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Securing the Future: Sustainable Land Use Practices for Environmental Security in the Western Ghats

Divyamol. M. V[1], Dr. Sijo K Manuel[2], Ms. Alphonsamma Francis[3]

[1,3]Alphonsamma Francis, (ICSSR Fellow),
[2]Research and PG Department of Political Science, St. Thomas College (Autonomous), Palai,
Affiliated to Mahatma Gandhi University, Priyadarshini Hills P. O, Kottayam, Kerala

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Abstract

The Western Ghats in Kerala are a treasure trove of natural beauty and biodiversity and considered as a nature lover's paradise, with their breathtaking landscapes, rich flora and fauna, and rich cultural heritage. Western Ghats, a biodiversity hotspot, faces unprecedented environmental threats due to unsustainable land use practices. Once a pristine and lush mountain range, the Ghats are now struggling to survive amidst widespread environmental degradation. The region has witnessed devastating landslides, such as the 2018 floods, which claimed hundreds of lives and displaced thousands. The fragile ecosystem is under immense pressure, threatening the very existence of this unique and precious natural heritage. This region's ecological integrity is crucial for maintaining ecosystem services, including water security, soil conservation, and climate regulation. This study examines the impact of human activities on environmental security in the Western Ghats and explores sustainable land use practices to mitigate these threats. This research paper assess the effects of deforestation, agriculture, and urbanization on ecosystem health and identify strategies for sustainable land management, including reforestation, agro forestry, and eco-tourism. It also highlights the need for a multidisciplinary approach to balance human needs with environmental conservation, ensuring the long-term environmental security of the Western Ghats. By adopting sustainable land use practices, we can protect this critical ecosystem and its essential services for future generations.

Key Words: Western, Ghats, Sustainable land use practices, Environmental Security

1. Introduction:

With the emergence of new challenges following the end of the Cold War, the relationship between environmental change, stress, and environmental degradation in relation to the security issue has gained increased importance. Nowadays, both the scientific and policy communities are interested in understanding the relationship between environment and security, particularly in light of the growing ubiquity of traditional security theories centered on national sovereignty (Zurlini, 2008, p.1351).

Environmental security is a critical aspect of human security that has gained significant attention in recent years. The concept of environmental security refers to the protection of the natural environment and natural resources from human-induced threats such as pollution, deforestation, climate change, and resource depletion. These threats not only harm the environment but also have severe consequences for human health, economic development, and global stability.

The impact of environmental insecurity is far-reaching, from devastating natural disasters to water scarcity, food insecurity, and loss of biodiversity. Climate change, in particular, poses a significant threat to human security, with rising temperatures, sea-level rise, and extreme weather events displacing communities, exacerbating social and economic inequalities, and straining global resources.

Moreover, environmental insecurity has significant economic consequences, from loss of infrastructure and property to decreased economic growth and increased healthcare costs. The World Health Organization estimates that environmental factors are responsible for approximately 25% of global disease burden.

To address environmental security, it is essential to adopt a holistic approach that balances economic, social, and environmental needs. This requires international cooperation, sustainable development practices, and innovative solutions to mitigate climate change, protect natural resources, and promote environmental stewardship.

Ultimately, environmental security is a matter of human rights, social justice, and global responsibility. By prioritizing environmental security, we can ensure a sustainable future for all, protect the most vulnerable populations, and promote peace and stability in an increasingly interconnected world.

The idea of security is always a debatable one. It has different dimensions and the environmental security poses a significant role. It has been evident in the perspective of ecology especially in the Western Ghats region of Kerala.

The Western Ghats, a majestic mountain range in western India, is a treasure trove of biodiversity, cultural heritage, and natural beauty. Stretching over 1,600 km, this ecological hotspot is home to a staggering array of plant and animal species, many of which are found nowhere else on Earth.

As one of the eight most diverse regions on the planet, the Western Ghats support an incredible range of ecosystems, from lush tropical rainforests to rolling hills, valleys, and scenic lakes. The range's unique geology, with rocks dating back millions of years, has created a diverse landscape that fosters an astonishing variety of flora and fauna.

