorporate preference heterogeneity in estimating the economic value of native tree species as well as a conditional logit model. In comparison with conditional and mixed logit estimates, both use and nonuse natures of green spaces were reflected more precisely on the parameter estimates of three latent segments. It was demonstrated that the latent class logit model could reveal the preference heterogeneity of respondents in their park use. As a result of latent class estimation, for those who frequently visit the park for recreation, the value of native tree species was not significantly important. On the other hand, those who concerned ecosystem conservation and had non-use value to the urban forest park were likely to value native species.

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D3-PVI-B-**3**

Valuing the Environment in Developing Countries: Modeling the Impact of Distrust in Public Authorities' Ability to Deliver Public Services on the Citizens' Willingness to Pay for Improved Environmental Quality

Ekin Birol[1], Sukanya Das*[2]

In this paper, we employ the choice experiment method to estimate citizens' valuation of an intervention that proposes to improve the quality of the wastewater deposited in the Ganges River, India. We interviewed 150 randomly selected citizens of Chandernagore, along the banks of the Ganges River, to elicit their willingness to pay (WTP) for this intervention, measured in terms of higher municipality taxes. The findings reveal that almost all of the citizens value wastewater quality, though majority protested the intervention, and stated that they do not trust the authorities for effective management of funds generated through additional taxes. To account for the high percentage of no intervention (status quo), the nested logit model(NLM) was used to analyze the data.The citizens first decide whether to choose an improved wastewater treatment program or to stay with the current STP (status quo); and then if they choose the improved program, they make a choice between the two different improved programs.

To better understand the citizens' choice of participation, we included some household-level characteristics in the branch choice equation. These characteristics are household size, share of food expenditure in total expenditure, and whether or not the household head has a university degree. The results reveal that those households who spend greater proportions of their total expenditure (as a proxy for income) on food are less likely to choose the improvement programs. On the other hand, citizens from larger households, which are likely to include children, as well as those from households with educated heads with university degrees and above are more likely to choose the improvement programs. The estimated WTP values for the NLM indicate that an average household values the improvement in water quality the most and is willing to pay Rs 8.6 more in monthly municipal taxes to ensure that the wastewater is treated with secondary treatment and the quality of the water discharged to the river is high. The citizens, however, derive negative values from investment in the regeneration of the park, given that they are already satisfied with the present facilities (status quo) provided. The significant discrepancy of WTP values across the two models reveals the importance of capturing the two-stage decision-making process that is modeled in the NLM.

Municipalities could rely to some extent on their citizens' WTP higher taxes but municipalities' performance, trustworthiness, accountability, as well as the citizens' perceptions of these, should be improved.

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D3-PVI-B-**4**

Economic Values of Improved Conservation of Wetland Attributes: A Discrete Choice Experiment of Urban Stakeholders of Kol Wetlands in India

Binilkumar Amarayil Sreeraman*[1], Ekin Birol [2], Ramanathan Ananthakrishnan [3]

Wetlands are one of the most important natural ecosystems, which help to sustain human life and
livelihoods by providing a diverse array of goods and services. Urban wetlands and the wetlands located in peri-urban areas offer a number of indirect/functional benefits. These include the provision of economic goods such as drinking water and ecological services such as natural waste water disposal. However, due to (i) the increasing pressure on land, as a result of growth of population and (ii) the unsustainable development pursuits followed by people, wetlands, world over (particularly, in countries like India), are facing severe degradation. Invariably, the role of public administration and policy makers has become very crucial in reversing the said unfavourable trend in the progress of nations and civilizations. One of the prime aspects, as far as wetland conservation is concerned, is the issue regarding the precise economic valuation of its services. The economic benefits generated by wetlands are often unaccounted for or undervalued in conventional cost-benefit analysis of projects and policies. The case presented in this study as an example for peri-urban wetlands is Kol wetland, located in Kerala, India. This wetland is a part of the largest Ramsar site in India known as Vembanad-Kol wetland. It simultaneously provides ecological as well as recreational benefits for the urban society and ensures the livelihood options for thousands of peri-urban and rural households who rely on irrigated farming (especially rice) and fishing for their livelihoods. In this study we employ a discrete choice experiment to identify the preferences of the urban stakeholders regarding the important attributes of the wetland and estimate the economic values of improving these attributes. Conditional and random parameter logit models with interactions are estimated to identify the heterogeneity exists among the urban stakeholders' preferences for the improvement in the select wetland attributes The findings reveal that there exists considerable heterogeneity across and within each one of the stakeholder groups' preferences. On average however they derive positive and significant values from the improved conservation and management of this wetland.

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[2] International Food Policy Research Institute, Washington DC, USA
[3] Indian Institute of Technology Bombay, India

D3-PVI- B-**5**

Mainstreaming Biodiversity Conservation and Ecosystem Services into Local Development Framework in Developing Countries: a Case Study of eThekwini Municipality (Durban)

Wanyu Shih*[1], Jose Oliveira[1]

This study explores effective political and institutional mechanisms that help mainstream biodiversity and ecosystem service (BES) conservation into local development process in developing countries. BES mainstreaming in developing countries is often complicated by their socio-economic unrest. The imperative socio-economic growth tends to override the call for environmental protection. The case study of the eThekwini Municipality (Durban) in South Africa shows that internalising BES into existing planning systems is a potential strategy for coordinating brown agenda (development) and green agenda (conservation) in an earlier stage of decision making. Both conservation and development decisions can be more rigorously discussed, if associated mechanisms for institutional, financial and implementation support is provided. This study summarises important lessons learnt from the municipality as follows:

1. Facilitate vertical and horizontal interplay via Integrated Land-use Plan. The BES conservation can influence overall planning systems in a consistent manner, from decision making levels to implementation levels, by preparing an Integrated Land Use Plan that provides comprehensive view for balancing development and conservation. The vertical mainstreaming can be achieved in a hierarchical planning system with a short review circle, which enables new BES considerations to be frequently updated. The horizontal mainstreaming can be facilitated by specifying how BES and sectors interrelate to one another and how conflicts can be avoided in each sectoral plan with cross-sectoral meetings and consultancy.
2. Optimise open space system as a conservation approach. Spatial planning is a tangible tool to systematically materialise BES conservation by managing land use activities in a city. For the conservation of ecologically valuable green spaces to be more defensible, identifying un-developable green areas with scientific reasons is important. Alternative solutions might be prepared in order to reconcile differing targets of local development.
3. Associate BES conservation with socio-economic uplift. For BES conservation to be more acceptable and justifiable in local development, green agenda should not go opposite to brown agenda and vice versa. Associating BES conservation to poverty reduction is one of the critical strategies. The Community Based Conservation that encourages local people working for nature and improves their livelihood is a win-win strategy in this regard.
4. Develop low cost tools for long-term implementation. The annual budget from government is often insufficient to sustain continuous works on BES conservation. Developing low-cost manners for sharing environmental stewardship with local people and receiving ecological compensation from development beneficiaries can release financial tensions from governments.

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Although some challenges remain to be improved, we believe that BES conservation can be better mainstreamed in cities of developing countries by addressing the abovementioned strategies in the process of development.

D3-PVI-C-**1**

Infrastructure Based Community Resiliency and Its Role in Urban Growth Management

Sameer Deshkar*[1], Vinayak Adane[1]

As India is becoming more and more globalized and urban, there is also an alarming increase in the urban catastrophes. These increasing trends of urban disasters have necessitated an integrated approach in the urban planning practices for achieving resilient urban developments. It is widely understood that such resilient developments largely depend upon the robustness of critical urban infrastructures and the socio-economic resilience of communities. The role of green infrastructures and biodiversity in urban risk resiliency has also been acknowledged through several studies. However, the serious gaps in infrastructure delivery mechanisms limit the effectiveness of mitigation measures in urban centers. In case of the green infrastructures, the delivery becomes even more difficult as there is an immense pressure on land and natural resources for development. Secondly, land use and urban fabric influence the nature and access to infrastructure services to a great extent. Accessibility to and availability of these lifeline services, therefore, needs to be planned taking into account the local characteristics and integrated in the overall urban growth management targeted towards achieving resiliency.

An evaluation framework for infrastructure based community resiliency has been proposed by S. Deshkar et al., (2011). It takes into account the blue (water supply), grey (drainage and sanitation) and green (open spaces) infrastructures together with key land use components for risk resiliency. The proposed framework can be used to prioritize areas in a city for implementing the resiliency measures. Secondly, when overlapped with other parameters of urban growth it can hint at an appropriate composition of a resilient urban development.

The above evaluation framework was applied to the city of Nagpur. It is best known as second green city of India and also holds administrative significance as the winter capital of Maharashtra state. However, currently is poised at a massive urban expansion to be catalyzed by the largest SEZ development in India.

The analysis shows that the settlements in city periphery, which is dominated by natural areas as well as those in the city core with no significant open green spaces both, have less resiliency levels. The peripheral regions lack basic infrastructure services while the core areas have inadequate supply of services due to high population density and aged infrastructures. However, the green and natural areas in periphery compensate the non-availability of municipal services and enhance the preparedness of local community to some extent. The intermittent zones show variations in their resiliency levels. But again those towards the western belt of natural areas show a higher resiliency. These areas have higher tree canopy cover and at the same time lesser population density. Hence, for a resilient development, population density, physical as well as green infrastructures become the pivotal components.

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D3-PVI-C -**2**

A Case Study of an Ecological Network Design in the Prefecture of Osaka, Focusing on the Concept of Rain Garden

Akihide Ano*[1], Sasaki Takeshi[1], Morimoto Yukihiro[2]

Intensive studies have been conducted to reveal the reality of biodiversity in city areas in Japan, so far. Urban biodiversity is not only important in terms of wildlife conservation, as it also has a relevant influence on the ecosystem services. Especially we refer to those ones that directly affect to the people, through cultural and regulating services such as in water control, climate regulation, recreation and aesthetics experiences.

The concept of the rain garden is a relatively new idea that was initially developed in North America. The rain garden is a vegetated space designed instead of the impervious surfaces. It is expected to reduce the risk of inland flood and to contribute water purification.. It is also expected to perform as the original habitat, which nurture indigenous species. The development of adequate design of the rain gardens in a city seems to be very important to maintain the wildlife diversity and urban ecological services, as explained, in order to be accepted by the citizens.

Although a rain garden can play an important role for the wildlife habitats and ecosystem services as mentioned above, very few studies have approached to the landscape–scale evaluation in city areas, under this concept. Therefore we organized a “rain garden project team” together with the students of Kyoto Gakuen University, and designed the ecological network in the cities of Moriguchi and Kadoma, in the Japanese prefecture of Osaka. Originally this area was covered by wetland, being later fully urbanized by houses, factories, paved roads and commercial facilities. Among eighty-four extinct plants in Osaka prefecture, more than half of them resulted to be wetland species. Because there is a special concern by the politicians and private sectors to conserve this local biodiversity, we expect that is now the time to consider a sustainable oriented design that at the same time, reduces the flooding risk while contributes to the biodiversity. We performed a biodiversity oriented rain garden simulation to change the inorganic built-up areas with affordable ways.. We also evaluated the rain garden scenario from the view point of the ecological network as for wetlands and reduction of the risk of inland flood.

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[2] Kyoto Gakuen University, Japan

D3-PVI-C -**3**

Role of Green Infrastructure for Climate Change Resilient Cities - A Case Study of Pune

Bhaskar Padigala*[1], Acharya Shrawan Kumar[1]

Green infrastructure (urban green spaces) is amongst the most significant elements of any urban landscape, both due to biomass and diversity. Their key role in climate change mitigation and ecosystem dynamics is well known. However, it is ironic that the vegetation has undergone destruction and degradation in the modern times due to rapid and haphazard urbanization in developing countries. This trend of rapid urban growth at the cost of decline in green spaces is making cities a major source of GHG emissions and at the same time making them more vulnerable to climate change impacts.

This objective of the study was to explore ecological conservation values of green spaces in an urban ecosystem. The study constitutes a geospatial approach to assess green cover changes, standing biomass, carbon sequestration potential of urban green infrastructure in Pune city.

The paper has been divided into two parts, first part deals with changes with urban Land Use / Land Cover Changes (especially UGI) using remote sensing technique. For this purpose Landsat ETM+ images of 1999 and 2010 was obtained for the study area. Using bands 1-5 and 7 of the pre-processed images the land use / cover pattern was mapped by supervised classification with the maximum likelihood classification algorithm. Five classes considered for the study are built-up land, barren & fallow land, water bodies, sparse & dense vegetation. Second part deals with estimation of carbon sequestration potential of urban green infrastructure for year 2010 in Pune using the light use efficiency (LUE) model.

Results showed that Pune's built up area has increased from 30.86% in 1999 to 49.80% in 2010, whereas barren & fallow land area has decreased considerably from 36.20% in 1999 to 21.11% in 2010. A total of 9.41 sq km. of combined vegetated (sparse and dense) area has been lost between 1999 and 2010.

The total estimated above ground phytomass for pune was found out to be 238643 tC yr^{-1}, i.e. average 34.99 tC ha^{-1} yr^{-1}, and the resultant total carbon dioxide equivalent sequestered annually, and was found out to be 0.87 million tCO_{2eq} yr^{-1} which indicates very good rate of carbon stocking and correspondingly highlights the significance of urban green infrastructure in planning for climate change resilient cities.

