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Exposed Roots of *Salvadora oleoides* in Aravalli Range Addresses Freeways Constraint: Ecological and Management Perspective

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Abstract

The rapid development of industries and modern cities in India coincides with the improved road networking in the last five years or so. An observation on such an effort in the state of Haryana is visualized from 2018-2020, which showed ecologically jeopardizing the pervasiveness of some important endemic vegetation like *Salvadora oleoides* a tree of greatest economic significance. The species is on the verge of decline in the state, where only 3.62% forest area surrounds the state geographical area of 44,212 km^2. This viewpoint highlights wounded and exposed root zones of *S. oleoides* causes deterioration due to one of the key developmental activities, *i.e.,* the construction of roads and the expansions of rural, state and national highways. Further, we provide an overview of various *in situ* and *ex situ* modes of conservation measures for *S. oleoides*. The conclusion is focused on invocation of better land use policy intervention to maintain natural ecosystems with the modernization.

Keywords: Protein-protein interaction; Support vector machine; Feature extraction; Genetic algorithm; Simulated annealing

Key Policy Highlights

Reporting of unethical ways of road development networks leads to the rapid decline in the natural range of *S. oleoides* distribution; ecological impact of lost individuals of *S. oleoides* on native and non-native biodiversity of the country; *In situ* and *ex situ* conservation and management of the species is required at policy level to maintain natural ecosystems with the modernization.

Introduction

Rationale

Haryana, one of the sporting capitals of India, regularly conducts regional and world level summits and events. The state faces several events of rapid urbanization and industrialization in cities, namely Ambala, Bhiwani, Gurgaon, Hisar, Mahendragarh, Najafgarh, Rewari and Rohtak [1]. The advancement is decoded by the Prime Minister Rural Road Development Project (PMRRDP) leading to the construction of large number of National Highways (NHs), besides linking roads to far flung villages and their conversion into the State Highways (SHs) National Rural Roads Development Agency (NRRDA) [2]. The National Highways Authority of India (NHAI) is a leading government organization under Government of India (GoI) for constructing the NHs. The NHAI provides contracts to industries to develop and construct the road, along with guidelines of road safety measures, digging of the lands, creation of dumping zones for the waste, etc. [3]. But these industries often manipulate the power given to them for the monetary benefit [4]. The kind of living standard required is usually not maintained at ground zero, though the developer thinks there is no long-lasting problem arising due to harm posed on the ecosystem [5]. Thus, the viewpoint shed light on the impacts of improper road networking, their repercussions and dire consequences to the arid ecological environments affecting the keystone species *S. oleoides* and finally suggests some management perspective to the policy makers.

Materials and Methods

During 2018-2020, surveys were conducted in the *S. oleoides* dominated forests and community lands in the state of Haryana. Here, we came into foray with the striking observations and ever alarming situations of the road safety measures. This included expansion of highways to remove roadside trees and the topsoil was excavated from the community forest lands of *S. oleoides* in a devastating manner (Figure 1a and Supplementary Figures 1(a-c)). This may cause forest health deterioration in the long run as the majority of desert biomes reside near the periphery of the root zone due to lesser soil moisture availability in the deeper pan of the arid land [6]. Further, it was observed that the stone crushers are built in open zones without any enclosures and safety measures. These were very close in proximity with the agricultural farm lands (Figure 1b and Supplementary Figure 1(d)). This led to the aeration of Suspended Particulate Matter (SPM) and is subjugated to the local cultivated crops and *S. oleoides*, whose impact would be easily visible on vegetations [7].

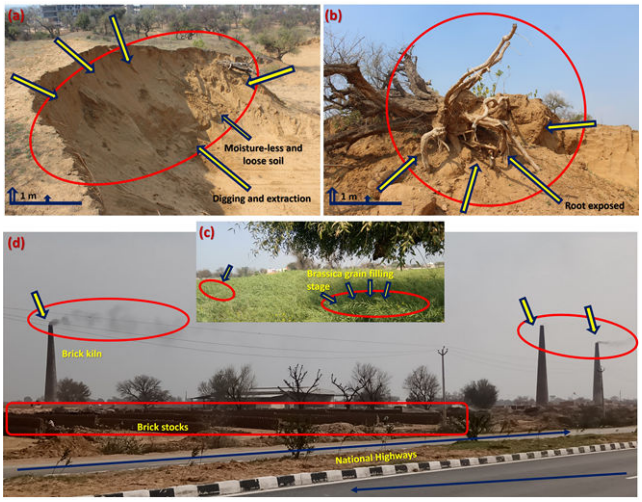

Figure 1: Digging of earth crustal layer at Haryana; (a) Ill-mannered digging in dominated *S. oleoides* area (Gothara community forest land, Rewari), (b) Grain ripening stage of mustard (Rudrol, Bhiwani), (c) Exposed root of *S. oleoides* (Rewari and Mahendragarh junction) and (d) Unauthorized brick kilns (Hisar-Bhiwani National Highways).

