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Review

Reappraising Natures and Perspectives of Wasteland in the Developing World with a Focus on India

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Abstract: This article seeks to provide an improved and more comprehensive understanding of the concept and theories on wasteland. It achieves this by focusing on the Indian context, allowing us to unpack the importance of including multiple perspectives of wasteland narratives; this means including more positive narratives of the potential of wasteland to inform and improve prospects for land policies in the Global South. Wasteland is commonly recognized as an underutilized category of land that may transform into a valuable resource base with proper management measures. The term waste has multiple angles that carry different notions ranging from fallow to agroforestry land in the Global South and brownfield to green space in the Global North. We conduct a narrative review approach to qualitatively analyze the concept of wastelands, which has been studied in the pre-existing literature from 1970 to the present. This unsystematic literature review approach incorporates multiple elements of wasteland discourse, like understanding the meaning of the term on a global scale, setting out the meaning of the term waste into multiple perspectives explicitly in the Indian context, along with different classes and management approaches to wasteland from a national perspective. The multiple perspectives of wasteland not only generate misconceptions of land resources but spawn difficulties in land-use policy, particularly for the Indian scenario. For sustainable land-use policy, reclaiming wasteland would be the best possible way for India and other countries in the Global South, which requires a comprehensive methodological overview on wasteland narrative.

Keywords: wasteland**;** Global South; India; policy; landuse; management

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1. Introduction

The term wasteland manifests with multiple notions and different synonyms in the Global South and North. The expression wasteland has different perspectives and outlooks based on the socio-economic status of a region, polity, historical land-use policy, and physiographic and regional variance. In the Global South, wasteland is primarily used as a synonym for unproductive lands, which combine with the inferior livelihood of the rural commons. Studies have shown that, particularly in the agrarian economy of rural areas in the Global South, there is a common association between the genesis of unproductive lands and rural poverty, which connects the term waste with "marginal unproductive land" [1], which is a socio-economic expression of wasteland in the Global South. On the other hand, wasteland-driven policies in the Global South show the conflict between rural agrarian communities and different administrative organizations. This implies that the term "waste" is a politically malleable expression [2,3]. Another form of wasteland is land degradation which is expected in the Global North and South. In some cases, wind and water erosion causes land

degradation. In some instances, the formation of urban wasteland is the product of industrial and chemical contamination, known as brownfield land [4]. For this reason, the term wasteland carries certain idioms and implies human–environment relations, land utilization, and land-use policies. The term was first used in the 13th century in English common law, where waste was considered vacant land [3] that could be redeveloped through proper management and policy implementation [1,2].Among the various expressions of wasteland, certain terminologies commonly used in the Global North include "informal green space", "no man's land", and "brown field" sites. These terms encapsulate both ecological viability and human intervention on the landscape [5]. Conversely, expressions such as "wild/savage","barren/uncultivated","fallow","degraded","marginal", and "desert" are prevalent in the Global South, carrying diverse associations between land and human interaction. For instance, wastelands are often labelled as marginal land due to the presence of marginalized (poor) communities. The term "wild", in reference to wasteland, often stems from colonial land-use policies, where aboriginal territories were categorized as savage or wild. Additionally, "degraded" is used to denote erosion and the deterioration of soil properties, rendering the land uncultivated and deemed to be wasteland [6–8].While the aforementioned terminologies typically convey negativity or a set of constraints, they may also possess different strengths. For example, deserts have historically been considered wastelands [7], overlooking their ecosystem services. In the Global South, vacant land, commonly termed as wasteland, is predominantly found in rural areas [7–9], currently unsuitable for economic activities [10–12] but which could be revitalized through effective policy implementations [13–15].

Hence the term waste is holistic and needs to be studied with a broad framework. Issues related to wasteland are increasingly becoming a central biophysical, political, and economic concern worldwide. The existing literature has yet to comprehensively analyze the multiple dimensions of this complex issue of human–environment relations that is predominant all over the globe in a comprehensive way to appreciate the complexity of wasteland issues. The existing literature on wasteland primarily focuses on multiple uses and techniques to restore the unused landscape and consider the unproductive character of unused lands. Different restoration techniques for wasteland could bring a positive approach where wasteland can be categorized as a potential resource rather than merely unproductive land. Simultaneously, considering the nature of wasteland is crucial for academic work to enable the creation of more sustainable land restoration policies. So far, studies have not fully considered the term waste in an interdisciplinary way. Rather each single discipline has considered the term waste from a single, explicit perspective. Therefore, a holistic, more improvised, and multidimensional approach is required to clearly understand the different aspects of wasteland, which we tried to fulfill in this narrative review.

In the academic literature, wasteland-related studies are mainly focused on two significant aspects: understanding the present status of wasteland and recognizing the potential prospect of wasteland. In most cases, wastelands are considered a barrier to economic utilization [16]. Still, in the present global scenario, where there are deep uncertainties and needs around fulfilling regional economic and commercial needs, waste is considered a potential resource base that may help fulfill the demand for food, energy, and other necessities [17,18]. There is a diverse range of the academic literature across disciplines studying wasteland, from physical to social sciences. Physical geographers are mainly concerned with the location-specific identification of wasteland clusters and their categories through the application of geospatial data [19–21]. Agriculture scientists primarily focus on crop suitability analysis in different wasteland areas [22–25]. Political science and development studies have shown wasteland-related development policy outcomes and the feuds between local communities and state governments in the Global South [26–28]. The literature on environmental history has shown the association of wasteland with colonial and post-colonial land-use policy in the Global South [29–31]. Some of the cases studied in the Global North have shown the utilization of wasteland for restoring urban biodiversity through the rejuvenation of brownfields and derelict sites [32–35].

In the Global South, wasteland reclamation for comprehensive rural development has become integral to land-use policy [36]. For example, about 69 million hectares (ha) of land in India are considered waste in areas defined as rural areas, out of which about 50% of lands are categorized as non-forest lands that can be converted into fertile land [37]. Converting wasteland into farmland may protect current fertile cropland from degradation [38], which can fulfill the demand for food, reduce poverty, and restore ecology at the national level [39]. Hence, wasteland may have multi-dimensional usability, which is yet to be explored. A more comprehensive amount of the literature considers wasteland as a natural resource that can be reutilized for multiple uses, afforestation, recreational uses, and suitable crop production [40–42]. Apart from a need to map out the different categories and identify the potential uses of wasteland, there is a need to analyze the comprehensive nature of wasteland as, so far, few studies have carried this out. From the above discussion, it is evident that different disciplines define and study wasteland through different understandings and narratives. The holistic nature of wasteland has not yet been comprehensively captured. Hence, instead of looking at one dimension of wasteland from a particular discipline or a particular regional setup, we require a better and more holistic framework to analyze the multidimensional nature of wasteland. This article focuses on two particular objectives of the wasteland narrative to create a better understanding of wasteland by reviewing the pre-existing literature; (1) to obtain a better and more comprehensive understanding of the wasteland literature to date in the Global North and South in general and (2) to analyze the role of wasteland and its narrative(s)in the Indian context of land policies and management, particularly.

To reach these objectives, we split our article into two parts: firstly, global representations of wasteland are explored through different definitions and management policies in the Global North and South; secondly, the Indian context of wasteland was focused on for a deeper understanding of different definitions from various perspectives and wasteland-related policies in India. The main reason for focusing on India is to set out an example of how unused lands can be transformed into a productive resource in the Global South, for which a primary theoretical base is necessary for wasteland narrative. Moreover, setting out an in-depth understanding of wasteland by approaching multiple dimensions will provide a broader outlook of unutilized landscape that can be an essential tool for land-use policy in the Global South.

2. Methodology

This meta-narrative review article comprehensively synthesizes the existing literature on wasteland, which identifies, appraises, and synthesizes relevant studies, facilitating an exploration of various dimensions of wasteland, such as definitions and perspectives, categories, and policy assessment. It also illuminates research gaps and challenges Through this approach, this review aims to enhance the quality, rigor, and transparency of its analysis, providing valuable insights and recommendations for future research and policy in wasteland management [36]. The methodology of this article consists of two main approaches: The first approach is to analyze the existing literature on wasteland, addressing the chronological order of wasteland-aided research over time, disciplines, and different contexts to scrutinize the range of approaches to studying a holistic view of wasteland. The second approach is to address multiple aspects of wasteland, i.e., definition and perspectives, categories, and policy assessments focusing on the Indian context with the incorporation of a global view.

Article selection process and meta-narrative analysis: The article selection process consists of four basic steps as follows:

(1) Initiation: the process starts with defining the scope and objectives of this review to guide the search for relevant articles on wastelands.

(2) Database search: a systematic search of literature databases is conducted, using keywords and search terms related to wastelands to ensure comprehensive coverage of the topic.
(3) Inclusion and exclusion criteria: Articles are subjected to inclusion and exclusion criteria to determine their relevance to the review. Criteria such as publication date, language (English), and geographic focus are applied to filter out irrelevant or duplicate publications. Selected articles are further appraised for their quality and suitability for analysis, assessing their methodological rigor, relevance, and reliability.
(4) Categorization of selected articles: Selected articles are categorized based on specific aspects of wastelands to facilitate a comprehensive synthesis of the literature. Categories include decade-wise, discipline-wise, and region-wise classifications, among others. In this regard, we have focused solely on peer-reviewed journals sourced from various platforms such as ResearchGate, Google Scholar, and Scopus. Conversely, when considering documents and reports on wasteland, we have exclusively favored those available from official and government-affiliated sources, namely the National Wasteland Development Board (NWDB), National Remote Sensing Agency (NRSA), and the Indian Council of Agricultural Research (ICAR).