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D3-PVI-C -**4**

Corporate sustainability Practices- What do Stakeholder Expect ? (An assessment of stakeholders' expectations)

Prasad Satya Venkat*[1] and Sandhya Sri[2]

Introduction and Background:

Corporate sustainable responsibility is one of the environmental issues that has increasingly attracted corporate attention in the recent years including in India, when a range of stakeholders, including governments, started paying more attention to the potentially very serious consequences, and to the need to take action. Companies around the globe have developed different strategies to deal with environmental governance in the recent past. Since 1995, companies' political positions have gradually changed from opposition to climate measures to a more proactive approach or a ''wait-and-see'' attitude, and many have started to take market steps to be prepared to deal with regulation, or to go beyond that, considering risks and opportunities. Some companies apparently rely on the course set by their national governments following the adoption of the Kyoto protocol, and wait until the actual implementation of climate policy before they take action.

Design/Approach/Methodology:

Sample of 1200 stakeholders taken to test 15 hypnoses designed to test expectations of stakeholders from Indian corporate sector. First discussed influence of share holders, NGOs, suppliers, stock brokers, academicians, followed by Financial Institutions & banks, employees & customers, & finally competitors, research analysts & public on sensitiveness of Indian companies towards sustainable practices adoption.

Results and Discussion:

The results are reported in Table 2, in which 79.88 per cent of the respondents believed that manufacturing companies are more likely to set targets for green house gas emission as a practice of integrated sustainable development. Of the total shareholders who responded, 81.03 per cent responded positively in favour of first hypothesis. Similarly academics and banks & FII have viewed the same, while 96 per cent of the research analyst also responded in the affirmative.

In respect of other hypothesis, the responses of the respondents varies between 79 per cent to 94 per cent (Table 7 to Table 12) which shows that the there is a great demand for better and efficient sustainable management by Indian Corporates. Highest response was given for the last hypothesis, where share holders along with other respondents responded which shows 97 per cent (Table 12). Lowest response was given to 8th hypothesis, where share holders along with other respondents like NGOs, employees and public responded at 75 per cent out of total respondents (Table 9). For the hypotheses 6 to 11 chi square test shows that there is no

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statistically different between the respondents (0.0454 $p < 0.05$, 0.278 $p < 0.05$, 0.002874 $p < 0.05$, 8.85 $p < 0.05$, 0.00105 < 0.05, 1.105 < 0.05 respectively).

Management Implications:

This paper has examined different perceptions on corporate response to sustainability and their disclosures. It aimed to capture this concept by showing how sustainable development strategies at different organizational levels can be linked to the societal and competitive contexts that companies face, embedded in a stakeholder view as part of sustainable development. Sustainable governance is currently a prominent example of broad environmental issue that primarily has a bearing on business through stakeholders who are trying to influence corporate objectives. Findings may influence the corporates to initiate their first step to showcase their responsibility towards sustainable development of the society which is the need of the hour.

D3-PVI-C -**5**

Corporate Ecological Intelligence: An Analysis of Indian Companies

B. Sandhya Sri*[1], Prasad Satya Venkat[2]

Purpose : A Significant amount of literature has established ecological obligation as a key organizational issues in developing countries too in recent times . Similarly, there is now also a growing body of literature that discusses the triple bottom line concept, which force the companies to address not only the financial and economic but also social and ecological of performance to recognize their interdependence, and to integrate them into the report process. The literature has promoted the supposition that corporate ecological intelligence practices are key corporate commitments now a days which concur with these corporate social accountability (O'Dwyer, 2005).

Design/Methodology/Approach: This research begins with designing two hypotheses and based on which two models are proposed. Variables concerning internal ecological accounting procedures are considered as independent variables and the score of the company on its ecological intelligence is considered as the dependent variable. Stepwise regression is applied to test the above two models of ecologically intelligence and non ecological intelligence to explore and establish ecological intelligence of select companies.

For the purpose of selecting corporate ecological intelligence firms, this study has identified 130 companies trading on Bombay Stock Exchange and National Stock Exchange (representing companies from different industry groups) whose operation are environmentally sensitive as grouped by the Pollution Control Board of India.

Data for this study is collected through a mailed questionnaire posted to the Chief of Accounting and Finance Departments of 130 Indian Companies listed on BSE & NSE companies during the period October 2009. In total, survey instruments are posted to 130 companies of which 91 responses are returned. Ecologically intelligent sample included 14 companies from fertilizers, 15 from Chemical, 10 from petrochemicals, 12 from pharmaceutical companies, 8 companies from steel and iron manufacturing. These companies are considered as the most sensitive towards environmental issues.

Findings : *chi-square* test portrays adoption of ecological accounting procedures is significantly higher for companies classified as operating in ecologically intelligent industry groups. Stepwise regression justified the two hypotheses and show the effectiveness of the model proposed by establishing greater number of companies in ecologically intelligent reported ecological information through annual reports. This paper examines ecological intelligence of the Industry as a factor associated with the adoption of ecological accounting and control procedures. It is established in conclusion, that 'ecologically intelligent' firms are more likely to adopt ecological accounting procedures is only supported for activities that are associated with significant ecological-related issues for the specific industries. Hence, this

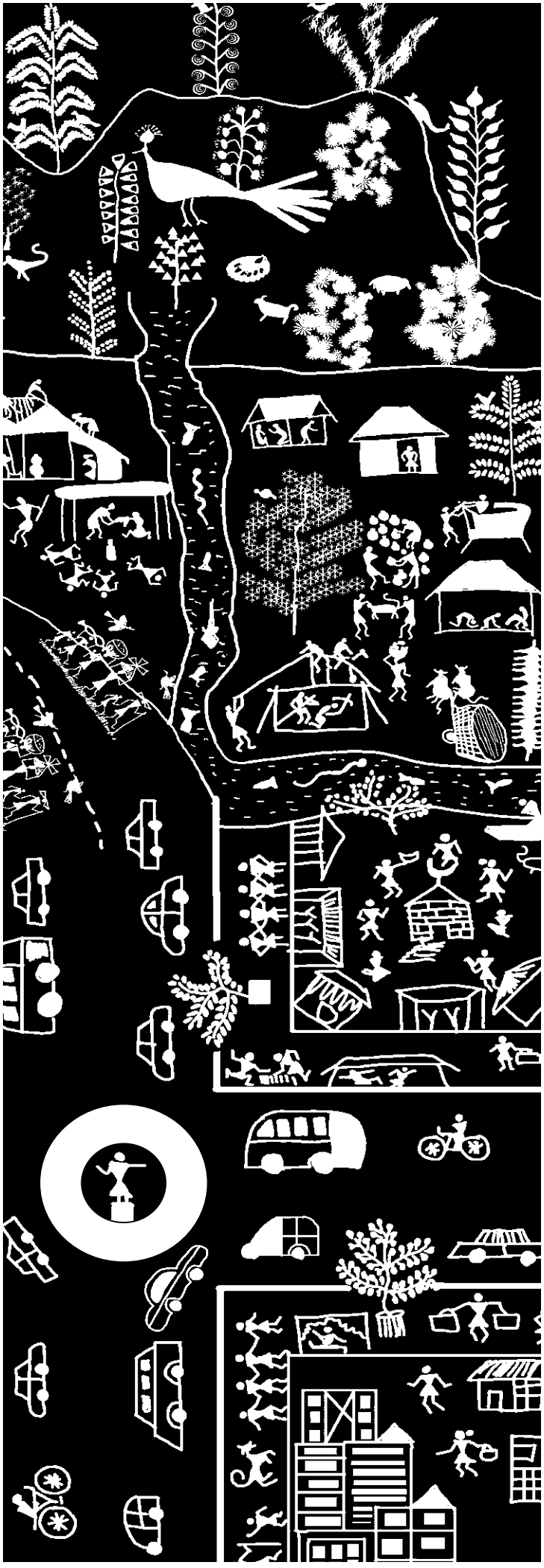
[1] Avn College, India

[2] Gitam University, India

study provides conclusive evidence that the ecological-intelligence of the firm's operations will necessarily result in increased likelihood of the development of ecological accounting procedures. The results of this study highlight a concern as firms move toward triple bottom line reporting and raise challenges as how will the traditional accounting information system be adapted to meet the change in the nature of the reporting framework that will be required, and how readily can the culture of the organisation assimilate the change.

PRESENTATION:

POSTER



P-**1**

Environmental Implications of 'Sand Reefs', at western coast of Maharashtra

Siddharth Biniwale[1]*

Numerous hummocky patches of living sand reefs made by tiny marine bristle Polychaete worms of the family *Sabellariidae* were discovered along Ratnagiri coast. Outstanding examples of this type of reefs are found at Harne-murud, Guhagar and Velneshwar shores. These reefs are located in shallow intertidal zone and are generally exposed at low tide. This study provides detailed information on producer, habitat, associated fauna and environment of coast builders for the first time from the west coast of Maharashtra.

Based on Field surveys and Laboratory processes provided details of interrelated biota of these micro-habitats.

Field surveys: Seasonal field surveys were carried out on all selected locations i.e. Harne-murud, Guhagar and Velneshwar shores.

Laboratory processes:
Samples were cased in clear cast polyester resin and various sections were examined.
Sieving experiments were performed on samples and micro-fauna were plotted on slides.

Observations and Conclusions:

Every field survey proved to be an exciting encounter with various creatures. Algae, crabs, and sea anemone were permanent members on sand reef mounds. Though number of their burrows and individuals vary with seasons their presence on sand reef mounds is everlasting. Algae even play a better role, by using these mounds as substrates and covering the surface of mound, it actually creates protecting layer on reefs. Sometimes the vacant crevices created by burrowing animals are letter occupied by sae-grasses. At low tides sand reef beholds as temporary shelter for various fishes, even sea snakes at times. This condition is well sensed by their predators and some like Kingfishers, Brahmini Kites, and White bellied sea eagle use sand reef mounds as hunting grounds. Others like sea slug, scorpion fish, some bivalves, are regular dweller members in these reefs. Often barnacles choose sand reefs as substrates and settles on reef mounds. All the activities of these creatures vary gradually according to the seasons, with respect to the stages in life cycles of particular species. But their interdependency on sand reefs is eternal.

P-**2**

[1] Foundation Ecological Security (FES), India

Ask The Stakeholders To Valuate And Make The Polluters Pay? Conceptualising Fishery Management Strategies – The Case of the Lakes of Kashmir

Neha Qureshi*[1], Mohan Krishnan[1]

Dal and Wular lakes are the pride of the Kashmir valley. Of late, both have suffered serious ecosystem damages aesthetically and consequently, economically. The rate of decline of the ecosystem is increasing at an increasing rate. These lakes are used for major economic activities relating to tourism, site seeing, recreational activities, fisheries, harvesting of food and fodder plants, irrigation of vegetable fields which have grown in number and extent during these years and is a natural receptacle for run-off from its catchments areas as the lake is surrounded by mountains on its three sides.

Nutrient leaching from vegetable production in floating gardens, discharges from revenue villages of human settlements within the lakes and from residents of houseboats have led to severe pollution of the lakes have adversely affected the eco-system, aesthetics and caused economic as well as welfare losses.

The objective here is an effort by the authors to seek 'directions' for attempting a improvement of the first author's masters dissertation work (Qureshi, 2013) where she is currently addressing multiple stakeholders' responses to fish production in major lakes of Kashmir through Contingent Valuation or Willingness to Pay technique.

Among several authors who have evaluated willingness to pay, Sivasakthi et al. (2010) have used a modified Tobit model to evaluate impact of water pollution caused by textile dyeing industries across highly, moderately and less affected farms in Karur district of Tamil Nadu. They have elicited the responses of the farmers in respect of their willingness to pay for internalizing the pollution effects. They have acknowledged that the WTP of the adversely affected stakeholders have been evaluated though it is polluters who should actually be paying.

Qureshi (2013) is an improvement of this work in the sense that not only one set of stakeholders (like farmers in Sivasakthi et al, 2010), but multiple stakeholders in fisheries like licensed fishers, retailers, wholesalers, consumers are being asked their WTP to internalize the pollution of the lakes of Kashmir.

As a next step in a variation or improvement of Qureshi (2013), we seek is to attempt asking the same set of multiple stakeholders in fisheries of lakes of Kashmir, to rank the list of actual polluters either in ascending or descending order and to ask what amount each of these polluters must pay by way of taxes to neutralize the pollution in the lakes.

We assume the budgeted expenditure for pollution alleviation in the current plan period of the Government of Jammu and Kashmir will be the benchmark amount. The output of this improvement of Qureshi (2013) will enable us to arrive at the sum the stakeholders desire the actual polluters should pay which is expected to be multiple times more than what the stakeholders themselves would be willing to pay. The outcome of this study would be a

[1] CIFE, India

perspective which would help the policy makers to clearly develop a progressive form of use taxes and non use exceptions for the lakes of Kashmir. It would also be based on polluters pay principle and could directly reduce the tax burden on the stakeholders of the lakes. It would lead to an improvement in fish production in the lakes of Kashmir if implemented.