It is a cradle of endemism, with numerous species that have evolved in isolation, such as the iconic Nilgiri Tahr, Lion-tailed Macaque, and Malabar Pied Hornbill. The range's forests are also home to majestic elephants, tigers, and leopards, while its rivers and streams support a dazzling array of fish, amphibians, and other aquatic life.

Beyond its natural wonders, the Western Ghats hold deep cultural significance. Indigenous communities have lived in harmony with these mountains for centuries, their traditions, languages, and

knowledge systems intricately linked to the land. The range is also dotted with sacred sites, historical landmarks, and architectural marvels, reflecting India's rich cultural heritage.

However, this range faces numerous threats from false land use practices. These practices are not only harming the environment but also jeopardizing the livelihoods of local communities. The illegal or unethical activities that involve the misuse of land, leading to environmental degradation, social injustice and economic losses fragile the ecosystem.

The Western Ghats of Kerala are home to many endemic species that are found nowhere else on Earth. However, due to various human activities and environmental factors, many of these species are facing extinction. Some examples of endemic species in the Western Ghats of Kerala that are threatened or extinct include Western Ghats Lion-tailed Macaque (Macaca silenus), a critically endangered primate species found only in the Western Ghats, Nilgiri Tahr (Hemitragus hylocrius), acritically endangered mountain goat species found only in the Nilgiri Hills, Kerala Red Rain Frog (Raorchestes keralaensis), acritically endangered frog species found only in the Western Ghats, Western Ghats Spiny Babbler (Turdoides affinis), a vulnerable bird species found only in the Western Ghats, Malabar Gliding Frog (Rhacophorus malabaricus), a vulnerable frog species found only in the Western Ghats, Coorg Yellow Bush Frog (Raorchestes coorgensis), Kerala Tiger Toad (Duttaphrynus beddomii), a vulnerable toad species found only in the Western Ghats, Wayanad Mahseer (Tor khudree), a critically endangered fish species found only in the Western Ghats etc.

2. Deforestation and land conversion

One of the most significant false land use practices in the Western Ghats region is deforestation and land conversion. Large tracts of forest land are being cleared for agriculture, urbanization and infrastructure development. It results loss of biodiversity, soil erosion, climate change, water cycle disruption which are treated under environmental consequences. The major social consequences from this act include indigenous community displacement, loss of livelihoods, cultural heritage destruction. Apart from these, economic losses like losses in sustainable forest products and ecotourism, increased poverty etc are the results of deforestation and land conversion. The Silent Valley project in the 1970s and 1980s led to the destruction of a significant portion of the Silent Valley project forest, which is home to the endangered Lion- tailed Macaques. The Attappadi region of Wayanad district has been widespread deforestation due to agriculture, urbanization and infrastructure development, leading to the loss of habitat for endangered species like Nilgiri Tahrs. Encroachment and deforestation have led to the loss of forest land and wildlife habitats in Wayanad including Wayanad wildlife sanctuary. Widespread tea plantation expansion has led to deforestation and land degradation in Munnar threatening the habitats of endangered species like the Nilgiri Tahr and elephant. The Idukki dam has resulted in the submergence of a large area of forest land and displacement of communities leading to deforestation and habitat loss. The Periyar Tiger Reserve has faced encroachment and deforestation threats, posing a risk to the habitat of endangered species like the tiger and the elephant. The Eravikulam National Park has faced deforestation and degradation due to human activities threatening the habitat of endangered Nilgiri Tahrs. The Parambikulam wildlife sanctuary has affected widely due to human activities and posing a risk to the habitat of endangered species like the tiger and the elephant. The Vazhachal forest has faced

deforestation and degradation due to human activities, threatening the habitat of endangered species like the elephants. Athirappally Hydroelectric project has resulted in the submergence of a large area of forest land and displacement of communities, leading to deforestation and habitat loss.

Unsustainable agriculture

Farmers are using unsustainable practices like monoculture, overuse of chemical fertilizers and excessive water usage. This had led to soil degradation, water pollution and loss of crop diversity. Monoculture refers to the practice of growing a single crop or species in a particular area or farm, often on a large scale. This approach has become increasingly common in modern agriculture but has several drawbacks. Monoculture leads to soil erosion, nutrient depletion and reduced fertility. It often relies on heavy pesticide and fertilizer use which contaminates water sources. It also replaces diverse ecosystems with a single species, reducing biodiversity and ecosystem services.

