12 Changing People-Nature Linkages Around Green Infrastructure in Rapidly Urbanising Landscapes: The Case of a Protected Area in Bengaluru Metropolitan Region of South India

B. Dhanya, K. S. Harini, and H. C. Chetan

Abstract

Urban protected areas are vital green infrastructure elements that provide a host of co-benefits ranging from mitigation of urban pollution and heat islands to recreation, in addition to their well-established role in biodiversity conservation. This study uses an ecosystem services framework to understand the transformations in people-nature interactions around a recently established protected area in a fast-urbanising landscape in South India. Data collection involved methods ranging from ecosystem services ranking to key informant interviews with diverse stakeholder groups in the protected area. The study revealed that provisioning services such as grazing land for livestock and water for drinking and irrigation are the most preferred by local communities, while protected area regulations prioritise management for conservation and recreational benefits that benefit urban dwellers. Though the impacts of conservation on the focal species remain uncertain, the repercussions on local livelihoods are immense as forest-dependent communities are pushed out to rely on urban job opportunities. The study calls for careful integration of diverse ecosystem service uses and stakeholder perceptions to manage protected areas as green infrastructure elements for social-ecological benefits in urbanising landscapes.

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S. Dhyani et al. (eds.), *Blue-Green Infrastructure Across Asian Countries*,
https://doi.org/10.1007/978-981-16-7128-9_12

Keywords

Ecosystem services · Social-ecological linkages · Vultures · Conservation · Urbanisation · Livelihoods · Stakeholders

12.1 Introduction

Protected areas (PAs or nature reserves) are a widely recognised strategy for safeguarding biodiversity at multiple levels ranging from species of conservation interest to iconic ecosystems and landscapes (Bruner et al. 2001; Eken et al. 2004; Hannah 2008). Over the 2000–2020 period, the global extent of PAs has increased from about 10% to at least 15% terrestrially (Secretariat of the Convention on Biological Diversity 2020). Globally 32.8% of protected land is under intense human pressure, and 57% of all PAs, concentrated in Western Europe, Southern Asia and Africa, encompass land under intense human pressure (Jones et al. 2018). With the current staggering rates of urban expansion globally, median distance from a nature reserve to an urban area is already less than 50 km in many regions (McDonald et al. 2008), and the extent of urban land within 50 km of PAs is predicted to triple from its 2000 value by 2030 (Güneralp and Seto 2013).

In many fast-urbanising landscapes, PAs have become the last remaining patches of critical green infrastructure providing a multitude of ecosystem services such as mitigation of urban pollution, heat islands and climate impacts, water provisioning and air purification. The role of urban green spaces in enhancing human physical and mental well-being and fostering social cohesion and stewardship is being better appreciated following the COVID-19 pandemic-induced lockdown across the globe (Ugolini et al. 2020; Kleinschroth and Kowarik 2020). Despite their diverse roles as vital green infrastructure elements, management of PAs in urbanising landscapes is fraught with intense conservation-development tensions. Tryzna (2014) describes certain distinctive stressors on urban protected areas, some of which include the large number of visitors who generally lack opportunities to experience wild nature, intense urban development, disproportionate impacts of crime, vandalism, littering, dumping and light and noise pollution and urban edge effects such as frequent and severe fires, air and water pollution and introduction of invasive alien species. Such impacts are more pronounced in urban peripheries of Global South where unplanned urbanisation has been driving astounding transformations of ecological commons and green infrastructure with serious repercussions on ecosystem-dependent communities (Mundoli et al. 2014, 2017).

India is estimated to add 416 million urban dwellers by 2050 and together with China and Nigeria will account for 35% of the projected growth of the world's urban population between 2018 and 2050 (UN 2019). Some of India's densest urban settlements are found just outside PAs (e.g. Sanjay Gandhi National Park in Mumbai and Bannerghatta National Park in Bengaluru) that are increasingly threatened by the growing urban sprawl (Rodary et al. 2018). Changing land use in peri-urban regions has disrupted the rural agricultural-forest continuum, blurring the historically fluid

boundaries between human and wild spaces (Vikas 2019). The impact of urbanisation on ecosystem services from blue-green infrastructure elements such as lakes (D'Souza and Nagendra 2011; Mundoli et al. 2014; Derkzen et al. 2017), wooded groves (Mundoli et al. 2017) and agriculture (Patil et al. 2018) in the peripheries of Indian cities is well documented; however, changing people-nature relationships around peri-urban PAs has not received adequate academic attention in the Indian context. This study attempts to understand the transformations in social-ecological interactions around a recently established PA in the vicinity of India's fastest growing metropolis, Bengaluru. We seek to unpack the role of urbanisation in mediating the synergies and trade-offs between biodiversity conservation objectives and the sustainability of local livelihoods with a view to inform the management of the PA as a green infrastructure component for urban resilience.

12.2 Methodology

12.2.1 Study Area

Ramadevarabetta Vulture Sanctuary (RVS), located between the North latitudes 12°45′963″ to 12°45′115″ and East longitudes 77°18′291″ and 77°17′466″ in Ramanagara district in the Bengaluru Metropolitan Region, is a unique landscape with huge granite rocks (Location map in Fig. 12.1). Ramadevarabetta State Forest,

