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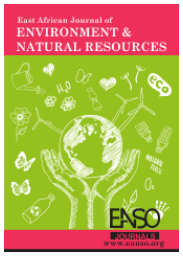

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Original Article

A Relative Importance Index Analysis of Drivers of Land Degradation in Agro-pastoral Systems in Mbulu District, Tanzania

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ABSTRACT

Growing concern over land degradation impacts everyone via food security, rising food costs, climate change, environmental threats, and loss of biodiversity. Land degradation harms food production, livelihoods, and the ecosystem. This study aimed at examining the drivers of land degradation in semiarid Agro-pastoral systems in semiarid areas of Tanzania by classifying land conservation practices adopted by the community in efforts to ensure land restoration within the selected district using a relative importance index approach. The study selected the Mbulu district as a study area and sampled 178 agro-pastoralists. A semi-structured questionnaire was used for data collection. The data collected were analysed using a Relative Importance Index to classify the most important criteria based on the participants' responses. Results show that the severity of the factors causing land degradation ranges from 66.97% to 70.90%: Cutting trees for building purposes (70.9%), overgrazing (70.79%), a lack of a land use plan (69.21%), charcoal burning (66.97%), agricultural practices including poor farming methods (66.97%), and land ownership and tenure system (57.98%). The study identified that 90% of agro-pastoralists do not use any land conservation practices, while less than 10% use the practices. The study concludes that the five dimensions identified have a considerable effect on land degradation. However, nearly 90% of sampled households did not use land conservation methods. Thus, the study recommended that stakeholders should increase efforts to reduce the severity of land degradation by engaging the local communities with frequent training and extension services and involving the community in protecting and managing their environment. Policymakers and conservationists should develop programs that will engage the community and put sustainable land management practices into action. Moreover, community development experts should be involved in the whole process of sustainable land management since they know how to engage the community through principles of community development.

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INTRODUCTION

Land is a valuable resource for humanity, comparable to air and water. Nonetheless, unsustainable exploitation of this resource generates land degradation. Land degradation is the outcome of human actions that exploit land, resulting in losses in its utility, biodiversity, soil fertility, and general health (Ziadat et al., 2021; Nkonya et al., 2016). Olsson et al. (2019a) in the Intergovernmental Panel on Climate Change (IPCC) special report on climate change and land, define land degradation as a negative trend in a land condition caused directly or indirectly by human-induced processes, including anthropogenic climate change, expressed as a long-term decrease or loss of at least one of the following: biological productivity, ecological integrity, or human value. Kiage (2013) also pointed out that land degradation is usually caused by the effects of climate, physical processes, and how the land is used. This suggests that land degradation is the outcome of various forces, including human actions that pollute or deteriorate soil quality and land utility. Universally, there are two categories of reasons for land degradation: direct and indirect. Human misuse of the land directly contributes to land degradation. Indirect causes of this include land tenure constraints, export-import policies, land politics, drought, poverty, inadequate counselling and extension services, and population pressures (Nkonya et al., 2011). Nevertheless, indirect causes, such as government policy and poverty, are commonly regarded as fundamental causes of the problem. This is the most critical environmental concern in the world, and it will worsen without rapid remedial action. Thus, countering it and implementing a sustainable management program require neutralising both types of causes.

Land degradation is a global problem that impacts everyone via food insecurity and rising food costs, climate change and environmental threats, and the loss of biodiversity as well as ecosystem services (Davies, 2016). It is estimated that about 20% of the world's vegetated surface has been degraded, impacting over 1.3 billion people and having a potential economic effect of up to $10.66 trillion (Zvoleff et al., 2020). It harms food production, livelihoods, and ecosystem goods and services. Also, it leads to the depletion of water sources, which forces populations to relocate to more habitable places. Generally, the impact of land degradation is experienced in two aspects: direct and indirect impacts. The former involves climate and land interactions in time and space, while the latter involves climate change consequences and land degradation separated in time and place (Tilauhun & Zewide, 2021). Land degradation threatens food production and rural lives, especially in developing countries (International

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Food Policy Research Institute [IFPRI], 2020). Nutrient depletion salinisation, pesticide contamination, soil erosion, vegetative degradation of rangelands, and agriculture-induced deforestation are major impacts. Unavoidably, land degradation has disproportionately negative effects on rural people, smallholder farmers, and the extremely poor.

