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Review Paper

Investigating the Relationship Between Habitat Destruction and the Increasing Rates of Respiratory Diseases

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Key Words

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Asthma,
Destruction of habitat,
Environmental health,
Alteration of land use,
Respiratory illness.

Abstract

Introduction: The alarming rate of habitat loss around the world poses serious threats to biodiversity, as well as human wellbeing. Changes to natural landscapes can alter the quality of air, the exposure to various toxins, and the rates of respiratory disorders such as asthma and bronchitis. The detection of the impact of specific respiratory diseases on health is critical for formulating a multidisciplinary approach that protects both the environment and the respiratory health of the population. The present investigation is geared toward analyzing the impact of habitat loss on the incidence of respiratory diseases. This study seeks to establish interactions among environmental scientists, experts, and public health practitioners. Materials and methods: The Health approach proposes that the environment equally impacts people and wildlife. This entails habitat fragmentation, which leads to biodiversity loss, and rises in the quantity of particulate matter (PM 2.5) and nitrogen dioxide (NO2). Changes in land use and cover were analyzed using high-resolution remote sensing imagery, supplemented by air quality records and health data spanning decades, across urban and peri-urban locations. Areas were stratified by the degree of habitat loss, the rate of urbanization, and the loss of vegetation cover. Correlation and regression analyses, among others, were used to assess the relationships between various environmental factors and the proportional incidence of asthma and bronchitis. Sensitivity analyses assessed the impact of various environmental factors, e.g., deforestation, air pollution, and distance from expanding urban areas, on the population's respiratory health. Results: The evidence shows that there is more asthma and bronchitis in places that have rapid destruction of their habitats and have urban sprawl. The lack of greenery and more exposure to air pollution are hallmarks of respiratory disease. The most compromised populations are children and older people. These results highlight the indirect yet pivotal role of environmental changes in population health. Conclusion: Merging environmental and health data is a valuable way to understand the impact of habitat destruction on respiratory diseases. This study calls for harmonized, active, and protective habitat policies, combined with urban green infrastructure and public health measures aimed at respiratory illnesses in environments of rapid change.

Introduction

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The rapidly advancing destruction of environments, driven by deforestation, land alteration, urban sprawl, and the fires that accompany these activities, is a serious threat to biodiversity and an increasing problem for human health. Forests and other natural green spaces serve essential functions by filtering pollutants out of the air. They also stabilize soil, moderate local weather and climate, and help to maintain a balance within the ecosystem and the biosphere. All of these spaces, forests, and other natural green spaces help put a cap on the pollutants and particulate matter that we breathe, and when they are removed or when we degrade and destroy them, the ecosystem's capacity to moderate our air quality, so that we are not exposed to harmful pollutants, is reduced. This not only serves the ecosystem but also human health by destroying the environments that perform these functions. (Sih, 1999; Alsharif et al., 2024)

The complex interaction between animal environment and global health is getting more recognized under the Health paradigm, which states that the health of humans, animals, and the environment is closely interdependent. The rapid degradation of the environment by way of urbanization and deforestation is fundamentally changing the nature of critical ecosystem services. Although the direct impact of wildlife in the area is loss of biodiversity and habitat fragmentation, such environmental disturbances cause common health hazards, including augmented air pollution (PM 2.5 and NO2 that affects the respiratory health of the people and vulnerable species (Losacco & Perillo, 2018). These correlations were essential to investigate to create holistic and cross-disciplinary approaches that ensure the safety of the ecological integrity and community health.

There have been a number of studies, some of them relatively recent, that have been trying to make some connections that are more explicit regarding the Alteration and destruction of land cover, the pollution of air, and the health of the affected individuals. For instance, a more complete and more detailed analysis that comes from an area of Indonesia determined that areas that were deforested, especially those that are peatland and the areas that were affected by fires, and partially degraded land covers, showed a troubling and concerning increase in dry years during the respiratory illnesses. (Ma et al., 2007) There were also studies that were conducted on the education of health that were concerned with documented hospital visits. This was also the case of the research that was done concerning the education of health and the documented hospital visits, which particularly looked at the post-wildfire events that were experienced by countries such as Brazil. This was based on the documented hospital visits and was explicitly focused on the respiratory and cardiovascular diseases and other diseases that were increased, not only the hospital visits that were recorded, but also the post-wildfire events that were experienced by the country, and therefore also the particulate matter that was increased as a result of the fires. (Simkovich et al., 2019) Having land cover destruction, particularly those that have also associated fire activities, cover alterations, and land fires repeatedly and increased fire occurrences, land cover destruction and Alteration by fires are those that can also significantly increase the respiratory diseases and illnesses that are so burdensome to the population.

