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Review Article

Asola Bhatti Wildlife Sanctuary-A Case Study of Ecological Restoration: Its Success and Present Status

Versha Goel[1] and Rita Rath[2*]
[1]Department of Zoology, Maitreyi College, University of Delhi, Delhi, India
[2]Department of Zoology, Dyal Singh College, University of Delhi, Delhi, India
[*]Correspondence: ritarath@dsc.du.ac.in

ABSTRACT

The Aravalli range is one of the oldest mountain systems of the world. It is a 560 km range, starting from a location near Delhi, passing through Southern Haryana, Rajasthan and ending in Gujarat. It has a unique biodiversity. In the last two to three decades, there has been a destruction of natural habitats and ecosystems due to the development of bursting infrastructure and hence, an urgent need for ecological restoration. Studies indicate that 40% of our country needs ecological restoration. The Asola Wildlife Sanctuary zone covers 32.71km^2 area on the southern Delhi Ridge of Aravalli hills, on the Delhi-Haryana border. Asola Wildlife Sanctuary was legally given protected status in 1986. On world environment day, June 5, 2021, UN declared 2021-2030 a decade on Ecosystem Restoration. The Bonn challenge is a global challenge to restore landscape, launched in 2011 by the Government of Germany and the International Union of Conservation of Nature. Due to the Supreme Court of India mandate in 2011, Government of India, defined Eco Sensitive Zones to limit the adverse anthropogenic activities on the ecosystem, biodiversity and natural resources. Several efforts have been made to restore Asola-Bhatti Wildlife Sanctuary area by planting saplings, rainwater harvesting, restoration of degraded land and habitat, agroforestry, herbal plantations, use of solar energy, organic farming, etc. In spite of all these efforts, there are still certain challenges that need to be addressed. Some of them are the lack of a protective wall, the absence of safe corridors for wildlife crossing, environmental pollution caused by Bandhwari landfill and water scarcity. There is also an official denial of presence of wildlife in the area, so that the forest land can be exploited. A futuristic approach for restoration could be use of microbes that improves the quality of the soil and hence the vegetation and biodiversity. A continuous reduction in the forest cover over the years and an increase in agriculture and settlement, resulting in more human-wildlife conflict has become the most important issue in conservation. Efforts are thus required towards ecological restoration, following a natural progression and assistive regeneration along with working on the threats (urbanisation, policy threats, cutting of trees) to prevent further degradation of the forest after restoration.

Keywords: Biodiversity, restoration, Aravalli, Asola, sanctuary, wildlife

INTRODUCTION

In various ecological zones, from forests to farmlands and mountains to oceans, humans live in a web, in consortium with the flora and fauna, and need to maintain an ecological balance for the sustainable development. This association is important for the human society, as it provides

various economic, social, and environmental benefits for the people and nature. A healthy ecosystem provides us with various services such as climate change adaptations and mitigation, biodiversity conservation to support our health and economy, carbon sequestration, oxygen, disaster prevention, water security, raw material, and many more (Millennium Ecosystem Assessment, 2005; Houghton, 2005; Gibbs et al., 2007; San-Jose et al., 2022). It also supports various industries like forestry, farming, tourism, etc. People are benefitted as it provides them with food, water, building material, etc. Fertile soil is the product of healthier ecosystem with rich biodiversity. In recent decades, however, unlimited and injudicious use of these resources has put the ecosystem under threat and their services are being damaged, degraded, and destroyed which directly impacts the nature and people (Arroyo-Rodríguez et al., 2020). Ecosystem restoration refers to restoring or revitalising the geographical area to its original condition as it was before its degradation and also conserving the ecosystem which have not degraded completely (McDonald et al., 2016). These restoration plans benefit biodiversity as well as human being through scientific approach and continuous monitoring (Wurz et al., 2022). Studies indicate that 40% of our country needs ecological restoration. Aravalli hill range with its unique biodiversity is one of the oldest mountain ranges in the world. It starts from an area near Delhi, passes through southern Haryana, Rajasthan and ends at Gujarat. Asola Bhatti Wildlife Sanctuary is a semi-forest Wildlife Sanctuary and among the protected areas in India, with the potential of working as a recharge zone of the ground water for Delhi. It is also considered as an area that can be developed as a shelterbelt against increasing aridity and for planning the strategies for long term restoration of the habitat. Reclamation of the large and small abandoned mine pits in the Bhatti area is in process and steps must be taken to develop them into wetland habitats. This paper aims to discuss the application of ecological parameters for restoration, restoration practices, human contribution and social context of restoration with reference to Asola Bhatti wildlife sanctuary as a case study.