Agricultural expansion

Increased in the amount of land used for agricultural production often at the expense of natural habitats, forests or other ecosystem is another important aspect of unsustainable land use practices in the Western Ghats region of Kerala. This results severe environmental problems like deforestation and habitat loss, Soil erosion and landslides, water pollution and depletion, loss of biodiversity and ecosystem services, displacement of indigenous communities and destruction of their livelihoods, increased vulnerability to climate change, soil degradation and nutrient depletion, increased use of chemical fertilizers and pesticides, decreased crop diversity and genetic erosion, negative impacts on human health and well-being etc. Monoculture practices are also lead to land degradation. A large number of monoculture practices can be witnessed in the Western Ghats region of Kerala. Tea plantations in Munnar and Wayanad, coffee plantations in Wayanad and Malappuram, spice plantations (e.g., pepper, cardamom, and cinnamon) in Idukki and Wayanad, rubber plantations in Kottayam and Pathanamthitta, arecanut plantations in Kannur and Kasaragod, coconut plantations in Alappuzha and Kollam, banana plantations in Thrissur and Palakkad, plantation of exotic species like eucalyptus and acacia are some practices under this category. It affects the region's unique ecosystem and has had negative impacts on local communities and their livelihoods. Efforts are being made to promote sustainable agriculture practices, conserve biodiversity, and support small-scale farmers in the region.

Urbanization and infrastructure development

Urbanization and infrastructure development are closely linked, as the growth of cities and urban areas drives the demand for new infrastructure to support the increasing population, economic activities, and quality of life. The clearing of forest land for transportation systems (roads, highways, public transport, airports, etc.), water supply and sanitation system, energy and power infrastructure (electricity generation, transmission, and distribution), communication systems (telecom, internet, etc.), housing and real estate development, commercial and industrial infrastructure (office spaces, industrial parks, etc.), public facilities (hospitals, schools, etc.), waste management and pollution control systems, parks and

recreational spaces and disaster resilience and emergency response infrastructure etc created a series of negative environmental and social impacts. The Western Ghats are home to many endemic species and these factors cause population decline and even extinction.

Over tourism

The negative impacts that can occur when a destination becomes overwhelmed by too many tourists is commonly known as over tourism is one of the significant problem faced by the Western Ghats region of Kerala. The outcomes of such acts include Environmental degradation, cultural heritage degradation, displacement of local communities, increased costs and decreased quality of life for residents, strained infrastructure and resources, decreased authenticity and uniqueness of the destination, negative impacts on local wildlife and ecosystems, increased traffic and congestion, decreased safety and security for tourists and residents, economic instability and dependence on tourism etc. Munnar, Wayanad, Thekkady, Alleppey, Kumarakom, Athirappilly, Vagamon, Kuttikanam, Peerumedu and Nelliyampathy are the some specific destinations that are experiencing overtourism in Kerala.

Climate change

Climate change is a pressing global issue that has far-reaching consequences for the environment, human health, and the economy. The Western Ghats region of Kerala, India, is particularly vulnerable to the impacts of climate change. This essay will explore the effects of climate change on the Western Ghats region of Kerala, including rising temperatures, changing rainfall patterns, increased frequency of extreme weather events, and impacts on biodiversity, agriculture, and human health.

Rising temperatures are one of the most obvious impacts of climate change in the Western Ghats region. The average temperature has risen by 2-3°C over the past century, leading to changes in vegetation patterns, increased evaporation, and altered ecosystems. This warming trend is expected to continue, with potentially devastating consequences for the region's unique biodiversity.

Changing rainfall patterns are another significant impact of climate change in the Western Ghats region. The region is experiencing more frequent and intense floods, landslides, and droughts, which can have disastrous consequences for local communities and ecosystems. The changes in rainfall patterns are also affecting the region's agriculture, with crop yields and productivity declining due to uncertain weather conditions.

The Western Ghats region is also experiencing an increased frequency of extreme weather events, such as landslides, flash floods, and heat waves. These events can have devastating consequences for local communities, including loss of life, property damage, and displacement.