Global, regional, national, and local organisations have developed numerous programs and efforts, particularly since the 1990s, and are still ongoing, to reduce the negative effects of land degradation. The outcome is the creation of policies, strategies, and projects to solve the problem. These include the Land Degradation Neutrality (LDN) idea, which was brought into the global conversation to encourage a more effective policy response to land degradation. It was also chosen as a target for Sustainable Development Goal 15, and the United Nations Convention to Combat Desertification (UNCCD) is building the capacity to reach the LDN's main goal. The UNCCD 2018–2030 Strategic Framework was made to help the world move toward LDN. Also, the Mediterranean Desertification and Land Use (MEDALUS) program was created in the European Union. Its goal was to understand, predict, and lessen the effects of desertification in Mediterranean countries.

In Tanzania, there are Frameworks and Guidelines on Land Policy, the Guidelines for Mainstreaming the National Action Programme to Combat Desertification into Sectoral Policies, Plans, and Programs; URT, (2007); URT, (1999); URT, (2002); and URT, (2010) and URT (2021) for improving environmental protection in Tanzania. All these instruments, among others recognise the importance of sustainable development and conservation efforts manifested in the growing role of ecological and environmental restoration.

A growing number of studies on the causes of land degradation offer a wealth of data recognising the significance stakeholders' actions. Natural causes such as seasonal rainfall variation and drought, as well as human activity, are examples of this (Zvoleff et al., 2020; Jiang et al., 2022). Furthermore, Belayneh and Tessema (2017) identified poverty as the primary driver of land degradation because the rural poor rely heavily on natural resources for subsistence, have limited access to capital fertilisers, and technology, and are therefore unable to engage in sustainable land management. Furthermore, the growing demand for charcoal in urban areas leads to forest and woodland loss. As a result, poverty forces communities to rely unsustainable on existing natural resources.

Soil erosion and drought are also associated with agro-pastoralism activities. The erosion problem is so severe because of historical interruptions to co-adapted agro-pastoral systems (Wynants et al., 2019). Soil erosion is intrinsically linked to overgrazing activities that occur in such systems. Overgrazing accelerates land degradation by causing soil erosion. Other causes of land degradation include; poor farming practices (Prager et al., 2011), climate change and natural disasters (Olsson et al., 2019b); excessive tree cutting and deforestation; bushfires; charcoal burning; a lack of land use plans and a land ownership and tenure system (Sklenicka, 2016; Olsson et al., 2019b). Additionally, Wynants et al. (2019) contend that this terrible problem is rooted in previous disruptions to co-adapted agro-pastoral systems.

However, the magnitude, rates, and impact of land degradation on people's livelihoods and environment vary across agro-ecological zones (URT, 2018; NBS, 2017). For instance, the most affected regions by land degradation are Manyara, Dodoma, Shinyanga, Simiyu, Singida, Arusha, Mwanza, Tabora, Mara, and Kilimanjaro (URT, 2022; CIAT & World Bank, 2016). This leads to small-scale farmers being more vulnerable in terms of food security, income, and livelihood in general. Therefore, this study aims at examining the drivers of land degradation in the agro-pastoral systems in the Mbulu district, Manyara region. Many studies have identified various drivers of land degradation, but there is a limited

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understanding of the severity of the drivers, which vary depending on the specific context. This study investigates the efforts taken by communities to reduce the severity of land degradation in the study area. This study provides an understanding of the severity of the drivers of land degradation which is critical for deploying effective actions to combat this crisis. It is critical for preserving livelihoods and creating resilience in the face of climate change's most devastating effects.

