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Developing a Virtual Tool for K-A-M-P.ing Plant Resources in Multi-Scale Urban Areas

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***Abstract*:- Vegetation or plant resources in urban areas are becoming scarce day by day, especially in densely populated and congested cities that are suffering from ever decreasing nature's footprint. This syndrome is typically seen in the Indian metropolises, particularly in those cities that are experiencing an escalating population density. Vegetations are fast losing their foothold in this skewed competition with human race that have priorities opposite to harmony with nature and look at trees as hindrances against so-called development. Other than the obvious environmental and cultural benefits, human society is also failing to appreciate the 'educational value' of vegetations that impart significant practical understanding of nature and how it works. However, knowledge dissemination has to come through technological aid befitting the digital era that we live in today. This paper discusses a simple virtual tool that can serve this very purpose and introduce vegetation resources to the society at large in a lucid manner so as to promote Knowledge-Appreciation-Management-Protection (K-A-M-P) of vegetation resources. The vertical stages of this introduction could be basic, starting with trees and then scaled up to include all other taxonomic classes of vegetation while it can be applied across a substantial number of disciplines like park management, property/estate valuation, scientific research, planning interventions, botanical / horticultural pedagogy etc. A precedent case exists in Arnold Arboretum of Harvard University, USA that is used to explore its botanical collections. The tool is essentially a web and mobile based Geographic Information System (GIS) application that can be easily used to collect information on a particular species or an individual specimen in any specific physical context, particularly nature-stressed multi-scale urban areas.**

Key words: Vegetations, urban trees, virtual access, GIS, web/ mobile application

INTRODUCTION:

Vegetation or plant resources in urban areas are reeling under extreme stress in their 'struggle for existence' and cohabitation with humans and their ever-expanding development 'needs'. Indian cities of different classes and varying scales are witness to this phenomenon of steady loss of nature and its resources, much due to environmental apathy, limited understanding of progress and short term gains. The emphasis here is more on urban trees, which are silent but effective workers of urban pollution abatement and the most beneficial companion of urban population. The price is also being paid by the same citizenry in terms of deteriorating public health, increasing health costs, loss of ecological and cultural benefits and lack of awareness on natural systems. This paper intends to focus on the lattermost aspect where knowledge and appreciation on part of the society can bring about positive changes in management and protection of these important plant resources, especially in urban areas. Thus develops the concept of K-A-M-P i.e. 'Knowledge, Appreciation, Management and Protection' of these components of the natural systems. Other than members of the civil society like responsible individuals, park managers, Government estate custodians, scientists and researchers, K-A-M-P is also targeted towards the young learners in schools and colleges who are mostly taught in close-door environments equipped with only theoretical knowledge on nature, in general and plant resources, in particular. Once a while visit to rarely occurring parks in the city might happen in certain cases, but even so, it is difficult for mentors to ensure uniform access to information to all beneficiaries/ students. It is obvious that K-A-M-P concept must be extended to these classrooms as well for creating more nature-aware future citizens. For either purpose and irrespective of the age-bracket, the objectives of K-A-M-P would be best fulfilled by some virtual means taking advantage of today's technological innovations. In this backdrop, the paper discusses a simple teaching-learning tool that can serve this very purpose in a smart way. The learning can be at varying vertical stages viz. basic, advanced and highly advanced while being applicable to disciplines ranging from touristic interest (for botanical gardens etc.), park & plant resource management, property/estate valuation, scientific research, planning interventions to botanical / horticultural pedagogy. The tool is essentially a web and mobile based Geographic Information System (GIS) application that can be easily used to gain virtual access to botanical information about a particular species or an individual specimen in any specific physical context, which the authors feel to be particularly useful in nature-stressed multi-scale urban areas for new learners or any interested member of the society. As such, this GIS based technology is widely used in forestry for planning and decision making (Kulshrestha et al, 2007). Multi-scale urban areas like highways/ pathways, district/ neighbourhood parks, Government estates, institutional/ commercial or residential landscapes, important historic gardens and public landscapes- all can be brought under the coverage of this tool so that a large section of the society learns to appreciate nature and becomes plant-literate. By popularizing the 'K-A-M-P' movement, conservation goals of botanical resources and its dependent bio-diversity habitats within the urban area could also be achieved to a large extent. In a city like Kolkata, with an area of 205 sq.