Climate change is also having a profound impact on the region's biodiversity. The Western Ghats are home to a vast array of plant and animal species, many of which are found nowhere else in the world. Rising temperatures, changing rainfall patterns, and increased frequency of extreme weather events are altering ecosystems and threatening the very existence of these species.

Agriculture is another sector that is being severely impacted by climate change in the Western Ghats region. Changes in temperature and rainfall patterns are affecting crop yields and productivity, leading to food insecurity and economic losses for local communities.

Landslides and landslips, floods in Periyar and other rivers, droughts in Palakkad and other districts, heat waves in Kozhikode and other coastal areas, sea erosion in Alappuzha and other coastal districts, water scarcity in Wayanad and other districts, impacts on tea and coffee plantations, changes in fish populations in rivers and coastal areas, increased risk of water borne diseases, mental health impacts on local communities etc are some specific climate change related issues in the Western Ghats region of Kerala.

Invasive species

Invasive species are a growing threat to ecosystems worldwide, causing devastating impacts on native species, habitats, and human well-being. These non-native plants, animals, and microorganisms outcompete native species for resources, habitat, and space, leading to ecological disruption and economic harm. The introduction of invasive species often occurs through human activities such as trade, travel, and migration. Once established, they can spread rapidly, exploiting vulnerabilities in the ecosystem. The consequences are far-reaching, leading to biodiversity loss and extinction, disrupted food chains and ecosystem processes, habitat destruction and fragmentation, water pollution and altered water chemistry, significant economic losses in agriculture, forestry, fisheries, and tourism negative impacts on human health through disease transmission and allergies.

Prevention and management strategies are crucial to mitigate the invasive species threat. This includes prevention: Avoid introducing non-native species to new areas, early detection: monitor for invasive species and respond quickly to new infestations, control and eradication: use appropriate methods to control and eradicate invasive species populations, restoration: restore degraded habitats and promote native species recovery, education and outreach: raise awareness about invasive species risks and promote responsible land management practices.

The Western Ghats, a biodiversity hotspot in India, is facing a significant threat from invasive species. These non-native plants, animals, and microorganisms are outcompeting native species for resources, habitat, and space, leading to ecological disruption and economic harm.

The Western Ghats' unique biodiversity is under threat from invasive species. It is crucial to take proactive measures to protect this ecological treasure and promote sustainable development in the region.Invasive species are a significant threat to the biodiversity of the Western Ghats region of Kerala, India. Some of the invasive species found in this region include Acacia auriculiformis (Ear-pod wattle), Acacia mearnsii (Black wattle), Chromolaena odorata (Siam weed), Eupatorium odoratum (Crofton weed), Gmelina arborea (Cashewnut tree), Lantana camara (Lantana), Mikania micrantha (Mile-a-minute weed), Parthenium hysterophorus (Congress grass), Pennisetum setaceum (Fountain grass), Prosopis juliflora (Mesquite) etc.

These invasive species can outcompete native species for resources, alter ecosystems, and even lead to extinctions. They can also have significant economic and social impacts on local communities. Some of the impacts of invasive species in the Western Ghats region of Kerala include loss of biodiversity, displacement of native species, alteration of ecosystem processes, decreased water availability, increased risk of wildfires, negative impacts on agriculture and forestry, economic losses for local communities andcultural impacts on indigenous communities.

Pollution

Pollution is a significant threat to the Western Ghats region of Kerala, India. The region is facing various types of pollution, including air pollution like industrial activities, vehicle emissions, and construction activities are leading to increased air pollution. Water pollution like industrial effluents, agricultural runoff, and domestic waste are contaminating rivers, streams, and groundwater. Soil pollution due to industrial activities, mining, and construction are leading to soil degradation and pollution. Similarly, increased tourism, construction, and industrial activities are leading to noise pollution. Increased urbanization and tourism are leading to light pollution. Plastic waste is accumulating in the environment, including in water bodies and forests, industrial activities and agricultural runoff, thermal pollution etc are cause severe damage to this fragile ecosystem.

