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Reclaiming Uzbek Lands: Preventing Overgrazing With Sustainable Management and Legumes

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Annotation: Contemporary food systems and consumption patterns lack sustainability on both domestic and global scales. The expected increase in demand for livestock goods in the future will necessitate not just more land for cultivation and enhanced yields, but an escalation in livestock production, as per current industry practices. Consequently, without shifts in consumption habits, there will be growing strain on limited assets over time. This is because livestock production relies on natural resources, exacerbating environmental degradation. Overgrazing not only diminishes species abundance but also results in considerable diversity loss within these ecosystems. Additionally, the degradation of grasslands can give rise to environmental issues like soil erosion, salinization, desertification, and wildfires. Nevertheless, grassland assets, being renewable, are crucial for preserving ecological stability and for upholding carbon equilibrium. To address these challenges, the report emphasizes the importance of soil stewardship in dry and semi-dry pastures. It suggests practices

like moderate grazing, rotational management, and incorporating legumes to improve soil fertility and livestock health, supporting land restoration in Uzbekistan.

Keywords: soil degradation, tragedy of the commons, sustainable land management, legume integration.

1. INTRODUCTION

Xenophon (2013) accentuate the significance of understanding soil properties for agricultural achievement, whereas FAO (2020) focus attention on the critical role of soil biodiversity in the global ecosystem. As per Wilsey (2018), around 40% of the planet surface is comprised of grasslands, encompassing approximately 70% of its agricultural land. Neal et al. (2020) present the concept that grassland ecosystems expand interactions among animals, plants, and microorganisms. Coban et al. (2022) point out that soil microorganisms are highly sensitive to environmental alternations, allowing them to quickly adjust to changes in ecosystems. This sensitivity underscores their importance as valuable indicators for assessing soil health. Hartmann and Six (2023) bring forward that earth bacterium are essential for facilitating nutrient exchange between vegetation and the topsoil, thus fostering the development of soil structures favorable for plant growth. Feltran-Barbieri and Féres (2021) imply that pasture deterioration often occurs due to factors such as excessive grazing, inadequate management of weeds and pests, and insufficient soil fertilization. Keesstra and colleagues (2019) state that a recent analysis of soil erosion in agricultural regions reveals degradation rates significantly surpassing soil formation rates by multiple orders of magnitude. Lodge and Tyler (2020) propose that livestock serve as substitutes, enriching native species diversity, and fostering the growth of forage plants. Bardgett et al. (2021) analyze that intensive livestock practices represent a major contributor to desertification worldwide. Liu et al. (2022) suggest that the geographical environment and severe climatic conditions present substantial obstacles to the recovery of sandy lands following grassland desertification.

Evans et al. (2020) assert that soil erosion poses a substantial risk to global soil health, consequently endangering food provision supplies for the expanding global population. Poesen (2018) emphasizes that soil constitutes a delicate environment, prone to deterioration under unfavorable physical, topographic, climatic, or human-induced conditions. Chowdhuri et al. (2021) underscore that soil erosion, stemming from these aspects, results in the depletion of fertile soil and a decline in agricultural output. Shahriary et al. (2021) attentively observed that overgrazing is diminishing in certain developed areas, whereas it has become prevalent in Asia. Zhang et al. (2018) make clear that due to extensive growth in animal husbandry, grassland ecosystems in Central Asia have undergone significant deterioration over the last three centuries, encompassing overall productivity of once abundant pastures. Mirzaev et al. (2019) noted that Uzbekistan is predominantly characterized by desert and semi-desert landscapes, covering more than 85% of its territory. Covering approximately 23 million hectares, the pastures represent half of the total land area, yet they have undergone notable degradation in the last 15-20 years due to imbalanced cattle farming practices. Yeneayehu and Wang (2020) give the idea that while overgrazing has led to a decline in forage availability, implementing careful rotational methods has shown significant overall improvements. Sheoran et al. (2021) draw attention to the value of legume crops in arid regions, thriving because of their capacity for nitrogen fixation, ability to tolerate drought, lower water requirements, and soil recovery, thereby addressing concerns associated with overgrazing and assisting rotational management.