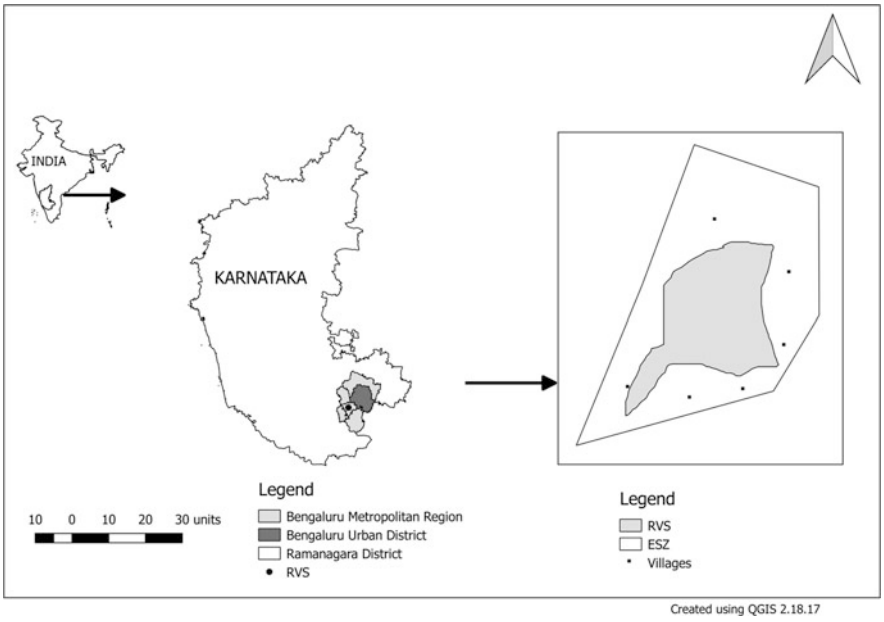

Fig. 12.1 Location map of RVS

originally notified under Section 17 of Mysore Forest Regulation Act in 1917, was declared as a wildlife sanctuary for protecting vultures in 2012.

From over 40 million in 1991–1992, the numbers of India's three vulture species of the genus *Gyps*, viz. the long-billed (LBV-*Gyps indicus* Scopoli), the slender-billed (*Gyps tenuirostris* G.R. Gray) and the white-rumped (*Gyps bengalensis*, J.F. Gmelin), have plummeted by a drastic 97–99.9% by 2007 (Bindra 2018). Social-ecological repercussions of this collapse have been catastrophic; millions of carcasses were left rotting in the absence of nature's most efficient scavengers thereby increasing the transmission potential of diseases such as tuberculosis, anthrax and foot-and-mouth disease, contamination of drinking water and explosion in feral dog population. The human health costs of vulture decline, and subsequent increases in dogs and rabies were estimated to be about $1.5 billion annually in India (Markandya et al. 2008). Cultural practices were also severely hit; for instance, sky burial rituals of Parsi community in India and Tibetan Buddhists, in which corpses are disposed of by vultures, had to be discontinued, and the dead is now burnt using solar power concentrators (Markandya et al. 2008). Extensive veterinary use of the anti-inflammatory drug diclofenac causing renal failure in vultures on ingestion of carcasses of treated livestock has been confirmed as the major reason for decline in Asian vulture populations (Prakash et al. 2012; Swan et al. 2006). In an effort to revive the vulture populations, the governments of India, Pakistan and Nepal withdrew manufacturing licenses for veterinary diclofenac in 2006 (Prakash et al. 2012).

RVS was reported as a unique vulture habitat in 2006, when a local NGO identified four species of vultures (LBV, Egyptian vulture (*Neophron percnopterus* L.), white-rumped vulture and king vulture (*Sarcogyps calvus* Scopoli)) as documented in archival records from the region (Lakshmikantha 2016). In 2012, an area of about 346 ha in Ramadevarabetta State Forest was declared as RVS by state government making it the first vulture sanctuary in India. Supporting around 150 species of birds belonging to over 40 families, RVS is part of the Important Bird Area network in India (Islam and Rahmani 2004). The tropical scrub and dry deciduous vegetation of RVS harbours fauna including sloth bear (*Melursus ursinus*, Shaw.), leopard (*Panthera pardus* L.), striped hyena (*Hyaena hyaena* L.) and jackal (*Canis aureus* L.) and flora such as ivory tree (*Wrightia tinctoria R. Br.*), used extensively in the local wooden toy-making industry. The famous Ramadevarabetta temple within RVS and the popularity of the hills as the shooting location of the blockbuster Bollywood movie *Sholay* draw large flocks of tourists year-round.

To further buffer the vulture habitat, an area of 708 ha within a radius of 130 m to 1.80 km around the boundary of RVS was declared as Eco-Sensitive Zone (ESZ) in 2017 (MoEFCC 2017). Stone quarrying, polluting industries, veterinary use of diclofenac, establishment of meat processing units and rock climbing and allied activities are prohibited within the ESZ, while commercial establishment of hotels and resorts and construction activities are regulated. Despite these measures, the vulture populations of RVS have dwindled considerably, with only two species, the LBV and the Egyptian vulture now found in the region, from the four species reported earlier. Partying at the hills leaving over liquor bottles and meat, movie

crews flying drones (Chetan 2016), poaching of hatchlings and adult birds (Khanna 2015), influx of photographers trying to capture the birds and tourist traffic to the temple during festivals along with lack of animal carcasses and nesting trees in the surrounding urbanising landscape (Abhisheka et al. 2011) have been reported to have driven away vultures from RVS. There are six villages in the ESZ (Fig. 12.1 and Table 12.1) with a total population of around 11,000 (MoEFCC 2017). Local livelihood options including livestock grazing in forests (prohibited in PAs under Wildlife Protection Act (WPA), 1972), forest produce collection (banned under Wildlife (Amendment) Act 2002) and quarrying activities (prohibited in ESZ notification) have been curtailed following sanctuary and ESZ notifications. At the same time, urban developmental projects such as construction of a 4 km bypass for the Bengaluru-Mysuru highway through the ESZ and Satellite Town Ring Road within 200 m of the ESZ (Rao 2018) are being proposed and implemented. Recognising the role of urban growth in further complicating the conservation-livelihood interactions in this landscape, we traced the transitions triggered by these drivers in people-nature linkages around RVS.

12.2.2 Data Collection

Data collection involved multistage interactions with stakeholder groups including local communities around RVS, conservationists and government officials over March–December 2019, as described below.

12.2.2.1 Exploratory Interactions in Villages

Preliminary exploratory interactions were held with groups of eight to ten members in eight locations in the six villages located in the fringes of RVS (inside the ESZ) using a checklist to collect information on land use, cropping, livelihood options, dependence on forests and perceptions on the impacts of the conservation project and urban expansion. Each interaction lasted for 80–90 min, and multiple discussions were conducted in two villages to capture the variations in perceptions based on caste composition. All interactions happened in the local language.