Therefore we seek the following clarifications

1. Is our theoretical conceptualization of the variation of Qureshi (2013) in order?

2. What CV model modifications in its Probit or Tobit form should be anticipated?

3. Are we on track in respect of the output and outcome of this planned study?

References

1. Devi Sivasakthi, T., C.Ramaswamy and S.Gurunathan (2010) Farmers willingness to pay to avert the negative externalities of pollution of dyeing industry in Tamil Nadu, Agricultural Economics Research Review, 23 (July-December): 245-252

2. Qureshi, Neha Wajahat (2013) Contingent valuation of multiple stakeholders responses to fish production in major lakes of Kashmir, Fisheries Economics, Extension and Statistics Division, Central Institute of Fisheries Education, Mumbai – 400061 (M.F.Sc. in Fisheries Economics - Work in progress).

P-**3**

Population trends of breeding land birds in Nagoya City, Japan for 25 years

Hiroshi Hashimoto*[1], Rina Takei[1], Teruaki Hino[1]

Urbanization and urban growth alter landscapes, and reduce area and quality of habitats for wildlife. For example, woods were fragmented, isolated and reduced by the urbanization, and agricultural lands in the urban fringe altered to housing or industrial sites by the urban development. Nagoya City, located in the central Japan, is a 400 years old city. However, urban growth, reduction of natural areas especially decrease of agricultural land by the urban development in the urban fringe is still in progress.

Bird census in major ca. 50 habitats in the city has been done every five years from 1974 by the City of Nagoya. We analyzed the population trends of breeding bird in Nagoya City using these census reports from 1985 to 2008. We picked up land birds species breeding in parks and woods of Nagoya City, and calculated the population trends of each species using by the computer program TRIM (Trend and Indices for Monitoring data) developed by Statistics Netherlands. TRIM is a freeware program developed for the analysis of wildlife monitoring count data. This program can analyze time-series of counts with missing observations. Long-term population trends were determined from multiplicative trends, which reflect the average percentage change per year. TRIM classifies trend estimates to six categories by the average percentage change per year and the 95% confidence interval of a trend estimate; steep decline (more than -5%), moderate decline (less than -5%), stable, moderate increase (less than +5%), strong increase (more than +5%), and uncertain. According to the results of analysis by TRIM, 3 species (Japanese Pygmy Woodpecker Dendrocopos kizuki, Narcissus Flycatcher Ficedula narcissina, Jungle Crow Corvus macrorhynchos) showed strong population increase, 6 species (White Wagtail Motacilla alba, Varied Tit Parus varius, Great Tit P. major, Japanese White-eye Zosterops japonicus, Carrion Crow C. corone) showed moderate population increase, and 4 species (Black Kite Milvus migrans, Japanese Wagtail M. grandis, Bull-headed Shrike Lanius bucephalus, Long-tailed Tot Aegithalos caudatus) showed moderate population decline in Nagoya City.

The populations of hole-nesting birds, such as Japanese Pygmy Woodpecker, Narcissus Flycatcher, Varied Tit and Great Tit, were increasing. This may be caused by growth of trees in the urban area that were planted mostly after World War II, and in abandoned coppice woods. Populations of two crows were also increased. These crows forage garbage in the city. The breeding range of White wagtail is expanding to the southward in Japan in these decades, and this species started breeding in Nagoya City from 1980s and increased rapidly especially in urban areas. On the other hand, the population of Japanese Wagtail was declined in Nagoya City though the numbers of observed sites was stable. The population of Long-tailed Tit declined though populations of the bird species that prefer similar types of forest such as tits and Japanese White-eye were increased. Decline of Bull-headed Shrike population may caused by decrease of farm land.

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P-**4**

Study of Biodiversity of Medicinal Plants at Malabar Hill, Mumbai

Tushar S. Kelkar*[1], Satish A. Bhalerao[1]

India is the second largest biodiversity in the world and vegetation biodiversity of our country is estimated to about 1,25,000 species including Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. In Maharashtra, the number is around 5050 species of flowering plants and out of this number about 1,500 have been identified as medicinal plants. The role of medicinal plants in human life is very important. We have rich systems of medicines in Ayurveda, Siddha, Yunani and Homeopathy. In Ayurveda there are about 600 medicinal plants mentioned for treatments of different diseases. Malabar hill is most upwardly mobile and posh residential area in southern part of Mumbai which is situated in the south of Cumballa Hill. Malabar hill is the highest point in downtown Mumbai with the elevation of 50 mts, offering a stunning view of the city that spreads out at its foothill. Some of the well known points are Raj Bhavan, Adinath Jain Temple, Walkeshwar and Banganga tank.

Main objective of present investigation was to survey the medicinal plants growing at Malabar Hill and to provide first hand information of medicinal plants with reference to their morphology, botanical names, medicinal properties etc. For the fulfilling of the objectives, several visits were given in different seasons; plants were collected and identified on the basis of morphology and with the help of Blatter Herbaria. During the investigation 126 plant species belonging to 53 angiospermic families and 1 fern were reported based on their abundance in different seasons.

P-**5**

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Genetic Effects of Habitat Fragmentation on Herbaceous Plants in Urban Areas: Case Study on Viola grypoceras A. Gray var. grypoceras in Kyoto City, Japan

Yuichi Toma*[1], Junichi Imanishi[2], Hiroshi Hashimoto[3], Masashi Yokogawa[4], Ayumi Imanishi[2], Yukihiro Morimoto[2], Yuki Hatanaka[4], Yuji Isagi[4], Shozo Shibata[2]

These days, biodiversity in cities attracts attention, and it is said that building ecological network, or connecting green space is necessary to conserve biodiversity. For one reason, it is generally thought that genetic diversity in plants declines if their habitats are fragmentated. Plant species in fragmentated areas may experience their reduced habitat and population size as well as potential disturbances in pollinator service and seed dispersal. Over time, this can lead to increased inbreeding, lower reproductive success, and disrupted gene flow. As a result, isolated plant populations can experience loss of genetic variation, increased population differentation and genetic drift. Over the long term, fragmentation will reduce the ability to adapt to changing environments, and then increase local extinction events. However, genetic effects of fragmentation in plants are complicated, and have remained relatively unexplored in urban areas. Therefore, it is important to evaluate genetic status in urban green space to conserve ecosystem.

We studied relationship between present and past landscape structure of green space and genetic structure of Viola *grypoceras* in Kyoto City. Viola *grypoceras* is suitable for studying the effect of fragmentation because it lives in both urban and mountainous areas, and is dependent upon ants for seed dispersal, which means that the moving distance of seeds is not long, and impact of fragmentation will be large. Kyoto City has long history of forest fragmentation, and there are many kinds of green spaces. In addition, we can obtain many old maps. The goal is to determine characteristics of green space that has high genetic diversity in Viola *grypoceras*, and contribute to developing city plan that takes into account ecosystem conservation. First, we imported land-use maps in Kyoto City after Edo Era and an ASTER satellite image into ArcGIS (ESRI) to extract green spaces. Second, we studied distribution of Viola *grypoceras* in isolated green spaces such as temples, shrines, gardens and parks, and unfragmentated green spaces such as mountains. In the study sites, we recorded the number of individuals, percentage of normal flowers, cover types and light condition by taking hemispherical photographs. Third, we took samples of viola leaves, and determined genetic structure. Finally, we constructed a model to explain variability of gene diversity in *Viola grypoceras* in urban green spaces.

P-**6**

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Research on the Environmental Design for Children's natural experience

Chihiro Takahashi*[1], Keitaro Ito[1]; Shun Tomii[1]; Tohru Manabe[1]; Kazuhito Ishimatsu[1]; Katsunori Fujiwara[1]

Recently, there has been a rapid decrease in the amount of open or natural space in Japan, in particular, in urban areas due to the development of housing. Peserving these areas as wildlife habitats and spaces where children can play is a very important issue nowadays (Ito et al.2010). This study focuses on the relationship between space characteristic such as vegetation structure and landscape element with children's activities.

This study site was a courtyard in Ikiminami-primary school, Fukuoka Prefecture, Japan. The children and their teachers at the school, and university students participated in workshops which were held for planning and construction. After that, the workshops have subsequently been taken place in order to improve to the biotope. There is a pond at the center in the biotope, and the biotope has become a habitat for wildlife such as birds, insects and fish. The biotope has bridges, hills and landscape elements made of plaster near the waterside where children play with nature. Since the construction in 2003, the biotope has become difficult for wildlife to live in because of eutrophication. Therefore, the workshops were set up for water purification. About 80 children of 12 years old, 20 teachers and 15 university students participated in the workshops.

First, the characteristics as areas wildlife habitats and spaces is discussed, by researching structure of vegetation in the biotope. The biotope was divided into 43 grids, and the vegetation was identified, the height of vegetation and the grassed area was measured. Next, children's activities were traced by means of a video camera at fixed point, in consideration of children's excurse activities such as playing tag and staying activities such as making crowns of flowers. The first 15 children who entered the biotope during the recess time were selected sample of investigation. Then, children's conscience and thought to the biotope is analyzed interviewing. A total 12 children were interviewed by a university student who participated in the workshops. Finally, the relationship between space characteristic and children's activities was discussed by mapping the result of research.

P-**7**

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Study on Use of Open Spaces to Design Ecological Network in Urban Area - Through the Research of Brown Fields, Green Roofs, Urban Parks

Gakuji Yokoyama*[1] Keitaro Ito[1], Kazuhito Ishimatsu[1]

In recent years, while urban green space have been decreasing by urbanization and urban biodiversity has been negatively damaged. It could cause large damage on the habitat for wildlife to lose green space even if it's small area. Environmental changes such as air pollution, water contamination can decrease quality of habitat. In isolated habitat, wild animals have been dying. Urban Green space play important role for urban biodiversity but dense land-use has been achieved and there are few open spaces in urban area. So it is difficult to create large green spaces for wildlife. Therefore it is important to preserve existing green spaces and to connect them with each other in order to keep and raise urban biodiversity. In addition, it is also important to evaluate open spaces which have not been regarded as abandoned sites and reflect them in the urban planning.

Under this contemporary condition, rooftops have been utilized as a habitat for wildlife. Number of green roof has been increasing year on year. However in Japan, green roofs have been built to lower the temperature of the building and it has not been regarded as habitat for wildlife. Recently researcher has begun to think that rooftops have value for wildlife but studies on rooftops in terms of biology are still not enough in Japan.

On the other hand, some researchers are focusing on brownfield. It is wastelands such as old factory sites and disused railway tracks as habitats. In European countries such as U.K., Switzerland, Germany, Sweden, brown field has been becoming important habitat for wildlife. In addition, there are some green roofs which have a characteristic same as well as brown field and it is called brown roof. Recently it has been shown that various kinds of species colonize brown field and brown roof (Gyongyver Kadas, 2006). While in Japan, researchers are less aware of brown field and regard it as a no value site for urban biodiversity.

In this study, It is analyzed the change of green space area at Kitakyushu city in Japan After that some cases of green roof in foreign countries are reviewed. Then biological features in three kinds of open spaces (brown fields, green roofs, and urban parks) are analyzed by means of vegetative diversity and soil invertebrate. As a result, I discussed utilization of the open space to design ecological network in urban area.

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P-**8**

Towards a Sustainable City: Case Study on the Surrounding Attributes of Neighbourhood Parks in Kyoto City, Japan

Shiwei Gou*[1], Katsue Fukamachi[1], Shozo Shibata[1], Junichi Imanishi[1]

Urban parks function differently from surroundings in different urban forms. By providing leisure and recreation opportunities for residents surrounded by a majority of building environment in the city, how they are evaluated becomes an important indicator of a city's "livability". This paper evaluates the urban parks by their surrounding environments from the standpoint of three normative principles about the spatial distribution of parks: diversity, proximity and social needs. Indicators related to population density, land use diversity, route connectivity and park intensity are calculated so that numerical comparisons between the study areas are available. Using neighborhood districts centering 29 neighborhood parks in the metropolitan area of Kyoto City, Japan as case studies, this study offers to analyze urban structures around the parks in order to set the stage for further exploring on how these spatial attributes affect the park usage and how people transfer their perceptions into the valuation process.

Analysis of spatial patterns surrounding the parks in each neighborhood district is done combing various methods such as Network Analysis, and Space Syntax Analysis on the route network, Diversity Analysis on the surrounding land use type and Intensity Studies on the population and parks area. With the help of ArcGIS software, Depthmap and other statistical analysis software, this study finds out that besides the simple categorization of parks on their sizes, there are major differences among the neighborhood parks in Kyoto from their surrounding context. A better scheme of urban planning and renovation of the parks in Kyoto should address these differences instead of just looking at their sizes and numeric amount. And also, studies on neighborhood parks proves to be of an appropriate scale level in a better prediction of the local economic and social variables which also affect the use of parks in an essential way. Through this study, a platform is also built for further studies on people's usage and perceptions on nature in urban parks in order to achieve a final goal of harmonizing people and nature under the urban framework through a spatial sensitive design of urban parks network.

