Chapter 5
Reshaping Neighborhood Parks for Biodiversity and People: A Case of Unsung Socio-Ecological Systems in Bangalore, India

Savitha Swamy and M. Soubadra Devy

Abstract Urban green spaces have recently gained a lot of attention, as they are known to provide various vital ecosystem services to the community. Bangalore, a south-Indian city, which was called the "Garden City" of India, has several large green spaces. It is only in recent years that small pocket green spaces such as neighborhood parks have been created. Although the importance of neighborhood parks is known, they are ignored and readily sacrificed for developmental projects, while the large heritage green spaces receive more attention and are conserved. The concept of the large spaces providing more services seems to have filtered into the minds of citizens, thus resulting in complete negligence towards the neighborhood parks. Cities are required to implement newer concepts which focus on small green spaces too, which could enhance the services they currently provide to the community. Thus integrating multiple concepts that not only focus on the ecological functioning but also the social needs of the community could help increase the stewardship which is currently lacking around neighborhood parks and much needed attention towards small green spaces. In this chapter, through an interdisciplinary approach, we suggest concepts that could help conserve smaller green spaces through better green space management in developing cities.

Keywords Bangalore • Ecosystem services • Neighborhood parks • Reconciliation ecology • Socio-ecological systems

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5.1 Introduction

Ecosystems the world over are under tremendous pressure and the scope and nature of their modification has changed drastically (Vitousek et al. 1997). Although modification of natural ecosystems cannot be avoided, because they satisfy basic human requirements such as food and shelter, there is an urgent need to conserve and achieve sustainability of the services and resources that ecosystems provide (Kenward et al. 2011). Cities have always drawn on their surrounding ecosystems for goods and services (Folke et al. 1997; Rees 1997; Rees 2003). Over the last decade, rapid development has resulted in two distinct landscape patterns: (1) encroachment into peri-urban areas resulting in sprawling cities and (2) encroachment into large expanses of greenery within the city, resulting in remnant small ordinary green spaces (Tratalos et al. 2007; Ricketts and Imnoff 2003; Kinzig and Grove 2000). Both patterns have increasingly disconnected people from the nature that supports them (Andersson 2006). To gain much-needed public involvement from multi-stakeholders for ecosystem preservation, the places where people live and work need to be designed so as to offer opportunities for meaningful interactions with the natural world (Andersson 2006; Miller 2005).

Negotiations of green spaces for development have led to sparse fragmented habitats, affecting biodiversity within the city. Such changes have allowed for rapid species turnover, extinction, reduction in specialists, and increase of generalists (Sodhi and Ehrlich 2010). For example, sparrows (*Passer domesticus*) that used to nest on house rooftops have now disappeared from the South Indian city Bangalore and are found only in the peri-urban areas (Dandapat et al. 2010). Similarly, increase in high-rise buildings has increased the number of Blue Rock Pigeons (*Columba livia*) because these buildings provide adequate nesting sites for them (Joshua and Ali 2011). In an ever-challenging task to conserve biodiversity within the city, there is a need to create and conserve green spaces which can be achieved by reconciling people's preferences with biodiversity requirements (UN-HABITAT 2010). Also, traditional theories of conservation biology focus only on large green spaces which cannot be applied any longer within cities; we need newer strategies and approaches. Reconciliation ecology which works within human-dominated ecosystem as defined by Rosenzweig is "the science of inventing, establishing and maintaining new habitats to conserve species diversity in places where people live, work or play" (Rosenzweig 2003b). There are a growing number of examples demonstrating that reconciling habitats within human-dominated landscapes has worked. For example, the US National Wildlife Federation has sponsored a campaign called "Backyard Wildlife Habitat," which encourages people to bring nature to their homes, which could vary in area from a few hectares to a single balcony. They have created and modified human habitats to provide the needs of some wildlife (Tufts and Loewer 1995) and this has even worked for endangered species such as the Eastern Blue Bird (*Sialis sialis*). It is important to focus on ordinary green spaces and change principles from the obsession of conserving rare and endangered species within urban habitats.