The dry region is very sensitive to the ecological thrust, if it is not natural. Importantly, the region surrounding the Aravalli ranges of northwestern India is highly potent to desertification due to its unsuitable soil condition and texture, low vegetation cover and arid climatic conditions [8]. Therefore, any activity that disturbs *S. oleoides* distribution or growth is highly dangerous to the ecosystem constituted by them. Hence, comprehensive efforts are necessary to ensure that the risk of contamination of fertile soil in agricultural, horticultural and natural lands is reduced to minimum [9]. As a researcher, we are very imperative to the nonscientific and ill-mannered extraction of soil from the natural range of distribution of any species. It is significant to understand the importance of proper land mining for urbanization, besides their evolutionary role in speciation as well as in ecological threats.

Results and Discussion

Conservational and ecological perspectives

Notably, the anthropogenic unrepairable events cause hindrance and difficulty in pursuing the progressive scientific research on the genetic diversity and conservation aspects of *S. oleoides*. The unprecedented development of NHs and uncontrolled expansion of human habitat, this species is on the verge of decline and shrinking abruptly. The factors like poor seed set, less seed viability, low germination and continuous exploitation are constantly contributing to affect the status of the natural population of *S. oleoides* [10]. It was observed that the major impacts came from the tractor trolleys, which were used to transport the dugout soil from community forest land (locally known as 'Vani'). Herein, the trunk roots get exposed to the harsh surroundings leading to the drying of trees and eventually dies, which seems to have died out naturally after the completion of developmental work (Figure 1c and Supplementary Figure 1(e-g)).

Another most important concern is the utilization of wood for burning in brick kilns. Most of the kilns have government permits, but the majority of them are illegal [11]. The legalized ones also exceeded their permissible limit of land digging and extraction and often continued to work even after their license expired (Figure 1d and Supplementary Figure 1(h-i)). Main concern is -whether business conducted by the industrialist in a legal manner which might have support of political favoritism? These repercussions cause land degradation that might suppress the natural regeneration of *S. oleoides* and may be cumulatively affected by the adverse climatic conditions. The seeds of *S. oleoides* are highly recalcitrant [12] and extreme drought conditions in the summer seasons are not feasible and favorable for the natural regeneration mechanism [13]. Further, being spineless, the species primarily used as a fodder source for cattle's (Supplementary Figure 1j), suggested the non-occurrence of species in a fallow land.

Given above-mentioned facts, the climatic factors, such as rainfall and temperature data were collected for three *S. oleoides* dominant districts, namely Mahendragarh, Rewari and Bhiwani (Figure 2a). Data from 2014-2018 revealed, the rainfall (mm) ranged from 825.90 (2014) to 1219.80 (2018), with an average rainfall of 1059.9 ± 70.01 mm and a total rainfall of 5299.40 mm occurred overall for 5 years. Due to the arid steppe climatic regime, no rainfall was recorded during most of the winter months. Similarly, district Hisar weather data for the last one decade represents the estimates of Haryana climatic forecast (Figure 2b). A total rainfall of 4234.10 mm occurred from 2010-2019, which ranged from 243.5 mm (2014) to 642.9 mm (2013) signifies the unpredictable variation over the years in a rainfall pattern. Furthermore, variation in maximum temperature was observed during December to February. Notably, the hottest month during the year was observed to be May and June, with an average maximum temperature of the Hisar was recorded as 32.24°C ± 0.22°C (over the decade). The frequently changing climatic data suggested variability in the rainfall and temperature for the region, which also illustrated the tree species evolutionarily adaptive response, is slow as compared to other life forms on earth. During the survey, the *S. oleoides* (populations as well as individuals) did not show frequent flowering and fruiting in northern Haryana and might be corroborates to the climatic data regime.

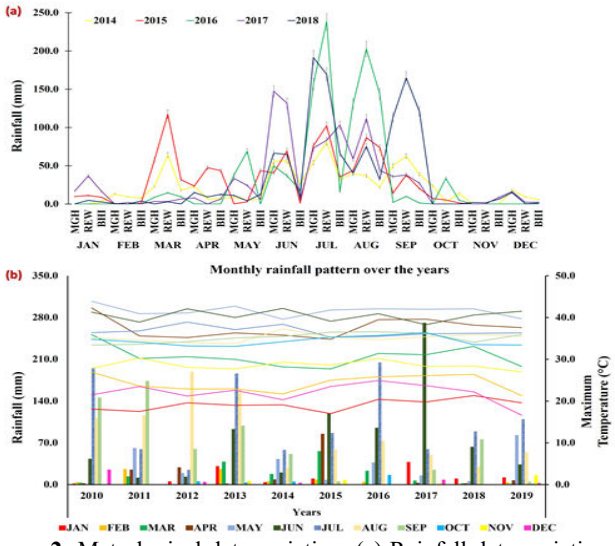

Figure 2: Metrological data variation; (a) Rainfall data variation of *S. oleoides* dominated districts of Mahendragarh (MGH), Rewari (REW) and Bhiwani (BHI) from 2014-2018 and (b) Rainfall and temperature data variation of Hisar over the decades (2010-2019).