These sequential steps demonstrate how articles are systematically identified, appraised, and categorized to inform this narrative review on wastelands (Figure 1). A total of 236 publications are classified into specific aspects to elucidate the trajectory of studies related to wasteland, discussing meanings, history, categories, and land-use policies. Publications are categorized into the decade-wise, discipline-wise, and region-wise literature, along with an amalgamation of these aspects with regional perspectives:

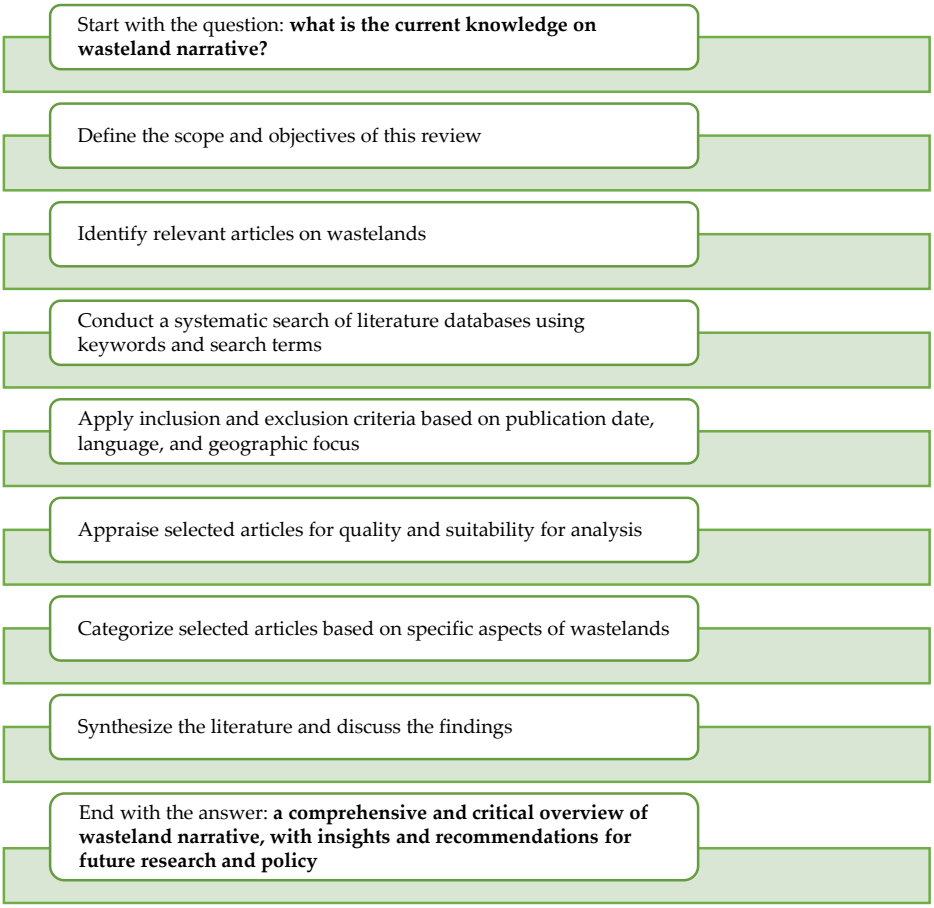

Figure 1. Flowchart depicting steps taken in the review process.

a. The decade-wise published literature: the literature is divided into seven decades from the 1960s to the present, revealing a swift increase in academic publications on wasteland-related topics from the 2000s onwards, peaking during 2010 to 2019 (see Figure 2).

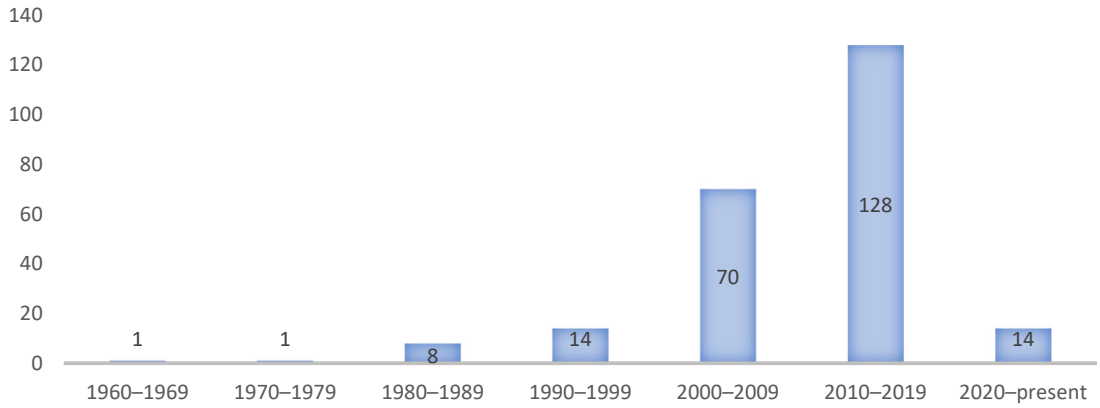

Figure 2. Decade-wise number of the academic literature published on wasteland and related topics.

b. The discipline-wise published literature: The literature is classified based on discipline, with some pieces potentially assigned to multiple disciplines. For example, the literature focusing on geospatial techniques and agricultural science may overlap (see Figure 3).

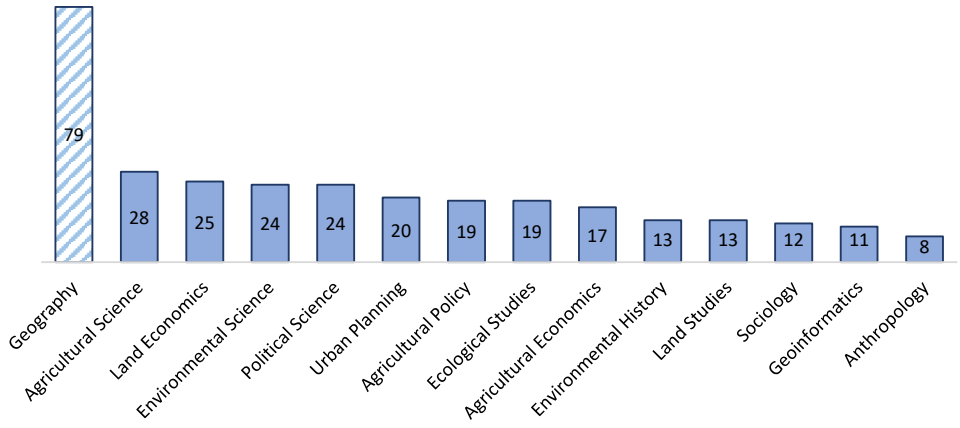

Figure 3. The discipline-wise published literature on wasteland and related topics used in the study.

c. The region-wise published literature: The literature is classified regionally, with some pieces potentially counted more than once if they cover multiple regional case studies

(see Figure 4). Regional perspectives are further overlaid onto issues associated with wasteland (see Figure 5), with a specific focus on the Indian context.

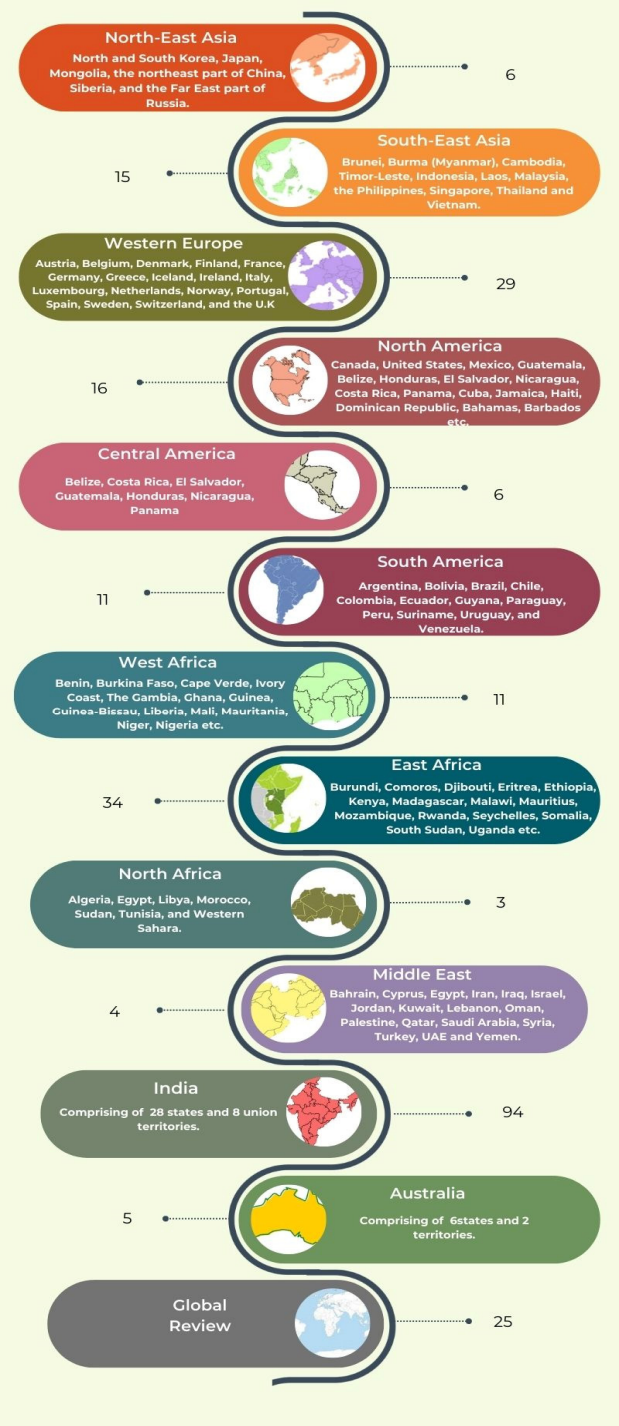

Figure 4. The region-wise academic published literature on wasteland.