These types of pollution are having severe impacts on the environment, human health, and the economy of the Western Ghats region of Kerala. Some of the specific impacts include deforestation and habitat loss, water scarcity and decreased water quality, loss of biodiversity, decreased agricultural productivity, negative impacts on human health, economic losses for local communities, cultural impacts on indigenous communities, decreased tourism and revenue etc.

Some specific examples of pollution as a threat to the Western Ghats in Kerala are air pollution from industrial activities such as The Kochi refinery and other industrial units in the region release large amounts of air pollutants, affecting the quality of air and human health, water pollution from agricultural runoff in which the use of chemical pesticides and fertilizers in agriculture in the region leads to water pollution, affecting the health of humans and wildlife, plastic pollution in rivers and forests where plastic waste from urban areas and tourist destinations is accumulating in rivers and forests, harming wildlife and contaminating water sources, the increasing number of tourists and vehicles in the region is leading to noise pollution, disrupting the natural habitats of wildlife, the growing urbanization in the region is leading to light pollution, affecting the natural habits of wildlife and the overall ecosystem, the mining activities in the region are leading to soil pollution, affecting the fertility of the soil and the health of humans and wildlife, the release of chemical effluents from industries in the region is polluting water bodies and soil, affecting human health and the environment, the thermal power plants in the region are releasing hot water into nearby water bodies, affecting aquatic life.

Environmental security is a critical component of human security, as it directly impacts the well-being and survival of individuals and communities. The concept of environmental security encompasses various aspects, including access to natural resources, environmental degradation, climate change, and sustainable development.

The concept of environmental security has emerged as a vital aspect of human security, recognizing the intricate relationships between human well-being and the natural environment. Environmental security encompasses various dimensions, including access to natural resources, environmental degradation, climate change, and sustainable development.

Access to Natural Resources: A Human Security Imperative

Access to natural resources, such as water, land, and forests, is essential for human survival. However, the depletion and degradation of these resources due to overexploitation, pollution, and climate change pose significant threats to human security. The lack of access to clean water, fertile land, and healthy forests can lead to food and water scarcity, increased vulnerability to natural disasters, and loss of livelihoods.

Environmental Degradation: A Threat to Human Security

Environmental degradation, including deforestation, soil erosion, and pollution, has severe consequences for human security. The loss of ecosystems and biodiversity can disrupt essential services like pollination, pest control, and climate regulation, leading to food insecurity and increased vulnerability to natural disasters.

Climate Change: An Existential Threat to Human Security

Climate change is one of the most pressing environmental security challenges, with far-reaching consequences for human security. Rising temperatures, sea-level rise, and extreme weather events can lead to displacement, food and water scarcity, and increased risk of conflict.

Floods and Landslides in Kerala

In addition to the above consequences, it is very significant to address the issue of floods and landslides in Kerala. It is one of the most densely state in India which makes it more vulnerable to the losses and damages on account of disasters. Landslides are a major hazard along the Western Ghats in Wayanad, Kozhikode, Idukki and Kottayam districts. The mountain regions experience several landslides during the monsoon season (Kuriakose, 2010) leading to road collapse, silting of river beds and creating heavy damages on public and private assets. Sea level rise, monsoon storm surges, and erosion are all threats to the coastline. Lately, hilly areas have been experiencing a slow hazard known as land subsidence as a result of tunnel erosion or soil piping. Kerala always experiences summertime drought conditions that are seasonal. Kerala went through sixty-six years of drought from 1881 to 2000. Kerala's land area is more than 50% susceptible to moderate to severe droughts. The Indian Meteorological Department (IMD) officially mapped Kerala State as mild to moderately arid following the drought years of 2002–2004, 2010, and 2012. According to the IMD, 2017 saw the worst drought in 115 years. The primary causes of the rising frequency of droughts are weather anomalies, changes in land use, customs, and human lifestyle.