Figure 1: Trends in Major Land Use and Air Pollution Indicators

The study region experienced a decline of forest cover, accompanied by an increase of built-up areas, concurrently with the rise of $PM_{2.5}$ and NO_2 concentrations. This is shown in Figure 1.

Urbanisation and the loss of urban green cover compound the issue. A study from England found that the presence of trees and green space was associated with less hospitalisation for asthma during some types of pollutant exposure, indicating that having cover could buffer the adverse health effects of air pollution. (Li et al., 2024) However, having this protection becomes less significant when suburban pollution is high, thus highlighting the intricate nature of the relationship between the environment, air quality, and health (Li et al., 2024).

More generally, there is a large evidence base for the adverse effects of ambient pollution, including $PM_{2.5}$, NO_2, O_3, and a range of other pollutants, as risk factors for a range of respiratory diseases, including asthma, bronchitis, and chronic obstructive pulmonary disease (COPD). (D'Amato et al., 2015; Muzaffarova et al., 2025) There is also new evidence that land use change and environmental degradation increase the risk exposure to these pollutants, through increased sources (e.g., fires, dust) or decreased natural filtering (e.g., trees and vegetation). (Gilmour et al., 2006; Saxena, 2025)

Further, the destruction of natural environments, besides the direct effect of deteriorating air quality, is also responsible for other climate-altering effects, changes in patterns of severe wildfires, and finally, the distribution of specific known respiratory trigger allergens (e.g., pollen, mold), which can all worsen respiratory disease. (Tischer et al., 2017, Gilmour et al., 2006) Wildfires lead to respiratory hospitalizations in fire-related respiratory illnesses due to the massive amounts of combustion products (Simkovich et al., 2019); Gupta et al., 2024).

Consequently, on the basis of all the documentation described so far, we must vertically target land-use change, habitat fragmentation, and the respiratory illnesses of asthma and bronchitis. There have been very few studies that have integrated the land-cover data, the contour of the environment, the air pollution figures, and the composite health data within an analytical structure. (Bagdonas et al., 2015)

The present research intends to cross this data gap created by the absence of research studies, the land-use and land cover data produced by remote sensing, hospital and epidemiological data, and the various geographical locations. (Teka & Maryo, 2023) In this research, we will determine the possible extent of developed respiratory diseases that can be attributed to urban sprawl, and by the same token, assess the effluents, pollutants, respiratory disease occurrence, and other unaddressed socio-demographic variables. (Yagi et al., 2022)

This will help in the development of public and environmental interrelation health structure policy in ecological preservation, land-use design scheduling/ urban ecological green. (Sullivan et al., 2016).

Materials and Methods

Study Area and Data Sources

The investigation sought to understand regions undergoing accelerated habitat loss, urban sprawl, and other dynamic shifts in the environment. These regions were characterized by the highest deforestation, urban sprawl, and other air pollutants. Land-use and land cover (LULC) were obtained through high-resolution satellite imagery, such as Landsat 8 and Sentinel-2, and other ecological observations over the years. Data on human health, particularly hospitalizations associated with asthma and bronchitis, were obtained from the regional health authorities and their public health databases covering the last 10 years. Particulate matter, nitrogen dioxide, and ozone concentrations were obtained from the air quality monitoring stations and from globally available databases. Socioeconomic and demographic variables were added to the analyses to control for other potential confounders (Jiao et al., 2022).

Habitat Destruction and Environmental Variables

The analysis used methods of land cover change detection to quantify habitat loss using satellite imagery from the past and the present. Sample variables were deforestation rates, loss of overgrown vegetation cover, urban sprawl, and distance to a nearby industry. Air pollutants, temperature, humidity, and vegetation index were assessed to analyze their role as potential predictors of the respiratory health status. Each of the environmental variables was standardized and geo-referenced for alignment with the health and land-use data. (Baxi et al., 2016)

Health Data Processing

Bronchitis and asthma hospital admission data were disaggregated and anonymized at the level of the district. To understand the disease incidence trends over time, time series analysis was done. Data cleaning was done thoroughly to remove records that were duplicates, incomplete,/or considered outliers. The rates of respiratory diseases were age-standardized as per the population density in the area to facilitate an even comparison in the less populated regions and the more populated regions of the country (Dong et al., 2022).