MATERIAL AND METHODS

The study was conducted in the Mbulu district, Manyara region, Tanzania. The district was chosen because it is comprised of arid and semi-arid regions. The indigenous people's practice of sedentary agro-pastoralism disrupts the natural balance of the environment, contributing to the district's susceptibility to land degradation (URT, 2018). The district is one of the five districts in the Manyara Region. It borders the districts of Karatu to the north, Babati to the east, Hanang to the south, and Iramba to the west. It is between three and four degrees south of the equator and between thirty-four and thirty-five degrees east of Greenwich. On the eastern portion of the Mbulu Highlands, the district's altitude spans from 1000 meters to 2400 meters (Mbulu District Council, 2007). In the Mbulu district, the temperature typically varies from *52 F* to *77 F* and is rarely below *48 F* or above *81 F while* Rainfall distribution varies from high precipitation to lower precipitation depending on the altitude of an area (Mung'ong'o & Jengo, 1991). Estimated rainfall is 700 mm/year on drier western slopes and 1500 mm/year on higher eastern slopes a marked mist effect at higher altitudes (Mbulu District Council, 2007).

The study utilised a cross-sectional design. The approach was chosen because it allowed researchers to compare diverse factors simultaneously. Similar to this study, characteristics such as age, gender, degree of education, marital status, harvested crops, animals, and economic activities were explored concerning land degradation drivers with minimal expense. The agro-pastoralists were the study's target population, whereas the sampling unit was a household. Thus, the study sampled 178 households using Yamane's (1977) formula. A multistage sampling technique was then employed to sample. In the first stage of a multistage sampling technique, Mbulu district was selected at random from the other five (5) districts in the Manyara region. In the second stage, four wards out of the 32 wards of the district were chosen as they were most impacted by land degradation and aridity. In the third stage, one village was randomly selected from each of the four selected wards using the random sampling technique. In the last stage, the study randomly sampled 178 households from the selected four villages proportionately (*Table 1*).

Table 1: Sample size distribution per ward

Ward	Village	Population	Sample
Bashay	Dirim	997	47
Silaloda	Qasirong	964	37
Masqaroda	Garbabi	776	46
Gunyoda	Gunyoda	982	48
Total		3719	178

Source: Survey data, 2020

The study used a household survey to collect quantitative data from households, whereby information concerning socio-demographic variables, types of land degradation, and their drivers were included in the questionnaire. The data were entered into the Statistical Package for the Social Sciences (SPSS) software to generate useful information for analysis.

Descriptive statistics (frequency and percentages) were used to analyse data on household

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characteristics, such as age, marital status, level of education, gender, and primary economic activity. Furthermore, the relative importance index was employed to analyse the land degradation drivers in the study area. The analysis was adopted because it allowed for the identification of the most important criteria based on the responses of participants and was also a suitable method for ranking indicators measured on Likert-type scales (Rooshdi et al., 2018). The Relative Importance Index of the drivers of land degradation was calculated using the below-specified function.

$$RII = \sum_{n}^{1} \frac{WS}{H \times N} \times 100\% \qquad [1]$$

Whereas: RII is the Relative Importance Index, WS is the weighting score assigned by each respondent on a scale from the lowest (1) to the highest score (5), H is the highest weight, and N is the total number of respondents in the study.

Based on the ranking (R) of relative indices (RI), the weighted average for the sample will be determined and ranked according to (Kassem et al., 2020) based on RII values: very high (VH) ($81\% \leq RII \leq 100\%$), high (H) ($61\% \leq RII \leq 80\%$), moderate (M) ($41\% \leq RII \leq 60\%$), low (L) ($21\% \leq RII \leq 40\%$), and very low (VL) ($0 \leq RII \leq 20\%$).