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P-**9**

Ecological and Sociological Values of Sacred Forests in Urban Green Spaces

Naoko Fujita*[1]

The characteristics of forests and green spaces in an urban or a suburban area depend on the area's historical diversity. It is accordingly important to understand the process of historical transition of the culture of such areas. Within an urban landscape, these spaces are fragmented and have been reduced by land-use management. It is necessary to not only preserve the uniqueness of an area that has been shaped by its history and culture but also to consider the long-term use of an urban space from the perspective of developing a wider landscape. Urban forests provide various social services that meet the recreational, esthetic, and community needs of people living in urban areas. They also provide ecological benefits, maintaining water and air quality, providing a habitat for wildlife, and functioning as refugia for native plants in urban landscapes. In Japan, forests associated with shrines and temples are recognized as important components of urban green spaces, particularly in rapidly urbanizing areas. Shrine forests are protected and managed in near-natural conditions for the purposes of religious worship and many are ecologically rich. Some shrine forests have been protected for centuries, and accordingly still retain the indigenous flora. Others have experienced various degrees of anthropogenic disturbance, whereas yet others have been artificially planted. Shrine forests exist in Japan because Shintoism enshrines the tradition of preserving vegetation in places of worship. The forests associated with Shinto shrines function as sites of nature worship. Those forests associated with Buddhist temples have esthetic value and are also used as places of religious training. Many shrine forests have been protected legislatively after being designated as national or regional monuments of historical value. There are, however, certain differences in the nature of forests associated with shrines and temples. Shintoism places greater emphasis on nature worship than does Buddhism, and shrine forests tend to be less intensively managed than those associated with temples. Further, shrine forests are considered sacred and are usually not accessible to the public, whereas temple forests have a long history of human intervention. The area of forest cover is usually greater for shrines than for temples. Differences also exist in the spatial distribution patterns of shrines and temples across landscapes. In Tokyo, shrines have a scattered distribution across the landscape, but are typically associated with specific geographical features, such as small hills, spring water, streams, and rivers, which are themselves objects of nature worship. In contrast, temples tend to be clustered in groups with a tendency to be located on foot slopes and flat areas, reflecting their historical development as temple villages, or "teramachi." In addition to their religious nature, historical events, such as bombing during World War II and subsequent rebuilding, have influenced the spatial distribution of shrine forests and other green spaces in Japanese cities.

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P-**10**

Bottom-up and Collaborative Process for Establishing the Local Biodiversity Strategy in Tokushima Prefecture, Japan

Mahito Kamada*[1], Mai Onishi[1]

Local governments in Japan have begun to establish the Local Biodiversity Strategy (LBS) around the year of CBD_COP10. A unique process in Tokushima Prefecture for establishing the LBS is now ongoing, as that has been initiated by civic sector.

1) 18 NGO groups and professional scientists voluntarily gathered and established civic council for the Biodiversity Strategy of Tokushima in June 2010. The action was begun prior to a decision of local government. The council has hold workshop every month, over 2 years continuously.
2) Proposal on a way of establishing the LBS, and on items that should be involved in the LBS was shaped and handed to the Governor in June 2011 by the council.
3) Following to the action of civic sector, local government started to set the LBS in August 2011. The local government and the civic council collaboratively established secretariat and held town meetings (TMs) at 9 regions in Tokushima from August to October in 2011, in order to collect public opinions broadly. Over 5000 opinions collected through TMs were analyzed by academic sector (Tokushima Univ.) and inputted into the advisory committee in February 2012.
4) The advisory committee, which was formed under an initiative of the local government in August 2011 and composed of scientists and responsible persons from business sector, aims to make a framework of LBS. The results of TMs were shared at the meeting in February 2010, which were organized by the advisory committee and members of the civic council and officers from over 40 governmental sections were gathered.
5) Next trials are i) to fix LBS target according to Aichi Target, and ii) to develop Plan of Actions (PoA). One of the challenges in PoA is to set a way of rearing persons who have knowledge and skills on biodiversity/ecosystem management and can make actions with responsibility. Educational program/curriculum is now being developed by NGOs collaboratively; each NGO has several events at various places/ecosystems in a year, and thus it can develop programs/ curriculums by that related events are served from NGOs and linked as a series under the adequate theme. The university will assist the program.

The actions of civic sector have been supported by self-motivation, and by getting several grants such as from Japan Fund for Global Environment. The continuity of actions, which has been kept under initiative and management of leaders, has resulted in generating strong ties between members and raising their responsibility, and then increasing social capital for mainstreaming the biodiversity.

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P-**11**

Building Social-Capital through Bottom-Up and Collaborative Process for Establishing Local Biodiversity Strategy in Tokushima, Japan

Mai Onishi*[1], Mahito Kamada[1]

"The Plan of Action on Sub-national Governments, Cities and Other Local Authorities for Biodiversity (2011-2020)" was adopted at CBD_COP10, followed to "Aichi/Nagoya Declaration on Local Authorities and Biodiversity" at the City Biodiversity Summit 2010. These adoptions expect to promote establishment of local biodiversity strategy (LBS) and the plan of action for biodiversity in local governments around the world. Almost local strategies in Japan seem to be established through top-down process with little chance for local people to input their opinions; local government makes framework alone and gets public opinions at the final process as public comment. It is difficult for the public to make responsibility for realization in this way. Sharing the process of making the strategy among related sectors must enhance to mainstream and realize the biodiversity centric policy.

The study illustrates how bottom-up and collaborative process enhances social-capital for mainstreaming the biodiversity, from the unique attempts in Tokushima Prefecture, Japan; the LBS is being constructed by an initiative of civilian sector. Analytical viewpoints are,

1) acquirement of skills for consensus building,

2) building up social ties, and

3) change of sense of responsibility and actions, in 3 phases in the process of making LBS.

Phase 1, start of collaboration: Members of 18 NGOs gathered and shaped proposal on LBS. In this period, members shared position and target of other NGOs, and made a common vision on the future biodiversity in Tokushima Prefecture. By holding workshops (WSs) periodically, members learned skill of managing WS as well as process of consensus building.

Phase 2, holding and managing town meetings: NGOs' member managed 9 times of town meetings (TMs) by using WS skill that was acquired through their own WS. The attitude of members changed from passive to active comparing to that in phase1. In this phase, strong ties were built up between members based on the trust, and official network with prefectural office was also built up through collaboration for holding TMs.

Phase 3, developing educational program/curriculum: Currently, NGOs' members get started to develop educational program/curriculum to rear persons who have knowledge and skills to manage biodiversity and ecosystems. The action is based on their responsibility to support the LBS, which is proposed by themselves. The relationship among NGOs might promote through this activity. In this phase, NGOs get consciousness on their leadership to other public people in mainstreaming the biodiversity.
The process in Tokushima shows that bottom-up and collaborative process in the establishment of LBS can build social-capital and generate power to complement the LBS.

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P-**12**

Assessing Dependence of Urban Activities on Ecosystem Services on a Regional Scale -A Case Study of Civilian Sector of Osaka Prefecture in Japan-

Tetsuro Takebata*[1], Takuma Toyoda[2], Robert Shaw[2], Takanori Matsui[1], Takashi Machimura[1]

In recent years, rapid urbanization has further upset natural ecosystems, and people are beginning to recognize that biodiversity conservation and sustainable use of ecosystem services in urban systems are essential targets for environmental sustainability. There is increasing research focused on assessing the relevance between urban activities and natural ecosystems by means of various indexes or frameworks. For instance, the City Biodiversity Index (CBI) project is an ambitious attempt to determine the linkages between urban systems and natural ecosystems. In particular, the CBI project requires the development of indicators to evaluate the dependence of urban activities on ecosystem services. Against this background, a means to assess such dependence of urban activities on ecosystem services was developed in this study.

In this research, a framework named "Ecosystem Service Use (ESU)" was applied in order to evaluate the dependence of civilian (residential and business) sector activities on forest ecosystems, using Osaka prefecture Japan as a case study. ESU is an ecological footprint-based index proposed in Shaw et al. (2010). This framework can evaluate the degree of dependence of human activity on ecosystem services by a footprint unit of hectares for each ecosystem. Here, five types of major forest ecosystem services are selected and FESU (Forest Ecosystem Service Use) levels for each area in Osaka prefecture were calculated. The selected services are as follows; construction wood supply service, cabinet-making wood supply service, paper-making wood supply service, CO2 absorption service, and NOx and SOx absorption service. After calculating the FESU of each area in Osaka prefecture, cluster analysis was conducted in order to analyze features of the dependence types on forest ecosystem services, Firstly, it was found that FESUCO2 was the dominant proportion of the total FESU in every area. The second major finding was that the proportion of FESU for business sectors was higher than that of residential sector (the civilian sector is divided into the business and residential sectors). Finally, the results of cluster analysis show that areas in Osaka prefecture are clustered into three groups of different characteristics. For example, one of the clusters has quite high dependence level on forest ecosystem services and uses these services provided by forests beyond Osaka prefecture.

This quantitative evaluation of the dependence level of urban activities on ecosystem services can be applied both in developed countries where reconstruction of natural symbiotic cities is planned, and to developing countries where urbanization is progressing, and thereby contribute to finding co-management models between urban and rural areas. Moreover, such evidence-based recommendations can lead to new pathways for urban development in developing countries aiming for sustainable development.

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P-**13**

Foliar Sound Absorption Capacities of Some Urban Trees

Payal Rane*[1], Ambika Joshi[1], Nitesh Joshi[2]

Noise is sound that exceeds the tolerance limit of a listener. Noise is increasingly being recognised as an important environmental pollutant and is a serious health hazard at high levels. Vehicular noise plays a major role in increasing noise levels.

Sound absorption coefficient is normally measured using expensive instruments and calculating absorption coefficients. The absorption coefficient of a substance falls within a scale from 0 to 1. The concept of this absorption coefficient was established by Sabine.

An attempt is made to device an inexpensive method to measure sound absorption. A sound absorption ratio was derived to measure sound absorption on a relative scale in a closed system. Sound absorption ratio of leaves of different tree species was studied. Observations were made using oscilloscope connected to a long impendence tube and a speaker at different frequencies like 500Hz, 700Hz etc. In designing the tube 500Hz – 1000Hz was taken as operating frequency for the reverberation testing and used in sound absorption test. To reduce the effect of attenuation due to walls of tube it was desired to have a large diameter of tube and long length so that at least two minima and one maxima could be found. An omnidirectional microphone was used to study standing pattern. Readings were taken with and without samples so that everytime when samples were replaced by the other the initial setting was not disturbed. Initial setting wave pattern was maintained by adjusting i/p power (i.e. current & voltage) of the speaker. Sound absorption ratio towards unity indicates poor sound absorption capacity. At 500Hz the noise levels are closer to audible range, hence it was used as reference and for comparison of absorption by plants at other frequencies.

According to the study, plants show higher absorption at different frequencies, such a *Syzygium cumini* shows higher absorption at 500Hz whereas *Ficus bengalensis* shows higher absorption at 1.1 KHz. Very high frequencies such as 6KHz show no absorption at all hence 100% transmission. Plants such as *Syzygium cumini*, *Ficus hispida*, *Sterculia urens*, *Ficus bengalensis, Eucalyptus globulus*, *Pongamia pinnata*, *Polyalthia longifolia*, *Ficus glomerata*, *Thespesia populnea*, *Barringtonia racemosa, Ficus religiosa*, *Hibiscus*, *Mangifera indica* and *Putranjiva roxburgii* showed good absorption ratios and thus help in noise abatement. *Azadirachta indica*, *Acacia auriculiformis* and *Delonix regia* were poor sound absorbers. Details of the studies carried out on these plants are presented in the poster.

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P-**14**

A Comparative Study on Foliar Dust Depositions of Urban Plants

Alkama Faqih*[1], Nitesh Joshi[1], Ambika Joshi[2]

Mumbai is a highly developed city and unique in its geographical location. The city has on its western side the Arabian Sea and has thick forest, the Sanjay Gandhi National Park, with industries spread on its eastern and western side. The city is of national importance as a business centre, with all types of vehicles moving along the roads of the city. The city faces high levels of suspended particulate matter levels. A study was conducted on the dust depositions on the leaves of 25 plants species growing along the road dividers of Colaba, Western Suburb and Western Express Highway in the months of December 2009 and March 2010. The plant species seen commonly at all the sites were *Bougainvillea spectabilis, Ficus benjamina, Nerium odorum*and *Pedilanthus tithymaloides. Ficus benjamina, Nerium odorum*and*Pedilanthus tithymaloides* were found to be relatively good capturers of dust. The leaves collected from all the three sites were washed; the dust was filtered and measured in grams per meter square. In December, 2009 the maximum dust was recorded on the leaves of *Nerium odorum,* 18gm/m^2 at Colaba, 19.3gm/m^2 at Western Suburb and 21.1gm/m^2 at Western Express Highway. Similarly in the month of March 2010 also *Nerium odorum* leaves showed maximum dust deposition, 30gm/m^2 at Colaba, 39.67gm/m^2 at Western Suburb and 64gm/m^2 at Western Express Highway. Maximum amount of dust was noticed on the leaves of *Nerium odorum* consistently in both the months. The morphology of leaf, orientation, branching patterns, and phyllotaxy play an important role in the dust capturing capacities of plants, along with micro-climatic conditions and contribution of dust from anthropogenic sources.

In the month of December, 2009 *Pedilanthus tithymaloides* is the second highest dust capturer in Colaba, 6.06 gm/m^2 and Western Suburb, 7.92 gm/m^2whereas at Western Express Highway it showed the least dust impaction, 14.6 gm/m^2. Similarly, *Ficus benjamina* was indicating third highest values of dust in Colaba, 3.4 gm/$m^2$and Western Suburb, 3.33 gm/m^2 but in Western Express Highwayit had second highest position, 18 gm/m^2. Unlike *P. tithymaloides* and*F. benjamina,* the dust impaction on the leaves of *Bougainvillea spectabilis* was lowest at Colaba, 1.17 gm/$m^2$and Western Suburb, 2.87 gm/m^2 but second highest at Western Express Highway, 20 gm/m^2.

