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An Integrative Review on Environmental Pollution and Health Hazard: A Culprit of 21st Century

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ABSTRACT

In the twenty-first century, environmental pollution has become one of the biggest risks to public health worldwide. The quality of the air, water, soil, and food has significantly deteriorated as a result of rapid industrialization, urbanization, deforestation, excessive chemical use, and unsustainable lifestyle choices. According to Modern medical science, pollution plays a significant role in immune dysregulation, neurodegenerative diseases, cancer, cardiovascular disease, respiratory disorders, and endocrine disorders. However, rather than addressing the deeper ecological and systemic causes of illness, modern biomedical approaches frequently concentrate on disease-specific management.

Ayurveda, provides a comprehensive and ecologically based framework for comprehending the connection between human health and the environment. Classical Ayurvedic texts describe the inseparable connection between the *Purusha* and the *Loka* through principles such as *Yat Pinde Tat Brahmande*. Epidemics (*Janapadodhwamsa*) and chronic illnesses are thought to be primarily caused by environmental imbalance (*Prakriti Vaishamya*). *Dushi Visha*, *Garavisha*, *Dooshita Vayu-Jala-Desha*, and *Ritu Vaiparitya* are examples of concepts that closely resemble contemporary ideas of long-term environmental toxicity.

To analyse the effects of environmental pollution on human health from an integrative perspective, this comprehensive review critically evaluates both contemporary scientific evidence and classical Ayurvedic literature. It highlights Ayurvedic etiopathogenesis, preventive principles, and therapeutic interventions such as *Panchakarma*, *Rasayana Chikitsa*, dietary regulation, and structured lifestyle management through *Dincharya*, *Ratricharya*, and *Ritucharya*, along with the avoidance of contaminated food. The review underscores the significance of Ayurveda as a preventive, complementary, and sustainable approach to addressing pollution-related health challenges.

Key Words *Environmental pollution, Dushi Visha, Janapadodhwamsa, Rasayana, Toxicity*

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INTRODUCTION

The state of the environment and human health are closely related. Civilizations have recognized the importance of clean air, pure water, fertile land, and well-balanced seasons for survival and

well-being since ancient times. However, in recent decades, natural ecosystems have undergone significant changes due to unprecedented industrial growth and technological advancement. A hazardous

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environment for human habitation has been produced by a number of factors, including food adulteration, soil degradation from chemical fertilizers, non-biodegradable substances like plastics, water contamination from pesticides, plastics and heavy metals like lead, mercury, and arsenic, and air pollution from industries and vehicle emissions¹. Environmental pollutants introduced to the human body through inhalation, ingestion, oral absorption. In addition to that massive number of Industrial pollutants have acute effect like burning, and irritation in eyes, nose, throat, coughing, skin rashes, dizziness, headache, and chronic health hazards like Asthma, COPD, Psoriasis, Infertility, Miscarriage, Hypertension etc. to the worldwide population.

According to current epidemiological estimates, household air pollution contributed an additional 3.1 million premature deaths worldwide in 2021, while ambient fine particulate matter (PM_{2.5}) air pollution alone was responsible for about 4.7 million premature deaths². This highlights the significant contribution of long-term exposure to environmental pollutants to the global burden of non-communicable diseases like Respiratory, Cardiovascular, prenatal, Genetical and Cancerous by interfering physiological function of the body.

Ayurveda implicates environmental pollution in other ways also. It views humans as an essential component of the cosmic order rather than as something separate from nature. Classical writings such as the *Charaka Samhita* emphasize

Janpadodhwansa, where "Dhwansa" means demolition and "Janpad" means a community or group of people. Thus, the term "Janpadodhwansa" literally means "a condition with massive demolition or annihilation of people or community." In *Janpadodhwansa*, a single disease may affect people with different Prakriti (constitution), Aahara (diet), Deha (body), Bala (strength), Satmya (suitability), Mana (mind), and Vaya (age) at the same time.

Even with advanced diagnostic and treatment tools, contemporary medicine lacks the ability to stop pollution related illness. Therefore, incorporating Ayurvedic principles is crucial for developing both preventative and therapeutic strategies.