12.2.2.2 Focus Group Discussions (FGD) for Participatory Ranking of Ecosystem Services and Disservices from Forests

Four villages where communities depend closely on forests at RVS, as identified in the preliminary explorations, were selected for further detailed ESS assessment. FGDs for ESS ranking were conducted in total six sites in the four villages, following Schreckenberg et al. (2016) and Drekzen et al. (2017). Each discussion lasted for around 2 h and was conducted in common gathering places such as *kattes* (a social gathering place under a tree, usually of *Ficus* species), schools, etc. Before the actual meeting, visits were made to the villages to meet people and invite them for discussion. It was ensured that people who have lived in these villages for more than 30 years and those belonging to all important caste groups are represented in the meeting. In villages with deep caste divisions, separate sessions were conducted for

Table 12.1 Profile of villages in the ESZ of RVS

Village number	Distance from PA (km)[a]	Area (ha)[b]	Population[b]	Major religions and castes[a]	Net sown area (ha)[b]	Major crops[a]	Irrigated area (% of net sown area)[b]	Livestock numbers[c]			
								Cattle	Buffalo	Sheep	Goat
1	2	151	978	*Iruligas*, *Vokkaligas*, *Bovi*, Muslims, *Bale banjegas*, *Koravas* and *Lingayats*	83.6	Ragi, mulberry and vegetables	42.11	131	10	22	47
2	2	588	1596	*Adi Karnataka*	361.2	Mulberry, papaya and banana	35.33	353	7	204	156
3	3	1581	3483	*Vokkaligas* and *Iruligas*	1026.4	Ragi, mulberry and vegetables	29.36	1074	29	357	558
4	5	234	1224	*Vokkaligas* and *Adi Karnataka*	122.2	Mulberry, ragi, mango and coconut	19.48	257	19	207	112
5	8	394	1286	*Vokkaligas*, *Kurubas*, *Lingayats* and *Madiwalas*	239	Paddy, vegetables, banana	29.57	327	5	30	57
6	11	588	2404	*Vokkaligas* and Muslims	346.8	Mulberry and vegetables	23.81	607	58	113	332

[a]Primary survey
[b]Ministry of Home Affairs 2011
[c]Department of Animal Husbandry and Dairying 2019

Table 12.2 ESS and disservices listed for participatory ranking exercises

Section	Group	Class type
Provisioning (biotic)	Wild plants/animals for nutrition, materials or energy	• Grazing livestock in forests • Fodder for stall-fed livestock • Fuelwood • Wild fruits and leaves • Medicinal plants • Other NTFPs
Provisioning (abiotic)	Surface/ground water for nutrition, materials or energy	• Surface/ground water for drinking and agricultural uses
Regulation and maintenance (biotic)	Regulation of baseline flows and extreme events	• Soil erosion control
	Atmospheric composition and conditions	• Temperature regulation • Air quality moderation
	Lifecycle maintenance, habitat and gene pool protection	• Habitat for useful or iconic flora and fauna • Pollination
Cultural (biotic)	Intellectual and representative interactions with natural environment	• Aesthetic benefits
	Spiritual, symbolic and other interactions with natural environment	• Tree worship and religious values

Source: Modified from Haines-Young and Potschin (2018)

different groups. Male and female group sessions were conducted separately in each site to assess the gender differences in the use of ESS from forests. Thus, a total of 11 discussions were conducted in the six locations to capture the changes in peoples' use of ecosystem services in the context of urban growth and the launch of the conservation project.

We used Ecosystem Services Approach to portray social-ecological interlinkages, following the Common International Classification of Ecosystem Services or CICES (Haines-Young and Potschin 2018). From each section of the CICES classification, types of ESS that were appreciated by participants in the exploratory interactions were selected for the ranking exercise. Fourteen ecosystem services were thus considered (Table 12.2), and additionally seven ecosystem disservices (conflicts with leopards (*Panthera pardus* L.), wild boars (*Sus scrofa* L.), sloth bears (*Melursus ursinus*, Shaw.) and snakes (Serpentes L.) and nuisance from mosquitoes, forest fire and antisocial activities due to increased tourist influx) that were highlighted in the interactions were also ranked. Important ESS benefits from PAs such as recreation and education did not figure in the ranking exercise as these were not found relevant for the local communities in the exploratory discussions.

Participants were asked to rank the services/disservices based on their relevance in two periods: present and past (20 years back when urbanisation pressure started mounting around Bengaluru). Picture cards depicting each service/disservice were used to facilitate people's understanding, considering that most of them are illiterate.

Each group arrived at a unanimous ranking of ESS after debating the relevance within the group and ordered the cards in columns based on the ranks, with the number one ranked service placed at the topmost position and lower ranks below that. After the ranking exercise, reasons for changes in preferences between the two time periods were elicited qualitatively in the group discussions.

12.2.2.3 Key Informant Interviews

Semi-structured interviews were conducted with seven key informants from the four selected villages using an interview guide consisting of open-ended questions. People who have lived in the village for more than three decades and members of local institutions like panchayats were selected as key respondents, taking care to include both genders and the major caste groups in the villages. Personal perceptions on the past and present land uses and livelihoods in their villages, experiences about changes in the use of ecosystems and impacts of the conservation project and urban growth were elicited in these interviews. Further three vulture conservationists were interviewed to understand the status of LBV—the focal species of conservation in RVS. A wildlife sanctuary official was interviewed to garner information on the management strategies for the sanctuary. Respondents were interviewed in locations convenient for them (house, office, etc.) for durations ranging from 90 to 120 min, except for the international vulture conservation expert who was interviewed over email.

12.2.3 Data Analysis

Data collected from interviews and ranking sessions were analysed using simple statistics such as percentages and averages wherever possible. Rank 1 was considered as the highest rank for both ESS and disservices with higher numbers indicating lower preferences. Ranks were converted to scores using the formula Score = 1/Rank. For instance, rank 2 was scored 0.5 (1/2) and so on. For both ESS and disservices, the lowest score was 0 (not considered for ranking indicating no relevance), while the highest rank was 1 for both groups. Spearman's correlation coefficient was worked out using SigmaStat 3.5 to assess the association of preference scores with gender and variation of scores with respect to the two time periods and distance of the village from the PA boundary.