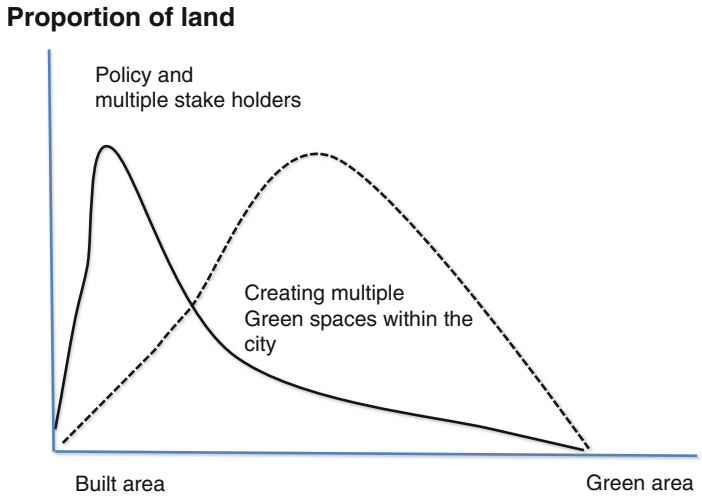

Fig. 5.1 Reconciliation ecology accomplishes biodiversity conservation and indirectly enhances the ecosystem services that small green spaces provide. (Adapted from Rosenzweig 2003a, b)

Through several such successful attempts within human-dominated landscapes, reconciliation ecology gives us hope that we can conserve and sustain habitats without necessitating a tradeoff between biodiversity and human use (Kenward et al. 2011). For example, within residential neighborhoods, creating home gardens, terrace gardens, neighborhood parks (NPs), and planting avenue trees by involving multiple stakeholders could increase the green areas as well as help conserve biodiversity (Fig. 5.1). Appropriate policies implemented effectively could also help increase the services that small green spaces provide to the community, thereby balancing green vs built-up areas within neighborhoods (Fig. 5.1). These habitats not only provide opportunities for human–nature links on a daily basis, but also deliver vital environmental services that contribute to a healthy and satisfying living environment, essential for human well-being (Millennium Ecosystem Assessment 2005).

Even if humanity is increasingly urban, we are still as dependent on the services that urban green spaces provide as before. This increasing urbanization has modified the ecology of landscapes by: changing habitats and leading to habitat fragmentation and creation of novel habitat types (Niemela 1999; Wood and Pullin 2000); altering resource flows including reduction in net productivity and increasing temperature and degradation of air and water quality (Henry and Dicks 1987; Rebele 1994; Donovan et al. 2005); shifting disturbance regimes, with many habitats experiencing frequent disruptions to development (Tratalos et al. 2007); and changing species composition and diversity (McKinney 2002). In fact, with all these escalating changes, and with increasing awareness, citizens have a growing expectation from these small green islands in terms of the range of ecosystem services (ESs) they provide such as: supporting (nutrient cycling, soil formation),

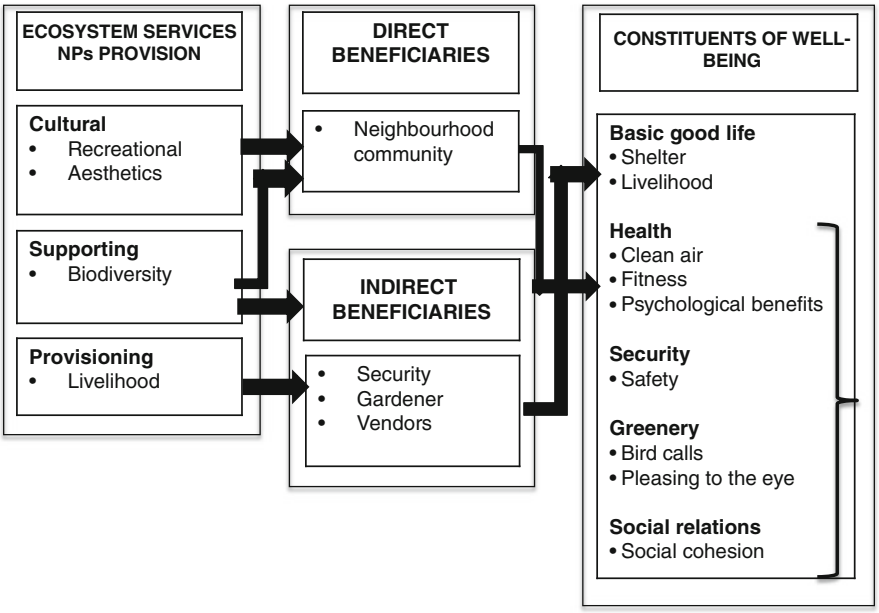

Fig. 5.2 Relationships between ecosystem services and human well-being. (Adapted from Millennium ecosystem Assessment 2005)