RESULTS AND DISCUSSION

Demographic Analysis

Table 1 presents demographic statistics correspondents' gender, age, marital status, level of education, and primary economic activity. Based on gender, there were more male respondents (n = 148, f = 83.15%) than female respondents (n = 30, f = 16.85%). In the age group, the majority of respondents were in the range of 46 and above years, accounting for 48.31% of the sample, followed by the 25-45 age group with 46.07% of the sample. The 16–24 age group accounted for only 5.62% of the sample. Concerning marital status, the majority of respondents were married (90.45%), followed by those who were not married (6.18%), widowed (2.25%), and separated or divorced (1.12%). The study also found that the majority of respondents have primary education (67.98%), while only a small proportion has attended secondary education (6.18%) and university/college (1.12%). A significant proportion (24.72%) of respondents did not attend school.

Table 2: Household characteristics in Mbulu District (n=178)

Variable	Categories	Frequency	Percentage
Age groups	16-24	10	5.62
	25-45	82	46.07
	46 and above	86	48.31
Gender	Male	148	83.15
	Female	30	16.85
Marital status	Married	161	90.45
	Not married	11	6.18
	Widow/Widowed	4	2.25
	Separated/divorced	2	1.12
Education level	Primary education	121	67.98
	Secondary education	11	6.18
	University/college	2	1.12
	Not attended school	44	24.72
Economic activities	Peasants	31	17.24
	Agro-pastoralist	143	80.34
	Employed in the formal sector	4	2.24

Source: Survey data, 2020

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Moreover, many respondents were engaged in agro-pastoralist activities (80.34%), followed by those engaged in peasants' activities (17.24%), and a small proportion (2.24%) were employed in the formal sector. Overall, the sample population appeared to be predominantly male, married, and engaged in agro-pastoral activities. Most respondents had only completed primary education, with a significant percentage having not attended school. The age distribution is skewed towards older respondents, with the majority being 46 years old or older.

Mean Values of Land Degradation Drivers

Age groups: *Table 2* shows that the 25–45 age group had the highest mean values for all six factors contributing to land degradation, suggesting that they are most inclined to believe that these variables cause land degradation. Nonetheless, 16–24-year-old drivers had the lowest mean values for all six drivers. This shows that younger people may be less aware of the drivers of land degradation and the associated environmental implications or may not have experienced them as much.

Table 3: Mean Values of Land degradation drivers

Variable	Categories	Mean WS on Likert Scale					
		D1	D2	D3	D4	D5	D6
	16-24	0.0376	0.0398	0.0398	0.0326	0.0376	0.0389
	25-45	0.3085	0.3261	0.3266	0.2671	0.3085	0.3188
Age groups	46 and above	0.3236	0.3420	0.3426	0.2801	0.3236	0.3344
	Male	0.5568	0.5886	0.5895	0.4821	0.5568	0.5755
Gender	Female	0.1129	0.1193	0.1195	0.0977	0.1129	0.1166
	Married	0.6057	0.6403	0.6413	0.5244	0.6057	0.6260
	Not married	0.0414	0.0437	0.0438	0.0358	0.0414	0.0428
	Widow/Widowed	0.0150	0.0159	0.0159	0.0130	0.0150	0.0156
Marital status	Separated/divorced	0.0075	0.0080	0.0080	0.0065	0.0075	0.0078
	Primary education	0.4552	0.4812	0.4820	0.3941	0.4552	0.4705
	Secondary education	0.0414	0.0437	0.0438	0.0358	0.0414	0.0428
	University/college	0.0075	0.0080	0.0080	0.0065	0.0075	0.0078
Education level	Not attended school	0.1655	0.1750	0.1753	0.1433	0.1655	0.1711
	Peasants	0.1166	0.1233	0.1235	0.1010	0.1166	0.1205
	Agro-pastoralist	0.5380	0.5687	0.5696	0.4658	0.5380	0.5560
Economic activities	Formally employed	0.0150	0.0159	0.0159	0.0130	0.0150	0.0156

Source: Survey data, 2020

Gender: According to *Table 3*, results from it show that Male drivers had higher mean values for all six drivers. Overgrazing, tree cutting, and charcoal burning may be more common among men. It might also indicate gender-related perceptual or awareness disparities.

Marital status: In *Table 3*, it is shown that Married people had the largest mean values for all six drivers, followed by widowed or separated/divorced people and never-married people. This may be due to differences in lifestyle, occupation, or environmental awareness.