In August 2018, the state of Kerala experienced a devastating natural disaster in the form of a landslide and flood. Millions of people were impacted by landslides, flooding, and heavy rains, which resulted in extensive damage and fatalities. Extreme rainfall set off the calamity, which was made worse by human activity like deforestation and land degradation as well as climate change. Over 400 people lost their lives as a result of the floods and landslides, which also caused over 1.4 million people to be displaced, destroyed homes, infrastructure, and crops, and caused economic losses estimated to be over 40,000 crores. Numerous districts in Kerala state experienced extensive flooding as a result of the 2018 heavy monsoon, which also led to a large number of minor to major landslides. A number of districts experienced flooding brought on by heavy rains for over two weeks. The impact of floods was increased by the torrential rains, which also caused several landslides and the forced release of excess water from 37 dams throughout the State. There were reports of nearly 341 significant landslides from 10 districts. The district of Idukki was devastated by 143 landslides. Throughout its 14 districts, 1,260 of the 1,664 villages were impacted. The worst-hit districts were Thrissur, Wayanad, Ernakulam, Idukki, Kottayam, Pathanamthitha, and Alappuzha, where the entire district was declared affected by flooding. At the height of the tragedy, 6,85,000 families were forced to relocate temporarily to relief camps due to the loss of assets and property, resulting in a total of 435 casualties from the devastating incident. Many lives were saved by the government's prompt and effective rescue and relief operations, which were greatly aided by the affected communities' self-organized mobilization and the skillful use of social media and information technology by volunteer youth groups. The people of Kerala also demonstrated incredible fortitude in the face of hardship, to the point where the majority of them returned to their homes to start over a week after the floodwaters subsided.

In the early hours of August 7, 2020, a massive landslide occurred at the Nayamakkad (Pettimudy) tea estate (77.01ºE longitude and 10.17ºN latitude), close to Rajamala in the Idukki district of Kerala (Fig. 1).In addition to uprooting numerous trees and poles and destroying four hutments known as "layams," which served as quarters for tea garden workers, this landslide claimed the lives of seventy people. This landslide destroyed the hutments and traveled quickly for approximately 1.3 km before debouching into the Kanniyar River. The landslide grew larger as it moved downward. Although landslides are frequent during Kerala's rainy season, this year marks the third time in a row that the state has seen catastrophic landslides as a result of unusually heavy rains.

20 kilometers from Kalpetta in the Wayanad district, Puthumala is a plantation village close to Meppadi, situated at an elevation of 1230 meters above mean sea level. On August 8, 2019, the state of Kerala experienced severe floods and landslides as a result of monsoon-season heavy rainfall. There was a significant landslide at the Puthumala village. Twenty hectares of land were pushed to a distance of roughly two kilometers by the landside, which had its epicenter at a height of 290 meters on the mountain. The examination of the precipitation data revealed that the region got about 500 mm of heavy rain in the 24 hours prior to the landslide. The landslide turned disastrous due to the lower soil structure. The land was weaker and wet from the rain; a massive landslide resulted from the pressure-induced crushing of rocks and soil. A sizable section of the hill had collapsed, and a broad swath of the valley floor was covered in rocks, mud, and other debris. High rainfall intensity that caused the soil to disintegrate, deforestation, shallow soil depth that allowed water to seep into soil piping or cavities,

cardamom farming on the mountainside that caused the soil to become loose, disappearing stream lengths from construction and occupation, and mining and construction done without following scientific methods on the hillside that altered the soil's structure were some of the main causes of landslides in this area. One of those smaller landslides that happened far into the forest was the precursor to the Puthumala landslide. About 100 acres of tea plantation in Puthumala were destroyed by the enormous landslide. The main source of income in the village was agriculture, with cardamom, pepper, coffee, and tea among its crops. According to the Wayanad District Soil Conservation Department's assessment, approximately 25,000 hectares had lost their top 2 cm of fertile soil, which would have a significant impact on agricultural productivity. There were silt deposits, land slips, and landslides on about 40 ha of land.

. Events of intense rainfall in the area washed away the nutrients in the soil. The entire 300-acre coffee and tea plantation was covered in soil due to a landslide. The landslide sites were on the list of places susceptible to landslides and are located in the ecologically delicate Western Ghats. The areas of Wayanad that are extremely and moderately prone to landslides, respectively, are 102.6 km2 and 196.6 km2, with certain areas also susceptible to the effect of soil piping. Future climate change is likely to result in an increase in landslide-prone areas. In order to prevent such, it is necessary to control and outlaw unscientific constructions, as well as land development activities and the operation of quarries in the district's landslide-prone areas.