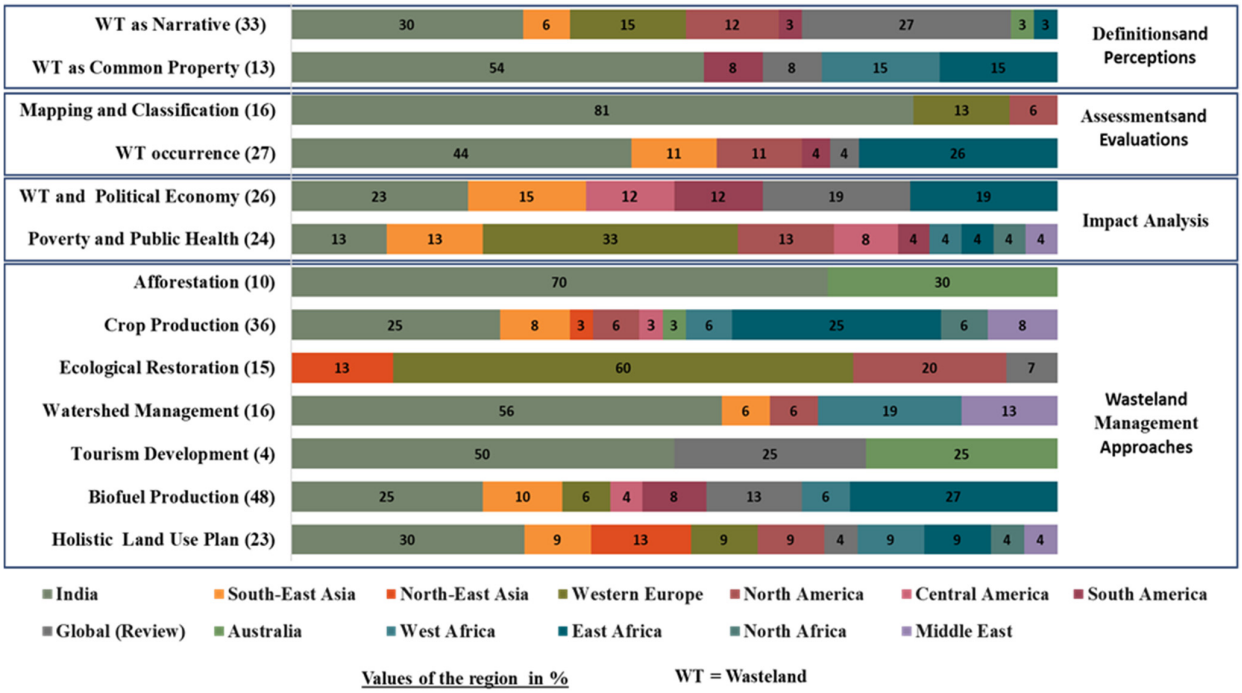

Figure 5. Region-wise publication on different wasteland-related issues.

2.1. Structure of the Review

Based on the meta-analysis mentioned above, we structure our narrative review into two major parts:

2.1.1. Global Overview of Wastelands

To recognize the global picture of wasteland narrative, we focus on two particular elements: the meaning and the policies associated with wasteland. This includes the following:

- Understanding how the term "waste" is used in the Global North and the Global South [6,8].
- Examining the basic differences of wasteland narrative in the Global North and South, particularly in their geo-physical setup, causes of wasteland formation, and its association with livelihood. We also compare the differences of wasteland-aided policies [3,4,7,8].
- The primary purpose of this global overview of wasteland is to provide the readers with a comprehensive background for understanding the current knowledge on wasteland narrative and then overlay it with a case-specific study in the Indian scenario. This deductive way of narrative review may serve as a viable policy-making approach to waste land, where planners can obtain the explicit details of wasteland in the Indian case by incorporating the holistic global overview as well.

2.1.2. Case-Specific Study in India

For the Indian case study, we aim to recapitulate what is known, and we carry this out by creating and using themes and grouping categories derived from the literature. The grouping categories of the literature are primarily based on three consecutive themes of wasteland narratives:

- Understanding the multidimensional perspective of wasteland: *We* follow these steps to highlight different perspectives of wasteland in the Indian scenario as follows:
  i. First, out of the total 94 literatures of wasteland in the Indian scenario, we set aside 18 literatures that explicitly define the meaning of wasteland as a finite concept.
  ii. Second, we group the 18 definitions into a chronological order to represent the decade-wise shifting in perspective in the wasteland narrative from the 1960s to the present (Table A1, Appendix A).
  iii. Third, based on the available 18 definitions, we further extract four individual interlinking perspectives: agro-economic perspective, bio-physical perspective, property right perspective, and political perspective of wasteland in the Indian context.
- Emphasizing different categories of wasteland: Although a number of different national organizations (Table A2, Appendix B), such as the Indian Council of Agriculture Research and the National Wasteland Development Board, have already classified different categories of wasteland, these classifications are very much integrated with the geo-physical aspect rather than integrating the socio-economic and political aspects of wasteland category. Therefore, we further categorize different wasteland classes in an interdisciplinary mode, where the bases of wasteland category are further classified into four types and fifteen sub-types (Table A3, Appendix C). The different perspective and categories of wasteland put further implications on wasteland management approaches across the globe (Table A4, Appendix D).
- Examining the policy associated with wasteland: to evaluate the wasteland-aided policy, we follow two consecutive steps that endorse the deductive way of interpretation:
  i. First, we classify the wasteland and land revenue system in the colonial era, which depicts the historical background of wasteland in India.
  ii. Second, we further reclassify the post-colonial wasteland policy into three segments depending on the approaches of wasteland-aided policies (Table A5, Appendix E).
  iii. After discussing the general overview of wasteland in the entire country, we further obtain region/state-specific wasteland-aided developmental approaches (Table A6, Appendix F).

By synthesizing global and regional perspectives, this review aims to provide a comprehensive understanding of wasteland narratives in India and beyond. It offers insights into the complexities of wasteland management and identifies opportunities for policy intervention and research collaboration. Thus, this review seeks to inform more sustainable and inclusive approaches to land use and environmental conservation in the face of growing global challenges.

3. Understanding the Concept of Wasteland in Global Context

Throughout the globe, the term waste is associated with "bare"[10] and "improper" for economic utility [43], as well as untamed [44] and "standing apart" from human utilization due to regional constraints. However, in certain regions of the Global South, particularly in Southeast Asian countries, the escalating rate of population growth and increasing human demands necessitate higher food production, thereby requiring more extensive land utilization [24,37]. The term waste keeps oscillating over time concerning the physical and geopolitical set up of a region and based on that, we seek to explain the wasteland concept separately in the Global North and South for a better understanding.

The wasteland narrative(s) in the academic literature in the Global North primarily emerged from England through urban development [45–47], where sometimes it is recognized as a social construction [47]. Generally, studies define urban wastelands as the

product of industrial wilderness [45]. Another group of scholars has considered the unstructured expansion of green space as the cause of wasteland in the Global North [48]. However, apart from England, the term waste is associated with multiple tags; for example, in Australia and New Zealand, unused lands are considered waste [49,50], which sometimes plays a vital role in conserving the scenic beauty in a city region in the United States [51]. Likewise, in the Indian context, wasteland in the Global North has multiple notations like brownfield [52]; derelict [53], which are vacant; and sometimes considered to be green spaces, which are the product of previous industrial exploits [54–56]. A group of the academic literature has regarded the substandard population pressure on land as one of the reasons for vacant wastelands in parts of the Global North [47]. In most cases, urban wastelands are associated with environmental degradation [54] and a weak socioeconomic structure that is an "effect of decline rather than a cause" [53]. For instance, cities like Glasgow in Scotland and the Ruhr district of North Rhine-Westphalia in Germany exhibit a high concentration of derelict sites, contributing to environmental degradation [57–60] and exacerbating weak socioeconomic conditions [61–65]. Nevertheless, it is unavoidable that neglected urban wastelands have an operational character and can be brought back to proper utilization [35]. Among the different utilizations of wasteland, ecological restoration through the conservation of flora and fauna has been prioritized in Western Europe's wasteland restoration [33,35]. Reforestation through the direct seed method is a long-term solution for reclaiming wastelands in northeast Queensland of Australia The foundation of ecological restoration of urban wasteland was initiated through the "Sustainable Brownfield regeneration agenda" (2002), which tries to reclaim brownfield sites in European countries (Ruhr area and south of Leipzig region in Germany, Nord-Pas de Calais in France, East Midlands in the UK, and Silesia in Poland) [35,47,53].