12.3 Results and Discussion

12.3.1 Shift in the Use of ESS and Disservices from the Forests

Participatory ranking exercises revealed that provisioning services such as grazing land for livestock, water for drinking and irrigation and fodder for livestock are the most preferred by local communities across villages, followed by cultural and regulatory services, both in the past and present time periods (Fig. 12.2). Other

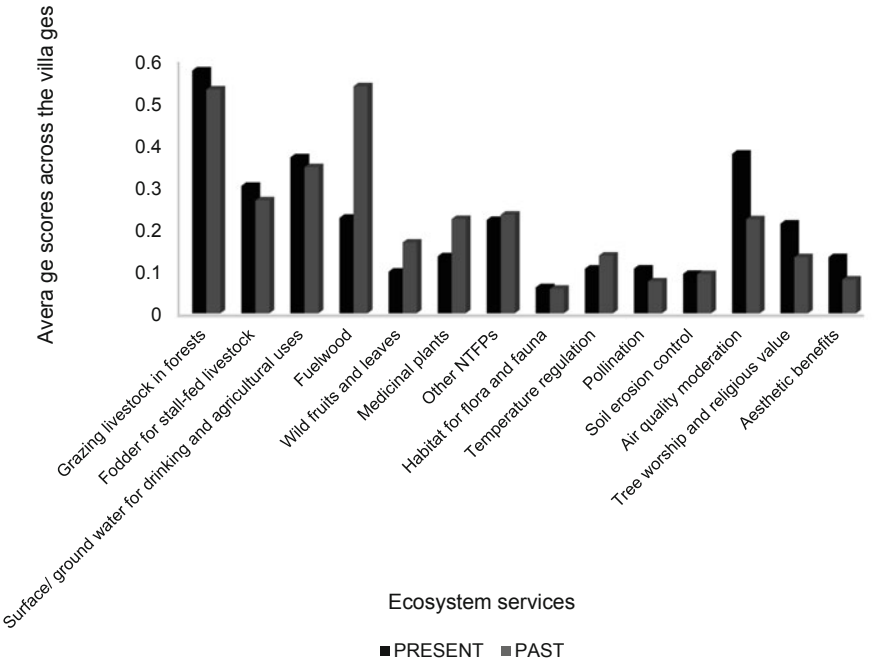

Fig. 12.2 Changes in ecosystem services from forests

studies also have shown stakeholders attributing higher relevance for provisioning services over regulatory and cultural services from forests (Agbenyega et al. 2009; Hartter 2010). Grazing livestock remains the highest ranked option across time periods. This is a crucial use of forests, especially for the socially marginalised and landless groups such as *Iruligas* whose prominent livelihood options have been forest produce collection and livestock rearing. The role of forest in water provisioning is also being acknowledged better now as indicated by the improved ranking—second position now—from third in the past. However, harvesting fruits and medicinal plants from forests has reduced as food from farms or markets and modern medicines, respectively, substitute these produces. Similarly, fuelwood collection which was the second most preferred use in the past is not ranked high in the present due to replacement by liquefied petroleum gas (LPG) as cooking fuel. But local communities continue to collect produce such as broom sticks for which there are no better replacements yet.

Preferences for the regulatory service—air quality moderation—and cultural services, religious and aesthetic benefits, have increased from past to present corollary to the decreasing subsistence use of forests. Shift in preference from provisioning ESS towards cultural services such as recreation in urbanising landscapes is well documented as in the case of ESS uses from lakes in Bengaluru (Derkzen et al. 2017). Growing concerns about air pollution from urbanisation, industrialisation and higher vehicular movement fuelled by increasing tourist visits to RVS have

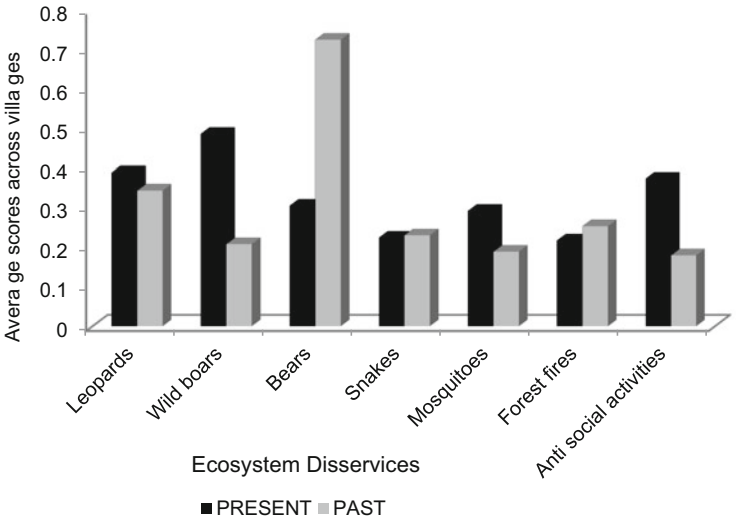

Fig. 12.3 Changes in ecosystem disservices from forests

sensitised people on the role of trees and green spaces in maintaining air quality, propelling this ESS to the third preferred position now. Other regulatory services—habitat for wildlife, pollination, soil erosion control and temperature moderation—were ranked consistently low in both present and past time periods.

ESS preferences also reflected the spatial and social locations of the stakeholders. Scores for the most appreciated service, grazing showed a significant positive correlation with the distance of the village from RVS (Spearman's rank correlation, rho $= 0.6$, $p < 0.05$). Communities in locations farther away from the forest tend to feel the negative impacts of grazing ban more severely in the absence of other grazing commons, while those close to the forest boundaries still use the peripheries for grazing as and when opportunities arise, when forest guards are absent or in some cases bribing the guards for gaining access. Absolute lack of access to forests for grazing resulted in higher appreciation of this service for respondents who live farther.