3. LITERATURE REVIEW

Public ownership implies no private ownership. Hardin (1968), a prominent biologist, argued that communal grazing systems create a scenario where each herder aims to maximize livestock count, but the costs of rangeland degradation from large herds are shared by the entire community. This lack of individual responsibility leads to the tragedy of the commons and, thus, Hardin strongly proposed privatizing commonly managed rangelands as a solution. At the same time, Đordevic et al. (2022) report that one of the primary challenges facing contemporary human civilization is ensuring survival, with food provision being of paramount importance. As such, attempts to decrease cattle numbers and production may not yield universal success. Vejchodská et al. (2022) focus attention on the fact that land scarcity is a significant concern both nationally and internationally, underscoring the importance of its efficient and sustainable management and distribution. Agricultural land transcends being merely a production factor but stands as a public asset vital for ensuring national food security, characterized by non-exclusivity. Dixon (2021) bring out the fundamental role of land in social and commercial interactions, with Rahimzadeh (2018) noting widespread support for agricultural land reforms across many nations, driven by the understanding that securing land tenancy status outweighs other forms of land rights arrangements. Bilotto et al. (2021) are convinced that carefully organized pastures contribute economical fodder solutions for cattle while effectively reducing carbon footprints on grazing lands, a notion supported by Pierre et al. (2023) who emphasize farmers' recognition of the significance of integrating legumes into forage systems. Jimoh et al. (2020) state that in recent times, the productivity of natural grasslands has proven inadequate for meeting the needs of livestock, leading to increased reliance on purchasing forage as a vital strategy for promoting sustainable growth of animal husbandry. Podebradská et al. (2022) suggest that achieving high-quality forage production necessitates a blend of expertise, methods, and tactics concerning soil, pasture management, silage varieties selection, recognizing their interconnectedness to ensure robust feed production and farm proceeds. Genes and Dirzo (2022) put forward that there is a lack of comprehensive understanding regarding the restoration of diverse and functional ecosystems following exposure to various stressors, despite the critical role this knowledge plays in ecological reclamation efforts. Liu et al. (2021) point out that effectively managing grasslands involves a continuous monitoring of crucial sustainability metrics to prevent soil degradation and address future climate change, posing a particular challenge for land managers.

Maes et al. (2020) suggest that the sustainable management of grasslands has gained prominence globally and is now a key aspect in advancing the UN SDGs. Fritz and Ramirez (2021) underline that climate change is a global concern. Karlsson et al. (2022) emphasize the crucial role of grasslands, which are essential for various ecosystem functions and provide critical services such as regulating water flow and mitigating environmental impacts, despite often being overlooked or underestimated. Zhou et al. (2023) note that degradation primarily manifests as a decline in vital ecological attributes, such as biodiversity, productivity, soil organic matter, alongside reduced provision of ecosystem services like forage yield. Harrison et al. (2021) suggest that population growth, dietary preferences, rising incomes, climate change, and urbanization are driving up the demand for livestock products, thereby intensifying pressure on agricultural landscapes. Moreover, in the absence of land use alterations, the livestock sector stands out as being the primary source of carbon pollution in agriculture. Giller et al. (2021) notice a recent growing interest in rotational management, whereas Aronson et al. (2020) emphasize global efforts to reintroduce traditional practices such as grazing for preservation or reclamation, which provide advantages to rural population. Olander et al. (2021) observe a rising trend among ecosystem managers to balance diverse ecosystem services across landscapes for different stakeholder groups. Chabert and Sarthou (2020) propose that discovering management solutions involves understanding how different actions impact ecosystem functioning and subsequent service supply. Song et al. (2020) propose restoring natural vegetation by excluding grazers as a