On July 30, 2024, at 02:17 PM, a landslide occurred in the vicinity of Mundakki, Chooralmala, Vellarimala Village in Meppadi Panchayat, Vythiri Taluk, Wayanad District, due to persistent heavy to extremely severe rainfall. The rubble has buried about seven hundred houses and commercial buildings. 231 bodies and 212 body parts have been recovered so far, according to the State Emergency Operational Centre (SEOC) Kerala. Approximately 119 people are still missing, 214 people have been rescued alive, and 630 people have received injuries overall. All of the relief camps in Wayanad have been successfully dispersed as of August 24, 2024, in the evening. Now, 702 families who were living in these camps have been moved into government housing, rented homes, and family members' residences. There are now 702 families—943 men, 984 women, and 629 children—that have left Chooralmala behind. There are five pregnant women among the people who were relocated. 2,556 persons in total have been impacted and are currently staying in makeshift shelters.

Sustainable Development: A Pathway to Environmental Security

Sustainable development is critical for addressing environmental security challenges. This requires a holistic approach that balances economic, social, and environmental needs. Strategies for sustainable development include renewable energy, sustainable agriculture, and conservation of natural resources.

Access to natural resources, such as water, land, and forests, is essential for human survival. However, the depletion and degradation of these resources due to overexploitation, pollution, and climate change pose significant threats to human security. Environmental degradation can lead to food and water scarcity, increased vulnerability to natural disasters, and loss of livelihoods.

Climate change is one of the most pressing environmental security challenges, with far-reaching consequences for human security. Rising temperatures, sea-level rise, and extreme weather events can lead to displacement, food and water scarcity, and increased risk of conflict.

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Sustainable land use promotes environmental security in several ways:

1. Conservation of natural resources: Sustainable land use practices like reforestation, afforestation, and habitat restoration help maintain ecosystem services, ensuring the long-term availability of natural resources. It is a critical aspect of environmental security. Natural resources like water, land, forests and minerals are essential for human survival and economic development. However, their over exploitation and degradation can lead to scarcity, conflict and environmental degradation threatening human security. Maintaining and sustaining the resources, equity, resilence, biodiversity protection, water security, food and energy security, supporting sustainable development and livelihoods, protecting indigenous rights and community interests are some ways to conserve natural resources. It is essential for environmental security as it mitigates climate change, prevents resource depletion, reduces conflict and competition, protects biodiversity and ecosystems, ensures sustainable economic growth, fosters international cooperation, supports disaster risk reduction, promotes social justice and equity and ensures a sustainable future for all.
2. Climate change mitigation: Sustainable land use practices like agroforestry, permaculture, and regenerative agriculture help sequester carbon, reducing greenhouse gas emissions and mitigating climate change. Climate change mitigation is crucial for environmental security in the Western Ghats, and can be achieved through forest conservation and restoration, sustainable land-use practices, renewable energy transition, energy efficiency and consumption reduction, eco-friendly infrastructure development, climate-resilient agriculture and water management, biodiversity conservation and wildlife corridors, community-led climate initiatives and education, research and monitoring programs and policy and legislative frameworks. Specific actions for climate change mitigation in the Western Ghats include Protecting and expanding forest cover, Promoting agroforestry and sustainable agriculture, investing in solar and wind energy, improving energy efficiency in buildings and industries, implementing eco-friendly transportation systems, developing climate-resilient water management systems, conserving and restoring wetlands and aquatic ecosystems, supporting climate-resilient agriculture and livestock production, enhancing biodiversity and wildlife corridors and fostering community-led climate initiatives and education programs.

   These actions can help reduce greenhouse gas emissions, enhance ecosystem services, and promote environmental security in the Western Ghats, while also supporting sustainable development and human well-being.
3. Soil conservation: Sustainable land use practices like no-till or reduced-till farming, cover cropping, and crop rotation help maintain soil health, reduce erosion, and prevent land

degradation. Soil conservation is crucial for environmental security in the Western Ghats, and can be achieved through sustainable land-use practices, soil erosion control measures, afforestation and reforestation, agroforestry and permaculture, contour farming and terracing, crop rotation and organic farming, soil testing and nutrient management, water harvesting and conservation, watershed development and management and community-led soil conservation initiatives.