Men and women have distinct leanings in ranking the services; men preferred regulatory services like air quality moderation, while women preferred provisioning services like grazing and fuelwood collection. No significant correlation could be found between the ranks assigned by men and women for all services. Caste positions also influenced preferences, reflective of diverse livelihood dependencies on forests, e.g. landless scheduled tribes (*Iruligas*) value services such as NTFP collection and livestock grazing, while landowning agricultural castes consider water provision for irrigation as the major service. In villages with homogenous caste composition, preference is mostly tilted towards a single service.

Among the various disservices, attacks by sloth bear were the most prevalent in the past (Fig. 12.3). But in the present, bear raids have reduced, and wild boar and

leopard attacks have increased. The key informant from FD attributed this change to improved food sources for bears inside the forest following planting of fruit trees such as *Tamarindus indica* L., *Ficus religiosa* L. and *Ficus benghalensis* L. (Manjunatha 2016). Community members pointed out loud music and noise from tourist resorts and quarrying activities as deterrents for bears from approaching human habitations. Higher food availability in forests led to an explosion in population of wild boars that now raid agricultural crops. Change in cropping pattern in response to crop depredation was also revealed in the exploratory interactions and FGDs. Sugarcane (*Saccharum officinarum* L.) and groundnut (*Arachis hypogaea* L.) which attracted bears were replaced by horticultural crops that are now prone to wild boar attacks. The major conflict currently is with leopards that raid on livestock, especially sheep. Up to 25–30 sheep were lost annually in some villages from leopard attacks, as reported in the FGDs. During 2010–2014, there were 355 cases of crop damage, 75 cases of cattle kills, 19 human injuries and 2 human deaths from wildlife conflicts in Ramanagara division for which compensations of INR 7,12,778, INR 3,17,250, INR 2,93,187 and INR 10,000,00 were paid by the Forest Department, respectively (Manjunatha 2016).

The use of forests as spaces for antisocial activities such as alcohol consumption is another disservice that has increased from past to present. Tourists who visit RVS party at the hills and leave over the liquor bottles and other trash (Chetan 2016). Both men and women expressed dissatisfaction over such activities, which they consider are consequences of urbanisation and changing cultural values. But women complained about local men also indulging in such activities, whereas men spoke about this as a disservice from outsiders. People found loud music played from tourist resorts on weekends and continuous vehicular movement in village roads disturbing. No trend was discernible with respect to distance of the village from the PA in ranking of the disservices.

12.3.2 Impacts of Urbanisation and Conservation on Livelihoods

Our research unravelled the multifarious impacts of the conservation project and urban expansion on livelihoods of local communities. Urban expansion was revealed to have mixed outcomes, for certain groups exacerbating the livelihood vulnerabilities created by the conservation project and for certain others ameliorating them, hinging on the resource endowments of the stakeholders. The ramifications were particularly acute on traditional livelihood activities such as animal husbandry and forest produce collection.

12.3.2.1 Impacts on Livestock Rearing

Both urbanisation and the conservation project has equally impacted livestock rearing, an important livelihood option for local communities such as *Adi Karnataka* and *Iruliga*. Spiralling urban demand for exotic crop produce, land, water and labour has been creating new agroecologies in peri-urban Bengaluru (Patil et al. 2018).

Within the ESZ of RVS, between 2009 and 2018, plantations of horticultural crops such as mango and coconut and timber species such as teak and *Melia dubia* grew by 47% and built-up area expanded by 14%, replacing agriculture and fallow lands (Harini 2019). In Ramanagara district, the extent of area under mulberry (*Morus* spp.) for sericulture jumped by 59% during 2008–2014 tied to the branding of Ramanagara as sericulture hub of Karnataka, while area under traditional rain-fed crop of groundnut (*Arachis hypogaea* L.) decreased by 53%, castor (*Ricinus communis* L.) by 43% and black gram (*Vigna mungo* (L.) Hepper) by 73%, during the same period. Such changes were facilitated by expansion of irrigation; irrigated area as percentage of net sown area increased by 20–200% in villages in ESZ between 2002 and 2011 (Ministry of Home Affairs 2001, 2011). Urban growth transforms traditional agriculture and animal husbandry practices on account of (a) conversion of grazing lands for low-cost housing or developmental projects and (b) shift to perennial cropping patterns such as horticultural orchards to cater to urban demand, precluding the grazing of livestock during non-cropping seasons. In these circumstances, forests continued to support the grazing needs of poorer communities. While landowning communities have responded to loss of grazing areas by shifting to hybrid breeds of cattle that are stall-fed, for landless people, maintaining such exotic cattle is not possible. High urban demand for milk also promoted dairying activities using exotic high-yielding breeds by resourceful groups. Those who could not afford such shifts have completely discontinued livestock rearing and now rely on itinerant wage labour and other urban job opportunities.

In 2012, exotic breeds constituted only 48% of the total cattle population in the district, whereas in 2019, 78% of all cattle raised were exotic. Sheep population declined by 65% during the same period (Department of Animal Husbandry and Dairying 2012, 2019). *Iruligas* have reduced or completely moved away from sheep rearing on account of loss of access to forests, other grazing commons and livestock depredation by wildlife. Around PAs in India, livestock depredation by carnivores is reported to have driven the shift from native to hybrid breeds of cattle, as hybrids are usually stall-fed avoiding conflicts with wildlife during grazing in forests (Bhardwaj 2018). Such changes also lead to declining tolerance from community for injury and death caused by carnivores in view of the enormous financial damage that farmers are likely to face on the loss of hybrid cattle (Bhardwaj 2018). But around RVS, livestock raid by wildlife was not highlighted as a reason for shift to hybrid cattle by dairy farmers; rather growing urban demand for milk was reported to have spurred intensive dairying activities.