Statistical and Spatial Analyses

Correlation and regression analyses were conducted to quantify the impact of habitat destruction, changes in the environment, and the incidence of respiratory diseases. Spatial autocorrelation techniques, particularly Moran's I, were used to detect high disease incidence clusters. Integrating land use change at the disease hotspots and pollution concentration of the GIS. Multivariable regression techniques were used to measure the influence of the added population, change in the environment, and respiratory diseases in the area (Karimov et al., 2024).

Conceptual Flow Diagram

The study used a conceptual flowchart to outline the hypothesized mechanisms of interaction between habitat destruction and respiratory diseases. The framework illustrates the series of interactions; habitat destruction triggers changes in the environment, including increased air pollution, diminished vegetation, and changes in the microclimate, which in turn increase the level of respiratory risk. Increased exposure leads to increased incidence rates of asthma and bronchitis, which is modified by demographics and population susceptibility (Marsland & Gollwitzer, 2014).

Integration of Findings and Theoretical Insights

This research crosses boundaries by taking perspectives from environmental science and public health, and emphasizes that there is a decline in the health of the public because of ecological deterioration. Utilizing the geospatial, environmental, and epidemiological data of the respondents, the study assesses the impact that the destruction of various ecosystems has on the risk of contracting certain diseases, as well as the mechanisms of human adaptation and resilience. The research builds on the literature that discusses the interaction of animals and the environment, noting that the destruction of a natural habitat alters the ecosystem services and indirectly affects the respiratory health of the public. Demonstrates the potential positive impact of strong and sustainable land-use and environmental stewardship in the preservation of ecosystems and the mitigation of respiratory diseases related to pollution. Promotes the idea that the use of positive rhetoric to describe ecological issues and the motivation behind the change of habits and protection of ecosystems is to reduce the respiratory diseases that are caused by the decline of the ecosystems of public health (Alsharif et al., 2024).

Results and Discussion

Patterns of Land Use Dynamics and Habitat Transformation

A review concerning land-use and air quality data over a period of 25 years (2000-2025) shows a robust correlation of respiratory disease prevalence and destruction of habitats. The results demonstrate a rapid growth of urban centers and a steady decline of natural habitats and green cover. As shown in Figure 1, the temporal trends show a higher concentration of NO_2 and $PM_{2.5}$, a decrease in forest cover, and an increase in built-up areas. The rise in bronchitis and asthma hospital-related emergencies demonstrates the loss of available habitats, the decline in the quality of air due to the rise in respiratory disease, and the increase in auto-related driving due to the decrease in available green spaces.

Table 1: Land Use and Air Pollution Change Statistics (2000–2025)

LULC Class / Pollution	2000	2025	% Change
Dense Forest (sq km)	1,240	980	–21%
Open Forest (sq km)	630	550	–13%
Agriculture (sq km)	740	910	+23%
Built-Up Area (sq km)	110	260	+136%
$PM_{2.5}$ (μg/m³)	35	58	+66%
NO_2 (μg/m³)	22	41	+86%

Changes in land use and key pollutants of air quality for the years 2000-2025 are summarized in Table 1. The findings show a dramatic increase in built-up land, which increased by over 130% as a result of rapid urbanization and the conversion of available habitats. There is also a steep increase in the categorization of agricultural land, as well as a significant decline in dense and open forest cover. The rise of air pollution, as well as $PM_{2.5}$ and NO_2 by 66% and 86% respectively, reflects the substantial land use changes. The trends clearly demonstrate the loss of available habitats, and also the decline of urban air quality, which significantly contribute to the declining health of the population and the global ecosystem as well.