LOCATION

The biodiversity zone of Asola Bhatti Wildlife Sanctuary covers 32.71 km^2 area on the southern Delhi Ridge of Aravalli hill range, on the Delhi-Haryana border (GPS location 28.2452^0 -28.2945^0 N and 77.1132^0 – 77.1613^0 E). It is an important part of the leopard wildlife corridor starting from Sariska National Park in Rajasthan and ending at Delhi Ridge. Various historical sites present near the sanctuary are Surajkund, Anangpur Dam, Tughlakabad Fort, Adilabad Ruins and Chhatarpur Temple. Villages such as Maidangarhi, Asola, Shapur and Bhatti are present within the sanctuary. Dozens of lakes which represent the abandoned open pit mines are also found in and around the sanctuary**.** Asola Wildlife Sanctuary was legally given the protected status in 1986. In order to restore the sanctuary, 2,679.29 acres of land was carved out from three villages namely Asola, Shapur and Maidangarhi. A ban was imposed on mining of the Badarpur in 1990 by Delhi government (Sawarkar & Hussain, 1996; Salim, 2010). In consequence, an additional 2,166.28 acres of land from the village Bhatti was also notified as a part of Asola Bhatti Wildlife Sanctuary in 1991.The sanctuary currently is under the Conservation Education Center (CEC), Bombay Natural History Society (BNHS), Delhi.

BIODIVERSITY AND NEED FOR CONSERVATION

Asola Bhatti Wildlife Sanctuary acts as a green lung and a potential carbon sink for Delhi, having the capacity to alleviate local level warming (Kushwaha, 2014). Asola is more popular for its bird fauna than for its animals. It is home to a large number of medicinal plants also. Dwivedi et al., (2018) studied the diversity of Angiosperms in the sanctuary and found found *Prosopis* as dominant exotic species and *Diospyros montana* as a dominant native species. Besides these, 82 other genera and 100 plant species were also documented (Table 1). The trees found in the area have a high potential for carbon sequestration and growth through natural regeneration, however, on account of the regular cutting of trees for the personnel use

by the villagers, most trees were in the lower diameter class (Kushwaha, 2014). As per the 1997 survey, it was home to 246 species of animals, including 3 species of Mollusca, one species of Thysanura, one of Odonata, 9 of Orthoptera, 4 of Isoptera, 4 of Coleoptera, one Diptera, 4 Lepidoptera, 5 Hymenoptera, 3 Chilopoda amongst invertebrates, and 2 species of Amphibia, 3 species of Reptilia, 196 species of Aves and ten species of Mammalia amongst vertebrates (Khanna & Sati, 2003) (Table 2). Agarwal (2022a) reported that according to BNHS in subsequent surveys, 252 species of birds including sparrows, kingfishers and others, more than 86 species of butterflies, 23 mammalian species such as leopard, nilgai (blue bull, the largest antelope of the country) blackbuck (fastest land animal surviving in the wild in the country), hog deer, black naped hare, Indian crested porcupine, small Indian civet, golden jackal, striped hyenas, Jungle cat, Indian Mongoose, and 28 species of reptiles such as monitor lizards, spiny tailed lizard are found in the sanctuary as confirmed by the camera traps (Table 2).