In the month of March, 2010 *Pedilanthus tithymaloides* was ranking second at all the three sites i.e. 6.2 gm/m^2 at Colaba, 20 gm/m^2 at Western Suburb and 27.9 gm/m^2 at Western Express Highway. *Ficus benjamina* showed the dust load lesser than *P. tithymaloides*and more than *B. spectabilis* at Colaba, 3.5 gm/m^2andat Western Express Highway, 4.41 gm/m^2 whereas at Western Suburb, it is the least, 21.1 gm/m^2. *Bougainvillea spectabilis* was found to be the weakest dust capturer at Colaba, 1.2 gm/m^2 but at Western Suburb and Western Express Highway it showed third and secondpositions with dust loads 5.6 gm/m^2 and 11.1 gm/m^2 respectively.

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Bougainvillea spectabilis was not found to be a good dust capturer at Colaba and Western Suburb but the dust values noticed at Western Express highway on the leaves of *Bougainvillea spectabilis* are comparatively higher. The higher dust impaction was observed on the plants at Western Express Highway. Construction of a flyover and buildings along the highway was operational at the time of data collection. The amount of dust deposition on the leaves was found more in the month of March on all four plant species Plants with high dust impaction on their surfaces are suggested for development of green belts in urban areas and for phytomonitoring studies of suspended particulate matter. Detailed studies are needed to screen the plants for as effective dust gatherers and monitors.

P-**15**

Avian Diversity of Lakes across a Development Gradient in Bangalore

Smriti Kumble[1,2], Roopa Simon*[1], Vivek Ramachandran[2]

Lakes in Bangalore city have dwindled in their numbers from over 250 to 81 in recent times, with population expansion and the resulting urbanization to blame. The remaining lakes still host 54 species of migratory birds, including the near-threatened Painted Stork, in addition to 56 resident species. Urban bird populations are useful as indicators of human impacts on the environment because they provide direct evidence of the effects of the urbanization happening in a large, developing city like Bangalore. Previous studies have found that avian abundance and diversity peaked at moderately developed sites, lending the impression that some urbanization may actually be beneficial to birds.

This study focused on the impact of varying levels of urbanization on migratory bird populations (and to a lesser extent, resident populations) at various urban and suburban lakes.

Six lakes were chosen across a development gradient: two each in the inner city, suburbs and outskirts. Each lake was visited three times over the course of three months. The point count method was used to observe and record avian diversity and abundance, while relative levels of development were qualitatively assessed using the following criteria: presence of buildings, roads, industry, point sources of pollution, and surrounding vegetation. The avian abundance and diversity were calculated using the Shannon-Wiener index for species diversity and the Jaccard's index for similarity of species composition. Species evenness was calculated for each lake using Pielou's evenness index with values derived from the Shannon diversity index.

The results revealed a negative correlation between levels of development and bird population and diversity. Suburban lakes, however, were shown to have the greatest abundance and diversity (2.09), followed closely by outskirts lakes in abundance and diversity (2.07). As expected, the inner city lakes had the lowest diversity (1.68) and abundance. These findings conform to those of previous studies and to the intermediate disturbance hypothesis. Diversity was maximum at moderate levels of development. The suburbs and outskirts lakes show the most similarity in species composition, while inner city and outskirts lakes show the least similarity. These results are mirrored, and largely influenced, by the respective similarities between the surroundings of the lakes and other lake characteristics such as foliage cover, lake size, heterogeneity of microhabitats and islands. Suburban and outskirts lakes possess the most similar conditions, especially concerning nesting and roosting sites. The results show that increasing levels of development do cause a decrease in avian abundance, but only to a certain extent.It is species composition that changes across a development gradient. The moderate to small differences in diversity between suburb and outskirts lakes suggest that other factors, like availability and diversity of food sources, lake area and depth, modification of shorelines or presence of invasive species might better explain the observed patterns of species composition. Further research on these factors as well as sampling across seasons would be required to better understand the avian ecology of Bangalore's lakes.

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P-**16**

Test of the City Biodiversity Index on Cities' Biodiversity in Local Scale

Yoshihiro Tokue*[1], Fumiko Imamura

There is a need to evaluate conservation efforts for biodiversity in cities by simple procedure for promoting biodiversity conservation in various regions. The City Biodiversity Index, also known as the Singapore Index on Cities' Biodiversity, measures biodiversity in cities and highlights how biodiversity conservation efforts can be improved over 30 cities around the world have tested, or in various stages of test-bedding the City Biodiversity Index. They include Curitiba (Brazil), Brussels (Belgium), Nagoya (Japan), Paris (France), Singapore, and so on. Little, however is known about the availability of the City Biodiversity Index for various scales, and there are not any case studies focusing on more local scale than cities, for example ward, district and so on. There are enormous significance in case studies focusing on different geographical conditions and scales, for improving the City Biodiversity Index more effective index. The purpose of this study is to examine the availability of the City Biodiversity Index (Conservation on Biological Diversity, 2010)for evaluate the conservation efforts for biodiversity in large metropolitan area in a local scale, and to have a better understanding of the City Biodiversity Index applying the different local scale. The study site is Kastushika ward in Tokyo metropolitan area which has been highly urbanized after World War II. The result indicates that the conservation efforts for biodiversity of Katsushika ward is evaluated adequately for the most part, however there remains some issues when using the City Biodiversity Index in a local scale. The result that obtained from indicator about "Native Biodiversity in the City" which evaluates seems to be applicable. By contrast, some indicators about "Ecosystem Services Provided by Biodiversity in the City" and "Governance and Management of Biodiversity in the city", can differ considerably according to the definition of activity relating to biodiversity.. On conclusion, the City Biodiversity Index is also meaningful indicators for local scale, however some indicators of ecosystems services and governance and management need to be improved.

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P-**17**

Tourism Development and Biodiversity: The Challenges to Sustainability

Pravasini Sahoo*[1]

Introduction:

Tourist destinations are places with a natural attraction for tourists and a special challenge to sustainability. These tourist destinations are dependent on a blend of different lifestyles, cultures, unique land formations, flora and fauna, and ocean and coastal resources. Therefore, tourism if badly planned, can cause severe damage to the land and particularly to the biodiversity; whereas if planned well can support and encourage the efforts of conservation. Hence, tourism is a double edged sword, and unless managed properly, it can be potentially a negative force. This presents a strong case for interdependence and tolerance between the needs of tourism, biodiversity conservation and overall destination development. To keep the destination alive and thriving to the tourists, the marketers and policy makers need to preserve the sustainability of the destination by holistically developing it in terms of environmental, economic and socio-cultural dimensions. Hence, this study provides a perspective on the sustainability issues faced by tourism destinations in their quest to sustainability and approaches to overcome these issues.

Research objectives:

To look into sustainable tourism development, and the challenges that destinations face as they attempt to build sustainability into their tourism development policies. It further recommends approaches to assist in planning and managing sustainable tourism development.

Methodology:

This is a conceptual paper which has reviewed articles on sustainable tourism development to establish the above objectives.

Key concepts:

By exploring sustainable tourism development, this paper has presented the literature in the following categories:

1) sustainability and sustainable tourism development,
2) sustainability issues faced by the tourism destinations, and
3) approaches to overcome the challenges to tourism development

Conclusions/ Findings:

Greater emphasis should be placed on tourism's potential to contribute to the conservation of biodiversity. It is vital that tourism planning and management processes be improved within the local government of the destination area in order to bring together both short-term and long-term goals such as economic growth, conservation of environmental resources and socio-cultural welfare of the local population. This paper concludes that achieving sustainability in tourism destinations that are part of the living space of local populations should be based on a planning and management approach that integrates ecological, economic, social, and cultural

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parameters and that balances the needs and objectives of residents, visitors, government agencies and private enterprises.

References:

Buckley, Ralf. (2012). Sustainable Tourism: Research and Reality. Annals of Tourism Research, 39 (2), 528–546.

Dwyer, L., & Edwards, D. (2000). Nature-Based Tourism on the Edge of Urban Development. Journal of Sustainable Tourism, 8(4), 267-287.

McCool, S. F., Moisey, R. N., & Nickerson N. P. (2001). What Should Tourism Sustain? The Disconnect with Industry Perceptions of Useful Indicators. Journal of Travel Research, 40 (2), 124-131.

Nyaupane, G. P., & Poudel, S. (2011). Linkages Among Biodiversity, Livelihood, and Tourism. Annals of Tourism Research, 38(4), 1344–1366.

P-**18**

Biodiversity of mossflora of Khandala and Lonavala and their Use as Bioindicators of Pollution

Soman Gauri *[1]

Mosses are highly developed groups of plants belonging to group of Bryophytes having a unique position between lower cryptogams and vascular cryptogams. They are highly sensitive to pollution and are bioindicators of pollution. Bioindicators are biological agents which indicate atmospheric pollution.

Mosses are used as bioindicators for their unique and specific responses.Some moss are extremely sensitive to pollutants and exibit visible injury symptoms. Some moss species absorb the heavy metals from atmosphere like Lead, Zinc, Copper, Arsenic etc. Khandala and Lonavala are twin towns in the Western Sahyadri ranges about 102 kms from Mumbai. About a decade ago many mosses were abundant and growing luxioursely at Khandala and Lonavala. However the area has undergone through tremendous physiognomic changes.There is a rapid increase in deforestration to encourage more tourism. Heavy metals are emitted from solid fuel combustion and are adversely affecting the environment.

Thus as a result environmental pollution is increasing day by day and causing a serious problem for urban biodiversity.The balance of nature,environment and form of vegetation is getting disturbed day by day. A survey was carried out to study the moss flora of these twin towns and the use of mosses as bioindicators in these urban towns. The present paper highlights the diversity of moss flora of this region and their use as bioindicators of pollution.A total number of 35 moss are described along with their growth forms and ecological habitats.

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P-**19**

Effect of Urbanization on Genetic Differentiation and Density of Disease Vector Populations

Christine Zolnik*[1], Evon Hekkala[1], Rich Falco[1], Thomas Daniels[1]

Urbanization has resulted in a loss of forested land, a reduction in the size of contiguous forests, and an increase in the amount of forest fragmentation. Ecological consequences include changes in wildlife communities, loss of biodiversity, and emergence of wildlife diseases. For instance, studies have shown that Lyme disease increases with forest fragmentation. This and other tick-borne diseases are ecological in nature, the result of environmental conditions that favor large tick populations. In the United States, the blacklegged tick (Ixodes scapularis) is responsible for transmitting several disease-causing pathogens to humans, including the agents responsible for Babesiosis, and Anaplasmosis, and is the primary vector of Lyme disease. This tick species survival is dependent upon forested habitats and access to wildlife host species. Most movement and dispersal of these ticks occurs on hosts. Understanding how human driven landscape changes affect dispersal of this tick species through inhospitable matrices (ex. urbanized areas), and ultimately their abundance and spatial distribution, can help to shed light on the epidemiology of diseases transmitted by these species.

This study explores the effects of urbanization on population density measurements, and population structure, and connectivity of the blacklegged tick. We examined the population composition of these ticks along an urban-rural habitat gradient extending 120 km northward from New York City, the largest urbanized and most densely populated region in the United States. Twelve forested parks along the gradient were sampled during June and July 2011, corresponding to peak seasonal activity for the nymphal stage of this tick, which is responsible for transmitting most cases of Lyme disease to humans. Tick population density measurements at each site were recorded and genetic differentiation between sites was compared using microsatellite markers. Tick population density measurements and genetic differentiation were compared between sites varying in level of urbanization (as measured by percent impervious surface and human population density around each site). First year data sets show a trend of higher tick densities in areas with intermediate urbanization (suburban environments) than in more rural or more urban areas. This is important from a human health standpoint since Lyme disease risk is positively correlated with tick density. Preliminary microsatellite data demonstrate differences in tick populations between rural and urban sites. While results are suggestive, these data support the need to explore the impact that urbanization has on the prevalence of tick-borne pathogens and the phylogeography of this species further. Future work will focus on testing ticks from each site for three pathogens that cause disease in humans and comparing patterns of tick populations with those of two major host species along the urban-rural gradient.

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P-**20**

Tree Census of Karad City, Maharashtra, India: A Step towards Conservation of Urban Biodiversity in Mitigating Climate Change

Chandrakant Salunkhe*[1]

Trees are home to 50% of the world's biodiversity. They provide subsistence to 1.6 billion humans and are the most vital element of urban landscape and serve as green lungs. Trees work hard for us every day cleaning our air and water, providing shade and a cooler environment. In recent times, awareness regarding green house gases, global warming, climate change, weather extremes and mitigation options added a new dimension to the life. Good practices in urban and peri-urban forestry can contribute to building a resilient city in terms of mitigation and adaptation to the effects of climate change. Trees constitute major component of urban greeneries and a basic framework of the landscape. Selection of right species and proper plantation design on the basis of available space are the fundamentals of successful planning. In Maharashtra state various programs have been implemented to increase green cover and number of trees at local and regional levels. But due to lack of mismanagement and improper planning results are not as expected. Tree diversity assessment and planning are two fundamental steps in enabling urban biodiversity conservation. The assessment involves survey of tree diversity exists locally. Tree census is an important scientific, technical, and educational method to assess their present status. The results will enable to characterize tree population in terms of its structure, function, and value. Tree census program was planned for Karad city in Maharashtra state in 2010 under the guidance of eminent botany experts and with the help of local NGO's and students. The main goal of this tree census is to increase level of understanding of local peoples and city stakeholders about values and importance of tree diversity and also to increase their participation that could lead to further environmental management and urban biodiversity conservation to mitigate climate change effects. In the beginning a workshop and training programme was organized for volunteers and participating organization to disseminate the concept and other details of the activity. In the year 2011 the census has been completed without any funds from government agencies or local agencies. The present paper explores existing tree composition, species richness and tree diversity inhabiting Karad city and experiences during this activity. It will certainly help to focus policies and investments aimed at protecting and managing trees in and around the city to strengthen urban livelihoods and improve urban environment in future.