In the Global South context, to adjust to human needs and maintain land sustainability, wastelands are recognized as a resource, where wastelands can be transformed from bare landscapes to fallow agroforestry land [66]. This brings the falsehood narrative of wasteland associated with the human–nature complex relation [67–69], where instead of looking for the possibilities, studies have considered it as an unwanted environmental entity. The primary factor of wasteland formation is land degradation through wind and water erosion [70], which set wasteland and degraded land as synonyms for each other [71–74]. In the Global South, wastelands cover large areas in the rural sectors [75,76], are often kept aside from crop production and economic utilization, and are primarily termed as common lands [76]. This makes wasteland a common property resource [77]. The reasons for untapped rural wastelands in the Global South are diverse, where there is over-dependency on current cropland [24], a lack of comprehensive land-use policy [37] and economic constraints [44], which are recognized as the leading factors. However, to achieve effective land utilization in order to respond to needs arising from the increasing population growth rate, some countries in the Global South have implemented effective wasteland reclamation policies to convert unused land into an economic good (Table A1 Appendix A). Among the different approaches to wasteland reclamation, which are being considered for sustainable land–water utilization, groundwater restoration and Integrated Water Resource Management (IWRM) are becoming much more viable for countries like India, China, Pakistan, and Indonesia. Approaches like community participation include home gardening, agroforestry, participatory forest management, and silvo-pastoral systems [24,76] are being recognized in the countries of SSA(mainly Ethiopia and Tanzania) and SE Asia(especially the Philippines, Thailand, and Vietnam) for wasteland reclamation. However, most of the countries in the Global South have considered bio-energy production for wasteland development. For example, China, Indonesia, and the Philippines adopted bio-energy production for their non-prime marginal cropland [78–80]. In Cambodia, about 53% of the arable land is considered waste, among which isolated borderlands are used for oil palm production [79,81]. The same approach has been adopted by Ethiopia, where marginal

wastelands are used for oilseed production [82–84]. Nevertheless, the commercialization of wasteland often involves multiple stakeholders, including government officials, private enterprises, non-governmental organizations, and local communities, each with varying visions and expectations regarding wasteland-related policies. In many cases, land classified as wasteland may be viable and useful to local communities. Labeling land as wasteland without considering its potential utility to local communities can lead to land disputes between these communities and government authorities. Such wasteland-related disputes among different sectors of the state contribute to the politicization of wasteland narratives [85–87], leading to confusion regarding the accurate identification of wasteland in the Global South.

Although wastelands can be seen as a dynamic land-use type in the Global North and South, there are some differences in wasteland narratives between the Global North and South as follows:

- In the Global South, wastelands are predominant in the rural sector, whereas planners emphasize urban wastelands in the Global North.
- In the Global South, the formation of wasteland and regional marginality are associated with each other. In the Global North, the relation between wasteland and regional marginalization is not unambiguously connected.
- In the Global South, development approaches to wasteland are significantly overwhelmed with economic prosperity (through energy security and job creation) and ecological restoration. Meanwhile, in the context of the Global North, the re-establishment of wasteland is predominantly emphasized by ecological restoration.
- In the Global South, land-use policy for wasteland regeneration is associated with unequal power relations and land grabs, which are not signified in the Global North.

Apart from the different approaches and interpretations of wasteland in the Global North and South, they are considered a valuable budding resource in both cases. In the era of globalization, land-use policies are also diffused from one part to another. For example, in early studies, urban development through brownfield regeneration was unambiguously bounded within the Global North [88]. However, countries like China, Pakistan, and India (especially in Kolkata city) are now dealing with sustainable urban development through brownfield restoration [89]. On the other hand, wasteland reclamation through oilseed production was mainly concentrated in humid tropical areas of the Global South. Still, in the modern global economy, oilseed production is also practiced by certain countries in the Global North [78,81], which proves the changing discourse of global land-use policy and how the vision of wasteland becomes assimilated between different parts of the globe over time.

4. Understanding Wasteland in the Indian Context

In this segment, we are focusing on India as a case study, with the aim of showing that wasteland reclamation policy may set the methodological aspect of wasteland reclamation for other countries in the Global South. The formation of wasteland is associated with environmental entities and their interface with human activity. A particular resource may be tagged with certain idioms based on different utilities. For example, land is one of the environmental entities and based on different utilization, categories like cropland and industrial land co-exist together. Since the outlook of wasteland varies from different disciplines and different geographical locations, defining wasteland always resultantly comes with certain unsound arguments. None of the literature on wasteland comes with a holistic theoretical framework of wasteland narrative. Based on the human–nature relation in different space, wasteland has different idioms and narratives. Likewise, from a bio-physical viewpoint, wastelands are regarded as degraded land [51–53]; resource utilization and property rights are considered common resources for local village communities [54,55]. On the other hand, wastelands are sometimes recognized as politically constructed due to the dissatisfaction of the local

community with land-driven policies [56,57]. The multiple elements in the wasteland narrative sometimes bring the phony notation of land-use associated with human–nature multifaceted linkage [46]. Hence, in this section, we seek to explain the multidimensional angle of wasteland from different perspectives. It is less comprehensive to consider the wasteland narrative from a single perspective rather than explaining it from different angles. Table A1 (Appendix A) shows the decade-wise available definition of wasteland arranged into different perspectives (agro-economic, property rights, bio-physical, and political) of the wasteland narrative in the Indian context. The main reason for defining wasteland from different perspectives in the Indian context is to make wasteland-driven policies more comprehensive so that none of the elements remains untouched.

4.1. Perspectives on Defining Wasteland in India

Among the different perspectives of wasteland, the economic and biophysical perspectives were prioritized over the decades due to over-dependency on land for sustaining livelihood and land degradation [90,91]. Since the 2000s, there has been a change in wasteland narratives through political intervention from wasteland-driven policies in India as well as other countries in the Global South. For example, in Brazil, Mexico, Myanmar, Indonesia, China, and Central and Southern Africa, about 87% of the total land and 250 projects are related to jatropha oilseed cultivation [92,93]. This agroeconomic transformation is caused by the rising price of food staples from 2008 onwards, which drove farmers to switch from food crop production to biofuel production [94]. This creates a launch pad for numerous private industries and state governments to get the opportunity to utilize farming land for biodiesel production, which creates a biofuel-related political environment through wasteland reclamation policy [95]. Hence, based on the available definitions of wasteland, we can discuss wasteland discourse from the perspectives outlined below.

(A) Wasteland from an agro-economic perspective

Agricultural production and property rights are the two united features of wasteland in India that are associated with the economic perspective of wasteland. Apart from the production or agro-economic perspective, a land resource is a fictitious commodity [96] that is not sometimes directly connected with market value [97]. To what extent production could be the leading factor in considering land as waste is still being determined. Specifically, in the Global South, economic sustenance in the rural sector is intrinsically related to the land where the activity occurs [98]. Regional growth, upgrading, and reclaiming wasteland or unused lands can be the best way to enhance production [99] and reduce marginalization [100]. Nevertheless, the possibility of reclaiming wasteland for production depends on the socioeconomic condition, geographical setup, and polity within a region [101]. In the underdeveloped regions of Africa, Asia, and Latin America, almost one-fifth of new crop production from 1990 to 2050 is expected to rely on expanding cultivated areas through conserving unused lands [102]. Hence, without a comprehensive assessment and a diverse range of visions, considering a portion of land as waste and not fit for production creates a barricade on wasteland policy.

(B) Wasteland from a property right perspective

The concept of commodity comes with the notion of "belonging to", as ownership is an essential and underlying principle in capitalism [103]. The ownership of a resource sometimes comes with emotional and historically customary use. For example, native people assert that land does not belong to them: they belong to the land [98]. The incorporation of property rights with land resources is connected through the precedence of the local community to enjoy benefits from their surrounding lands [104]. On the other hand, among different types of individual land rights (use right, income right, and transfer right), marginal lands come under underused rights [105] and are treated as common property resources. Since marginal lands are substandard for production, they

are free from the choice of wealthy farmers and taken by village subsidiary tenants [106]; this further weakens marginal lands due to low down care and investment by poor village tenants [107]. Due to substandard infrastructures and unsatisfactory income generation in rural India, low investment in land is a common observable fact [108,109]. Also, the nature of investment of farmers depends on land tenure, as farmers are likely to spend and improve the lands that they own [110] and for which they have long-term utilization rights rather than the lands that they operate under short-term use rights [111]. Even if farmers need more confidence about reaping land for long-term profit, they use their holdings to maximize short-term returns [112]. This might be one of the reasons that in the Indian scenario, most of the wastelands are considered common [113,114] and distributed among the deprived group of the village community [54]. Nonetheless, the rural poor often rely on common property lands for survival through fuelwood production and fodder gathering [115]. This brings the question of how far village common lands should be considered waste or an economic good.

(C) Wasteland from a biophysical perspective

The depletion of the biophysical characteristics of soil and erosion by water and wind mainly create land degradation, which is one of India's prime causes of wasteland formation [116]. Therefore, most of the definitions of wasteland have land degradation as a synonym [117]. Conversely, some regional examples demonstrate ambiguity in the relationship between wasteland and land degradation. For example, the formation of the Grand Canyon by deep erosion [49,118] of the Colorado Plateau by the Grand Canyon River and its tributaries [119] causes severe land degradation [120]. From this viewpoint, the Grand Canyon can be regarded as degraded, but how far can we consider it waste? This eroded and less fertile portion of the United States is a significant tourist destination [121]. Now, let us consider some small-scale land features in Garbett, a census town in West Bengal, India. There is a landform called Gongoni (it can also be spelled as *Gangani*) which is formed due to the formation of ravines and erosion by the Shilaboti River [122,123]. This landform is unsuitable for crop production as it lost its fertility due to erosion. Nevertheless, Gongoni is now considered a prospective tourist destination in West Bengal and India [124]. This set of examples brings the acceptance of multiple forms of economic utilization of land even if it is not suitable for crop production, proving how universally all degraded lands are not wasted.