Table 1: Some indicative flora and fauna of Asola Bhatti Wildlife Sanctuary (based on Census till 1997). Modified from Khanna & Sati (2003); Editor-Director (2003). Zoological Survey of India, Kolkata.

	Plant species	**Animal species**	
1.	*Prosopis juliflora*	*Zootecus pullus* Gray	*Uromastix hardwickei* Gray
2.	*Acacia nilotica*	*Panatala flavescens* (Fabricius)	*Hemidactylus brooki* Gray
3.	*Acacia leucophloea*	*Acheta domesticus* Linn	*Bubulcus ibis*
4.	*Anogeissus pendula*	*Gryllus bimaculatus* De Geer	*Milvus migrans lineatus*
5.	*Butea monosperma*	*Gryllodes sigillatus* (Walker)	*Psittacula eupatria*
6.	*Capparis decidua*	*Acrida exalta* (Walker)	*Eudynamus solopacea*
7.	*Azadirachta indica*	*Coccinella septempunctata* Linn.	*Upupa epops*
8.	*Balanites aegyptiaca*	*Danaus chrysippus* (Linn.)	*Dinophium bengalense*
9.	*Carissa opaca*	*Camponotus compressus* (Fab.)	*Oriolus orio/us*
10.	*Dalbergia sissoo*	*Scolopendra morsitans* Linn.	*Macaca mulatta*
11.	*Withania somnifera*	*Rana tigrina Daudin*	*Hystrix indica*
12	*Ziziphus nummularia*	*Rana cyanophlyctes* Schneider	*Herpestis smithi*

The survey carried out by the BNHS, in collaboration with the state forest and wildlife department recorded, among other endangered species, the presence of near threatened pallid harrier (*Circus macrourus*) for the first time in November 2017 and then in 2022. Officials at the Asola Bhatti wildlife sanctuary also recorded the presence of northern goshawk (*Accipiter gentilis*) in February 2022, indicating a positive impact of rejuvenation efforts inside the sanctuary on fauna (Gandhiok, 2022a). According to the reports of the sanctuary officials, the developed lakes inside the sanctuary are turning into an important stopover for the migratory birds such as steppe eagle (*Aquila nipalensis*), which were spotted in November 2021 in flocks, indicating an increase in the prey population in the area, due to the efforts of the forest department, which has worked on improving the habitat along with the conservation of soil and water in the area. There is, thus, a need for the protection and management of these winter habitats and to continue with the restoration process in the sanctuary.

Table 2: **Faunal status during the period of restoration through periodic surveys (from 1997 till date).** Modified from Khanna & Sati (2003), Editor-Director (2003), Zoological Survey of India, Kolkata; Agarwal, (2022a).

Faunal Group	Number of species as per 1997 survey	Number of species as per 1999 survey	Number of species updated as on 15 May 2022 survey (census to be completed by 2023)
Chordates			
Pisces	0	3	*
Amphibia	2	5	*
Reptilia	3	7	28
Aves	196	198	252
Mammalia	10	18	23
Non Chordata			
Arthropoda			
Chilopoda	3	5	*
Insecta			
Apterygota			
Thysanura	1	1	*
Holometabous			
Lepidoptera	4	27	86 (butterflies)
Diptera	1	1	*
Hymenoptera	5	13	*
Coleoptera	4	4	*
Hemimetabolous			
Orthoptera	9	9	*
Odonata	1	12	*
Isoptera	4	4	*
Mollusca	3	3	*
Total	**246**	**310**	**389**

**Survey not yet completed*

CAUSES OF DEGRADATION AND BENEFITS OF RESTORING ECOSYSTEMS

A sustainable future for all can only be achieved by maintaining a balance between ecological and socio-economic welfare. Due to anthropogenic activities, the balance within the ecosystem is disrupted resulting in the degradation of the various ecosystems leading to various environmental problems. Conversion of forests to farmlands occurred during the period of 1980-2012 (Lewis et al., 2015). Human encroachment, unlimited use of the resources, harmful policies such as subsidies for intensive farming, and weak tenure laws that

encourage deforestation are some of the other factors causing the degradation of the ecosystem.