regulating (climate, hydrology), provisioning (food, water), biodiversity, cultural (recreation, enhancement of property value), and many others (Millennium Ecosystem Assessment 2005). Studies have shown that the ESs provided by green spaces are directly related to human well-being and sustainability of the city (Bolund and Hunhammar 1999; Daily 1997). As the Millennium Ecosystem Assessment (MEA) is about improving human well-being, from the information we have gathered the community also identifies biodiversity as a service; we therefore use a modified MEA framework throughout this study (Fig. 5.2). The community perceives biodiversity to provide it with benefits such as fruit and flowers through pollination. Thus, we choose to include biodiversity under supporting services (Fig. 5.2).

In order to increase livability, several countries are developing newer greening concepts such as vertical and roof top gardening and implementing them to provide ESs to the population and also act as corridors specifically for the mobile taxa to move from one patch to another (Getter and Rowe 2006). With the increase in people's dependence on urban green spaces for recreation/esthetics and other ESs, there is an urgent need to gear up the functioning of these spaces through conservation and appropriate management practices (Devy et al. 2009).

To achieve biodiversity conservation and to enhance ESs, multiple stakeholder involvement at various scales and policies that can be adapted with the changing environment, are needed. Urban systems have long been considering the social and

the ecological systems as two different elements within a common system. Both these systems in fact are interwoven and need to be perceived as a socio-ecological system which can help us understand the resilience of such a system and strategize towards sustainable development of urban green spaces (Tarraga and Miguel 2006). For the last few years, developing countries have been attracting people from all over the world. This has resulted in exchange of cultures, leading to changes in lifestyle, attitudes, perception of people, and, to a large extent, has also influenced our urban green spaces by bringing in trendy looks (Swamy and Devy 2012). For example, people in India are switching over from traditional home gardens to manicured lawns and turf which is the natural vegetation in temperate countries. Even offices and institutional campuses are experiencing the same trend. Recently developed neighborhood parks (NPs) in Bangalore are no longer wooded stands and these changes have resulted in a cascading effect not only on the biodiversity sheltered by the traditional green spaces, but also on the processes and functions of the urban ecosystem that promote human health and well-being (Millennium Ecosystem Assessment 2005).

To conserve and maintain a resilient green space with minimal biodiversity components providing optimal ESs, one has to develop innovative partnerships, collaboration, and stewardship, which the socio-ecological system framework demands (Stringer et al. 2006). Adaptive co-management, which is "learning while doing," could be a useful model to adopt as it offers opportunities to examine the potential of collaboration between partners which integrates ecology and society (Hahn et al. 2006). Adaptive co-management also focuses on creating functional feedback loops between social and ecological systems, and has been a useful tool in tracking sustainable paths and building social-ecological resilience (Berkes and Folke 1998; Gunderson and Holling 2002). It relies on seizing a window of opportunity and linking diverse set of actors operating at different levels, often in networks from local users to municipalities to regional and national organizations (Ernstson et al. 2010). For example, residential neighborhoods comprise diverse green spaces, from NPs, avenue trees, and institution campuses to home gardens. Linking them at the neighborhood scale would require municipality, local academic institutions, and home garden owners to work together to help develop a green network at the neighborhood scale (Fig. 5.3). Perhaps modelling a socio-ecological system and projecting various paths under various scenarios based on current management will help all players visualize the future of some existing systems in cities.

In recent years, conservation and sustainability of natural resources have also been highlighted in the urban context (Newman 1999). Unlike pristine ecosystems, where unsustainable extraction has led to deterioration of resources (Ostrom 1990), in the urban context it mainly pertains to reduction in ecosystem services (ESs) provided by green spaces because of developmental activities. Following inefficient management and lack of monitoring green spaces for improvement or conversion to alternative use by the governing body responsible, urban ecologists have stressed and demanded an integrated approach, arranging for multiple stakeholders,