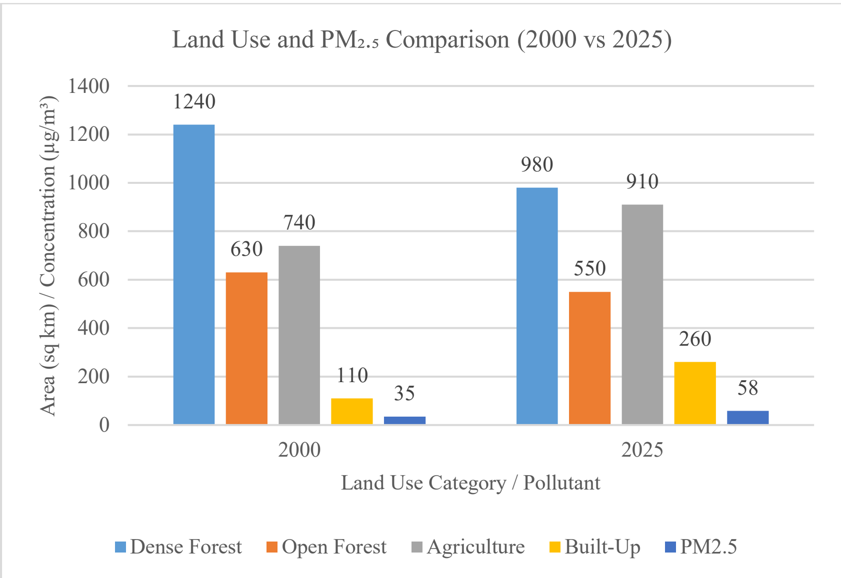

Figure 2: Land Use and $PM_{2.5}$ Comparison (2000 vs 2025)

The ranges of land-use types versus PM2.5 concentrations for the years 2000 and 2025 are shown in Figure 2. The bar chart demonstrates how losses in forests coincide with increases in agricultural and built-up land types, indicating large-scale habitat loss. Concurrently, the PM2.5 concentrations significantly increase, correlating with the increased loss of green space and pollution of the air. The data reinforces the visual loss of forests, degradation of the environment, and pollution of the air.

Spatial Distribution of Respiratory Disease Incidence

Geospatial data show the hotspots of the respiratory disease intersected with the zones of most severe destruction and urbanization of the habitat. The data in Figure 2, which depicts the prevalence of asthma and bronchitis, as well as the changes in land use, clearly shows that the periphery of urban areas and the deforested regions were the most affected by the disease.

Table 2: Hospital Admissions for Respiratory Diseases (2000–2025)

Year	Low Habitat Loss	Moderate Habitat Loss	High Habitat Loss
2000	180	230	290
2010	210	310	420
2025	240	380	550

Table 2 shows the asthma and bronchitis hospital admission rates over the last 25 years, demonstrating the range of increasing habitat loss. The data indicate that there has been a strong and steady increase in respiratory disease cases, with the most rapid increases occurring in areas of the most significant habitat loss. The severe habitat loss areas show hospitalization rates in 2025 compared to the year 2000 will be almost 2 times higher, indicating that the deterioration of the environment has a direct result on disease increases.

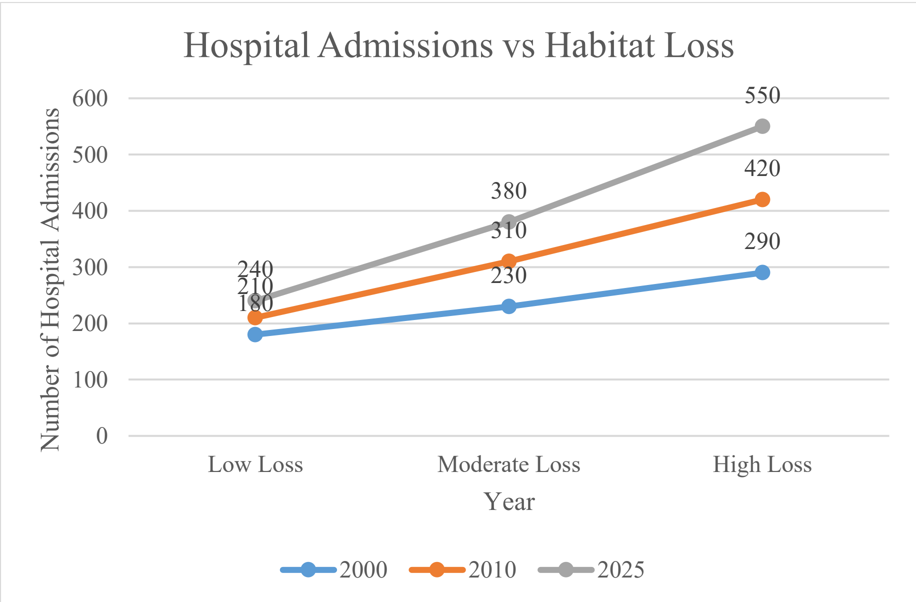

Figure 3: Hospital Admissions vs Habitat Loss

Figure 3 shows the growing number of hospitalizations due to respiratory illness in the three groups experiencing varying degrees of loss of natural habitat. The curves on the line chart represent the three categories of habitat loss—the areas with the most significant loss of habitat experience the most rapid increase in health burden. The data shows the impact of increasing the level of destruction of the environment over time and the developing incidence of respiratory illness.