This review seeks to re-examine environmental pollution and its health impacts from an Ayurvedic perspective, bridging ancient wisdom with current scientific knowledge to suggest integrated approaches for prevention and care.

AIMS AND OBJECTIVES

This review aims to examine environmental pollution and its health impacts from an Ayurvedic perspective, integrating classical Ayurvedic concepts with modern scientific evidence to propose comprehensive preventive and therapeutic strategies.

MATERIALS AND METHODS

This review summarizes the previous work done by ancient as well as contemporary scientists and

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researchers focusing on *Dushi visha*, *Janpadodhwansa*, *Srotodushti*, Pollutants, Microplastics, Heavy metals, Air Pollution and toxicity, The search has been done in classical Ayurvedic literature like *Charaka Samhita*, *Sushruta Samhita*, *Yajurveda* and their authoritative commentaries. and contemporary biomedical research related peer-reviewed journals indexed in PubMed, Scopus, Google Scholar, AYUSH Research Portal, and WHO reports on environmental pollution irrespective to date and time. After reviewing more than 45 publications and their outcome the review paper provide insight for integrative approach to provide solution for environmental pollution and health hazards

CONCEPT OF ENVIRONMENT IN AYURVEDA

According to Ayurveda, the environment plays a crucial role in determining one's health. The same Panchamahabhuta: Prithvi (earth), Jala (water), Agni (fire), Vayu (air), and Akasha (space), make up both the universe (*Loka*) and the individual (*Purusha*). The microcosmic representation of these elements within the human body is inevitably impacted by any disruption in these elements at the macro level. This interdependence is emphasized by the traditional proverb *Yat Pinde Tat Brahmande*³. Disease eventually results from environmental imbalance, which also causes *doshic* imbalance, impaired *Agni*, *Ama* formation, *Srotas* obstruction, and *Ojas* depletion.

JANPADODHWANSA: AN AYURVEDIC CONCEPT OF ENVIRONMENTAL EPIDEMICS

According to Acharya Charaka, the etiology of diseases has been broadly classified into two categories *Asadharan Vyadhi* and *Sadharan Vyadhi*. *Asadharan Vyadhi* refers to diseases that are related to an individual's constitution (*Prakriti*), immunity, and lifestyle factors. In contrast, *Sadharan Vyadhi* refers to diseases that affect large populations irrespective of personal constitution or immunity.

Such large-scale destruction of communities is described as *Janapadodhwansa*, which occurs due to the vitiation of four common environmental factors—*Vāyu* (air), *Jala* (water), *Deśa* (land), and *Kāla* (climate/season). It is mentioned that the severity and health hazards increase progressively from *Vāyu* to *Kāla*. The reason for this is that environmental factors such as air, water, and land can be comparatively managed or avoided to some extent, whereas climatic disturbances are extremely difficult to control or escape, thereby posing greater risks to public health.

MODERN CONCEPT OF ENVIRONMENTAL POLLUTION

According to modern view environmental hazards are growing day by day due to fast industrialization, vehicle smoke, parali and the household pollution sources such as biomass fuel combustion and domestic waste. These factors collectively deteriorate the quality of air, water, and soil, posing serious risks to public health.

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Modern epidemiology recognizes that large populations are simultaneously affected by environmentally induced diseases, which closely mirrors the Ayurvedic concept of

Janapadodhwamsa. The correlation between Ayurvedic and modern concepts of *Janapadodhwamsa* is summarized in Table 1.