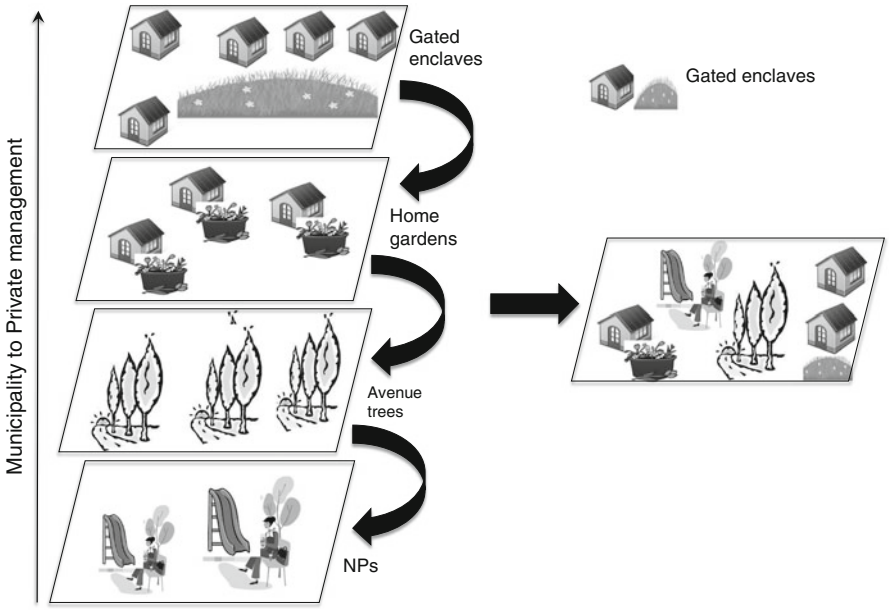

Fig. 5.3 Green network within residential neighborhoods in the presence of neighborhood parks

including citizen groups, to prevent further deterioration of urban ecological systems (Grimm et al. 2000; Pickett et al. 2001).

Bangalore city, once known as the "Garden City" of India, has seen a great level of erosion in green spaces, so much so that it has lost its earlier identity and is now looked on more as the "Silicon Valley" of India (Nagendra and Gopal 2010). Like other Asian cities, Bangalore has taken a path that faces a dilemma between conservation of green spaces and development. Although policies on urban green space exist, they are seldom enforced by the Bruhat Bengaluru Mahanagara Palike (BBMP), horticulture departments (urban governing bodies), or the citizens, and are more often violated. Policies, which lack flexibility, adaptive resilience and multi-institutional involvement, have been identified as causal factors for inefficient green space management in the urban context (Olsson et al. 2007; Olsson et al. 2004). Most of the policies related to green spaces that exist today for Bangalore were formulated several decades ago (Ravindran 2007). As policy makers did not foresee the complexities, the policies drafted remain largely outdated, as they are unable to tackle issues that are prevalent today. Apart from being outdated, these policies do not integrate feedback from stakeholders and other basic processes that regulate the dynamics of green spaces within the system in order to function better (Tarraga and Miguel 2006). Here we focus on neighborhood parks (NPs) because large green spaces within the city receive exceptional patronage from the citizen groups, naturalists, and several other stakeholders. In contrast, although NPs are vital green spaces within neighborhoods, they are completely neglected and lack public empathy; hence they are constantly under threat of alternative uses such as

institutional playgrounds and civic amenity centers (Swamy and Devy 2010). Rosenzweig (2003a) suggests that it is essential to reconcile nature even in places where people live, work, and play. Thus, this chapter delves into the premise of transforming NPs, which are emerging as necessary "urban commons" at a neighborhood scale, to support at least "ordinary nature". We also provide a framework based on some of our findings to make NPs multifunctional.

5.2 Key Findings

Ecosystem services—Integrating the community's requirements such as esthetic and recreational services, mixed landscape types that people prefer to open or compact parks, increasing density of NPs in the neighborhood and enhancing biodiversity beginning with people's most-liked taxa (Swamy 2013; Fig. 5.4). A biodiversity fondness survey was conducted, and the Likert-scaling method was employed to assess people's tolerance levels towards nine commonly encountered taxa in NPs (Meyers et al. 2005). A total of 425 questionnaire surveys were conducted amongst park users to identify their fondness across 9 taxa that were