The impact of ecosystem destruction can be seen in the form of increased flooding due to the erosion of soil and lack of trees, climate change causing the sea levels rise due to the melting of the glaciers, and natural disasters such as tsunamis, earthquakes, and droughts.

The landscape restoration approach can be adopted carefully and efficiently to reverse the negative impact of unplanned growth and development (San-Jose et al., 2022). This refers to the composition (land covers) and configuration (spatial arrangement of land cover) in the determined area. This will also help in combating desertification, improving water security, food security, and maintaining a balance between environmental and social needs for the benefit of the stakeholders. Various ways by which we can control environmental degradation are planting more trees, rainwater harvesting, practicing the three R's i.e. reduce, reuse, and recycle, reducing the use of chlorofluorocarbons, managing fuel consumption, treating the industrial effluents before dumping them in water bodies, reducing the use of fertilizers, control population growth, etc. (Shrinkhal, 2019). This will also be an important step to achieve the Sustainable Development Goals (SDGs) by protecting and improving the livelihoods of people who depend on them, conserving biodiversity, reducing the risk of natural disasters and helping to regulate disease (San-Jose et al., 2022).

THREATS AND CHALLENGES

The major challenge is to give complete protection to the area (Mani, 2022). The villagers, surrounding the sanctuary, resent any attempts of the forest officials to mark a well-defined fenced area around the sanctuary. Non-cooperation and violation of the rules by local villagers are major barriers to the restoration process (Jain, 1994). The absence of forest boundaries leaves large parts of Aravalli area legally and physically unprotected and in a danger of encroachment from the neighboring villagers and farmland owners. Cutting of trees by the villagers has resulted in deforestation. An increase in the agricultural settlement and a continuous reduction in the forest cover due to urbanisation has resulted in more human-wildlife conflict (Pillai, 2021; Mani, 2022). This has become one of the most important issues in conservation. Faridabad- Gurugram highway and railways which bisect the Aravalli range and wildlife corridor in several places pose a great risk to wildlife. In the absence of a safe wildlife corridor connecting Sariska National Park in Rajasthan to Asola Bhatti sanctuary in Delhi, deaths of over 10 leopards in 4 years between January 2015-2019 have been reported, since these wild animals use these roads to go to Asola or towards Sariska (Dhankar, 2019). However, according to forest officials of the sanctuary, the possibility of man-animal conflict in future would be reduced as the prey base in the Asola is now sufficient for the leopard. The macaques captured from Delhi streets, as a measure to protect the residents, were translocated to Asola (Singh, 2013) which serve as prey for the leopards. It is also understood that the leopards move out of the forest area if they are unable to find their prey there (Agarwal, 2022b). Another important concern is the official denial of the presence of wildlife in the area. The attempt by MCD (Municipal Corporation of Delhi) to get possession of Bhatti Mines area as an alternative landfilling site, by modifying the HC (High Court) order passed in 1996 which prohibited the use of this area as a landfilling site, is also a threat to the intended restoration (Garg, 2010; PTI, 2022).

BHATTI MINE PITS

The mined pits have undergone geomorphological processes and the nature of the pits has completely changed since 1994 (PTI, 2021). They are transformed into water bodies now acting as recharging zones. Some of the pits store rainwater even today. According to forest officials the pits are home to threatened species, including a family of leopards. A wide range of animals and plant species are found in and around these mine pits. These water bodies are the only source of water for wild animals. According to orders of the National Green Tribunal

(NGT) and High Court, these water bodies cannot be used as dumping grounds but should be restored and preserved for recharging groundwater (PTI, 2022).