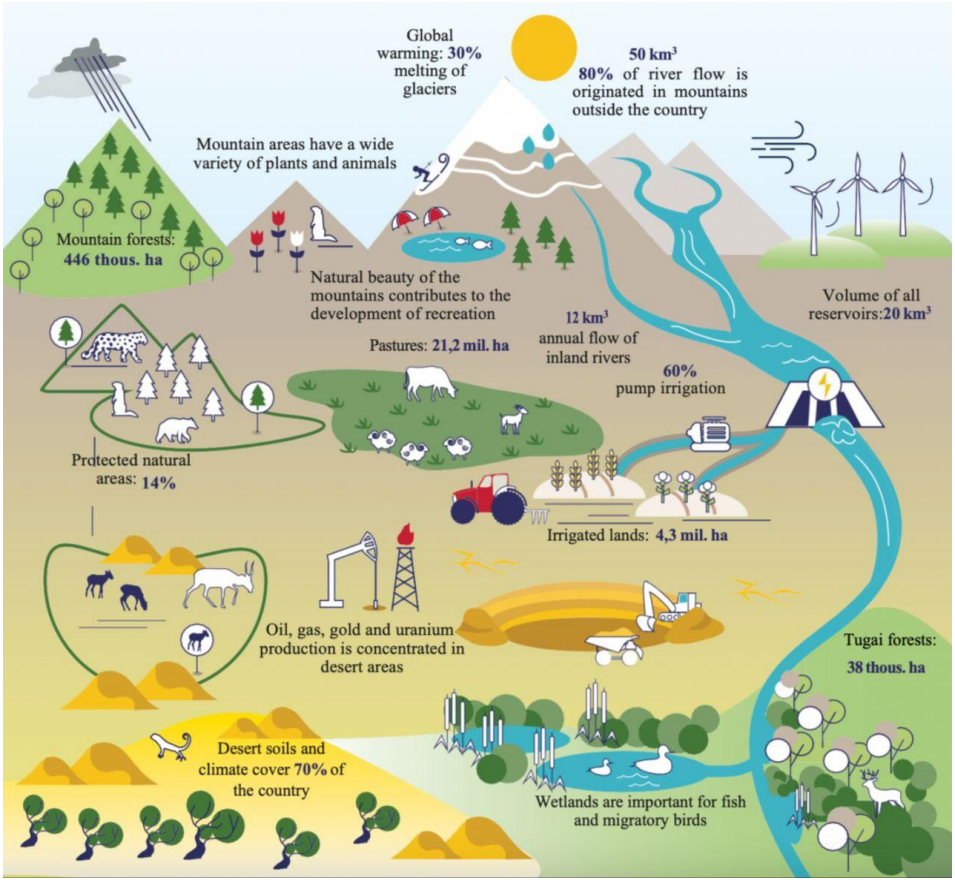
direct method to improve degraded rangeland conditions, yet Lewis et al. (2019) argue that while this approach may enhance water quality, it does not consistently address conflicts over ecosystem services for all stakeholders. Rieb and Bennett (2020) propose an alternative strategy for balancing trade-offs by adjusting local-scale management practices to ensure that actions aimed at enhancing one ecosystem service do not compromise the provision of another. Swanson et al. (2015) accentuate rotational grazing as an example of such a practice, providing managers with the flexibility to determine the duration of cattle presence on rangelands and the seasons during which they graze. Souther et al. (2020) propose that strategic rotation provides advantages to ecosystems by stabilizing the grassland community and bolstering its resilience against interference. Ma et al. (2019) assert that enhancing nutrient accessibility, such as through controlled grazing or soil enhancements, stimulates plant development, thereby augmenting carbon absorption.

Medina Hidalgo et al. (2022) accentuate the importance of livestock production in food and socioecological systems. Galanakis (2023) outlines the significant challenges confronting the global food environment, including population growth, climate change, geopolitical conflicts and pandemics, and food supplies. Kim et al. (2019) maintain that in a cereal market with insufficient supply for both animals and humans, disparities in purchasing power are likely to extend intensive livestock farming practices. Komarek et al. (2021) project a 14% rise in per capita global demand for red meat protein and a total increase of 38% by 2050 if income and population trends maintain a moderate trajectory. Campbell et al. (2017) argue that there is a broad consensus on the necessity for transformation in national food systems to mitigate their significant environmental impacts, such as methane emissions from livestock and N_2O emissions from fertilizer application in crop cultivation. Wezel et al. (2021) call attention to the increasing focus on grazing management, which is perceived as a response to present-day obstacles, serving to preserve grasslands. Schmitt et al. (2021) additionally argue that it can improve livestock production. Kremen and Merenlender (2018) stress the crucial role of equilibrium to advance landscape multifunctionality, safeguarding the sustainability of pastures. Teague and Kreuter (2020) of the view that integrating pastures into diverse cropping systems, with prolonged periods of land rest, could enhance grazing management practices. Li et al. (2021) demonstrate that intercropping could offer solutions to several significant challenges in modern agriculture, thus promoting the achievement of productive, efficient, and sustainable agricultural practices. Bansal et al. (2022) present that crop-livestock systems operate on a reciprocal exchange principle: crops provide feed for livestock, and in turn, livestock farms contribute manure for plant fertilization. This interplay forms a conversion cycle between the crop and livestock sectors, promoting internal resource recycling within the system. Cummins et al. (2021) have proposed that recent research suggests advantages in herbage production and ecosystem service provision by integrating plants from various functional groups like grasses and legumes. Calles et al. (2019) state that beans are recognized as a valuable addition to cereal-based cropping systems, contributing to food security by providing affordable sources of protein, minerals, and vitamins. Gajender et al. (2021) suggest that embracing an integrated farming system represents an effective method for managing resources. This approach entails carefully blending different elements to boost productivity on small-scale farms, ensuring that each component complements with the others.