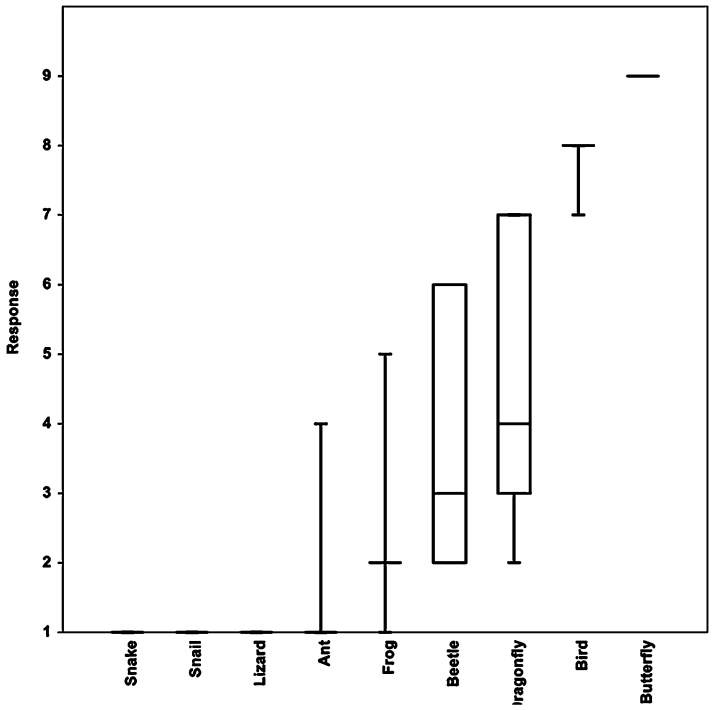

Fig. 5.4 Fondness survey across nine commonly found taxa within neighborhood parks using the Likert scale where 1 represents complete intolerance towards the taxa and 9 extreme fondness

commonly found in NPs. A nine-level scaling method (Dawes 2008) was used, where nine denotes fondness towards the taxa and one indicates complete intolerance. The Likert-scaling helped identify the two taxa that people were fond of—birds and butterflies—which were then sampled systematically in all 37 NPs, using the point count method. The results showed that users were fond of butterflies followed by birds. Some taxa such as lizards, snails, and snakes belonged to the intolerant scale (Fig. 5.4) and were disliked by all (100 %) respondents.

Biodiversity support services—Based on the density and sizes of parks, four distinct groups were recognized—high-density NPs along with the presence/absence of large green spaces (HNP + LP; HNP-LP) and low-density NPs in the presence/absence of large green spaces (LNP + LP; LNP-LP). The species accumulation curve across three classes of parks embedded within a 2-km buffer was compared for birds, butterflies, and insects, and showed varying NP densities within a 2-km buffer. High density packing of NPs in the absence of large parks (HNP-LP) and low density of NPs in the presence of large parks were high in species richness (LNP + LP; Fig. 5.5). LNP-LP showed a lower level of species accumulation; there were very few locations in the city with HNP + LP.

Creating high-density NPs and/linking sparse NPs to the large green space in the vicinity could help enhance biodiversity support service within NPs and their neighborhoods. Linking several small green spaces can also increase local species richness within residential neighborhoods (Fig. 5.5).

Management—Linking multiple stakeholders could help distribute responsibilities and increases efficiency and knowledge to help create a resilient system, such as involving the Residential Welfare Association (RWA) in managing the park in collaboration with the municipality along with the participation of ecological organizations. These were classified as (Fig. 5.6) co-managed NPs (henceforth CoM NPs)—the tenure of all the parks within the BBMP boundary is managed and owned by the BBMP horticulture department. Through the "adoption policy," as stated by the BBMP horticulture department, interested individuals within a few areas have formed an RWA, a statutory body, which has collaborated with the BBMP horticulture department in managing the parks within their neighborhood. This was compared with city-managed NPs (henceforth CiM NPs). The BBMP horticulture department manages and maintains the NP through its employees who are gardeners and landscape contractors. Social Network Analysis (henceforth SNA) is a useful tool to study effectively the governance organizations, comprising individual actors who are linked together through various relationships (Scholz and Wang 2006; Bodin et al. 2006; Crona and Bodin 2009; Ernstson et al. 2010). A survey started with the president of the RWA and followed a snowball effect until the complete network of actors was covered.