BANDHWARI LANDFILL AND WASTE PLANT

Of the 30 acres of Aravalli land, being used as a landfill, 14.86 acres of land is under the Aravalli Plantation Project, given the legal "forest status" as per Supreme Court orders, with protection under the Forest Conservation Act, 1980 (Dey, 2020). The landfill site is also close to the last remaining patch of native Aravalli forest, a sacred grove for locals, and is affecting wildlife, soil, water and humans all around it (Dey, 2020). The Bandhwari landfill is very close to the ground water aquifer and thus the leachate discharge is causing environmental pollution. In an order, dated March 1, 2019, NGT observed, "It is clear that damage to the environment is taking place by contamination of groundwater on account of leachate discharge." The Aravalli Bachao activists want the Bandhwari landfill to be shifted as it is estimated to have about 35 lakh tonnes of untreated, mixed waste. Therefore, the prevention of the use of this area as landfills and dumping sites is very crucial for restoration.

GOVERNMENTAL POLICIES FOR RESTORATION

Based on the principles of restoration, India has several policies in the existing framework. The Wildlife Protection Act, 1972 is one of the oldest and most comprehensive wildlife laws in the world and few other policies are National Forest Policy, 1988 and the National Agroforestry Policy, 2014 (Borah et al., 2018). On world environment day, June 5, 2021, UN declared 2021-2030 a decade on Ecosystem Restoration, the conservation of biodiversity. The Department of Environment of Delhi Government, in the year 2000, commenced a 5-year programme on rehabilitation of 2,100 acres of Bhatti Mines area at the cost of Rs.823 lakhs. The project was extended for another 3 years at an additional cost of Rs. 493.19 lakhs. Supreme Court ruling (2011) led the government to define Eco Sensitive Zones (ESZ) around the Asola Bhatti wildlife sanctuary to limit human activity in order to reduce the adverse effects on ecosystem, biodiversity, and natural resources. In these areas, the mining activities are prohibited along with the inhibition of any commercial activity and establishment of the hydro-electric projects (Dayal, 2019). Out of the total 12.17 km^2 area designated as eco-sensitive zone, 11.82 km^2 fall in Faridabad and 0.35 km^2 in Gurgaon. Eco sensitive zones function as the shock absorbers that regulate and manage the activities around the area for its protection. Since Asola Bhatti lies on Delhi-Haryana border, Ministry of Environment Forest and Climate Change (MoEFCC) had notified the buffer zone of 15.55 km^2 for the Delhi side of Asola Bhatti in 2017 (Sharma, 2019).

A joint publication of the government of India's MoEFCC, and IUCN provides data regarding the initiatives taken by India toward restoration (IUCN, 2018). The Bonn challenge is a global challenge to restore the landscape, launched in 2011 by the Government of Germany and IUCN (India being one of the global partners) and work with the SDGs (Borah et al., 2018). India has already brought an area of 9.8 million hectares under restoration since 2011, indicating that work to restore these landscapes is already underway. At the United Nation Framework Convention on Climate Change (UNFCCC) Conference of Parties (CoP) in 2015, held at Paris, the government of India made a Bonn Challenge pledge to bring 13 million hectares of degraded land into restoration by 2020 and an additional 8 million hectares by 2030, becoming one of the first Asian countries to join the global commitment, with one of the largest pledges from the region (Borah et al., 2018; IUCN, 2018). As per the report by IUCN (2018) India's total area is 297,319,000 ha of which pledged area is 26,000,000 ha (8.74%) and the total area under restoration presently is 9,810940 ha (3.3%).

GOVERNMENTAL INITIATIVES FOR RESTORATION

In order to preserve the rich biodiversity and prey base for different animals, it is also important to enrich the local plantation by growing native trees and shrubs which in turn would provide an adequate ecosystem for the herbivores. To achieve this goal, the Wildlife Institute of India is to prepare a wildlife management plan to ensure that wild animals and birds are protected and sustained at the Asola-Bhatti Wildlife Sanctuary (Agarwal, 2022a). Following is the list of the initiatives taken by the government for the restoration of Asola Bhatti wildlife sanctuary:

1. Regeneration projects began in 2020 to recreate 10 microhabitats in 12 hectares of land and another 2 hectares for restoring the grasslands (Harigovind, 2022). Open land in the forest of Aravalli hills with abundant sunlight is optimum for growth and development of grasses that can sustain a large number of biodiversity, especially browsers and grazers and also mammals, rodents, and reptiles (Dixit, 2021).
2. An initiative was taken by the government for the ecological restoration at the sanctuary by starting a plantation drive with around 14 varieties of grasses and 33 lakhs of saplings (Gandhiok, 2022b). The grasses selected are those which will help in increasing the microbial population which in turn will result in increasing the availability of nutrients to the plants. The grasses identified to be planted are Buffel grass, Johnson grass, Mauritian grass, Daabh, Crowfoot grass, Kash, Munj, Needle grass, Lemon grass, Dhoob, Vertiver and Rat tail grass, among others (Gandhiok, 2022b). The initiatives taken to restore the landscape is already showing some results. In parts of the sanctuary where the human footprint is reduced, grasses have already started growing (Dixit, 2021). Due to continuous efforts and absence of the human interference, the green cover has increased over the last decade from 324 km^2 (21.9%) in 2019 to 342.2 km^2 (23.06%) in 2022 (Gandhiok, 2022b).
3. Emphasis is on the assistive regeneration of plants and not on the mass plantation of trees thus reimposing the significance of grassland and shrubs (Harigovind, 2022). Assistive regeneration helps in complementing the existing vegetation such as Palash and Dhau and removal of invasive species like Lantana, Vilayati Kikar, Subabul and Parthenium grasses that suppress the natural growth.
4. Approval has been given by the Delhi government, for the construction of 45 km long patrol passage outside the sanctuary to prevent encroachment and trespassing of forest land (Mani, 2022).
5. Other initiative by Haryana government, is to use abandoned mine pits for conserving rain water in the monsoon season that will help to supply sufficient water in summer season.
6. A wildlife protection awareness event titled '*Van Jeev Sanrakshan Abhiyan*' at the Asola Bhatti Wildlife Sanctuary was launched by the government from 2 October, 2021 to 8 October, 2021 to sensitize masses about the importance of wildlife protection. Due to the pandemic in 2019, lockdown was imposed which reduced the human intervention in the sanctuary and has resulted in a definite increase in the population of mongoose, civet cat, golden jackal and Porcupine (Pillai & Gandhiok, 2021). Even leopard and a single striped hyena was spotted in the sanctuary.
7. Under the master plan for rejuvenation and redevelopment of Asola-Bhatti mines area, fourteen mining pits (4 large and 10 small) in Asola Sanctuary are to be transformed into reservoirs that will help recharge Delhi's groundwater (Jain, 2022).
8. As a part of the master plan to promote eco-tourism, butterfly trails, wildlife trails, cycle tracks, walking tracks, bird-watching spots and ropeways and others will be created.

FUTURE APPROACH (COMPLEMENTING BOTH FOREST CONSERVATION AND SUSTAINABLE MANAGEMENT)

The strategic collaboration in the past and present for the restoration process of the wildlife sanctuary has definitely shown advances during the past decades and has set the platform for long term future achievements.