On the biodiversity front, the habitat of Pavo cristatus and Siberian migratory birds gets exposed to the biotic predators and population as such, to the abiotic factors (Figure 3 (a,b) and Supplementary Figure 1(k-m)). Now, these ecological effects are visualized easily, as the impact is more severe than what might be presumed during this kind of unethical and non-scientific construction.This kind of uncontrollable effects on the local environment of the residents and to the biome as a whole, the SPM and Respirable Particulate Matter (RPM) remains in air for prolonged period which is heavily inhaled by the living organisms [14], leads to the several health problems, such as respiratory, mental, heart and liver diseases, etc.

Figure 3: Predatory exposure of biodiversity; (a) National bird exposed to biotic and abiotic stress and (b) Avian diversity.

Management options

Land degradation due to mining activities at unprecedented levels causes massive ecological threats; whose impact will remain for an extended period, might not be noticed today but highly devastating in future scenarios with changing climatic conditions. Earlier, researchers reported the ecological dislodging of biodiversity from local to regional and further to global level [15]. The Sustainable Development Goals (SDGs) as depicted by the United Nations (UN) should be followed at ground level in each and every perspective of the developmental agendas [16]. Otherwise, meagre signatories to the forum could not solve the concerns raised through unparalleled demands of the countries. Herein, we suggest suitable measures which may vary from country to country, but their consequences and effects are seemingly similar. Invariably, most of the European nations have developed their germplasm bank for many forestry species [17], which needs to be replicated across the entire world. Priority list of indigenous germplasm should be immediately developed at provenance, state and national levels in discussion with the stakeholders, farmers and researchers. Policy decisions should be from bottom to top, which is generally least pronounced. Atleast, 2-3 germplasm banks in accordance with the agro-climatic zones for each road side accessions or genotypes representing populations should be given the priority and dedicated lands should be materialized for the purpose. The *ex situ* conservation mode will be applied for the species, which needs proper monitoring and utmost care during the initial year of survival. Or otherwise, an *in situ* mechanism will be applied by giving incentives to the community forest lands for protecting the natural genetic resources. The unifocal and dissident equilibriums should be placed between the authority and executives, which minimize the problems and instigate the mechanism to solve the issue. The direct benefits of the germplasm banks are unparalleled, as it brings all wild materials to common place, which could be easily protected and then multiplied for afforestation programmes through seed or by vegetative means. Indirect benefits are the ecological sustainability and maintenance of diversity that will also help in the assemblage of the pollinators and other wild animals [18]. In India and many parts of the world, *in situ* and *ex situ* assemblage of wild relatives of crops, animals, insects, beneficial microbes, so on and so forth were done earlier, which is limited for forestry tree species and required an inception. Due to the ever-increasing human population and limitations of lands across the world, it might be possible that after this century, the generation next might not be able to see the forests. Therefore, this decision has to be taken at the world level for the priority dedication of land for the conservation of forestry tree species [19].

Needful to say, the regular monitoring and evaluation will be required for the proper management of the road networking programme across the world. Though the timely completion of the project is necessary, beyond that, the precious life of every living creature is important and significant for human well-being. It would be better to involve scientific manpower to foresee the developmental work on a routine basis, report preparation and suggestive measures (Figure 4).

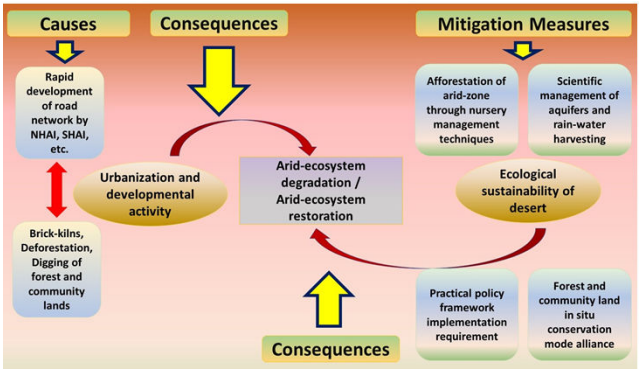

Figure 4: Flow chart showing arid ecosystem degradation and restoration: causes and consequences.

Conclusion

Article 42 and 48A is written in the Directive Principles of State Policy (DPSP) of the Indian Constitution (DPSP taken from Irish Constitution) states about the right to freedom of clean air and surroundings to the resident of this country besides emphasize on the protection and improvement of the environment and safeguarding of the forests and wildlife. Unfortunately, the government does the needful but the industrialist's act differently in terms of their monetary benefit irrespective of the surroundings of the residents of the country. The hominid required all living and non-living materials for their sustainability, exploitation of any of these could make human life in danger. Polluted air, water and soil will make the living being more susceptible to diseases. Recently, an n-COVID 19 virus get exposed to human population in Wuhan province of China; therefore, rapid mutagenic effect of virus causes more than 6,398,648 deaths and over

572,872,470 infected cases worldwide. Not only this, due to global warming and climate change effects, there are permafrost regions, such as Arctic and Antarctic, Greenland Siberian plateau, etc., on earth might get exposed and supposedly devastating microbes may seriously harm the humans and biotic community as a whole. Given these considerations, we emphasized that the developmental activities required to be done with proper scientific and geological upgradation of facts. Otherwise, the natural world may get exposed to unnatural things.

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