Using SNA, this study delineated the management structures responsible for NPs and identified gaps and means to strengthen the networks from the current state to the near-ideal state so as to provide enhanced services through better green space governance (Fig. 5.6). The numbers of actors (individuals) within the CoM NPs seem to differ across the replicates, hence allowing for structural variations and adaptive flexibility unlike CiM NPs, which are uniform The CiM replicates show

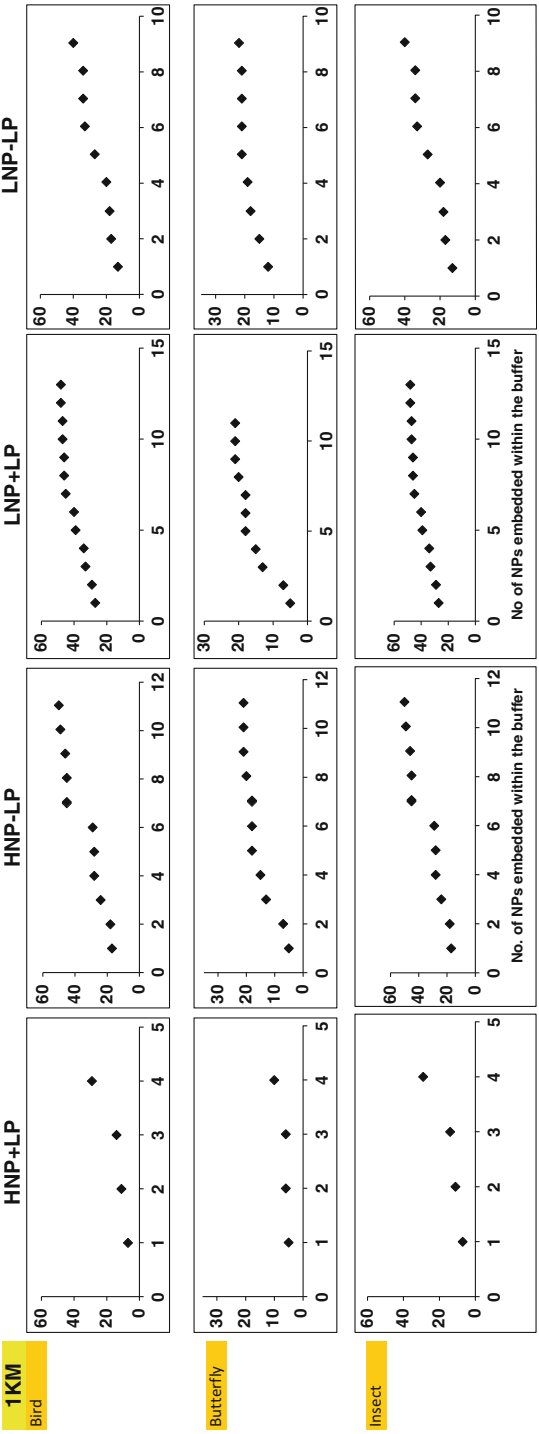

Fig. 5.5 Species accumulation with increasing NPs in buffer of 1 km with various combinations

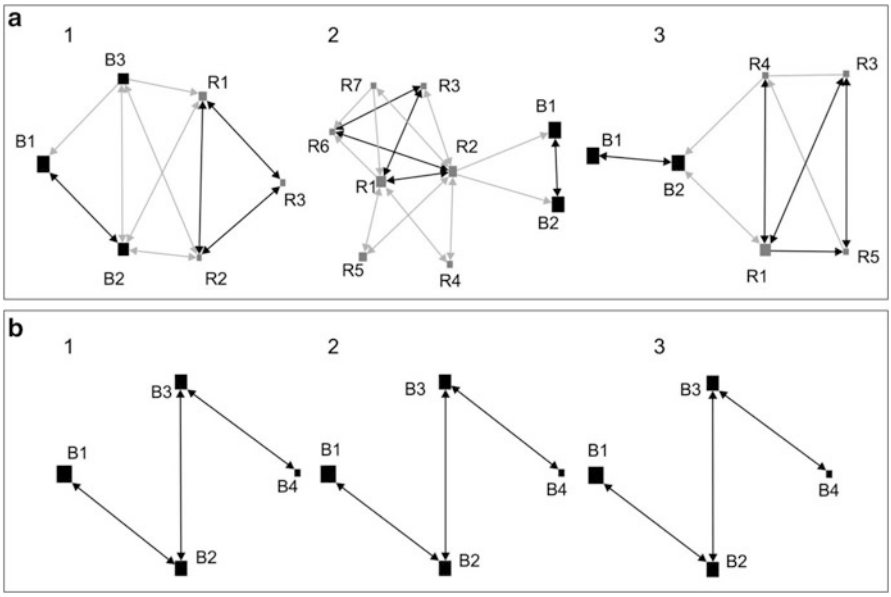

Fig. 5.6 Involvement of multiple stakeholders across replicates demonstrating strength (represented by *thickness*) and flexibility. R (in *gray*) represents actors within the RWA and B (in *black*) represents actors who belong to the BBMP horticulture department. *Thicker lines* represent higher levels of interactions between actors. *Symbols* represent an actor who is a single person, size of the symbol represents his/her position in network