12.3.2.2 Impacts on NTFP Collection

During FGDs and key informant interviews, people reported collection of diverse produces ranging from honey, fuelwood, bamboo, broomsticks to wild greens such as *seege* (*Acacia concinna* (Willd.) DC.), *bade* (*Foeniculum vulgare* Mill.), *thonde* (*Coccinia grandis* (L.) Voigt), fruits of *bel* (*Aegle marmelos* (L.) Correa), *elche* (*Ziziphus jujube* Mill.), *nerale* (*Syzygium cumini* (L.) Skeels), *amla* (*Phyllanthus emblica* L.), tamarind (*Tamarindus indica* L.), custard apple (*Annona squamosa* L.)

and roots of *magali* (*Decalepis hamiltonii* Wight Arn.) before the initiation of conservation project, but at present, occasional collection of honey, greens and firewood only is reported.

*Iruliga*s (also known as *kadupujararu* or the priests of the forests) the traditional hunter-gatherer community have been extremely forest-dependent, foraging on wild tubers, fruits and honey and hunting rats to meet dietary requirements. Sales of honey, *magali* roots and firewood were the mainstay of their livelihoods. *Iruligas* possess rich traditional knowledge on wild medicinal herbs and sustainable harvesting of honey from shrubs, hollow trees and rocks. The beehives are smoked to harvest honey in a process that doesn't harm the bees (Iyer 2016). The extensive ethnobotanical knowledge of *Iruligas* also comes in handy to avoid beestings using herbal repellents while collecting honey (Krishna 2020). If the hive is small with less honey, small amount is consumed in forests, and if large amounts are available, honey collected is brought back home and shared with others. Honey collected from shrubs is considered the tastiest and is consumed with wild tubers, dug from forests using a sharp stick and boiled and seasoned with forest peppers. Green leaves of several edible species are also cooked this way (Radhamani 2014). With restricted access to wild food sources, the community is now dependent on free supply of rice through food security programmes, and the low-quality food leads to poor health and nutritional outcomes including high rates of infant mortality and maternal mortality (Mutharaju and Kodandarama 2019). After PA declaration, some *Iruliga* community members were purportedly arrested for collecting and selling *Magali* roots.

Loss of access to natural resources from exclusionary conservation has been reported to cause severe impoverishment among poor, indigenous rural (Brockington and Igoe 2006; Dowie 2009) who depend heavily on "subsidy from nature" in the form of fodder, water, wild food and other forest produce to meet basic consumption and livelihood needs (West et al. 2006; Angelsen et al. 2014). Conservation displacement increases the importance of wage labour as communities whose traditional livelihood and labour opportunities are disrupted find themselves exposed to networks of capitalist exchange (Brockington and Duffy 2011), a trend visible around RVS.

12.3.2.3 Community Perceptions on Livelihood Impacts of the PA

Community involvement in the management of RVS and livelihood benefits from the PA has been minimal, as reported in our interactions. Community members are provided wage labour in pre-monsoon tree planting and plantation maintenance programmes of FD. FD has also organised training programmes on controlling forest fires, but community participation in the programme was underwhelming as reported by a key informant who is member of Panchayat. A few families in the *Iruliga* settlement near the entry gate of RVS run small shops for tourists, and one of them is employed as a guard with FD. This group had a positive outlook towards the conservation project despite its impacts on their customary livelihoods. Larger landscape level and socio-economic changes have been rendering traditional occupations non-viable even before the conservation project, in their opinion. For instance, FGD participants among *Iruligas* noted that honey resources in forests

have dwindled as a consequence of intensive chemical use in surrounding mango orchards decimating honeybees. At the same time, people also acknowledged the importance of labour opportunities that mango orchards provide when forest-dependent livelihoods are declining. Thus, the urban demand for food produce has both positive and negative impacts on *Iruliga* livelihood sustainability. In fact, most respondents from this settlement portrayed urban growth as beneficial since amenities including road, electricity connection and accessibility to cities that facilitate exploration of wage labour opportunities have improved. However, *Iruligas* in other settlements away from the PA boundary expressed anguish against the conservation project on account of declining access to forests. Thus, the attitude towards and benefits from conservation is heavily determined by spatial location, i.e. proximity to the sanctuary, besides the social hierarchy in terms of caste position.

The landowning class that comprises of upper castes found opportunities in urbanisation in terms of higher sales and rental value of land and improved access to education and jobs. Land was acquired by government from villages for highway construction and other developmental projects including the proposed textile park for which 50 ha of land in one village has been identified (Department of Industries and Commerce G 2016). Land value has skyrocketed from INR 5000 per hectare to INR 1.75–2.5 million in the past decade depending on availability of irrigation and proximity to highway. The attitude towards conservation project was mostly neutral among upper castes except for concerns over the possibility of ESZ regulations restricting land sales, land use changes and further agricultural expansion.

Discontent was apparent among the Scheduled Caste group of *Adi Karnataka* with both urbanisation and conservation project. Urbanisation has made life more expensive and the community less cohesive in their opinion, with sociocultural practices such as collective celebration of festivals fast-disappearing. This community has been leasing out agricultural land from landowning groups, but with rampant land sales and conversion, it has become difficult to avail land on lease for farming, while the conservation measures ban the use of forests for livestock rearing.

The impacts of displacement created by protected areas are spread unevenly across diverse actors within local communities, and community responses are contoured around age, caste, class, gender and ethnicity (Hall et al. 2015; Dao 2016). Kabra (2019) while examining contestations within and between different caste groups to corner resource flows associated with state welfare in a conservation displacement site in central India argues that the distribution of risks and opportunities among the affected population tends to enhance existing socio-economic inequalities and power imbalances. Around RVS, both the landowning class and sections of the scheduled tribe community who expect economic gains from the conservation project expressed positive attitude towards it, while the subaltern caste group of *Adi Karnataka* perceive themselves as losers in the tussle between conservation and livelihoods, accentuated by urbanisation.

12.3.3 Impacts of Conservation on the Status of Vultures in the Urbanising Landscape

Our interactions with multiple stakeholders showed that RVS faltered in the stated objective of conserving critically endangered LBVs. LBV populations at RVS have plummeted from 22 to just 4 between 2011 and 2020, and since 2014, there has been no breeding success (2019 email from Mr. Shashi Kumar and Mr. Darshan, Karnataka Vulture Conservation Trust). At the same time, Egyptian vultures have become more abundant over years, from 5–6 to 30–35 facilitated by increased availability of silk pupae from sericulture units and chicken waste in the surrounding region (Kaggare 2019). LBVs feed only on medium- to large-sized carcasses like those of cattle and other large mammals and have not adapted to the decreasing availability of such food in the landscape.