1. The sanctuary should be protected by a continuous boundary wall to keep animals protected and prevent human intervention.
2. The dependence of the local people on the resources (forest, biomass, water, and road) from the sanctuary should be reduced.
3. Sufficient water holes and food supply should be provided in the sanctuary so that animals thrive in this area and more breeding can take place.
4. Efforts should be made to make the abandoned mine pits perennial by connecting them to a pipeline from the nearby villages, as water sources for the wild animals throughout the years.
5. Development of safe wildlife corridors should be encouraged for animals to move around fearlessly. A buffer zone should be developed outside the sanctuary to prevent any human- wildlife conflict (Sharma, 2019).
6. Strong anti-poaching policies should be adopted.
7. Regular and periodic wildlife census should be carried out as being done by the Bombay Natural History Society (BNHS) in collaboration with state forest department to assess the changes in the wildlife area and the problems faced by the animals in that area (began in March 2021 to be completed in 2023). This will help to enrich the habitat to ensure the availability of food and water for the animals to thrive well and will also support more breeding. The census is done using pugmarks and trap cameras and subsequently, leopards and jackals will be tracked via the radio collars (Madan, 2021).
8. Abandoned mine pits formed due to the illegal mining of red Badarpur sand and stones should be converted into lakes and restored as wetland habitats.
9. Bioremediation is an eco-friendly, cost effective and efficient technology for managing environmental pollutants. It is a biotechnical process that can clean up contaminants from polluted sites using biological organisms such as bacteria, fungi and plants (Strong & Burgess, 2008; Bove et al., 2015; Morris et al., 2018; Spina et al., 2018). The process of bioremediation involves degradation, detoxification, eradication of chemical pollutants or hazardous wastes, and immobilisation, mobilisation and transformation of metals from the environment. These soil microbes can be used to decompose landfill waste, improving the quality of the soil and hence the vegetation. They help in restoring the original natural surroundings and prevent further pollution (Majumdar, 2002; Demnerova et al., 2015). The microorganisms metabolise these pollutants using their enzymes to obtain energy and for biomass production (Tang et al., 2007; Selbmann et al., 2013; Abatenh et al., 2017; Bhandari et al., 2021). *Bacillus subtilis* acts as an efficient denitrifying agent in the agroecosystem and maintains soil health by eco-friendly remediating technologies (Mahapatra et al., 2022). The bacteria are safe bio-enzymatic cleaner which in nature are continually working in the organic soil to digest the waste and soil to simple products that can be consumed by bacteria. They can also be easily manipulated genetically to enhance the enzyme production which catalyse the chemical reaction between bacteria and soil for waste degradation (Bhandari et al., 2021). Various microbes like nitrogen fixers, phosphate solublisers, plant growth promoters and associated nitrogen fixers are responsible for making the nutrients available to the plants (Kour et al., 2020).

10. Inclusion of non-government/private and local organisations in the planning and implementation of restoration programmes should be encouraged for their technical expertise and knowledge of the local conditions.
11. Strengthening the exclusive zones for species-centric and habitat-centric approaches work well for the success of the restoration process.
12. Mass awareness programmes to sensitize about the importance of wildlife protection is of utmost importance. To achieve this goal, CEC in collaboration with BNHS in Asola wild life Sanctuary, gives an insight to the visitors about the conservation of flora and fauna via field based educational programmes.

CONCLUSION

Some success has been achieved in restoring the ecosystem of the Asola Bhatti and its surrounding area by giving it a protected status, which is evident from the increase of biodiversity in terms of both flora and fauna over the years as seen through various surveys. The various steps taken by the Government in case of Asola Bhatti wildlife Sanctuary, therefore could possibly be the way forward for restoring other habitats which have undergone ecological degradation. Restoration ecology has shown tremendous growth as a discipline of applied science. Restoring isolated and fragmented natural areas may not restore ecological functions and replicating the past ecosystem may not be feasible due to global climate change. However, further efforts are still required towards ecological restoration and its maintenance aimed at rehabilitation of ecological functions and not merely a re-composition of previous biodiversity. Restoration process may aim at natural progression, assistive regeneration, and working on the threats (urbanisation, policy threats, cutting of trees) to prevent further degradation of the forest after restoration. This can be achieved by continuous monitoring of habitat maintenance, forest cover prevalence and its configuration, land fragmentation, periodic surveys and ensuring proper implementations of all Governmental initiatives and policies. Awareness of the importance of a balanced ecosystem and informed participation of the public in its maintenance is needed to get fruitful results of restoration. Since restoration ecology has a direct link to human interests, these efforts are to be supported by the people. This will go a long way in helping the world to achieve the United Nations SDGs -a vision for 2030.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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