Education level: *Table 3* depicts those respondents with merely a primary education had the highest mean values for all six drivers, followed by those with secondary or university/college education. This indicates that further education may be linked to improved awareness of drivers of land degradation with the associated impact.

Economic activities: In *Table 2*, it is evident that agro-pastoralists had the highest mean values for all six drivers, followed by peasants and formal sector workers. This shows that agriculture and

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pastoralism may be more directly tied to land degradation than others and that people in formal employment may have greater possibilities to adopt sustainable behaviour.

Generally, *Table 3* provides insights into how different demographic variables perceived the drivers of land degradation in the study area. The insights may help policymakers and environmental conservation and management stakeholders to develop interventions that address environmental challenges.

Relative Importance Index Analysis

Relative index analysis was used to rank the land degradation drivers according to their relative importance. *Table 4* shows the ranking results for each driver of land degradation using the relative index analysis in *Equation 1*. The six land degradation drivers examined in the study are identified by the IDs D1 to D6. The RII value for each driver represents its relative importance in causing land degradation, where higher values indicate a more significant impact in causing land degradation. The ranking column shows the order in which the drivers were ranked based on their RII values, with the highest-ranked driver being assigned a rank of 1 and the lowest-ranked driver having a rank of 6. The importance level column indicates the level of importance of each driver in causing land degradation, using the following categories: very high, high, moderate, low, and very low. From *Table 3*, the drivers with high levels are considered highly important, while those with moderate levels are considered moderately important in causing land degradation in the Mbulu district.

Table 4: The Ranking results, Relative Importance Index, and Importance level

ID	Land degradation drivers	RII value	Ranking	Importance Level
D1	Agricultural practices including poor farming methods	66.97	4	High
D2	Overgrazing	70.79	2	High
D3	Tree cutting for building purposes	70.90	1	High
D4	Land ownership/tenure system	57.98	6	Moderate
D5	Charcoal burning	66.97	5	High
D6	Lack of the land use plan	69.21	3	High

Source: Survey data, 2020

Based on these ranking results, five criteria were highlighted as having high importance levels in explaining land degradation drivers with RII values between 66.97% and 70.90%. The RII results show that the top five drivers that cause land degradation are cutting trees for building purposes (D3), overgrazing (D2), a lack of a land use plan (D6), charcoal burning (D5), and agricultural practices including poor farming methods (D1). The identification of these drivers is consistent with previous studies (Khan et al., 2021; Singh et al., 2021). They are often associated with the expansion of agriculture urbanisation, and deforestation, which are major factors contributing to land degradation globally (FAO, 2020). These drivers have RII values greater than 69, indicating that they are highly important in causing land degradation. The driver with the lowest RII value is land ownership or tenure (D4), indicating that it has the least impact on land degradation. This is because the majority of inhabitants in the study area do not settle at one point while performing economic activities.

Land Conservation Practices

Table 5 provides information on the community land conservation practices undertaken in the study area. The table shows the frequency and percentage of each conservation practice reported by the participants. According to *Table 4*, the most common response (90.44%) was that the community did not engage in any land conservation practices. Only a small fraction of

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respondents engaged in conservation practices such as tree planting (1.68%), terracing (4.5%), and mulching (1.68%). This can be attributed to several factors, such as the lack of extension services in their areas to guide them in land conservation practices. All the options for land conservation needed technical skills that were not available in the villages where the study was conducted. This highlights that the low level of adoption of land conservation practices can have negative impacts on the environment and the livelihoods of community members. This can ultimately dilute the efforts of stakeholders' involvement in ensuring food security, environmental protection, and economic well-being strategies.