4. DISCUSSIONS

Boon et al. (2022) emphasize the expanding body of research dedicated to meeting the urgent need for adapting to climate change. Spiller et al. (2022) note a growing decline in public acceptance towards intensive livestock production. Liao et al. (2020) stress the importance of transitioning grassland systems for sustainability in global dryland regions, while Zhu et al. (2020) put forward the resource constraints and diminished ecological services in the temperate grasslands of Central Asia. Campos et al. (2018) note that in this region, land use is predominantly dominated by rangeland-based livestock production, along with crop cultivation.

At the same time, Burrell et al. (2020) argue that the worsening of soil conditions, combined with overgrazing, heightens the vulnerability of these ecosystems to degradation. Oripov and Davlatov (2018) observed that during disintegration of international system of socialism, numerous countries experienced a decline in cattle numbers, contrasting with Uzbekistan, where the livestock numbers remained stable and even increased. Naumov and Pugach (2019) noted a considerable increase in cattle numbers (2.3-fold) between 1992 and 2017, alongside a 73% reduction in fodder crop acreage and a notable decline in pastures managed by agricultural producers during the same period. Currently, livestock constitutes 31% of the total gross agricultural output, underscoring its vital role in generating rural revenues. As reported by the Ministry of Ecology, Environmental Protection, and Climate Change of Uzbekistan (2023), the nation covers an expanse of 44.9 million hectares, of which 26.2 million hectares (58%) are allocated for agricultural activities. However, despite having 21.2 million hectares of pastures, desertification primarily arises from livestock overgrazing, leading to the degradation of 70% of these pastures. Bardgett et al. (2021) adds that various factors, including land relinquishment, contribute to a wide range of challenges. Jacobs and Street (2020) encourage that difficulties might still be surmountable through knowledge-sharing and partnership networks, serving as mechanisms to connect different stakeholders, policies, and implementation efforts. Molnár et al. (2020) emphasize the considerable significance of comprehending the shifts in herders' modern perspectives and attitudes, among other considerations, to effectively address the changes.



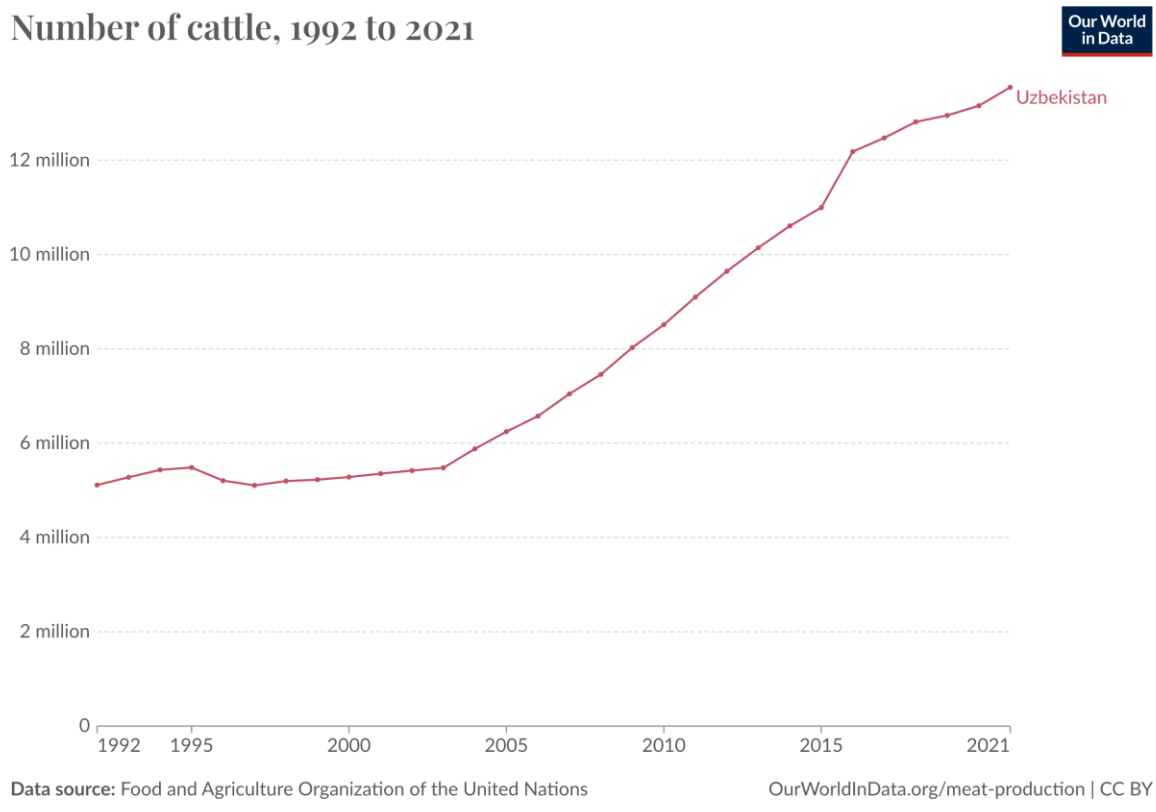
Picture 1. Nature of Uzbekistan in figures and facts