On the other hand, household-level disputes and land fragmentation are common in rural India [125]. The practice of land fragmentation causes a reduction inland utility, sometimes referred to as a "Social Wasteland" [126,127] that somehow is not associated with degradation; instead, it is an output of a social phenomenon. This proves how universally all wastelands are not degraded by nature.

(D) Wasteland from a political perspective

In the Global South, land reclamation policies provide the groundwork whereby different sectors merge for different motives, creating a pseudo-scientific approach to land utility [128,129]. The biophysical landscape is often recognized as the foundation of a political economy within a setup [130], where the state becomes an active agent of the whole picture [131].

Land reclamation projects in Southeast Asia often integrate the power of exclusion [132] and large-scale land acquisitions [133]. This brings a defined argument on who the gainers are and who the loser is in a land development project. Is it only externally market-oriented, or is it for the development of the local community [134]? In this regard, India's biofuel production for wasteland development sets a great example where state policy, private enterprises, and the local community play different roles. In this regard, oilseed production was promoted when the National Wasteland Development Board (NWDB) considered wastelands the best suitable sites for oilseed production [135]. This statement raises a few questions: what are the major wasteland categories that suit oilseed production, and why are they not reproduced for food crop production? This set of

questions becomes more prominent when studies in Tamilnadu state show how lands marked as waste by government officials have multiple uses by the local community. This also points to tensions between government interests and community interests.

In some cases, farmers have sold pieces of their land (sometimes knowingly, sometimes not), thinking that their lands are not suitable for crop production and would be helpful for oilseed (Jatropha) production [136]. Oilseed production can meet the need for energy and reduce poverty in rural areas, but in the end, produced fuel is mainly consumed in urban areas [134]. This is how the changing political economy generates a complex local agricultural setup and socio-ecological changes, and the rural setup primarily acts as a donor region. In this regard, the political ecology becomes a valuable domain to shed light on the abovementioned factors. We must acknowledge that the availability of agricultural land is lessening due to the increasing population growth rate and demand from other sectors. At the same time, shifting food crops to cash crops becomes doubtful when the country loses self-sufficiency in food production [137], associated with increased food prices [138]. The study shows that in the case of Tamilnadu state, a significant amount of land has been distributed in the rural sector that comes under the national biofuel policy [139] to produce energy and wipe out poverty [140]. Some districts like Coimbatore and Thiruvannamalai in Tamilnadu show over-exploitation of groundwater resources for oilseed production, where production of other crops becomes minimized [141]. This causes agricultural labor shortage due to rural–urban migration, where small-scale farmers tend to migrate to the nearby urban sectors to work as daily laborers or engage in the manufacturing sector [142]. This socioeconomic transformation in the rural sector is indirectly associated with regional transformation through the growing non-agricultural sector in the rural economy that generates out-migration, a shortage of food crop production, and an influx of population from the rural sector that creates pressure on urban amenities. Thus, land deals in the Global South are less transparent, ignoring land sovereignty of commons and bringing improper assessments of different land uses. In the Global South, most land deals and the perception of lands are based on the physical environment and land characteristics [143]. Flat plain lands allowing for crop production without significant effort are often considered ideal land [144], whereas semi-arid savannas and so-called "marginal lands" are considered wilderness [145]. The "undeveloped" frontier land in dense tropical rain forests [146]; vacant, undervalued, or state land [147]; or geographically remote borderlands [148] are concerned with different forms of power that create struggle over land rights and thus generate different definitions and identities [149]. This makes the wasteland entity "politically constructed" [57], where the winner is on one side, and the loser is on the other.

4.2. Classification of Wasteland

The wasteland classification was first introduced by the National Remote Sensing Agency (NRSA) in 1985 into eight subcategories with their areal expansion [150]. Later, in 1987, the Indian Council of Agriculture Research (ICAR) classified wastelands based on causative agents (water, wind, man, and others) and their potential utilization [151]. From 2000 onwards, the classification of wastelands came up more precisely when the NRSA (now NRSC) and the Department of Land Resource jointly published on waste lands at least every five years. According to the Atlas, in 2000, the total wasteland area in India was 20.16% [152] which was reduced to 16.96% in 2019 (Table A2, Appendix B) [153], somehow indicating the positive side of wasteland development projects all over the country. Also, national organizations should have considered the socio-cultural factors for wasteland formation. The socio-economy and polity are the driving agents of LULC change within a geographical setup. Based on different factors, we can reframe the classification of wasteland into two broad categories (Table A3, Appendix C): a wasteland framework focusing on causal factors and wasteland studies focusing on the potential usability of wasteland.

(1) Wasteland's causal factors are as follows:
    (a) Wasteland due to natural factors: Wastelands form due to natural inputs like wind and water erosion or natural degradation. For example, rocky outcrops, gullied/ravenous land, glaciated areas, and sandy areas naturally produce them where human economic activity may not be possible.
    (b) Wasteland due to anthropogenic factors: Socio-cultural, economic, and political processes are responsible for creating marginal lands, which can be recognized as anthropogenic wasteland. We can classify anthropogenic wasteland into three categories as follows:
        (i) Socio-cultural wasteland: this type of wasteland is mainly formed by socio-cultural factors [154], such as land fragmentation due to family disputes, which causes social wasteland.
        (ii) Political wasteland: Political fabrication creates a solid foundation of disputes and the obstruction of development policy. The formation of a political wasteland is the product of disputes among local farmers, private enterprises, and local government. In this regard, Singur, in the Hooghly district of West Bengal, India, sets a perfect example of the formation of political wastelands. The state government announced the promotion of Tata Motors Company for a "Nano" factory (small car factory) in Singur, some 30 km NE of Kolkata city. Nevertheless, the policy's central issue was selecting agricultural land, which was one of the prime agro-based regions in the district and for the state. As a result, the opposition party raised agitation against the land acquisition with the help of local farmers. As a result, Tata Motors Group left West Bengal and chose Gujarat state for their Nano factory [155]. The result ended with the origin of wastelands in Singur [156], where the disputes have made the land unfit for agriculture and industry.
        (iii) Wasteland due to economic activity*:* Mining, other industrial activities, and "*jhum*" farming reduce soil fertility [157]. In India, mining wastelands are predominant, whereas chemically contaminated land is another category of wasteland, sometimes recognized as brownfield land in European countries.

(2) Wasteland's potential usability
    (a) Cultivable wasteland*:* Cultivable wastelands are the specific group of wastelands suitable for reuse through effective management. For example, salt-affected land, gullied/ravenous land, water-logged or marshy land, upland with or without scrub, *Jhum*or forest blank, and sandy areas are the categories of cultivable or utilizable wasteland. Some types of cultivable wasteland can be re-utilizable for agricultural production, which is categorized as "Cultivable Wasteland" [158–161]. Nevertheless, the extent of potentially reusable culturable wasteland (Table A4, Appendix D) depends on the regional policy and economic affluence within a region [162–164].
    (b) Uncultivable wasteland*:* Due to meteorological and geographical factors, a few categories of lands that are not fit for use are known as uncultivable wasteland. Among this group of wasteland, barren hills, ridges, rock outcrops, and snow-covered areas do not attain any economic uses. Nevertheless, we cannot deny their inherent environmental significance, accommodating essential ecological activities on the earth's surface.

4.3. Management Strategies of Wasteland in India

Wasteland management policies in India can be classified broadly into two successive stages colonial and post-independence wasteland policy (Table A5, Appendix E). The colonial wasteland policy can be further classified into two sub-stages based on the nature of the taxation system and attitudes towards forest lands. In contrast, post-colonial

wasteland policies can be classified into three stages based on national organizational setups and national-level policies.

1. Land revenue system and perception of wasteland during the British Raj

John Locks's theory of property highly influenced the land revenue system and perception of wasteland in the British Raj's colonial land-use policy [84]. Croplands were considered productive, and forests, common grazing lands, and pastures were considered wasteland [31,165]. The second phase of colonial land-use policy was manifested by deforestation due to the demand for wood for the Royal Navy Shipbuilding Company [166] and cropland expansion in India [167,168]. This is how forest became a wasteland for productive resources for the British economy.

2. Wasteland and its management in the post-independence period

- The first stage (1950–1980):

The year 1951 was remarkable due to the commencement of the first five-year plan, which focused on increasing cultivated land and generating food security. This brought the implementation of (1) tenancy reforms, (2) the abolition of intermediaries, and (3) land redistribution [169]. During that time, the National Commission on Agriculture (NCA) was formed, which tried to convert wasteland for agricultural enhancement [170]. For this reason, the NCA estimated that the wasteland area was about 175 million ha (approx. one-third area of land in the country), and social forestry was regarded as the best possible method to convert wasteland into productive land [171]. Nonetheless, the objectives of this phase were unsatisfactory due to unequal land distribution, where underperforming lands were mainly distributed among the poor.

- The second stage (1980–2000):

The second phase of the post-colonial wasteland development policy was emphasized by introducing the National Wasteland Development Board (NWDB), the integrated wasteland development program (IWDP), and the national watershed development project, directly associated with a wasteland development program. The NWDB was formed in 1985, which first defined wasteland at the national level for optimum uses, mainly for fuel wood and fodder plantation. Meanwhile, the IWDP tries to develop wastelands in non-forest areas [172]. However, the watershed development approach tries to develop wasteland through its "Ridge to Valley approach" [95], where wastelands are identified explicitly in isolated patches within a demarcated area [173]. Apart from programs that directly emphasized wasteland development at the national level, few land reclamation programs have emerged. Among those, the Desert Area Development Program (DADP) and Drought Prone Area Development Program (DPAP) are much more significant given that they try to optimize the ecological balance and economic stability in fragile areas [174]. The main drawback of this phase was that different land reclamation approaches narrate wasteland differently, where deserts and drylands are recognized as waste [175].