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km., population density of nearly 25000 persons per sq. km. (KMC web sources) and only 7% green area, a simple starting point for Kolkata's K-A-M-P would be documentation of existing vegetation reserves in its scantily occurring urban green patches. The objective is to allow scientists, citizens and visitors gain better access to the vegetation structure, both virtually and physically. Thus it would also help in promoting and supporting scientific understanding with detailed information on vegetation species, including their taxonomic placement and role as habitat.

The following figure shows the intention and purpose of the tool in question and how it aims to bridge nature and society:

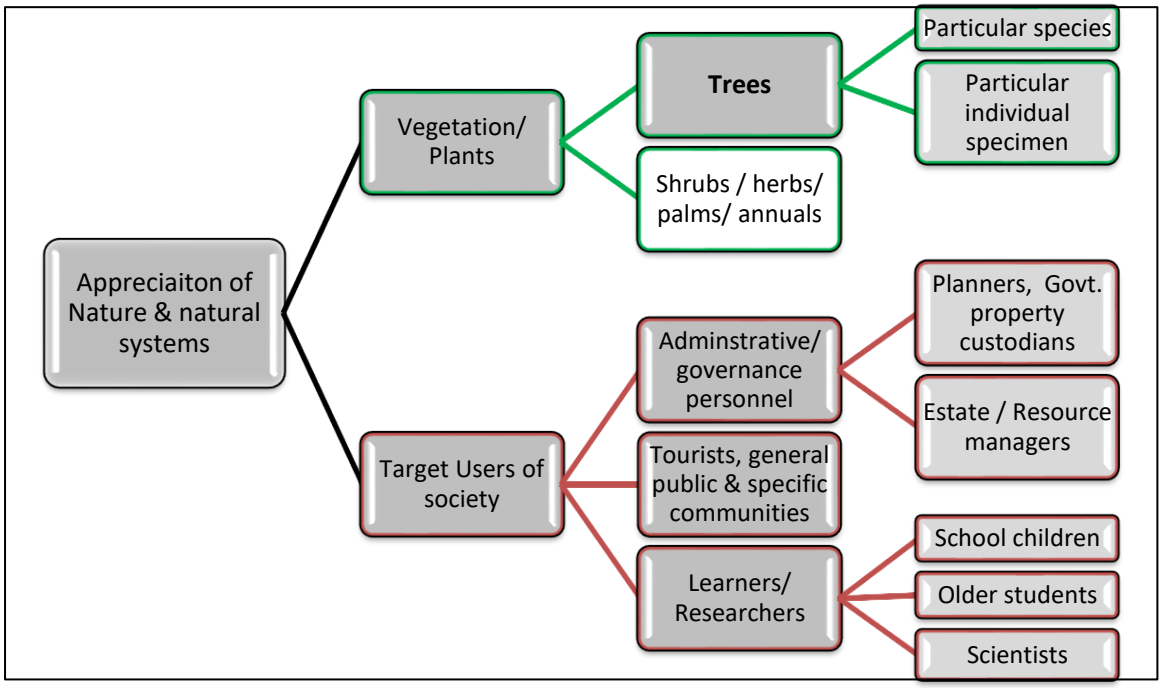

Figure 1: Conceptual Linkages between Nature and Society for better understanding of vegetation resources

With this background of concern and concept, the present paper aims to report a pilot study that was conducted at the Jadavpur University campus in Kolkata involving documentation and inventory creation of individual trees in a select area through field survey, recording the identified attributes of the trees including taxonomic and phenological aspects through both field survey as well as literature sources and finally, using GIS application to link it to the web and mobile based application to form a basis of information and interpretation for University community.

PRECEDENT STUDIES:

Arnold Arboretum of Harvard University has been using a mobile mapping technology developed on a particular software platform called Mobile Interactive Map (MIM) since 2012 to help both scientists and visitors access its botanical collections both physically and virtually (DeMeritt, 2013). The Arboretum is known for its well-curated diverse plant collections accessioned from different countries and its support for scientific research. Through MIM, these collections have been made accessible online through both smart phones as well as desktop browsers, enabling interested individuals to simply click on the map and access a plant database covering its natural history, taxonomic classifications as well as individual plant stories.