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P-**21**

Urban Biodiversity and Environmental Management Efforts in Jamshedpur: A Case Study

Kiran Shukla*[1], Meenu Kumari[2]

The role of preservation of urban biodiversity as a holistic, environmental strategy is not a new idea for the city of Jamshedpur. For this oldest and largest planned industrial city with 13.4 million population, adopting and pioneering eco-friendly urban planning has always been a key area of focus ever since its inception in 1908. It was the benchmark development for post independent Indian industrial cities such as Bokaro, Bhilai, Rourkela and Durgapur, which were established in completely rural areas.

This paper is a case study approach in documenting and evaluating current practicesof Jusco, a sister concern of Tata steel, taking care of city's urban planning and utilities services, with regard to the city's civic amenities and on also its effects on the biodiversity conservation and management. The objective of the study is to highlight the fact that industrialization and conservation of natural resources are not mutually exclusive and the example of Jamshedpur may be emulated by other industrial towns as well.

The methodology adopted in this paper is an evidence based approach for analyzing habitat and biodiversity protection. The efforts undertaken by Tata Steel speak highly of the Steel giant's responsible and consistent approach towards environmental management. It received global recognition after it was selected as the only South Asian representative in UN Global Compact Cities project for the future. An example of astute planning is the sprawling 238-acre "Jubilee Park" which play a crucial role in thermo-regulation of the area and effectively functions as the lungs of Jamshedpur. It also improves the microclimate of the city by reducing the heat and carbon foot print. Similar efforts earned the city the first ISO 14001 certificate in the country for meeting the highest environment management system standards. A unique program of eco-restoration has been started by Tata Steel and Forest Department on Jugsalai muck-dump to create a green habitat which will be a tourist destination. As a part of biodiversity conservation, it has a biodiversity park having a zoo and botanical garden. The city is also committed for a cleaner and greener city, which is done through continual tree plantation drives, enhancing the green infrastructure in the city and inside the factory as well as other projects like urban rainwater harvesting sheds that are regularly seen in and around Jamshedpur.

Biodiversity is a limited natural resource that is impacted through urbanisation which is very well taken care of in the city of Jamshedpur. "Satisfaction of life" is very high in Jamshedpur city in comparison with its agglomerations like Adityapur, Jugsalai and Mango which is not part of Tata Steel lease area.

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P-**22**

Can Urbanization and Biodiversity Join Hands Together: Our Role in Being an Urban Citizen

Piyashi DebRoy*[1], Mohan Krishnan[1]

Introduction

According to a report released by the United Nations titled 2011 Revision of the World Urbanization Prospects, among the 450 urban areas in the world having a population of at least 1 million in 2011, almost 60 per cent are exposed to the risk of a natural disaster. Asia is home to two-thirds of these cities. A lot of attention is focused on the world's megacities where, in fact only 4 per cent of the world's population currently live in megacities. The same is observed in our country where most of the attention in urbanization discussions goes towards the major metros, where as there are equal number of urbanization – biodiversity issues in other small cities in the country as well. The concept of linkage between urbanization, biodiversity and ecosystem services keeps on flowing in the minds of environmental and natural resource economists, research scholars, sometimes scientists and to the most NGOs. Therefore, what is felt to be relevant is to capture these linkages and present them in an appealing and simple way to the common people where in they feel that research in biodiversity is not only for the sake of research scholars, but also for the application of research to each and every section of the society.

Are biodiversity and ecosystem services required in urbanization of India?

According to the first report on the Status of India's environment (1985) authored by Anil Agarwal, India's environmental problems were caused by the excessive consumption patterns of the rich that left the poor poorer. At first, in the Indian context, urbanization does not only mean clearing out natural greenery, such as removing out large tracts of forests, filling up ponds in urban areas, clearing out mangroves and wetlands, and encroachment on farmlands in sub-urban areas for expanding industrialization by merely copying plans and designs implemented elsewhere, especially from the west. Have the modern planners of urbanization forgotten that our ancient architectural experts designed buildings which had spaces for allowing the natural breeze, sunshine, subtle shadows, and natural whispers and even pots or platforms for birds to feed on them (source: Prof. Anil Gupta, Indian Institute of Management, Ahmedabad) – facilitating the existence of not only people, but the whole biodiversity?

Conclusion

As urban citizens, we must learn to act as watch dogs to protect our own environment from the consequences of unsustainable projects around us. The administrative, technical and managerial staff of the urban local bodies need to be strengthened. It is totally inadequate to talk only of sustainable rural development in India; we cannot save the rural environment or rural people dependent on it, unless we can bring about sustainable urban development in the country. According

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to the environmentalist Anil Agarwal, as well informed citizens, we not only have rights, but also duties to perform in this.

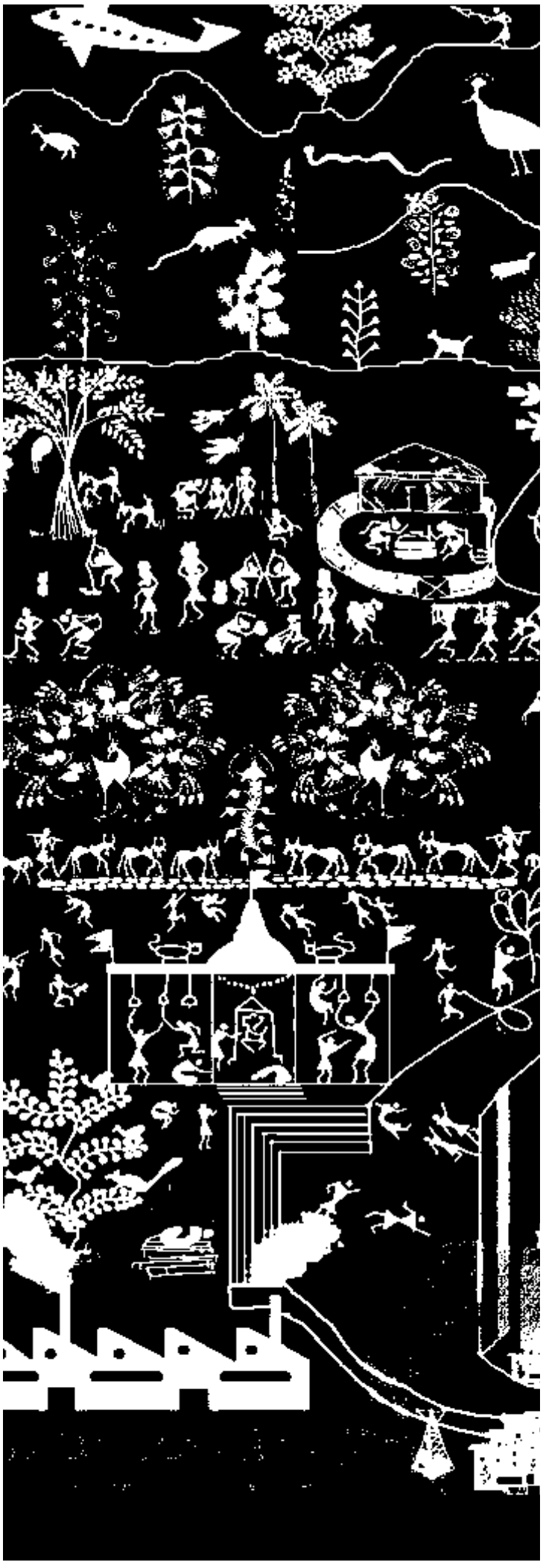
P-**23**

Assessing Vulnerability of Farmers' Livelihood in the Coastal Wetland of Bangladesh

Md. Zahidur Rahman[1], Saeed Ahmed Siddiquee[1]

The research was conducted in the coastal wetland to investigate farmers' livelihood vulnerabilities pertaining to climate change. The present research is highly related with a public interview to capture the data directly from the field related with random data sampling based information. The farmers within the study region of costal wetland were earnestly affected by various types of hazards like, river bank erosion, salinity intrusion, tidal flood, erratic rainfall, monsoonal cyclone, water logging as well, which are directly colligated to climate change. Agriculture is the main source of economy, which is jeopardized by almost all the hazards. In the study area most of the farmers (46.36%) were having below 0.2 hectors of land and only 4.54% farmers had above 0.3 hectors. The major field crop of the study area was rice (*Boro/Aman*). Generically farmers were not acquainted to cultivate *Aus* in this area. During *Aus* growing season (kharif-1) the salinity intensity became higher and they had less opportunity to use the land for *Aus* cultivation. Majority of the farmers (72.73%) used rain water for agricultural purpose instead of river water. As a consequence, around 37% farmers were migrating from affected areas to non affected areas and among the displaced farmer 21% were permanent and 16% were seasonal. In rainy season, more than 25% households were confronting water logging, tidal flood problems due to low plinth height of the houses. The farmers had been suffering from various communicable and non communicable diseases like chronic obstructive pulmonary diseases, malaria, dengue, cholera, encephalitis, malnutrition and prevalence rate of the climate change associated diseases was 5.09. The present study revealed that climate change induced hazards severely leading to crisis of freshwater, decreasing in rice and other essential crop production. Finally, the study in the coastal wetland found that environmental migration, food deficiency and health problems that increasing vulnerability and reducing the sustainable capacity of the farmers to climate change adaptation. The livelihood of majority of the farmers in the coastal wetland was very dull and farmers community in the study area, a p poorest among the poor.

[1] Eminence, Bangladesh



OTHER ABSTRACTS

A-**1**

Knowledge and Values of Wildlife among People in Kuala Lumpur, Malaysia

Baharuddin Zainul Mukrim[1], Sivam Alpana[1], Karuppannan Sadasivam[1]

Urban biodiversity has received lot of attention across the world. Recent convention at Nagoya reinforces the commitment towards conservation of biodiversity in urban planning and design. Local planning, habitat conservation, public and stakeholder awareness are key contributing factors to urban sustainability. Traditional Ecological Knowledge (TEK) assessment has been widely applied to investigate the level of people's knowledge of biodiversity. However, majority of the existing studies focus on mega fauna and biodiversity and fewer investigations are on public knowledge associated with urban biodiversity.

This paper presents urban dwellers' knowledge and values of biodiversity in Kuala Lumpur. Knowledge is a critical factor that influence people's attitude to biodiversity and there by muster support for conservation. The study present results of a study of urban residents live within a distance of 2 km from urban parks. People were asked to identify, from pictures, commonly found wildlife species in urban parks. The results presented in this paper are based on people's response to identifying 12 wildlife species, and 9 questions related to basic character of the wildlife such as birds, reptiles and small mammals. Majority of residents incorrectly identified commonly found birds and their knowledge of protected bird species was low. Among the six protected bird species they could correctly identify only one species (Alcedo at this /Kingfisher). The study indicates that most of the respondents have better knowledge of the wildlife general characters. Then, citizens of Kuala Lumpur also have perceived the Moralistic values towards urban wildlife. The findings of this research are useful in formulating policies for conservation of urban biodiversity and promote sustainable planning and design of cities.

A-**2**

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Exploring Ecological and Cultural Resilience across the Australian Continent: Green Infrastructure as Design Strategy

Simon Kilbane*[1]

This paper outlines research regarding the planning and designing of a bold new continental-scale 'Green Infrastructure' for Australia. This 'National Green Network' is a proposed framework of (re)vegetated corridors that reach across the entire Australian landscape. The purpose of the network is to enable species to adapt to climate change, to sequester carbon, to secure riparian zones and to increase landscape health and amenity.

Research focuses upon the spatial exploration of two key principles. First, in accordance with the International Convention on Biological Diversity, a minimum 10% of all of Australia's existing 85 bioregions must be protected; and second, that the spatial design of the Australian landmass endeavours to maximise connectivity between otherwise isolated fragments of existing habitat.

At a continental scale, these two principles are met through the allocation of space to form a national green infrastructure 'grid' of protected areas. Not intended as a plan, it merely allocates space to this purpose. Therefore, a 1300 x 25 kilometre 'transect' located in the south west of Western Australia establishes a detailed study area and allows exploration of this new infrastructure at a finer scale. Covering a diverse range of landscapes and land-uses from 'urban' to 'wilderness', the green infrastructure grid is incrementally adjusted and recomposed to suit actual landscapes at a finer scale.

The paper will close with a discussion of the urban area of Perth in light of this new proposed intervention through a series of mapping overlays and visuals.

How could a modern metropolis be retrofitted with this new green infrastructure? Breakdowns of the typical complexities and contingencies involved in maintaining the research principles lead to a spectrum of hybridised design outcomes, neither purely ecological nor cultural which must be negotiated in order to maintain a robust system.