Table 1 Janapadodhwamsa – Ayurvedic and Modern Correlation

Ayurvedic Factors	Description in Ayurveda	Modern correlation	Health Impact
<i>Vayu Dushti</i>	Polluted, unseasonal toxic air	Air pollution (PM2.5, NOx, SO2)	Asthma, COPD ⁵ , CVS disease ⁶
<i>Jal Dushti</i>	Contaminated foul-smelling water	Heavy metals, Microplastics, microbial contamination	Diarrhoea, Typhoid, Hepatitis, Renal Disease DNA damage, neurological effects ⁷
<i>Desha Dushti</i>	Polluted soil, unhealthy land due to non-biodegradable substance	Pesticides industrial waste	Intestinal obstruction, Epidemics, chronic bronchitis, elephantiasis, nutritional disorders ⁸ . etc
<i>Kala Dushti</i>	Abnormal seasons, climate imbalance	Climate change, global warming	Epidemics, nutritional disorders ⁹

ENVIRONMENTAL POLLUTION AND DOSHA IMBALANCE

Environmental contaminants disrupt the normal tridoshic equilibrium by acting as *Agantuja Nidana*¹⁰:

- *Vata Dosha* is predominantly aggravated by air pollution, noise, and electromagnetic exposure, leading to anxiety, insomnia, neurocognitive disturbances, and degenerative disorders.
- Waterborne toxins, heavy metals, chemical pollutants, heat, and radiation are the main factors that vitiate *Pitta Dosha*, causing inflammation, *Rakta dushti*, liver dysfunction, skin disorders, and carcinogenic tendencies.
- Soil and food contamination, pesticides, moist environments, and sedentary lifestyle factors all exacerbate *Kapha Dosha*, which leads to *Ama* formation, metabolic sluggishness,

obesity, respiratory congestion, and metabolic syndrome.

IMPACT OF ENVIRONMENTAL POLLUTION ON STROTAS

Acharya Sushruta described 11 pairs of *Strotas* in sushrut sharirsthan. Pollutants cause *Srotorodha* (channel obstruction), impairing physiological transport and communication. Key affected systems include:

1. ***Pranavaha Srotas***: Chronic air pollutants cause *Ama* deposition and *Vata-Kapha dushti* leading to impaired respiration and inflammatory lung disorders.
2. ***Udakavaha Srotas***: Chemical contaminants disturb fluid regulation resulting in dehydration, edema, and electrolyte imbalance.
3. ***Annavaha Srotas***: Polluted food and water impair *Agni* causing *Mandagni*, *Ama* formation, and chronic digestive dysfunction.

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4. **Rasavaha Srotas:** Circulating toxins vitiate *Rasa dhatu* leading to poor nutrition, fatigue, and reduced immunity.
 5. **Raktavaha Srotas:** Accumulated *Dushi Visha* contaminates *Rakta* causing inflammatory, hematological, and dermatological disorders.
 6. **Mamsavaha Srotas:** Chronic toxin exposure leads to *Dhatu kshaya* resulting in muscle weakness and fatigue.
 7. **Medovaha Srotas:** Persistent pollutants aggravate *Kapha* and *Ama* leading to obesity, dyslipidemia, and metabolic syndrome.
 8. **Asthivaha Srotas:** Heavy metals and toxins aggravate *Vata* causing bone demineralization and degenerative changes.
 9. **Mutravaha Srotas:** Renal toxin accumulation impairs filtration leading to urinary and nephrotoxic disorders.
 10. **Purishavaha Srotas:** Gut toxin retention disrupts elimination resulting in constipation, diarrhea, and toxin reabsorption.
 11. **Shukravaha / Artavavaha Srotas:** Endocrine-disrupting pollutants cause *Dhatu dushti* leading to infertility and reproductive disorders.
 12. **Manovaha Srotas:** Neurotoxic pollutants aggravate *Vata-Pitta* causing anxiety, insomnia, cognitive decline, and stress disorders.
- Impact of environmental pollution on strotas is depicted in Figure 1.