Specific techniques for soil conservation in the Western Ghats include contour bunding and trenching, mulching and cover cropping, rock wall construction and gabion structures, soil nail technology and geo textiles, bioengineering and biotechnical stabilization, hydroseeding and hydro mulching, terracing and bench terracing, soil conservation through agroforestry, integrated nutrient management and precision agriculture and conservation agriculture

These techniques can help reduce soil erosion, improve soil health, and promote environmental security in the Western Ghats, while also supporting sustainable agriculture, water resources, and biodiversity conservation.

4. Biodiversity protection: Sustainable land use practices like habitat restoration, wildlife corridors, and conservation agriculture help maintain ecosystem services, protect endangered species, and preserve biodiversity. The Western Ghats, a biodiversity hotspot, is home to a vast array of flora and fauna. Protecting this biodiversity is crucial for environmental security, as it supports ecosystem services like pollination, pest control, and climate regulation, maintains water cycles and water quality, provides natural barriers against natural disasters, supports sustainable agriculture and food security, has cultural and spiritual significance for local communities, offers opportunities for eco-tourism and sustainable development, helps to regulate the climate and mitigate climate change, supports scientific research and development, maintains soil health and fertility and ensures the long-term health and resilience of ecosystems. By protecting biodiversity in the Western Ghats, we can ensure environmental security, support sustainable development, and preserve the natural heritage of this unique region.
5. Water cycle regulation: Sustainable land use practices like forest conservation, wetland restoration, and efficient irrigation systems help regulate the water cycle, maintain water quality, and prevent water scarcity. Water cycle regulations are a crucial aspect of sustainable land use practices in the Western Ghats. The region's unique geography and climate make it a water-rich area, but also prone to water scarcity and quality issues. Maintain water yield and quality, regulate water flows and prevent floods, recharge groundwater aquifers, support aquatic ecosystems, enhance water use efficiency, promote water literacy and community engagement, support sustainable agriculture and food security, mitigate climate change impacts, protect water sources and infrastructure, ensure water equity and access etc are some useful practices for sustaining the land in the Western Ghats region.
6. Disaster risk reduction: Sustainable land use practices like floodplain management, landslide prevention, and drought-tolerant agriculture help reduce the risk of natural disasters and promote environmental resilience. Disaster risk reduction in the Western Ghats region of Kerala is crucial due to the area's vulnerability to various natural hazards. Some strategies for disaster risk reduction in the region include:

1. Landslide mitigation measures: Terracing, contour bunding, and afforestation
2. Flood control measures: Watershed management, floodplain zoning, and early warning systems
3. Drought management: Water harvesting, rainwater storage, and efficient irrigation systems
4. Climate change adaptation: Agroforestry, conservation agriculture, and climate-resilient infrastructure
5. Community-based disaster risk management: Training, education, and community engagement
6. Ecosystem-based disaster risk reduction: Conservation of forests, wetlands, and water sources
7. Infrastructure resilience: Strengthening of buildings, bridges, and roads
8. Early warning systems and emergency preparedness
9. Watershed development and management
10. Research and development: Improving understanding of hazards and vulnerability

7. Food security: Sustainable land use practices like sustainable agriculture, agroecology, and permaculture help ensure food availability, access, and utilization, promoting food security and nutrition.
8. Human health: Sustainable land use practices like reducing pollution, maintaining ecosystem services, and promoting ecosystem-based adaptation help protect human health and well-being.
9. Economic benefits: Sustainable land use practices like eco-tourism, sustainable forestry, and sustainable agriculture provide economic benefits and incentivize environmental stewardship.
10. Social justice: Sustainable land use practices like community-led conservation, indigenous rights, and equitable land distribution promote social justice and environmental equity.

In conclusion, environmental security is inextricably linked with human security. Addressing environmental challenges is essential for ensuring human well-being and survival. This requires a collaborative effort from governments, international organizations, civil society, and individuals to prioritize sustainable development and environmental protection.

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