that the links between all actors are one-way. The absence of two-way links clearly demonstrates the strict hierarchical system within the BBMP horticulture department (Fig. 5.7) in governance and management; hence, showing a linear top-down relationship within CiM NPs and among the BBMP actors belonging to CoM NPs (Fig. 5.7).

Governance and policy—A bottom-up approach, with a feedback mechanism in place could help develop a better green space management for NPs. The absence of two-way links among the municipality employees clearly demonstrates the strict hierarchical system within the BBMP horticulture department in the governance and management thereof; hence, showing a linear top-down relationship (Fig. 5.7). Involving the Resident Welfare Association (RWA) could help in complex linkages (Fig. 5.6), rendering the management more flexible and strong both in terms of knowledge and interaction to make efficient decisions that feed back into the system.

The existing policies are reviewed and a conceptual model for pocket green space is proposed at neighborhood scale based on the findings on ESs provided by NPs and appreciated by the citizens in Bangalore. The results showed that although NPs provide intangible services that are essential for human well-being (Bolund and Hunhammar 1999), they constantly face threats of being replaced by development activities. Lack of stewardship to safeguard these pocket green spaces has led to easy conversion to alternative uses. General apathy towards NPs could stem from the fact that the "vital services" provided by them have not been highlighted

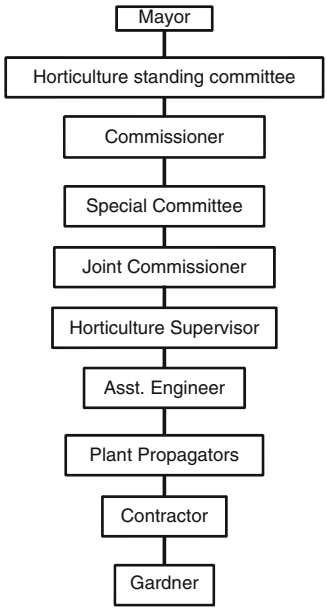

Fig. 5.7 Hierarchical chart of management personnel within the BBMP horticulture department

vis-à-vis large heritage parks (henceforth HPs), which by their sheer size and long duration of presence in the city have received larger patronage by citizens and conservationists. Although, HPs provide ESs similar to those of NPs but at a higher magnitude, they have also attracted the "nature enthusiasts" because of the higher biodiversity they support. All articles from two popular and well circulated dailies, *The Hindu*, *Deccan Herald* and *Times of India*, regarding threats to green spaces were collected between 2007 June and 2012 May, and these were used to assess the stakeholders' contributions through participation in protests towards diverse green spaces within Bangalore city.

Results obtained from a total of 122 newspaper articles clearly suggest that there is an upsurge of citizenry involvement whenever there is a threat to large green spaces and avenue trees, but threats towards NPs go unnoticed and do not gain so much publicity (Fig. 5.8). The newspaper article survey over a period of 6 years has shown that only two NPs were put to alternative use. In contrast to this, interviews with the park target groups revealed that, in several areas, plots allotted for NPs have been converted into civic amity centers or playgrounds. Bangalore saw the major infrastructure expansion from 2009 and 2011 which saw rampant expansion of roads and clearing of large parks for mass transit systems. This brought citizens and environmental groups to protest in the street. This served as feedback to municipality and has brought some respite to the clearing of avenue trees and large green spaces. There is also general apathy among the citizens towards neighborhood parks, although they are used on a daily basis.