12.3.3.1 Community Perceptions on Vulture Conservation

In group discussions and interviews with local community, respondents unanimously observed that vulture population in RVS had decreased from the past (from 50 to 100 a decade back to only 10–12 now); however, there were seasonal variations in their abundance, ranging from as low as 3 in summer up to 15 during monsoon season. Respondents related the reduction in vulture population to dwindling food and water sources, radiation from mobile towers, construction projects, decline in tree populations in the landscape and poaching by some traditional hunting communities. Though there is a general awareness about decline of vulture population, their ecological role as scavengers and the need of establishment of a sanctuary for vulture conservation were not recognised by local community. However, respondents were aware of and concerned about the change in rules about using the forests after declaration of sanctuary, especially restrictions on grazing.

Though ecological role was not appreciated, local communities want vultures to be conserved due to cultural values. Key respondents spoke about cultural practices such as offering food to vultures during death-related rituals on the belief that the deceased soul would enter heaven. This practice, according to them, is not followed now as vultures have become rare. Activating such cultural links therefore would be a crucial step towards building positive perceptions and a sense of ownership of the community towards conservation project. Markandya et al. (2008) and van Dooren (2010) recognise the role that Hindu mythology associated with a revered vulture God, *Jatayu*, has played in vulture conservation in Indian subcontinent.

12.3.3.2 Perceptions of Vulture Conservationists and the FD Official

As grazing ban was highlighted as the major negative impact of conservation project in community interactions, we solicited the opinion of conservationists on the usefulness of banning livestock grazing in the PA. There were contradictory opinions: some found the ban necessary because disturbance from any human movements, especially during feeding, could lead vultures to abandon the food and fly off, whereas others opined that grazing ban is not particularly beneficial to vulture population. Heavy tourist influx and ongoing construction of a highway

bypass in the ESZ were recognised as huge threats to vultures by both the local community and conservationists. Noise from vehicular movement close to the nesting site of the vultures and from blasting of explosives to crack boulders for road construction could threaten the chicks or the just migrated vultures that are new to the landscape. Shift in animal husbandry practices from native breeds to exotic breeds with higher milk yield was recognised as a major driver of vulture decline in RVS by experts. Hybrid cattle are expensive to maintain and are therefore insured, and on death, burial of carcasses is mandatory to claim the insurance, leading to scarcity of cattle carcasses for LBV to feed on. Conservationists thus agree with the community perceptions of decrease in vulture numbers from food shortage.

There was no consensus between the conservationists interviewed about the best conservation strategy—studies to understand breeding and flying behaviour and establishment of captive breeding centres for vultures were highlighted as urgent requirements by the local vulture conservation group. Suggestions have been put forth to bring carcasses of mammals dying in road kills from PAs in the nearby districts for the vultures to feed on, after testing for presence of diclofenac. Some of the experts were sceptical about a sanctuary as conservation strategy, given that vultures routinely travel 50–100 km, and, in their view, addressing the threats, especially drug contamination of carcasses in areas of feeding potential, to create a safe zone for vultures is a more effective protection measure.

According to the FD official interviewed, vulture populations at RVS are showing an increasing trend, and nesting activity has also been noticed. The official justified the ban on livestock grazing as undisturbed forests are beneficial not just for the vultures but also for other wild fauna. FD has carried out afforestation projects in RVS, and consequently between 2009 and 2018, forest area has increased by 19.25% within the ESZ of RVS (Harini 2019). However, experts point out that barren landscapes are conducive for vultures as their huge wingspan demands large open spaces for landing. Afforestation therefore is not likely to have any direct positive impact on the area as a vulture habitat. LBV nests exclusively on rock cliffs, while Egyptian vultures could occasionally nest and roost on coconut trees. A growing area under horticultural plantations of coconut may marginally promote nesting and roosting of Egyptian vultures.

12.4 Conclusions

Several positive and negative feedbacks are conspicuous between vulture conservation, local livelihood sustenance and urbanisation process around RVS (as depicted in a driver-pressure-state-impact-response or DPSIR diagram in Fig. 12.4); for instance, expanding cultivation of coconut trees to cater to urban demand for the produce and waste from chicken shops and sericulture units enhancing EV population is a positive feedback, while the shift to hybrid cattle for meeting demand for milk from the city has led to shortage of cattle carcasses and high use of veterinary drugs negatively impacting vultures. Thus, as the vulture experts suggested,

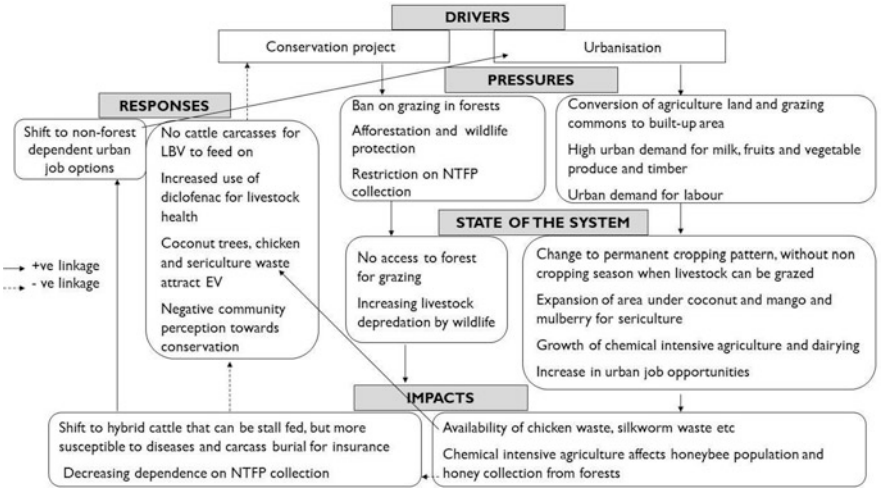

Fig. 12.4 DPSIR framework depicting conservation-livelihoods-urbanisation interactions

declaring a limited area as a sanctuary without acknowledging these larger landscape level social-ecological linkages might not lead to revival of LBV population.