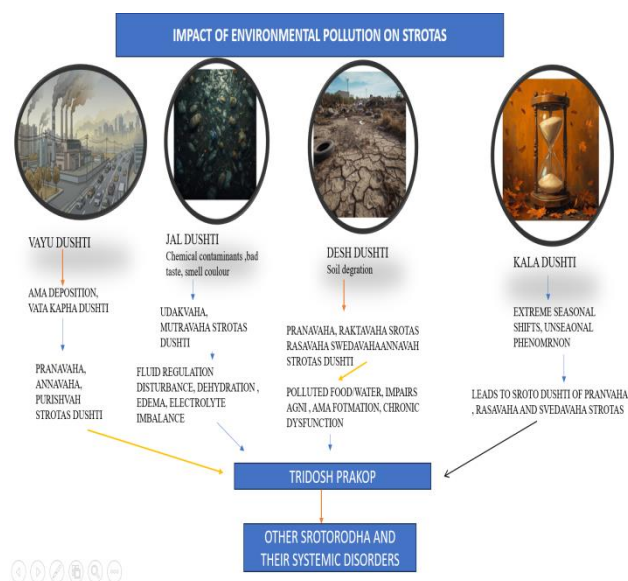


Figure 1 Impact of Environmental pollution on *Srotas*

CONCEPT OF VISHA IN AYURVEDA

Visha is defined in Ayurveda as anything which disturbs *Tridosha*, *Dhatu*, *Agni* and *Srotas*, and not only those which result in death immediately. Any environmental pollution can be considered as *Agantuja Hetu* and can be covered under one of the classical types of *Visha* listed in Ayurveda¹¹.

- Plant and mineral toxins such as pesticide contaminated fruits and vegetables, heavy metals in water and soil, dust and contaminated air are related to ***Sthavara Visha***.
- Toxins originating from animals, such as PCBs and mercury contaminated seafood, contaminated milk, contaminated meat, and animal dander are part of ***Jangama Visha***.
- ***Kritrim Visha*** is comparable to modern day synthetic poisons in plastic, pesticides, industrial chemicals, cosmetics, food preservatives, foodstuffs, artificial colorants and drugs.

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DUSHI VISHA AND CHRONIC ENVIRONMENTAL TOXICITY

Due to low potency and partial detoxification, these toxins persist in the body as **Dushi Visha**, producing cumulative toxicity rather than acute poisoning. *Dushi Visha* is most relevant to chronic environmental exposure, as it **accumulates over time**, remains latent, and manifests as long-term disorders such as cancer, endocrine dysfunctions, metabolic diseases, allergies, and neurotoxicity. The Pathogenesis of Dushi Visha is illustrated in Figure 2 whereas

Table 2 compares the features of Dushi Visha with Chronic Toxicity.

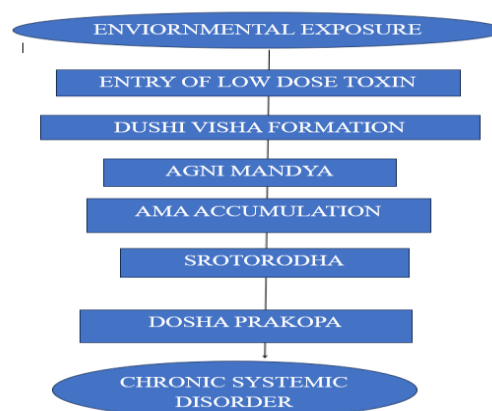


Figure 2 Pathogenesis of Dushi Visha

Table 2 Dushi Visha and Modern Chronic Toxicity

Feature	Dushi visha	Chronic toxicity
Nature	Latent, cumulative toxin	Bioaccumulative pollutants
Trigger	WeakAgni, stress, season	Oxidative stress, immunity loss
Disease	Skin, infertility, fatigue	Autoimmune, cancer, neurodegeneration

MANAGEMENT IN JANPADODHWANSA (ENVIRONMENTAL POLLUTION)