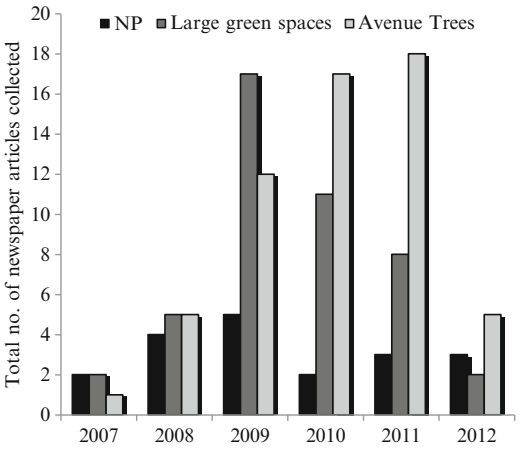

Fig. 5.8 Citizenry participation towards green spaces in Bangalore city

5.3 Conceptual Model

A conceptual framework is proposed by us for sustainability of NPs based on findings (Fig. 5.9).

Integrating and gradually converting the dominant open type (trees only along the boundary of the park) NPs to mixed landscape type (trees along the boundary wall and scattered in the center of the park), with taxa-specific habitat features such as canopy cover, shrub abundance, and herb proportion within NPs and in the surrounding landscape, could enhance local species richness within NPs and at the neighborhood scale. Increasing neighborhoods with higher densities of NPs than are prevalent now could not only facilitate diverse recreational services for the community but also help achieve conserving biodiversity in the neighborhood. Our analysis on determinants of biodiversity support services showed that a high density of NPs can be effective even in the absence of large parks, while a low density of NPs in the presence of large parks can enhance local species richness (Swamy 2013). Linking other neighborhood green spaces such as home gardens, avenue trees and NPs could also effectively help enhance biodiversity at the neighborhood scale (Fig. 5.3).

A bottom-up approach which incorporates not just popular services such as esthetic and recreation, but also biodiversity services, by involving multiple stakeholders, allowing for both direct and indirect feedbacks into the system; would help develop better green space policies.

This can be a daunting task if the governance organizations responsible for neighborhood green spaces are absent or are not efficient in managing these critical spaces. Thus, the governance organizations responsible for green spaces within neighborhoods could play an important role in enhancing and building green networks. Knowledge on NPs can provide enhanced services, but the dominant governance structure, which is driven by the municipality, continues to manage them without knowledge of the biodiversity perspective and people's requirements. Discontentment amongst the citizen group with the inability of the municipality to

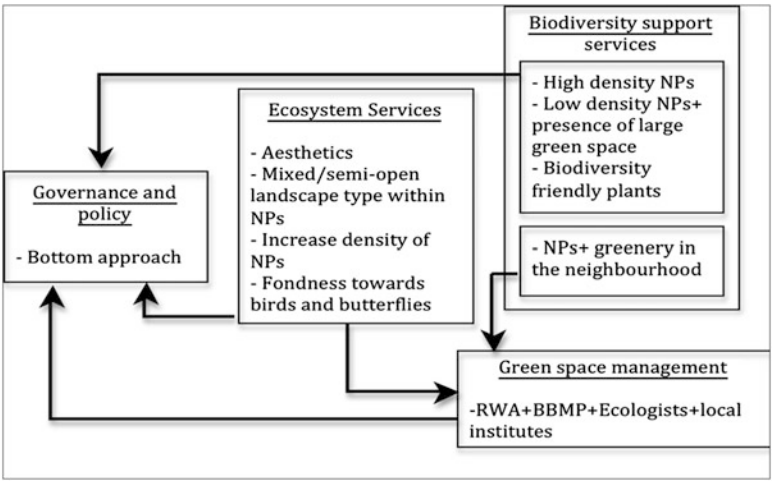

Fig. 5.9 Conceptual framework by linking ecosystem services around neighborhood parks

manage NPs, has led them to form a group through a Residential Welfare Association (RWA). Such stewardship has also helped prevent conversion of a few NPs into alternative use (Anonymous 2001). RWAs have collaborated with the municipality to improve the management of NPs through co-management (Fig. 5.6). This newly emerging governance structure has, to an extent, allowed citizens to incorporate facilities within NPs according to their requirements. Lack of ecological knowledge amongst the RWA members and the municipality does not allow for enhancing the ESs of NPs. Thus, to strengthen the co-management around NPs requires involvement of ecologists and conservation biologists for sharing knowledge, building the capacity of the neighborhood community for growing biodiversity friendly plants within homes, installing accessories such as nest boxes, and, finally, involving local academic institutions such as schools and colleges in long-term monitoring programs with the municipality. This will help multiple stakeholders to come together onto a common platform to scale up NPs to provide enhanced esthetic, recreational and biodiversity support services.

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