Though the conservation outcome of establishing RVS remains uncertain as far as the focal species is considered, the repercussions on local livelihoods are conspicuous as forest-dependent livelihoods are pushed out to rely on urban job opportunities. While changing cultural preferences brought about by proximity to urban centres might also have influenced such shifts, restrictions on forest use is the major trigger. Diclofenac, the well-known driver of vulture extinctions, does not appear to be the major risk factor as of now owing to the shortage of cattle carcasses for vultures in this landscape. Social-ecological transformations including land use transitions, changes in agriculture and animal husbandry practices and alienation of the forest-dependent communities from fortress conservation approaches are bigger threats to the sanctuary and the vulture population. Under the intense influence of a metropolis, cultural and aesthetic values of green infrastructure for urban visitors are prioritised overlooking the local provisioning needs. It is ironic that while the local community is criminalised for minor livelihood use of forests, several ecologically devastating state-sponsored development schemes such as expansion of highways are carried out undeterred.

Conflicts of interests in and perceptions towards the conservation project are evident between stakeholder groups; local people clearly recognise grazing as the most preferred ecosystem service from the forest, whereas some conservationists and FD consider grazing as a threat for the vultures and other fauna. Recreational uses of the forests were not valued by local people; for FD, this is an important service as a potential revenue generator. Negative preference of local people towards PAs is triggered by the restriction of access to forests and lack of involvement in its management, and the probability of positive preference decreases with increasing

dependence on provisioning services (Amin et al. 2015). The ecological impacts of excluding livestock have been often disastrous in other PAs in India; colonisation by invasive species and consequent changes in vegetation composition resulting in biodiversity decline have been reported in the absence of other herbivores to fulfil the functional role that livestock play in human-influenced ecosystems (Nautiyal and Kaechele 2007; Zeeshan et al. 2017).

12.5 Implications and Recommendations

The study clearly reveals the need for inclusive approaches of planning for green infrastructure—the PA in this case—in urbanising areas. A socially just approach of conservation should carefully craft mechanisms to integrate local livelihood needs as part of the conservation plan while remaining cognisant of the differential impacts of conservation on local populace. Buscher and Fletcher (2019) outline a new future of conservation that is "convivial" instead of exclusionary and preserves integrated spaces of diverse landscapes and governance systems within which multiple human stakeholders and other species can coexist equitably. An inclusive model of conservation that allows sustenance of livelihood activities of forest dwellers and leverage indigenous knowledge for protection of the ecosystem and its iconic raptors could be the way ahead for a robust conservation strategy in RVS. Cultural links with vultures enshrined in rituals, myths and folklore that were extolled during our interviews could be invigorated to ignite community's interest in the conservation project thereby creating integrated spaces of coexistence.

It is important to recognise that "community" is a heterogeneous entity with intrinsic power asymmetries that are further worsened by alienation created by conservation. Dispossessed communities are left dependent on the vagaries of urban wage labour markets that are highly volatile, accentuating livelihood vulnerability as has happened during the COVID-19 pandemic. India witnessed large-scale reverse migration from cities to rural areas in the wake of the pandemic. At this critical juncture, maintaining the historic linkages of communities with forests and even encouraging communities to forge sustainable linkages with forests should be a priority for conservation plans. Restoring the community's right to forest produce and traditional forest management practices is crucial for sustaining people's participation in conservation. Envisioning PAs as pathways for sustainability goals beyond biodiversity conservation and as part of wider social-ecological systems helps foster sustainable human-nature relationships, environmental health and livelihood and landscape resilience (Loos 2021).

While most of these recommendations hold true for many PAs in the Global South, in the case of a peri-urban PA, tele-couplings with macro level factors such as global- and national-level socio-economic changes and policies arising from the proximity to an urban centre are to be recognised as unique pressures. In the present case, such pressures are evident in the form of the post liberalisation economic changes in India that accelerated real estate boom, population growth, densification and sprawl in urban peripheries. These factors are manifested as different direct

stressors on the landscape such as extensive conversion of rural land, changes in cropping practices to produce certain commodities for urban food consumption, increased recreational demand from urban centres, etc. Governance challenges are also rampant, with multiple urban planning agencies and institutions responsible for the management of the PA. In the present case, parastatal agencies including the Bangalore Metropolitan Region Development Authority, Ramanagara Urban Development Authority and Satellite Town Ring Road Planning Authority are all responsible for landscape planning, while the Forest Department is responsible for management of the PA, and coordination between these agencies for devising an integrated approach of planning and management are often lacking. Planning for nature reserve as urban green infrastructure should be mindful of such challenges that are quite different from conservation issues in rural areas. Both urban growth and the area designated for biodiversity conservation to meet commitments set under Aichi targets and other biodiversity frameworks are predicted to intensify in the coming decades in the Global South, so are the conflicts between urbanisation and conservation. Preserving PAs as protected islands devoid of human pressure in a sea of urban growth might not lead to sustainable outcomes, if the intense social-ecological interactions around urban PAs that are amplified by urbanisation are not factored in. A deliberate reorientation of current conservation planning approaches to reimagine the role of PA as urban green infrastructure with multiple ecosystem service uses to diverse stakeholders is undoubtedly vital for inclusive and sustainable urbanisation in the Global South.

Acknowledgements We thank local community members in RVS for participating in the interviews and group discussions as part of this study. Karnataka Forest Department, Ramanagara Division, and Karnataka Vulture Conservation Trust, Ramanagara, supported this research by sharing data on vulture ecology and status at RVS. Samudyatha R., The University of Trans-Disciplinary Health Sciences and Technology, Bengaluru, assisted us in data collection. The financial support from Azim Premji University, Bengaluru, for this study is gratefully acknowledged.

Conflict of Interest Statement The authors report no conflict of interest for this publication.

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