- Third stage (2000–present):

The third stage of post-colonial wasteland development was primarily initiated through the second part of social forestry by promoting oilseed production in wasteland areas to restore ecology and the economy [176]. Another reason to implement social forestry in the third stage was associated with the unsatisfactory outcome of watershed development, as it was not entirely focused on wasteland [177]. National biofuel promotion is constructed in two successive parts: the first one is the National Mission on Biodiesel Development (NMBD), initiated in 2003, and the second is National Mission on Biofuel promotion in 2009. In the first phase, the Jatropha plantation [178] was mainly prioritized for wasteland development. The Indian planning commission claimed that promoting 10 million ha of Jatropha could generate 7.5 million metric tons of fuel and construct employment for 5 million people per year [179]. The reason why Jatropha got promoted in India is because of the successful policies across tropical and subtropical

areas [180], particularly in Mexico, Central America [181], and parts of Africa [182]. The most positive aspect of Jatropha is that it can grow in any soil condition, precisely in sandy soil, stony soil, etc. [183]. Throughout 2008, India was the world's primary cultivator of Jatropha, with around 407,000 ha under cultivation, nearly 45% of global production [10]. Still, during the second phase of oilseed production, Jatropha was not specified, but there was an aim of an increase of 20% for the blending target. Despite the early success of the oilseed policy through wasteland reclamation, some figures of the study show the unsatisfactory outcome of oilseed production for employment generation [184]. For example, in Tamilnadu, Jatropha has been considered less superior to other oilseeds (Prosopis) based on the availability of jobs per hectare [185]. However, field-based analysis shows that Jatropha has higher moisture content and a long growth period (about 3–4 years), making it less suitable for fuelwood [186]. Apart from the facts mentioned above, "biofuel-related land grab" [26] has become an integral part of Indian wasteland policy. Political ecologists were arguing as to whether oilseed production was meant for wasteland reclamation or only for Jatropha promotion [95,187].

Table A6 (Appendix F) represents India's region-specific wasteland reclamation procedure, where afforestation and watershed developments seem to be quite well spread. Afforestation is a part of social forestry; at the same time, watershed development programs may not fully consider the development of wastelands, but they improve the overall ecology and economy in a demarcated area [188]. Within a boundary of a watershed, there might be different developmental approaches like agricultural development [189], soil moisture maintenance [190], and the protection of land degradation [191]. Watershed development is a comprehensive approach [192] for the sustainable use of land and water [193], and, more importantly, it is also associated with employment generation.

4.4. Wasteland Management in India: The Challenges and Recommendation

The diverse range of land-related national policies, multidimensional socio-cultural practices, and different geographical setups create barriers to converting wastelands into valuable resources in India. It is beyond doubt that wastelands represent a potential for national growth, and that the reclamation of wasteland may serve "something" more than "nothing" [31]. In other words, it is essential to recognize the "something", which means that we need to identify areas where wasteland can serve as a precious resource, and "nothing", which means we need to identify obstacles to wasteland reclamation at the national political level.

a. Challenges of wasteland reclamation in India

Based on our review of the literature and the studies carried out on wasteland in India, we have identified the following challenges of wasteland reclamation in India:

- The historical influence of wasteland narrative*:* The historical notation of wasteland remains the same in present day India's land-use policy as it did in previous historical periods. Likewise, in the Indian context, the colonial notation of and approach to wasteland is visible, as it is in other parts of the globe. For example, deserts were considered an obstacle for early European-American settlers in the USA as they were devoid of production and human settlement. From the Native American viewpoint, deserts are not regarded as waste due to their ecological value [194]. The southwestern desert in America is often considered a wasteland which allows the demolition of such lands in a method of nuclear colonialism. As a result, the desert part of America has turned from a wasteland to a literal wasteland [195]. In the context of literal wasteland formation, in India the open natural ecosystem or sometimes the semi-arid ecosystem are tagged as degraded wasteland sites in land-use classification, without considering its ecosystem valuation. This array of different

misclassifications is carried out through the historical colonial land-use policy [196].

- Policy inconsistency**:** After the commencement of the NWDB in 1985, the ecological importance of wasteland was prioritized, but before that, wastelands were only judged as valuable from an economic outlook. There was always a clash between ecological restoration and economic enhancement in wasteland reclamation policy. For example, wasteland reclamation through Eucalyptus plantations in the social forestry program can effectively achieve economic security. In most cases, Eucalyptus extracts groundwater from deep inside, and the soil becomes dry with low moisture content.
- Lack of explicit wasteland development policy: Not all land reclamation policies fully consider wasteland development. For example, watershed management only considers wasteland reclamation individually. Rather, it is useful for the overall development of a certain area. On the other hand, social forestry is regarded as one of the prime wasteland reclamation policies. Ideally, it is used for protecting natural forests and sustaining local dependency on natural forest resources. Nevertheless, these policies may only be considered an optimum wasteland policy for some regions. For example, social forestry may not be applied in dryland areas due to water scarcity. Indeed,as the Global Energy Network Institute shows, there are only a few specific regions in India (a few states of central and southern India) where the climatic and lithological structure is favorable for the growth of biofuel [197].
- Regional inequalities: Unequal and improper capital investment can be regarded as the organizational cause of land degradation and wasteland formation. In India, less developed regions are experiencing low capital investment due to geographical constraints, climatic variability, and political instability, which result from the concentration of wasteland hotspots being restricted in some specific zones. Low regional affluence also creates a foundation for wasteland conversion.
- Problem in identifying wasteland: Different academic centers, research institutes, and government organizations identify it in multiple ways with their different methodologies. This sets out multiple notations of wasteland (ranging from degraded land to fallow), and based on that, the areal extension of wasteland varies in different registered documents.
- Struggle between local farmers and state policies: The struggle between environment versus economic development often drives the land reclamation policy to the extent of disputes between the state government and the local community. Moreover, in a few parts of India, the wasteland reclamation policy has become parts of land-grab-related disputes between local farmers and the state government [198]. This indicates how land-related policies are sometimes less comprehensive, making a particular community vulnerable.
- Lack of comprehensive database: Multiple laws administrated by different government organizations at the central, state, and district levels include the Ministries of Law and Justice, Rural Development, Mining, Industries, Infrastructure, Urban Development, Tribal Affairs, Home Affairs, and Defense. As a result of this, there is no comprehensive record available as it is difficult to manage over a thousand original and active central and state land laws [199]. Moreover, mismanagement is a predominant example in India that combines with different associated factors [200]. Sometimes the formation of wasteland is driven by socio-political factors rather than physical inputs [30]. Nevertheless, whether the wasteland is good or bad must not be ignored by us, as it is a product of nature, and if it is worse, there would still be a preoccupation with long-term environment and human relations [46].

b. Necessity and recommendation to retrieve wasteland

To achieve a stable human–land ratio in India, more lands must change status to fulfill the increasing demand for food [201]. In these circumstances, converting wasteland to cropland is the best way to increase production and reduce pressure on current productive lands [201]. This scenario is common and a common issue that needs addressing, not only in the Global South but also in the developed world. In Britain, urban wastelands are considered a probable resource base to prevent unemployment [14]. India has a significant population (177 million) affected by wasteland formation, food crises, and unemployment [202]. The livelihood of about 1.5 billion rural peoples worldwide is currently associated with wastelands, which the rural commons use in diverse utilization [203]. In the Indian context, wastelands are always linked up with the economy and livelihood, which is taken up in land reclamation policies. In this regard, wasteland reclamation and land expansion to increase production become ideal solutions. Here, the crucial question is how much wasteland can be reclaimed, as all wastelands do not have a productive capacity. For instance, glacial areas and rocky outcrops are unsuitable for agricultural production. Therefore, critical assessments must be conducted to detect which wastelands are suitable for crop production. Now, a few land types are not directly suitable for production or economic generation. Despite that, they have great ecological and environmental significance that needs to be separated from human intervention. For example, controlling desertification is necessary, but we must not expect food production and the continuous modification of deserts to lead to environmental destruction in the long run. More importantly, it would be better to extend our thought process to wastelands to tackle any recession in a country or region. Keeping this fact in mind, we suggest a few essential recommendations for wasteland management, particularly concerning India and the Global South:

i. Identifying wastelands per their characteristics is the primary task for effective land-use planning. This leads to the separate identification of cultivable and uncultivable wastelands. Cultivable wastelands have the potential for plantation, so identifying culturable wasteland and integrating it with a population cluster, regional climate, soil characteristics, and geology is the best way to analyze crop suitability.
ii. Apart from culturable wasteland, unculturable wastelands can be utilized for other economic activities, excluding agriculture. Sometimes scenic beauty can be useful to convert a landscape into a tourist destination. For example, Kimberly's "Big Hole", which results from diamond mining (mining wasteland), has been developed into a famous tourist destination. Meanwhile, Chornobyl (Ukraine) and Fukushima (Japan), both sites of which have experienced nuclear disasters, are now becoming world-class tourist attractions [204].
iii. The assessment of current farmland is necessary to understand the degree of degradation so that current farmland may be protected from the degradation process.
iv. Wasteland identification needs to have certain criteria to have a clear separation of wasteland and cropland. Incorporating geospatial techniques, a field-based study by soil scientists, an agro-economic survey by planners, and opinions from local commons directly linked with lands are mandatory for long-term effective land utilization.
v. A participatory approach is the key for wasteland reclamation and long-term Sustainable Land Utilization (SLU) in any region of India. The main reason participatory approaches are recognized as an integral part of resource management is the reliability of local commons on resources and their decision-making ability to conserve the localized resources.
vi. Circular land utilization is another innovative way to reuse the sustainable utilization of vacant and underutilized sites through infill measures. Circular land use aims to reuse derelict sites by prioritizing inner development over outer development. In parts of Western Europe, the circular utilization of wasteland through the stages of recycling–production–reuse is significant where the contaminated topsoil is distant, and subsoil is reutilized for economic activity [162]. However, circular land

utilization through wasteland reclamation is much more abundant in the Global North than the Global South because wastelands in the Global South are significantly abundant in rural sets up, which are not the product of contamination.