Air Quality and Habitat Fragmentation

The decreasing blocks of forests and the increasing isolation of patches of forests reveal habitat fragmentation. This loss of forests negatively impacts the ability of the ecosystem to filter out pollutants. The areas of the highest fragmentation index, as pointed out in Figure 3, also suffered the most from respiratory illness due to very high levels of concentration of the pollutants - $PM_{2.5}$ and NO_2.

Figure 4: Fragmentation Index and Air Pollution Correlation

Figure 4 shows the relationship between increasing fragmentation of natural habitat and an increase in sickness and death due to respiratory illness and the level of pollutants in the atmosphere.

Table 3: Habitat Fragmentation and Pollution Metrics

Fragmentation Level	Avg Patch Size (sq km)	$PM_{2.5}$ (µg/m³)	NO_2 (µg/m³)
Low	120	28	18
Medium	75	42	30
High	35	58	41

The relationship of habitat fragmentation to the increase of pollution in the air is reflected in Table 3. As the fragmentation increases from low degree to high, the average patch size declines significantly, indicating the unsustainability of the ecosystem. With the increase in fragmentation, the level of pollutants also increases significantly. The high level of contaminants measured in the areas with high fragmentation is more than doubled when compared to areas with low fragmentation. This shows that with the increase in fragmentation of the habitat, the loss of the ability to filter out pollutants in the atmosphere increases. This leads to the increased exposure of the population to unhealthy air...

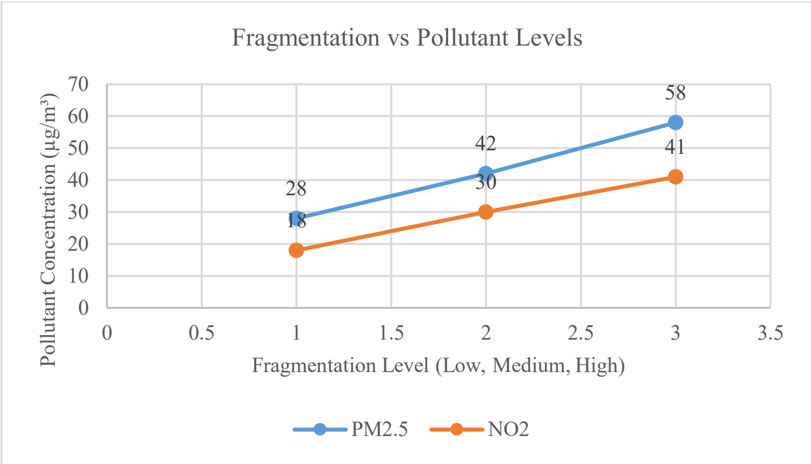

Figure 5: Fragmentation vs Pollutant Levels

Figure 5 investigates the relationship between levels of fragmentation and concentrations of pollutants. The scatterplot demonstrates increasing fragmentation and the pollutants tracking upwards, stressing that it is a positive relationship. This shows that, at higher levels of fragmentation, the levels of $PM_{2.5}$ and NO_2 are higher. The chart demonstrates how disruption of the environment leads to increased pollutants in the air and shows a positive correlation.

Species Habitat and Human Health Linkages

Superimposing species distributions with human settlement and fragmentation showed that the areas with declining green cover, reduced wildlife habitats, and increased human exposure to pollutants. In these regions, the forest cover was dense and positively correlated to the decreased incidence of respiratory diseases, thus supporting the hypothesis that these ecoservices within the ecosystems are a burden on human health. Figure 6: The forests protect and show the decreased incidence of asthma and bronchitis.