During *Janapadodhwansa*, Charaka Samhita describes Panchakarma as the best line of treatment, which includes five therapeutic procedures: *Vamana* (therapeutic emesis), *Virechana* (therapeutic purgation), *Asthapanavasti* (therapeutic decoction enema), *Anuvasanavasti* (therapeutic oil enema), and *Shirovirechana*¹² (therapeutic administration of medicine through the nasal route). In addition, daily *Pratimarsha Nasya* is advised as a preventive measure to protect the respiratory system from airborne pollutants. The methodical use of *Rasayana* has also been mentioned in this context to enhance immunity and *Ojas*. For environmental purification, *Dhoopana* (medicated fumigation) is recommended in cases of air pollution, while *Kataka* (*Strychnos potatorum*) seeds are useful for clarifying and purifying contaminated water. Regarding soil pollution *Anantadi Yoga*, an Ayurvedic formulation described in the Sushruta Samhita (Kalpastana), is traditionally believed to remove toxins from contaminated soil¹³. Besides these pharmacological

and environmental measures, *Sadvritta Paalan*, certain social and behavioral practices are recommended, including truthfulness, compassion for living beings, charity, prayer, taking preventive measures, residing in favorable locations, observing Brahmacharya, engaging with religious texts, serving sages, and associating with Satvik and knowledgeable people; implementing these practices during *Janapadodhwansa* can be life-saving for individuals whose death is not predetermined.¹² It is more challenging for a person to give up water than air, space than water, and time than space¹⁴. Acharya Sushruta correlated *Janpadudhwansh* with *Maraka*. In cases of *Maraka*, Sushruta has recommended the use of medicines collected before the onset of disease and the strict use of pure water¹⁵.

PREVENTIVE PRINCIPLES IN AYURVEDA FOR ENVIRONMENTAL HEALTH

Ayurveda emphasizes prevention over cure through:

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- **Dinacharya and Ritucharya:** Daily and seasonal regimens strengthen *Agni*, enhance detoxification, and build resilience against pollutants.
- **Ahara (Dietary Measures):** Consumption of fresh, organic, seasonal, and sattvic food minimizes toxin intake and supports metabolism.
- **Vihara (Lifestyle Practices):** Pranayama, yoga, meditation, and ethical living (*Sadvritta*) mitigate the physiological impact of environmental stressors.

ROLE OF PANCHKARMA IN ENVIRONMENTAL TOXICITY

In today's world, many community health problems resemble the effects of *Dushi Visha* described in Ayurvedic texts, arising from continuous exposure to environmental pollutants, poor diet, and unhealthy lifestyles. Therefore, the treatment principles of *Dushi Visha*, particularly detoxification therapies, can be effectively applied to manage pollution-related disorders. *Panchakarma* supports deep detoxification by preventing toxin accumulation and eliminating existing *Dushi Visha* from the body. It is a safe, affordable, and holistic approach that not only alleviates toxin-induced diseases but also promotes overall physical and mental well-being¹⁶.

RASAYANA CHIKITSA AND REJUVENATION

With the gradual rise in urbanization, environmental pollution and microbial contamination of air and water have greatly increased. This leads to oxidative stress, the

generation of free radicals, and a decline in both physical and mental health. Ongoing exposure to pollutants, an unhealthy lifestyle, processed food, and stress add to degenerative and metabolic disorders. *Rasayana therapy*, which is the science of rejuvenation, offers the potential for longevity, relief from diseases, and a strengthened defense system by providing essential phytochemicals and antioxidants. *Rasayana* drugs, mostly derived from plants, help reduce cellular damage caused by reactive oxygen species, boost immunity, maintain normal body functions, and promote overall health and longevity in a polluted environment.

After detoxification, *Rasayana* therapy restores tissue integrity, immunity, and vitality. It counteracts oxidative stress, slows aging, and improves resistance to future environmental insults.

MODERN EXPERIMENTAL AND CLINICAL EVIDENCE

- **Experimental Evidence:** Animal studies show that Ayurvedic herbs known as Vishaghna have antioxidant, liver-protecting, and chelating properties. **Tinospora cordifolia** (Guduchi) reduces oxidative stress caused by arsenic and cadmium by normalizing antioxidant enzymes¹⁷. **Curcuma longa** (curcumin) has a strong neuroprotective effect against mercury toxicity by activating the Nrf2-mediated antioxidant response pathway¹⁸. **Triphala** protects the liver from damage caused by chemicals, likely through the activation of the Nrf2 antioxidant signaling pathway¹⁹.