vii. Wasteland reclamation can serve as a valuable tool in bolstering resilience against the challenges posed by contemporary climate change scenarios. For example, regions such as dry sub-humid and semi-arid areas, which are more densely populated than arid zones, often face obstacles in crop cultivation due to insufficient rainfall or inadequate water harvesting methods [42,54]. Plateau regions may experience a dry sub-humid climate, receiving adequate rainfall, but the absence of scientific interventions for sustainable land use leads to water scarcity and the formation of wastelands [117]. In this context, these ecological areas can be utilized to achieve a sustainable land-to-human ratio by reclaiming wastelands for crop production [202]. However, this does not entail converting deserts or arid lands into croplands, as it could disrupt wind circulation patterns. Instead, focusing on reclaiming existing wasteland areas in economically viable climatic zones can play a significant role in mitigating the adverse impacts of climate change. This approach can also compensate for less economically productive regions, such as arid ecosystems.

Moreover, landscape is an environmental entity whose spatial attributes are continuously modified [69], and under this alteration, something remains wasted when it becomes worthless or unused for an individual purpose. In this regard, the concept of wasteland relates to Thompson's (1979) [205] "rubbish theory", which claims "objects move both into and out of the category of rubbish." In contrast, the observation by Strasser (1992) [206] implies that an object no longer useful to someone may be desirable to others. Thus, wasteland is a land use with many unmatched attributes compared to other currently productive land-use types. However, if managed effectively, in the future, wasteland can also be productive in many ways using the dynamic manifestation of the complex interrelationship between humans and nature.

5. Conclusions

We identified a diverse focus range on wasteland in our review; the narrative has different expressions which oscillate depending on time and region. Nevertheless, across studies, it has been shown that wasteland reclamation is essential to maintain the optimum land–human ratio, SLU, poverty–hunger reduction, ecological balance, and overall regional prosperity. The iteration of land as waste without a holistic assessment brings a false narrative on unused grounds that asserts unequal advantages among different social groups, where one section of people becomes a gainer, and another becomes the loser. Sometimes land is the switch from a small-scale farmer to a private enterprise. As a result, small-scale farmers migrate to the urban sector for jobs and become part of the urban poor. About half of the world's population still resides in the rural sector; in India, this percentage is about 65.97 (2018). Though there is a significant influx of rural populations in the urban sector through migration, the absolute number of the rural population is not drastically changing in India and other countries in Southeast Asia.

Moreover, the primary source of GDP has shifted from the agriculture sector to other sectors, but many populations still depend on natural resources. In addition, it is not always possible for the migrated rural population to be able to get jobs in urban centers as capital investors are much more motivated by for-profit maximization instead of giving jobs to the migrated rural poor. In this circumstance, SLU is the best possible way to optimum livelihood security in the rural sector by utilizing unused lands. The question is whether wasteland reclamation needs to be allied with crop production or other approaches. The wasteland development approach depends on some of the specific parameters like the type of wasteland, regional geo-climatic condition, and polity of a particular region. Nevertheless, any wasteland utilization will provide some height of economic or ecological output.

The vibrant and multidimensional outlook of waste land needs to be assessed using scientific criteria to consider a piece of land as waste. This also needs the assimilation of a number of aspects rather than framing the waste narrative from a single attribute, i.e., crop production. The different perspectives of wasteland, i.e., the agro-economy and political and biophysical perspectives, are being carried out through the argument of "how far a land is being considered as waste". In this regard, the notion of "waste" generates an off-putting narrative without even discovering the potential utility of a piece of land from multiple angles. Hence, to generate the less controversial scientific criteria to consider a piece of land as waste, the assimilation of the economy to the ecological aspect needs to be drawn for an integrated wasteland assessment. In this regard, considering the Indian scenario, multiple organizational definitions of wasteland carried out using agricultural productivity as the prime criteria somehow seem to be argumentative. When considering the land–human ratio with enormous population density, expecting and utilizing a land for production becomes an obvious scenario. Therefore, a notion like cultivable wasteland can be rephrased into prospective productive land, whereas uncultivable wasteland may be newly tagged as unproductive crop land. Now, there are a number of subcategories of unproductive crop land/uncultivable wasteland which can be further mapped out for investigation from ecological, cultural, and environmental aspects to apply innovative measures to give them potential to increase GDP. In a single line, the term wasteland is somehow the clash between the narrative, i.e., wild/degraded/bare/unproductive, versus the notion, i.e., land with opportunities. Hence, a wasteland assessment needs to have a hypothetical outlook, which needs to be rectified through empirical observation in the practical field. It is still necessary to set out an academic argument and overview of wasteland dynamics across disciplines, which is the continuous process of reframing the vibrant nature of wasteland to use it effectively.

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Appendix A

Table A1. Decade-wise definitions with different perspectives/themes of wasteland in Indian and global context.

Decades	Definitions	Perspectives	References (India)	References (Global)
1960 to 1969	Left out without being cultivated for some reasons	Agro-economic	[207]	-
1970 to 1979	Not available	Not available	Not available	-
1980 to 1989	Underutilized degraded land due to soil and water management	Bio-physical	[11]	-
	Ecologically unstable with lack of trees and crops	Bio-physical	[208]	-

	Degraded land with inherent or imposed disabilities	Bio-physical	[209]	-
	Degraded lands that are currently underutilized	Bio-physical	[52]	[66]
1990 to 1999	Common property lands used by the rural poor for fuelwood and fodder gathering	Property rights	[115]	-
	Underutilized degraded land that can be reclaimed through reasonable effort	Bio-physical	[210]	[64]
	"Bad" and needed to be eliminated	Political	[87]	
2000 to 2009	Miscellaneous land types that are presently not suitable for production	Agro-economic	[9]	[80]
	Common property lands	Property rights	[113,114]	-
	Politically malleable term applied for fallow and agroforestry lands	Political	[45]	57
	Degraded lands that are currently underutilized	Bio-physical	[117]	[67,68]
	Wastelands are political constructions	Political	[56,57]	[56]
2010 to present	Production of biomass is less than its optimum productivity	Ecological and economic	[211]	[81,89]
	Any land which are not privately owned	Property rights	[86]	-
	Empty, unproductive spaces can be improved for economic and environmental aspects	Agro-economic	[10]	[164]

Source: Prepared by the author.

Appendix B

Table A2. Organizational classification of wasteland category and itsarea(in percentages).

Types of Wastelands	Subtypes	Percentage (%) of Area Covered by Each Category
Gullied/ravenous land	Medium ravine	0.20
	Deep/Very deep ravine	0.09
Scrubland (land with or without scrub)	Land with dense scrub	2.25
	Land with open scrub	3.03
Waterlogged and marshy land	Permanent	0.05
	Seasonal	0.16
Land affected by salinity/alkalinity	Moderate	0.14
	Strong	0.05
Shifting cultivation	Current Jhum	0.12
	Abandoned Jhum	0.14
Scrub forest (underutilized notified forest land)	Scrub-dominated	2.63
	Agricultural land inside notified forest land	0.66
Degraded pastures/grazing land	-	0.20
Degraded land under plantation crops	-	0.01
Sands (coastal/desert/riverine)	Sands—coastal sand	0.02
	Sands—desert sands	0.25
	Semi-stabilized-to-stabilized (>40 m) dune	0.28
	Semi-stabilized-to-stabilized moderately high (15–40 m) dune	0.36
	Sands—riverine	0.09
Mining/industrial wasteland	Mining wasteland	0.07
	Industrial wasteland	0.01

Barren rocky area	-	2.87
Snow cover and/or glacial area	-	3.28
Total	-	16.96

Source: [153].

Appendix C

Table A3. Classification of wasteland based on causative agents and potential uses.

Basis of Wasteland Category	Main Types of Wastelands	Subtypes of Wasteland	Nature and Prospect
Based on causative agents	Natural wasteland	Rocky outcrop	Natural wastelands appeared physically and in most cases water and wind erosion were the leading causes
		Gullied/ravenous land	
		Glaciated areas	
		Sandy areas	
	Anthropogenic wasteland	Political wasteland	Kind of disputed land where in most of the cases there is a struggle between state policy and a local community
		Socio-cultural wasteland	Another category of disputed wasteland where there is a struggle between families or within a family
		Wasteland due to economic activity (industry, mining, and Jhum cultivation)	Occurs due to unsustainable human–environment relations which have potential for reuse
Based on potential uses	Culturable wasteland	Salt-affected land	Caused by naturally and human-induced factors yet they can still be reused through proper management
		Gullied/ravenous land	
		Water-logged or marshy land	
		Upland with or without scrub	
		Jhum or forest blank and	
		Sandy areas	
	Unculturable wasteland	Barren hill, ridge, or rock outcrop	Naturally produced and are not possible to use for production or economic activities
		Snow-covered areas	

Source: Prepared by the author.

Appendix D

Table A4. Some of the selected wasteland reclamation measures in different countries across the globe.