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A-**3**

Values of Urban Wetlands in Supporting Waterbirds on the Swan Coastal Plain, Western Australia

Tammy Hanson*[1]

Wetlands are critical ecosystems that support a diversity of waterbird species. This paper presents findings of research aimed at increasing the understanding of the critical role that urban wetlands play in supporting waterbird species. Waterbird diversity is dependent upon factors including time of year, hydrological cycles, habitat and food provision, proximity to other wetlands and surrounding land-cover.

Over a 7 month period waterbirds were studied at five urban wetlands located upon the Swan Coastal Plain, Perth. A desktop analysis was used to determine land-cover (impervious surface, size) and habitat (water, edge, grass and island). An analysis of results revealed correlations with waterbird abundance, richness, diversity and evenness. Where percentage of water cover was greatest, higher waterbird abundance, richness, diversity and evenness was observed. Wetlands with larger percentages of surrounding impervious surface displayed higher species richness, diversity and evenness. Finally, the time of year and corresponding seasonal hydrological change was an influencing factor upon water cover and waterbird presence.

The study highlighted the critical role that these urban wetlands play in providing habitat for waterbirds throughout all seasons. The ecological values of these modified wetlands are misunderstood by the community and government organisations. On the Swan Coastal Plain, a large percentage of wetlands have historically been cleared and/or significantly modified and continue to be cleared today for urban expansion. However, some local councils are working to improve wetlands in their precincts through establishing vegetation buffer strips to absorb nutrients entering the wetland, by re-establishing or providing additional habitat for waterbirds.

[1] Men of the Trees, Australia

A-**4**

The Impacts of Climate Change and Urbanisation on Phenology of Plant and Animal Species in Japan

Yuko Onishi*[1], Sadahisa Kato[2], Naota Hanasaki[1], Kiyoshi Takahashi[1], Yasuaki Hijioka[1]

Urban ecosystem is particularly vulnerable to climate change as warming is exacerbated by urban heat island effects and scattered habitat patches limit natural adaptation. The ecological impacts of climate change are already evident in species' distributional and phenological changes in Japan, although there has been little research explicitly assessing the vulnerability of plant and animal species in urban areas.

Using the nation-wide phenological data over the past five decades, we analyse the phenological shifts of 20 plant and animal species in urban and rural areas in Japan and quantify the magnitude of phenological changes caused by climate change and urbanisation. We then build quantitative models to assess the vulnerability of urban ecology to climate change. We employed machine-learning statistical models (random forest and artificial neural networks) under the SRES A1B scenario using four climate models, MIROC 3.2hires, MRI-CGCM2.3.2, CSIRO-MK3.0, and GFCGM2.1 for three time frames; 1981-2000, 2031-2050, and 2081-2100.

Statistical analyses of past climate changes showed that the average temperature in urban areas increased by up to three times as high as that in rural areas since the 1950s. The phenological shifts largely followed this trend, although the responses varied greatly between species as well as seasons and locations, e.g. autumn tree phenology in metropolitan areas exhibited the largest changes. Nevertheless, the large disparity between the urban and rural phenology clearly indicated significant effects of urban heat island on species' phenology over the past five decades. The future projections based on four climate models indicated that spring phenology of many plant species would advance in response to temperature warming. On the other hand, phenology of some insect species was projected to be delayed, suggesting that phenological mismatches between interacting species could be widened.

In response to recent climatic changes, some species have shown signs of autonomous adaptations, for example, changing their distributions or food sources. However, the adaptive capacity of species is largely unknown especially under the projected rapid phenological shifts that are likely to continue at least up to the end of the century. Depending on the species, human-led adaptation measures may be effective for maintaining ecosystem functions and services, such as planting of earlier flowering sub-species for food and pollination of the insects, and conserving corridors to facilitate natural distributional shifts.

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A-**5**

A Chance for Biodiversity in Tropical Cities - Guidelines for Urban Design and Implementation

Tertilt Trudy Maria[1]

In many parts of the world wildlife in cities are still seen as unwanted guests. Cities are for people – nature protected areas are the places for wildlife to be. However, since the invention of motorized traffic, human settlements are spreading rapidly outwards into the countryside and into the most remote natural areas. Cities are occupying more and more territory worldwide. This made green space within the city boundaries a new necessity.

Besides the size-factor of urban agglomerations, cities are often located in biodiversity-sensitive spots like the transition zone between terrestrial and aquatic habitats, which make it necessary to take into account the requirements for animal migration into urban planning concepts. With growing insight of close inter-relationships between the built and the biotic environment, biodiversity-friendly measures came into the focal point. Some of these remaining urban biodiversity 'hot spots' (relict nature) went into a protection scheme but the priority of green space development was devoted entirely for human use. Public parks in an urbanized environment were considered incompatible for harbouring wildlife.

Numerous publications discussed the benefits of parks for bio-physical and bio-chemical services for the urban population; followed by studies supporting arguments in the field of education / environmental awareness and ethics. Green spaces in general are now understood to support human social and medical health systems. Recent studies indicate that biodiversity itself is directly linked to a strengthened immune system and a lower prevalence of infectious diseases and allergies.

The level of biodiversity differs widely among urban parks, mainly depending on the design, plant selection, management and the degree of human disturbance. The article will discuss a number of indicators that can insure bio-richness in parks in temperate and tropical climate zones where the original natural vegetation cover includes forests. To achieve a bio-rich park, a set of guidelines for design and management of green spaces are provided. Like many other tropical cities, Singapore's urban greenery consists of 80% non-native vegetation cover. Only now, the city started its first test-plantings exclusively with native plants. Especially in fast developing tropical cities, securing long-term space for vegetation to mature and green space connectivity is a special challenge. Another problem is the accessibility of (clean) surface water. Cities that also harbour a diverse flora and fauna can assess their potential for high biodiversity levels in parks with following indicators:

- High numbers of native plant species and abundance
- High number of mature trees
- Areas with spontaneous vegetation
- High numbers of fruiting trees and fruiting shrubs
- Multi-storey plant arrangements

[1] NParks Singapore, Germany

- Access to permanent and temporary water sources
- Mix-in of micro-habitats retrieved from local natural areas
- Low number of manicured plants
- High number of plants growing in natural habits (no clipping)
- Allow leaf layer to build up
- No application of pesticides, herbicides and chem. Fertilizers
- High green space connectivity

A-**6**

Crossing the Cities: Opportunities for the Conservation of Bird Communities in Urban Areas in the Neotropics

Juan Amaya-Espinel*[1,3], Laura Agudelo[2], Andres Morales Rozo[3], Cristian Bonacic[1]

There is a significant concern about the negative effects that expansive growth of urban areas worldwide may cause on the biodiversity and the services that provide. In response, is evident a significant increase of the efforts to identify, protect and recover conservation opportunities at the urban level. In fact, there is growing the study of patterns related to changes in biodiversity along urban gradients, mainly in developed countries. However, little is known about the potential role that different kinds of green urban spaces play in the maintenance of the wildlife in many developing countries located in the tropics, where priorities for biodiversity conservation are high. We conducted a study to assess these opportunities, from a biological indicator group such as birds, in various green elements present at Bogota, the main and largest city of Colombia, a mega-diverse country. It was evaluated in 4 contrasting geographical areas (12,806 ha) within the city where 940 points were characterized by birding in point counts with 20m radio with 3 repetitions over a year. 153 species of birds within 39 families were recorded, included 121 residents, 32 migratory and 6 endangered species. Comparison of areas and kinds of green spaces were obtained by statistical analysis like rarefaction curves, diversity index and jacquard and bray curtis analysis. The results show a city dominated by a few species with about 70% of all registered individuals and a large number of rare species. The natural green areas as well as those in regeneration, show an important role as reservoirs of these rare birds. Urban parks, cemeteries and green areas mixed with infrastructure like green corridors, showed interesting options such as sinks or stepping-stones. However, these trends are not uniform throughout the city, showing great contrasting to analyze the information for the whole city, for each of the selected geographic areas and at each of the types of green spaces that were evaluated. This study presents an accurate picture of the current state of the community of birds present in a highly transformed area in the neotropics as well as the opportunities and challenges offered for the conservation on urban spaces.

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[2] Sociedad Antioqueña de Ornitología, Chile
[3] Asociación Bogotana de Ornitología, Chile

A-**7**

"Green infrastructure and design"-A Drive towards Sustainable urban ecosystem

Suchilipsa Das[1]

An urban ecosystem is simply the community of plants, animals, and humans that inhabit the urban environment. Environmental stresses also modify the natural elements of urban ecosystems. Trees are subject to high levels of air pollutants, road salts and runoff, physical barriers to root growth, disease, poor soil quality, frequent drought, and reduced sunlight. Animal and bird populations are inhibited by the loss of habitat and food sources, toxic substances, and vehicles. Partnering with nature instead of conquering it is at the heart of sustainable urban ecosystems. Sustainable planning and design recognizes systems that are best suited to human needs and capabilities, then creates and manages these systems to be as self-sustaining as possible. Self-sustaining or regenerating systems allow nature to manipulate the physical and chemical environment rather than relying on subsidies provided by humans. Self-sustaining landscapes, such as gardens with native plants, require less energy, water, and other resources to maintain than traditional landscapes, and they produce fewer pollutants. The green infrastructure and design is a vital component of communities that are striving to be more than plots of bulldozed land, networks of roads, and collections of soulless buildings. Now, green infrastructure is more often related to environmental or sustainability goals that cities are trying to achieve through a mix of natural approaches. Examples of “green” Infrastructure and design include green, blue, and white roofs; hard and soft permeable surfaces; green alleys and streets; urban forestry; green open spaces such as parks and wetlands; and adapting buildings to better cope with floods and coastal storm surges. This paper includes the ecological structure, function and service of those infrastructures. The provision of green infrastructure should be guided by some principles which should be strictly adhered to the eco-town developers, planners and managers. A check-list of issues and items that every eco-town GI strategy must cover. The environmental benifits such as carbon sequestration, biodiversity conservation, reduce energy use etc are got by the green infrastructure. The green development phases and the potential problems related to this development is also included in this paper. A GI strategy can also benefit from and will need to pay attention to policy.

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Factors Influencing Distribution of Asian Clam in the Huong River in Hue City in the Central Vietnam

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Introduction

In Hue City at the central Vietnam, an Asian clam has been caught in the Huong River and cooked in the traditional manner. However, in these years, the fishing style and the cooking culture native to this old city are at the crisis because the catch yield of the clam suddenly deceased. In this study, the present state of the calm fishery was described referring to the water quality, the sediment characteristics and the spatial pattern of the clam. Then, factors influencing the clam population would be discussed.

Methods

The filed survey was conducted in the Huong River running through the urban area from the southeast of this city to the lagoon. There is a movable barrage installed for irrigation at 1km from the river mouth. It is operated to close in the dry season and open in the rainy season. Twenty-four sampling points were established from the river mouth to the point approximately 14 km upriver. The water sample, the bottom sediment and the clams were collected in July and October 2010 corresponding to the dry and the wet season, respectively. Water column characteristics was represented with water temperature, water depth, pH, salinity, DO, BOD, COD, T-N, T-P and the concentration of Chlorophyll-a. The sediment property was explained with temperature, ORP and the ignition-loss. Each clam was measured for shell length. Then analyses were conducted on (1) the comparison of the shell length between seasons, (2) the comparison of the shell length between the stream path divisions, (3) the correlation of the clam abundance with the water and bottom sediment quality and the distributional pattern, and (4) the relationship between the population density and the fishing points.

Results and Discussion

The water collected in the upstream and the downstream of the barrage was fresh water and brackish water, respectively, and the bottom was covered with sand. All clams collected were identified as *Corbicula fluminea*. They intensively aggregated in the area from the barrage up to the point about 3km upriver. The results from 4 analyses were, (1) the ratio of young shells compared with all clams collected was high in the dry season, and the ratio of adult shells was significantly high in the wet season, (2) the large clams inhabited the upstream area and the smaller ones were aggregated in the downstream area, (3) the interrelation between the water quality, the sediment quality and the population density was not confirmed, (4) at the present, the strong fishing pressure concentrates on the area where the population density was high.

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From the evidence that the population density of the clam drastically decreased in the wet season, it was inferred that the clams those accumulated at the barrage during the dry season were washed away after the barrage was opened in the wet season, or were mostly harvested. In other words, the spatial pattern of the clam was influenced by the impacts of the flow alteration by the operation of the barrage or the fishing pressure.

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Project TRUE – Teen Revitalization through Urban Ecology: Insect Biodiversity of the Prospect Park Zoo in New York City

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Historically, environmental education has focused on studying and learning about nature in rural settings; however, underprivileged urban student populations may lack the appropriate resources to access these types of educational opportunities. As a result, urban environmental education, or environmental education occurring within urban areas (e.g. Rocking the Boat), is an appealing alternative because it allows for more effective use (more people served per dollar) of publically available money and an opportunity for young urbanites to gain pride in, and connect on an emotional level to their surrounding ecological community. Furthermore, developing environmental literacy in children and young adults helps to nurture the next generation of environmental stewards. The Wildlife Conservations Societies City Zoo's (Central Park Zoo, Prospect Park Zoo and Queens Zoo) in New York City (NYC) and Fordham University, Bronx, NY have partnered to develop a pilot teen urban environmental education curriculum focused on urban insect biodiversity in the Prospect Park Zoo of Brooklyn, NY a highly urbanized borough of NYC. Project TRUE is an experiential-based learning program, whereby high school students participate in a semester long research experiment that introduces them to fundamental concepts in urban ecology, scientific design, ecological methods, mapping, digital media publishing, and scientific writing.