METHODOLOGY:

The present pilot study involved the following seven stages, also represented in figure 2:

i. A two-acre natural patch in the University campus was selected as the study area
ii. Extensive field survey for spatial data collection: documentation of the existing trees and the Global Positioning System or GPS locations for each individual tree was noted down
iii. Similar survey for non-spatial data collection: Taxonomic, morphological and phenological attributes were noted down
iv. Formation of detailed database with the above attributes (as in figure 3)
v. Linking of spatial and non-spatial data carried out on ArcGIS platform and map generation
vi. Re-validation of all information through field verification
vii. Creation of web and mobile based application

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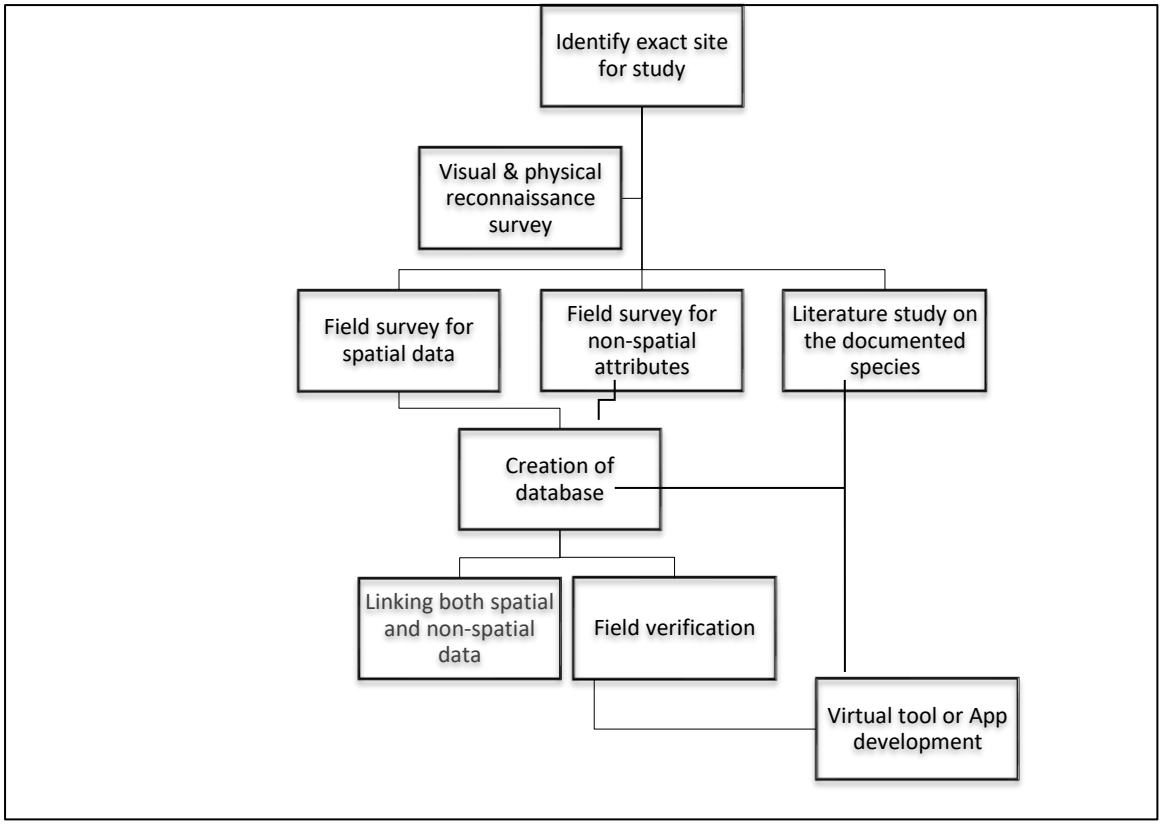

Figure 2: Basic Methodology of the study

CONSIDERATIONS AND TREE ATTRIBUTE SELECTION:

The selection of the trees for mapping and documentation was done based on their age and height, such that none is less than five years and/or more than five feet tall. The non-spatial attributes were: taxonomic classes, morphological characteristics like trunk girth at breast height, crown height and crown spread while phenological attributes were flowering period, fruiting period, whether evergreen or deciduous and defoliation period. International Union for Conservation of Nature (IUCN) status informing about the global conservation status of the species was also added. This format has been chosen to be in conformity with forest resource survey (Jim, 2008; Tyagi et al, 2007) and is further explained in the Table below:

SELECTED TREE ATTRIBUTES			
Taxonomic classification	**Morphological characteristics**	**Phenological attributes**	**IUCN Status**
• Family, genera, species	• Trunk girth • Crown height • Crown spread	• Evergreen or Deciduous • Flowering period • Fruiting period • Defoliation period	• Extinct • Threatended • Lower risk

RESULTS AND DISCUSSION

This two acre Green Zone has a total of 151 nos. matured Palms and tree individuals with four Palm and 30 tree species with an almost 50:50 share of evergreen and deciduous species (Bardhan et al, 2019). The tree density per acre is 75.5 while species diversity per acre is 17, both of which are reasonable considering the size of the patch and its dense setting. The map of the zone with these 151 tree-and-palm individuals marked discretely is shown in figure 3.

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Figure 3: Map of the two-acre patch in the University campus showing GPS location of the exisitng trees on Google Earth Pro Map

The Geographic Information System (GIS) enabled tool will be used by the mobile application user to access the plant database having geographically referenced information at site or on map and retrieve desired information through a simple click. The tool administration will have to store different kind of information in various layers to make these available to the users when sought. Figure 4 depicts a representation of these four corner-stones of the tool:

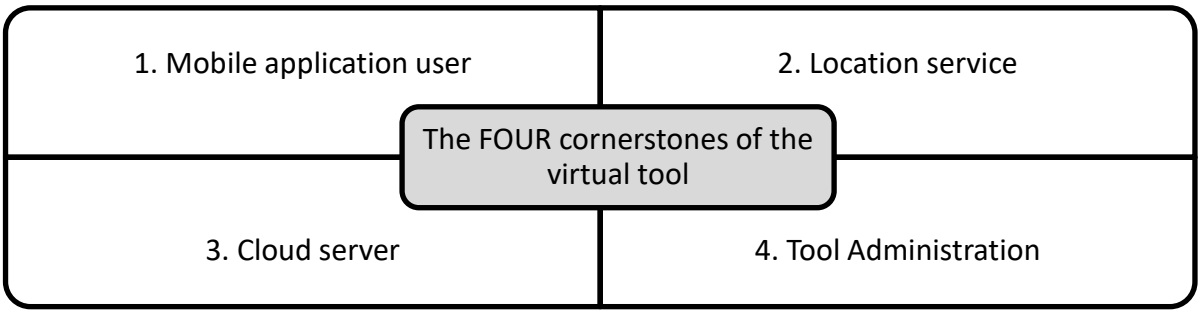

Figure 4: The four cornerstones of the virtual tool

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At the basic level, this information not only helps to **know** and **appreciate**, but also in understanding and interpreting complex issues related to **management** and **protection** of the plant species. This tool is currently at its final stage and waiting to be checked for its operational effectiveness and elimination of error. Once this experimental phase of the pilot study is successfully completed, the tool could be made accessible to the university community before being widely open to general public.

CONCLUSION

This study springs from the premises of concern for nature-devoid urban areas and large scale apathy to nature and natural systems that are rooted in overall ignorance about the benefits of nature, particularly trees. The tool in question is being developed as part of a pilot study to bring society closer to nature by using technology. It is envisaged that this tool would help in Knowing-Appreciating-Managing-Protecting nature, environment and trees, especially in the much needed urban areas of varying scale. Eventually, by widening the database, the tool can cover all taxonomic classes of the plant kingdom and also extend to different built environments to help in nature conservation and property management as well as making planning interventions. The future avenues for this tool are spread both vertically and horizontally like including a large number of attributes, extending it to all other plant classes and apply in forestry and national parks etc.

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