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- **Clinical Evidence:** Clinical studies show that Panchakarma therapies significantly lower biochemical markers of oxidative stress. They also improve the quality of life for patients exposed to chronic environmental toxins^{20, 21}. *Rasayana* therapies like Ashwagandha, Amalaki, and Guduchi have demonstrated immunomodulatory and stress-reducing effects. These therapies help improve resilience against pollution-related illnesses²².

1. **Epidemiological Correlation:** Lancet Commission reports confirm that air, water, and soil pollution are among the leading causes of non-communicable diseases globally²³. The Ayurvedic concept of *Janapadodhwamsa* provides a predictive framework for such large-scale health impacts.

DISCUSSION

The present review critically interprets environmental pollution through the Ayurvedic framework and demonstrates a strong conceptual correlation between classical doctrines and modern environmental health science. Contemporary biomedical literature identifies air, water, and soil pollution as major contributors to non-communicable diseases through mechanisms such as oxidative stress, chronic inflammation, immune dysregulation, endocrine disruption, and bioaccumulation of toxic substances. These mechanisms closely resemble the Ayurvedic descriptions of *Agantuja Nidana*, *Dosha Dushti*,

Agnimandya, *Ama* formation, *Srotorodha*, and *Ojas* depletion.

The concept of *Janapadodhwamsa* described in Charaka Samhita provides a predictive public health model wherein vitiation of *Vayu*, *Jala*, *Desha*, and *Kala* leads to widespread disease irrespective of individual constitution. This parallels modern epidemiological observations where environmental exposures affect large populations simultaneously. Similarly, the notion of *Dushi Visha* offers a classical explanation for chronic, low-grade toxicity resulting from prolonged exposure to pollutants, comparable to modern concepts of cumulative toxicity and bioaccumulation.

The review also highlights the systemic impact of pollutants on various *Srotas*, reflecting multi-organ involvement observed in environmental medicine. Experimental and clinical evidence supporting antioxidant, hepatoprotective, immunomodulatory, and detoxifying effects of Ayurvedic interventions strengthens the plausibility of these correlations. *Panchakarma* therapies demonstrate potential in reducing biochemical markers of oxidative stress, while *Rasayana* drugs exhibit protective effects against toxin-induced cellular damage. Importantly, Ayurveda extends beyond symptomatic management and emphasizes prevention through *Dinacharya*, *Ritucharya*, *Ahara*, *Vihara*, and *Sadvritta Paalan*. This preventive and ecological orientation aligns with current global calls for sustainable and integrative health models.

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However, despite promising conceptual and experimental parallels, large-scale, well-designed clinical trials and mechanistic studies are required to establish standardized protocols and validate outcomes in pollution-related disorders. Integrating Ayurvedic preventive strategies with modern environmental health policies may offer a comprehensive and sustainable approach to mitigating the growing burden of pollution-induced diseases.

CONCLUSION

Environmental pollution is a serious issue affecting health around the world. It's linked to an increase in chronic illnesses, including metabolic, inflammatory, and degenerative diseases. In this context, Ayurveda offers a valuable perspective by explaining these health effects through concepts like *Janapadodhwamsa* (the destruction of communities), *Dushi Visha* (harmful substances), *Dosha imbalance*, *Agnimandya* (digestive issues), *Ama* formation (toxicity), and *Srotorodha* (blockages in the body). Interestingly, many of these ideas align well with modern research on toxicity, oxidative stress, immune dysfunction, and environmental health studies.

Ayurveda suggests various treatments, such as *Panchakarma* and *Rasayana Chikitsa*, paired with preventive practices like *Dinacharya* (daily routine), *Ritucharya* (seasonal practices), *Ahara regulation* (diet management), and *Sadvritta Paalan* (ethical living). Together, these create a holistic approach aimed at detoxifying the body,

boosting the immune system, and restoring balance.

Looking ahead, research should aim for thoughtful clinical trials and collaboration across disciplines to confirm the role of Ayurvedic practices in fighting pollution-related health issues. This could greatly enhance public health and promote well-being in a world that is facing increasing pollution challenges.

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