In spring 2012 the Project TRUE pilot study was initiated with a group of 5 students (ages 15-18) selected from local high school that require students to participate in an internship to graduate. Their goal was to evaluate insect diversity between a managed site and an un-managed site in the Prospect Park Zoo. Students collected insects using pit-fall traps on a weekly basis over a 2-month period and identified each to family level. They then recorded insect richness and abundance for each of the two sites and Shannon-Wiener diversity was calculated. The students also created insect identification guides for the Prospect Park Zoo based on their findings. In order to assess the success of this pilot study, we administered standardized surveys with the student participates and evaluated both place attachment and sense of place at the beginning and end of the research project. Place attachment and place meaning are components of sense of place, which has been shown to positively correlated pro-environmental behavior. We found that after participation in Project TRUE, students had greater place attachment and sense of place indicating that their participation in the Project TRUE strengthened students' connection to nature in their own back yard. Although out sample size was very small, the lessons learned during this pilot study will be used to improve Project TRUE and expand the size of the program to best serve underserved urban populations.

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Exploring the Roles of Ecological Networks and Ecosystem Service Assessments in Socio-Ecological Systems

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Spatial heterogeneity in urban ecosystems results in increasingly isolated remnant patches unable to support ecological processes. The ecological network concept, as a sub-system of green infrastructure, has emerged in the past two decades in response to expectations for a balance between conservation and development in human-altered environments. It is a spatial concept developed to facilitate the connection of critical ecosystems for protection and restoration of biodiversity. The notion of a sustainable landscape not only emphasizes ecological integrity and the provision of ecological services, but also complex social interactions that are not externalized in dynamic and complex ecosystems. This paper reviews and critiques literature on ecological networks published between 1995 and 2011, focusing on the viability of multiple services provided in the planning and implementation process. Included is a commentary on whether ecological services, as an indicator of value, sufficiently capture the social dimension. An extensive literature search was carried out using keywords of ecological network, biodiversity conservation and ecosystem services. The paper addresses how the primary ecological role of the connectivity embedded in an ecological network relates to social responses. It is contended that these responses remain uncaptured in the decision-making process. A set of challenges and issues remain, however, for integrating biodiversity conservation with other sustainable uses of landscape. This paper suggests potential research directions that could help address these challenges.

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Differential Effects of Variables Related to Urban Environments on the Bird Community Associated With a City in the Neotropics (Bogotá, Colombia)

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The expansive growth of urban areas worldwide has generated a significant concern about the negative effects that this phenomenon may have on the ecosystems, their biodiversity and the ecosystem services that these provide. In response, there is a significant increase in efforts to identify, protect and recover the conservation opportunities at the urban level. Proof of this is the growing study of patterns related to changes in biodiversity along urban gradients. However, little is known about the effects of different variables of configuration of urban space (i.e. the height of the buildings, the presence of roads, the local population density, etc.), on the possibility of generating a truly successful conservation strategy. This study documents the relationship between urban variables such as predominant landscape coverages, vegetation, population density and area of roads, with the structure and composition of the community of birds present in the main and largest city of Colombia, a mega-diverse country with near of 7 million people. For seven months during 2008, these variables were characterized and correlated in 200 fixed points (625.2 ha) with 200m radio through a landscape-scale analysis in four contrasting areas of the city. Comparison of ranges and statistical analysis by one way ANOVA and canonical correlation analysis were used. 94 species of birds within 28 families were recorded, included 76% residents and 28% migratory species. Additionally, we recorded some species with conservation concern as Gallinula melanops (Spot flanked Gallinule) whose national threat category is critical (CR), Eriocnemis cupreoventris (Coppery bellied Puffleg) almost endemic and near threatened (NT) globally and Eremophila alpestris (Horned Lark) in globally threat category of endangered (EN). We concluded that the assessed variables modify and influence significantly the composition and structure of this community, mainly those related to the landscape coverage predominant, population density and area of roads. These results represent opportunities and challenges for the bird communities conservation on urban contexts in neotropical cities and offer a starting point to generate recommendations and more precise criteria to guide future design or interventions of urban green spaces.

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Sites of Community Importance: biodiversity action plans for the conservation of natural resource-Suggested guidelines to decision-makers.

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In the last decades, the rate of decline and even disappearance of species and related habitats, ecosystems and biodiversity has increased throughout the world. This loss of biodiversity is deplorable and has adverse effects on economic development since it is the basis for the food, fibres, drink, medicines, industrial processes, agriculture and fisheries activities that are essential for our survival (COM-2001-162, European Commission). Under the Habitats Directive (92/43/CE), Natura 2000 sites are selected in each bio-geographical region as the Sites of Community Importance (SCI), which become part of the network. Since the beginning of 1990s, in order to achieve sustainable development and integrate environmental into sectoral policies and policy areas, European Community have covered the biodiversity strategies and action plans. The proposed paper combines international and European biodiversity policies (from large to local scale) and literature with the case study research of the SCI in Lombardy Region (Italy) in order to suggest the line guides to decision-makers. Starting from revealing the management efficiency of the SCI by agencies and consortiums, the manuscript underlines that the internationally important wildlife and habitats play a key role for recreational and economic benefits, social welfare and environmental and landscape conservation. The equilibrium between satisfying the people's needs, the requirements of economic development and environmental protection is reachable.

The natural resources strategies of the Lombardy has stressed the following objectives: conservation of wild fauna and flora, preventing biodiversity loss related to the management of water, soil, forests and wetlands. Often at the local scale, the site preservation has extreme difficulty implementing. In order to integrate biodiversity into cross-sectoral environmental measures and into the urban plans, the objectives and actions detailed by regions and local authorities must be based on the environmental liability, environmental impact assessment, strategic environmental assessment, public participation and access to information. Therefore the local authorities should give priority to the SCI that are of most importance in conservation terms: infrastructures, new urban developments and public services must not threaten SCI and ecological networks that ensure a full range of ecosystems, habitats, species and landscapes. The paper highlights the priority actions with the aim to improve the conservation and sustainable use of biodiversity on territory located inside or around the SCI. The study assembles and proposes guidelines to use during the decision-making process, into the urban plans and the urban management taking into account policies and local regulations affecting soil such as agricultural policy, fisheries and aquaculture. Politicians, stakeholders and citizens should be more aware of the strategic role that the SCI play: these sites produce ecosystem services, and they are able to significantly contribute to biodiversity conservation if they are managed effectively. The local authorities need to work together with citizens, public organisms and experts. It means controlling and managing the land-use projects and natural resources towards sustainable objectives. During the decision-making process, local communities can reinforce special action plans for threatened species and sites, formulating a shared framework for a sustainable development.

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A-**13**

Combining Remote Sensing and Landscape Metrics for Urban Development to Monitor Urban Spatial Variation – Examples from Growing and Shrinking Regions

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Large-scale urban development is likely to be one of the primary sources of environmental change over the next decades, and more of this development will take place in India and China than in any other two countries. Rapid urban growth can have severe consequences for environmental sustainability creating an urgent need for alternative pathways to development. Satellite data and further geo-information data are used for landscape ecological evaluations, e.g. to predict structural diversity in landscape, to derive quantitative data on open space fragmentation and on interlink of biotope structures. Satellite images are just as much used to identify compensational areas for planning of building land in conurbations or to quantify landscape metrics by means of derived medium and high resolution satellite parameters in order to calculate neighbourhood relations of objects.

Within the last two decades landscape structure indices or metrics have been implemented on remote sensing image data for different mapping scales. As original input data topographic maps, aerial photographic data as well as satellite images have been used. Thus the analysis of historical samples represents the base for the comparison of current as well as of future landscape structures and enables predicates to evaluate the dynamics of the landscape. Nature, in particular in the suburban cultural landscape is described regarding indicators such as structure (line or planar expansion, cutting, island areas, etc.), dynamics (entry of the modification processes) and texture (neighbourhood relations to other land use forms). This is based on the identification and computation of static and dynamic indicators that help providing a synthetic assessment of suburban landscapes. The indicators will also allow the comparison of the environment's condition in different conurbations. The static indicator includes proportion of urban land uses at different points in time, of road network cutting land uses, but also fragmentation of recreational sites within metropolitan areas and of built-up areas within green spaces in suburban areas. Dynamic urban area indicators refer to typology of changes and the transition from one land-use class to another.

A methodological approach is presented applied to different parts of Europe in growing as well as shrinking urban regions, after which monitoring and evaluation of a landscape diversity in suburban landscapes are feasible on the basis of medium and high resolution satellite data.

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Internalization and Payment of Watershed Environmental Services: Pragmatical Lessons

Luis Gámez*[1]

A pioneer initiative in Heredia, Costa Rica was motivated by the concern of the local water and electricity company (ESPH) for the urgent need to protect the city water supply and its catchment area from the risk posed by urban sprawl and changes in landuse in the upper watershed. Acknowledging the threat of degradation of the catchment area, a valuable social and economic benefit obtained a very low cost, the ESPH creatively applied economic instruments to address expedite field actions. A local and financially self sufficient environmental services payment scheme supported by water company customers, was developed specifically to protect and conserve the catchment area and water sources.

To make this scheme operative, adjustments were introduced in March 2000 to the water service monthly bill in order to make all categories of end-users, contribute directly to finance the cost of protection and maintenance an adequate forest cover in strategic areas for infiltration and recharge of ground water. An additional amount of approximately US $ 0.3/m3 is charged in the monthly water bill in all categories of the water company customers. This stream of fresh revenues is earmarked in order to offer a direct and tangible monetary compensation to private landowners for forest protection and restoration in key points of the watershed used for water supply. Participating landowners receive a payment close to US $ 120 /hectare/yr. for protecting forest located near areas used for the city water supply. This amount represents the opportunity cost of landuse (mainly marginal dairy farming and grasslands) to generate the high quality water environmental service.

In 2011, the ESPH scheme covered1191 hectares of forest and reforestation in public and private land. The financial contribution of end users in Heredia to compensate for the costs borne by the national park and landowners for forest conservation, responds to a high benefit - low cost investment strategy based on a social equity and the user-pays-principle. This initiative is fully independent in administration and self-sufficient in funding, and does not rely on government or international aid for its operation. This case study can provide some sense of what is achievable in terms of stimulating operative markets for environmental services through direct and tangible *willingness-to-pay* in a developing tropical country.

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Vulnerability of Urban Ecosystem and Biodiversity in Dar Es Salaam City (Tanzania)—Initiatives and Policy Perspectives

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Since 1961, independence of Tanzania, there is continual growth of the urban population. Cities like Dar es Salaam rely heavily on ecosystem services for their existence and growth. A number of cities in Tanzania are dependent on ecosystems because of the large proportion of poor inhabitants. There is approximately 40 % poor population living in Tanzania. The urban poor cannot afford to purchase services and goods. They rely on ecosystems to provide clean air, water, fuel, food, construction material and other services.

It is expected that 70 per cent of Dar es Salaam five million residents live in informal, unplanned settlements that lack adequate infrastructure and services. An estimated 30 per cent of the Dar es Salaam economy is based on biological products and processes. The impact of human activities is disturbing the ecosystems in Dar es Salaam—a business, and financial city of Tanzania. The local government is not able to manage the flora, fauna and natural resources in integrated way which is essential for sustainable development.

Issues and Challenges

People who want to live in the city depend on biodiversity in the existing environment but which is posing a threat to peaceful and coherent life of urban citizens. Increasing human activities in Dar es Salaam city are causing the progressive loss of species of plants and animals at a rate far higher than the natural background rate of extinction. Rapid unplanned urbanization in Dar has led to flood risk in many informal settlements, with a wide range of associated health and other problems for residents. The ecological and hydrological role of wetlands is not well incorporated in urban development planning. A number of issues have arisen like how many there are parks, open spaces, forest areas, trees, etc within the boundary of Dar city? Whether poverty, industrialization, etc. posing a threat to biodiversity and ecosystem of Dar city? Whether the government is investing money to protect natural capital or disturbing them only for economic benefits? How far air pollution and solid waste is disturbing biodiversity in the city? Whether there is any effective policy to protect and save flora and fauna? How far local government is implementing guidelines and strategy as enshrined in Climate Policy formulated by the East African Community (EAC)?

Initiatives

The Government of Tanzania and the local government of Dar es Salaam have taken a number of initiatives to protect biodiversity. The local government has created mechanisms for tapping and flaring the gases produced at the dump, Industries are being shifted away from residential areas. The government has taken steps to eradicate unplanned areas in many zones of the city. The local government has taken various initiatives such as coastal management, Kinondoni Integrated Coastal Area Management, Community Infrastructure upgrading Program, etc.

Policy Perspectives

The capacity of Tanzania Meteorological Agency needs to be improved in weather and climate monitoring. The city of Dar is pioneering the use of innovative and cooperative initiatives involving urban ecological conservation, restoration and maintenance that will help ensure that the country's rich natural heritage is not destroyed. The local government of Dar is trying to become leaders in biodiversity protection and management and making effort to form policy development on urban biodiversity. A city like Dar is a key to ensure a better tomorrow and the survival of life on metro city.

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