Source: Ministry of Ecology, Environmental Protection, and Climate Change of Uzbekistan (2023)

https://zoinet.org/wp-content/uploads/2024/01/UZB-eco-report-2023-RU-web.pdf

Losapio et al. (2024) suggest that overgrazing in public pastures leads to reduced biodiversity and productivity. On the other hand, Stampa et al. (2020) indicate that there is a growing demand for the sustainable management of pasture-based production, driven by consumer preferences for

natural and healthier food options. Qian et al. (2019) carry on with the argument that recognizing and adopting efficient land use practices are recognized as essential approaches to enhance land productivity and improve farmers' economic status from poverty. According to Naumov and Pugach (2019), a notable aspect of the livestock sector is that the majority of livestock products originate from small-scale family producers in rural regions, with an average landholding size of 0.35 hectares in rainfed areas and 0.04–0.08 hectares in irrigated regions. These producers contribute to over 90% of meat and milk production, owning more than 11.5 million head of cattle, representing 94% of the total population, 16 million head or 83% of sheep and goats, 85% of horses. It is noteworthy that "small-scale farms operate with enhanced transparency and are capable of crafting premium-quality, organic products that overcome the conventional supply chains overseen by major enterprises" (Arnalte-Mur et al., 2020). However, as per Naumov and Pugach (2019), absence of private land ownership and restrictions on subleasing hinder the development of market mechanisms for redistributing land between owners and users. Consequently, land users encounter challenges in adjusting their land holdings' size as needed, making it difficult to acquire additional land for expansion. Moreover, as all land in Uzbekistan is state-owned and centrally distributed, there is no land market, thereby limiting the growth opportunities for successful small-scale livestock farms. Zorya et al. (2019) put forward that the welfare of rural households relies not just on land and herd size but also on livestock quality and access to productivity-boosting technologies, particularly feed and adequate veterinary services. Hardin (1968) add on that addressing these pressing challenges requires more than technical solutions but necessitates outright privatization of communal pastures.



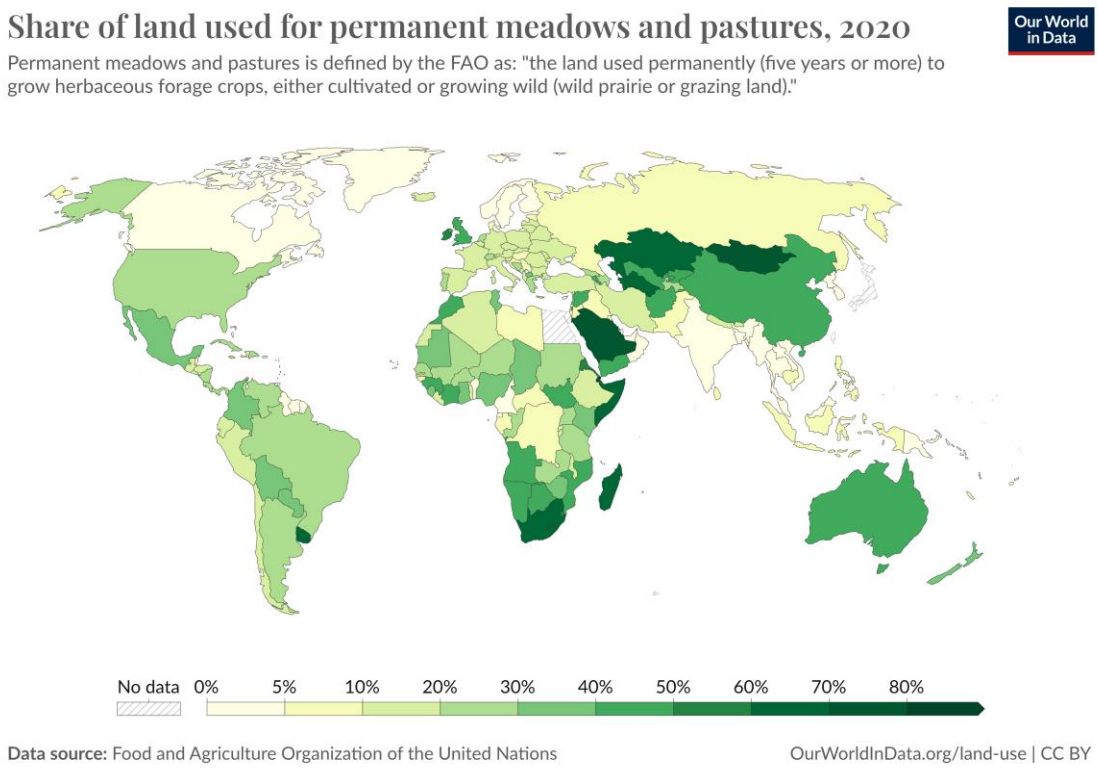
Picture 2. Number of cattle, 1992 to 2021