Country	Site	Approach	Reclamation Process	Organization	References
Pakistan	Indus basin	Reclamation of salt-affected wasteland	Land and water conservation through ground water treatment	Provincial Irrigation Departments (PIDs) and Water and Power Development Authority (WAPDA)	[212]
	Quetta, Zhob, Killa (part of Baluchistan)	Prevent watershed degradation	Delay Action Dams (DADs) to recharge ground water for maintaining ecological balance	IUCN, 2008	[213]
Egypt	Nile Delta region	IWRM approach	Strengthening surface and ground water management	The World Bank Global Environmental Facility	[51]

			with capacity building approach	(GEF) Trust Fund initiated the project in 2011	
Jordan	Zarqa River basin	Range of land restoration through the 'Al-Hima' approach (traditional land management system in the Arab region)	Sustainable, collective use of land resources amongst relevant communities by protecting natural resources, rangelands, and forests	With the assistance of IUCN and the Jordanian Ministry of Agriculture (MoA) since 2010	[214]
Ethiopia	Gunung district (Areka)	Maintaining soil fertility and preventing erosion	African Highland Initiative (AHI) has developed methodologies and processes that could be useful for soil fertility management	Awassa Research Center; the Awassa College of Agriculture; CIAT; and the International Livestock Research Institute (ILRI), 1997	[215]
Brazil	Paraná III watershed (Itaipu dam)	Rain-fed intensification for the development of family farming	Preventing topsoil erosion through Contour bunds, with terraces in between, constructed across the slope	From 2008, it was based on civil society's participation in the farming settlements From 2015 onwards, it has received partial assistance from the United Nations Water for Life Program	[216]
Indonesia	Buru district, Maluku province, and Malang in East Java in Indonesia	Indigenous approach to modify the fallow's vegetations	Producing fallow or secondary vegetation during the inter-cropping phase	This intensive shifting cultivation system is primarily carried out by the local aboriginal farmers From 2011 onwards, The International Development Research Center (IDRC-Canada)has provided their support to keep this traditional approach intact	[217]
Philippines,	Tinoc and I fugao in Philippines	The traditional "Banaue Rice Terrace" agroforestry system	In this method, rice is planted in terraces, whereas trees are planted above the terraces which act as a natural water supplier for the crop	This is one of the oldest traditional farming strategies by I fugao farmers which has existed for more than 2000 years	[218]
Tanzania	Shinyanga and Arusha regions	Silvo-pastoral system	Ngitiri: a successful traditional method of land rehabilitation in Shinyanga, with the extensive ground cover of shrubs, grasses, herbs, and forbs also helping to prevent soil erosion	With the collaboration of Tanzania Forest Services (TFS Agency) and Sukuma agropastoral community from 2000 onwards	[219]
Burkina Faso	Yatenga province	Agroforestry	Complex cropping system concentrating runoff water and manure in micro± watersheds	Institut de Recherche pour le development (IRD)	[220]

Uganda	Upper Nile, Victoria	Watershed management	Gully reclamation for productive purposes	USCAPP (Uganda Soil Conservation and Agroforestry Pilot Project) in 1992	[221]
China	Shanxi Province	Ecological restoration	Vegetation establishment and ecosystem creation to optimize land productivity and soil fertility	The Municipal Land Bureau, the Mining Group, and the Department of Land Expropriation from 1991 to 1995	[222]
Germany	Demolition sites in Berlin	Industrial wasteland restoration	Introduction of native grassland species (steppe and prairies) which has low maintenance cost	This innovation was carried out with the effort of theGerman Research Foundation	[223]
England	Industrial-contaminated sites in London and other cities	Gentle Remediation Options (GROs) through managing contaminated site restoration with ecological enhancement	Removes the surface soils, stores them carefully, and then replaces them in their original sequence and then with vegetation cover	Implemented by the Department of Environment, Food and Rural Affairs from2009 onwards	[35,161]

Source: Based on the available literature.

Appendix E

Table A5. Stage-wise wasteland-related policies in colonial and post-colonial period in India.

Stages	Sub-Stages	Main Program and Policies	Specific Features	References
Colonial wasteland policies	First half of 19th century (until 1920)	Land revenue system Land was regarded as an economic entity only	Forest, pastures, and grazing ground was regarded as waste	[165]
	Second half of 19thcentury (from 1920 to 1950)	Deforestation to expand agricultural land	Forest was no longer regarded as waste due to ship building industry in England	[168]
Post-colonial wasteland policy	First stage (From 1950 to 1980)	Redistribution of land and tenancy reform	Unproductive lands (wastelands) were mainly distributed among the poor	[169]
		Conservation of dry regions	Improvement in dry and drought-prone area through dry farming	[199]
		Formation of the National Commission on Agriculture (NCA)	Estimated total area of wasteland and initiated a centralized wasteland development program	[170]
		Integrated watershed development program in the catchment of floods	Enhance productivity and tackle menace of floods	[188]
		First stage of social forestry	Concept of productive forest where the main aim was to achieve ecology and economic sustenance	[178]
	Second stage (1980–2000)	Formation of the National Wasteland Development Board	Wasteland utilization through forestation and tree plantations	[172]

			to tackle the demand forfuel wood and fodder	
		National Land Use and Conservation Board	Introduction of desert and drought area development program	[95]
		Integrated wasteland development program	Wasteland development mainly in non-forest areas	[95]
		National watershed development projects	For comprehensive development with the integration of land and water	[173]
	Third stage (from 2000 onwards)	Second stage of social forestry	Oilseed production to produce renewable energy and employment generation in wasteland-dominated areas	[176]
		Formation of national rain-fed area authority	Holistic development in rain fed area	[199]
		Integrated Water Resource Management (IWRM) and water security	Rainwater harvesting, development of ground water and comprehensive land, water development	[224]

Source: Prepared by author.

Appendix F

Table A6. State- and region-wise wasteland reclamation approaches in India.

State and Region	Approach	Reclamation Process	Organization	References
Madhya Pradesh (Chambal Valley)	Ravine Reclamation	To restrict the progressive growth of ravines and utilize lands for productive purposes	Central Ravine Reclamation Board in 1967	[225]
Andhra Pradesh	Watershed approach	Microsite improvement is carried outby digging pits at spacing and of a size appropriate to the tree species	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in 2007	[54]
Andhra Pradesh	Bio-dieselplantation	Rehabilitate common property resources (CPRs) with biodiesel plantations (Jatrohpacurcas and Pongamiapinnata), which is a participatory approach through the formation of a self-help group (SHG)	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in 2007	[54]
Rajasthan	Fodder grass plantations	Semi-arid systems, where livestock is the mainstay of livelihoods for the survival and where common grazing lands are used to support fodder requirements of the livestock population	ICRISAT and BAIF Institute of Rural Development	[42]
Dehradun-Mussoorie (limestone mined	Vegetation in rehabilitation	Sustain esthetic attractiveness and visual impact ofecology	Forest Research Institute and CSWCRTI,	[226]

areas in Shahastrdhara belt in the Himalayan region), Uttarakhand		through the plantation (Eulaliopsisbinata)	Dehradun and Eco Task Force in 2001	
Neyveliin, Tamilnadu	Afforestation	Ecological stability and esthetic enhancement through the plantation	Neyveli Lignite Corporation (Tamil Nadu), India, from 1970 to 1986	[227]
Gujarat (wastelands in Mahi River stretch)	Agroforestry system	An indigenous bamboo and Anjan grass (Cenchrusciliaris)-based on a silvo-pastoral system for enhancing the productivity of ravines	Anand-based Foundation for Ecological Security (FES), Gujarat State Watershed Management Agency (GSWMA), Gujarat State Land Development Corporation (GSLDC), forest and agricultural departments	[228]
Kota, Rajasthan	Fruit-based agroforestry	Productive utilization of ravines through fruit-based agroforestry	CSWCRTI, Research Centre, Kota (2006 to 2011)	[229]
Sukhomajri in Panchkula district, Haryana	Watershed development programmers	Agricultural development and equitable distribution of irrigation water	CSWCRTI, Research Centre Chandigarh and Hill Resource Management Society (HRMS) in the 1980s	[230]
Lower and middle Himalayas in Tehri and Garhwal districts, Uttarakhand	Watershed management	Integrated watershed management project (IWMP) for soil and water conservation for horticulture development and crop production	Central Soil and Water Conservation Research and Training Institute, Dehradun, during 1975–1986	[231]
Andhra Pradesh	Afforestation	Carbon sequestration and wasteland treatment through Jatropha curcas	International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) from 2004 to 2006	[232]
Satpura region, Madhya Pradesh	Afforestation	Reclamation of degraded wasteland through the plantation of medicinal plants	Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow, and National Botanical Research Institute (NBRI), Lucknow, in 1982 and 1989	[233]
Sodic lands of Sultanpur district, Uttar Pradesh	Afforestation	Rehabilitation of sodic soil through leguminous tree plantation	Forest Soil and Land Reclamation Division, Forest Research Institute, Dehra Dun, 2002	[234]

Khurda Bhubaneswar, Odisha	Reclamation of salt-affected wasteland	Biodrainage plantation of trees (Acacia Mangium, Casuarina Equisetifolia)	ICAR-Indian Institute of Water Management, Bhubaneswar, 2011	[235]
Bundelkhand region (Uttar Pradesh, Madhya Pradesh)	Rain-fed and supplemental irrigation	Single and double cropping: cereal, beans/mixed for market, complemented with dairy	International Crop Research Institute for the Semi-Arid Tropics	[236]

Source: Based on the available literature.

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