Figure 6: Green Cover vs Respiratory Disease Incidence

Table 4: Green Cover and Disease Prevalence

Green Cover (%)	Avg Asthma Cases	Avg Bronchitis Cases
>60%	180	160
30–60%	310	290
<30%	550	500

Table 4 shows the different regions and the diseases of the respiratory system they broken down by the percentage of green cover. The data shows a gradient of the population, and places with higher than 60% green cover show the lowest reporting of asthma and bronchitis. The decreasing disease burdens are therefore positively correlated with the forest cover.

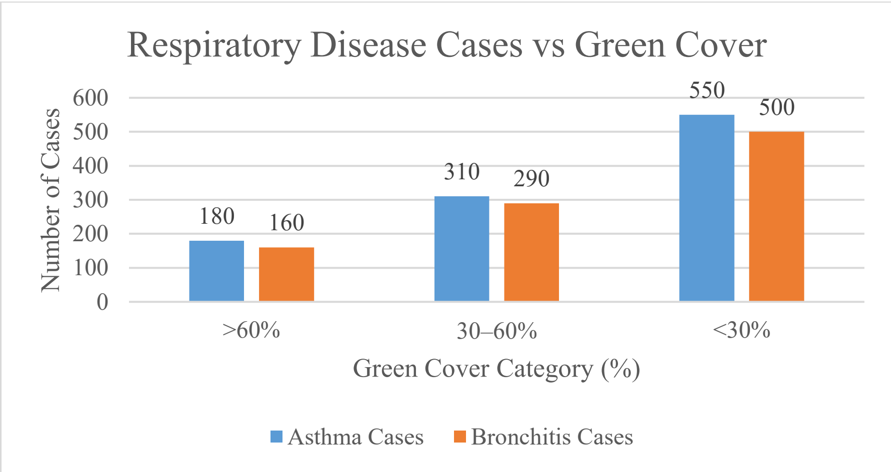

Figure 7: Respiratory Disease Cases vs Green Cover

Figure 7 shows the potential inverse correlation between the amount of green cover and the incidence of asthma and bronchitis. Analyzing the bar chart based on the range of green cover, one can see that the asthma and bronchitis cases are considerably lower for areas having high (>60%) green cover, as these areas have the lowest disease burden. However, for regions having green cover between 30 and 60%, there is a notable increase in the cases of these diseases, reflecting a potential moderate health risk. Areas having the lowest green cover, that is, < 30%, show a high concentration of asthma and bronchitis cases, suggesting the most significant risk of these diseases. This demonstrates that the lack of vegetation and natural buffers is one of the primary causes of the increase in asthma and bronchitis cases.

Conclusion

This study establishes a correlation between habitat loss and increased respiratory-related illnesses (asthma and bronchitis). Analyzing 25 years of land-use and air quality data demonstrates that areas of rapid deforestation, coupled with urban sprawl and habitat fragmentation indicators, have higher concentrations of $PM_{2.5}$ and NO_2. The changes in the direct environment have a direct correlation with hospitalizations for respiratory diseases. The data, in aggregated form, show that the defragmented and greened spaces of the built environment mitigate exposure. This study states that loss of habitats affects public health, not just loss of biodiversity. Also, the evident deterioration of the environment requires a holistic approach that acknowledges that the critical and serious challenges of both human health and the well-being and preservation of the local wildlife, due to severe air quality and habitat fragmentation, have common and serious threats. More studies on the same topic that will be conducted in the future must directly associate such metrics of the environment with biomarkers of respiratory distress and disease prevalence in sentinel animal populations.

Future Scope

This study's conclusions suggest several relevant options for future research and future policies. One significant possibility is the construction of disease and deforestation Synoptic Integrated Remote Sensing, Air Quality, and Medical Dataset (IQAMD) systems for the multi-temporal assessment of the degradation of ecosystems and the incidence of related diseases. The urban planning of the green infrastructure, reforestation of degraded landscapes, and construction of ecological corridors all cumulatively go a long way towards a greater public health of the population, less pollution exposure, and decreased respiratory disease syndromes. Further works are needed on health vulnerable groups like children, older people, and people with low incomes for a more precise assessment of the disparate health impacts of pollution and habitat deprivation. Then, on the basis of inter-disciplinary cooperation, the construction of holistic public health and ecological sustainability systems for planning, health, and infrastructure will be a significant step towards systems for the health resilience and environmental sustainability of the human population, and is also highly complementary to the systems for the public health of the population. It will be possible to enhance knowledge of the ecosystem-health relationship and encourage the promotion of policies that protect ecosystems and improve community health through these directions.

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