Source: Food and Agriculture Organization of the United Nations

https://ourworldindata.org/grapher/cattle-livestock-count-heads?tab=chart&country=UZB

Capstaff and Miller (2018) argue for the need to strengthen agricultural resilience and ensure economic stability by cultivating forage that can thrive in arid conditions while providing high quality fodder. Lal et al. (2022) underline the abundance of legumes in rangelands and their

utilization of resources like light, water, photoassimilates, and nutrients. Ergon et al. (2018) suggest that they thrive without human intervention, possessing traits that facilitate survival in challenging environments, making them vital for preserving native species and reducing land degradation. Stević et al. (2020) propose that compared to biomass from other plant families, Leguminosae decompose faster, resulting in nitrogen enrichment for subsequent crops. Hall et al. (2020) underscore the multitude of benefits rangeland forage crops offer compared to cultivated counterparts, showcasing their abilities in vegetative propagation, regrowth potential, stress tolerance, nutrient remobilization efficiency, biomass conversion, and enhanced efficiency in water, nutrient, and energy utilization. Tessema and Feleke (2018) emphasize the higher protein content in legume forages compared to carbohydrate-rich cereals, advocating for the integration of both types of crops in livestock feed to ensure comprehensive nutrition essential for supporting livestock productivity. Jensen et al. (2020) advance that integrating intercrops into cereal systems could reduce nitrogen fertilizer application by 25% and preserve land resources. Rau et al. (2023) assert that Medicago sativa L., a significant legume crop in Uzbekistan with a rich history of application, can enhance soil fertility and physicochemical properties through cultivation, thereby promoting a symbiotic relationship between application and conservation initiatives. Gillespie and Volaire (2017) state that extensive root system enables lucerne to access water sources inaccessible to numerous other crops, enhancing its resilience in arid environments. Clark et al. (2019) explain that transitioning to plant based protein agroecosystems would lead to enhanced natural resources management due to their significantly reduced resource and energy requirements. Domiciano et al. (2020) additionally observe that integration of livestock incorporating forage and crop-based components, along with arboriculture, has emerged as an approach, promoting the development of more environmentally friendly approaches.



Picture 3. Share of land used for permanent meadows and pastures, 2020

Source: Food and Agriculture Organization of the United Nations

https://ourworldindata.org/grapher/area-meadows-and-pastures

5. CONCLUSIONS

The report presents a comprehensive analysis of the challenges facing national pastures and offers practical solutions to mitigate overgrazing and land degradation. The study emphasizes the critical importance of rational land management in dry and semi-dry rangelands, underlining the need for moderate foraging intensity alongside potential of rotational management and legume integration to restore degraded lands. It discusses the challenges faced by livestock sector, including land ownership issues and the lack of market mechanisms for land redistribution. The integration of legumes into rangeland systems, as suggested by various studies, offers promising opportunities to enhance soil fertility, reduce application of nitrogen fertilizers, and improve cattle conditions. By implementing these strategies, Uzbekistan can reclaim degraded lands, improve livestock productivity, and safeguard the long-duration sustainability of rangeland biodiversity.

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