Table 5: Community Land Conservation Practices

Parameter	Frequency	Percent (%)
None	161	90.44
Terracing	8	4.5
Tree planting	3	1.68
Mulching	3	1.68
Contour farming and tree planting	2	1.2
Contour farming and terracing	1	0.6
Total	**178**	**100**

Source: Survey data, 2020

Therefore, it is essential to develop strategies to encourage and promote land conservation practices in the area. The remaining responses were for combined practices, including contour farming and terracing (0.6%) and contour farming and tree planting (1.2%). Overall, the results suggest that there is a low level of engagement in land conservation practices among the community in the study area. These findings are in line with Savari et al. (2022), who argued that low levels of knowledge, extension services, and skills might limit the adoption of land conservation behaviours.

CONCLUSION AND RECOMMENDATION

This study examined land degradation drivers in semiarid agro-pastoralist systems in the Mbulu district, Tanzania. The data were analysed using the relative importance index method and descriptive statistics (frequency and percentage). The findings show that five dimensions (agricultural practices such as poor farming methods, overgrazing, tree cutting for building reasons, charcoal burning, and a lack of a land use plan) have a considerable effect on land degradation (between 66% and 71%). While one driver (land ownership or tenure systems) has a 57.98% moderate impact on land degradation, on the other side, nearly 90% of respondents did not use land conservation methods.

The results show that there is a clear need for providing frequent training and extension services about the impact of land degradation and how to get the community involved in protecting and managing the environment. This study gives policymakers and conservationists useful information on developing programs that can train the community about the benefits of land conservation and management on the technical skills needed to put the practices into action, and make sure that extension services are available to help the community put sustainable practices into action. Moreover, community development experts should be involved in the whole process since they know how to get the community involved in their issues. This can eventually contribute to the accomplishment of land degradation neutrality goals.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest associated with the publication of this paper. In addition, all ethical concerns, including plagiarism, mutual consent, misconduct, data manipulation and/or fabrication, duplicate

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publication and/or submission, and redundancy, have been managed by the authors.

Contributions of the Authors

PTS and PMS jointly developed the study, and PMS collected the data with significant input from PTS. The manuscript was designed by DU and BNN, who also analysed and interpreted the data. The first version of the manuscript was revised by PTS, DU, and BNN. All authors read and approved the final version of the manuscript.

REFERENCES

Belayneh, A., & Tessema, Z. K. (2017). Mechanisms of bush encroachment and its inter-connection with rangeland degradation in semiarid African ecosystems: a review. In Journal of Arid Land (Vol. 9, Issue 2, pp. 299–312). https://doi.org/10.1007/s40333-016-0023-x

CIAT & World Bank, (2016). Climate-Smart Agriculture in Tanzania. CSA Country Profiles for Africa Series. International Centre for Tropical Agriculture (CIAT); World Bank, Washington, D.C. 25 p.

Davies, J. I. (2016). Enabling Governance for Sustainable Land Management. *Elsevier eBooks*, 67–76. https://doi.org/10.1016/b978-0-12-801231-4.00006-9

FAO. (2020). Global Assessment of Soil Degradation. Food and Agriculture Organization of the United Nations.

International Food Policy Research Institute (IFPRI), '2020 Global food policy report: Building inclusive food system, International Food Policy Research Institute, Washington, DC, 2020

International Food Policy Research Institute. (2020). *Land degradation in the Developing World: Issues and Policy options for 2020*. (Policy Brief No. 44).

Jiang, L., Bao, A., Jiapaer, G., Liu, R., Yuan, Y., & Yu, T. (2022). Monitoring land degradation and assessing its drivers to support sustainable development goal 15.3 in Central Asia. *Science of the Total Environment*, *807*, 150868. https://doi.org/10.1016/j.scitotenv.2021.150868

Kassem, M. A., Khoiry, M. A., & Hamzah, N. (2020). Using Relative Importance Index Method for Developing Risk Map in Oil and Gas Construction Projects. *Jurnal Kejuruteraan*, *32*(3), 441–453. https://doi.org/10.17576/jkukm-2020-32(3)-09

Khan, M.A., Ahmad, S., Hussain, M., & Ullah, S. (2021). Drivers of land degradation in the mountainous regions of Pakistan: A case study of District Swat. Journal of Mountain Science, 18(1). 1-16.

Kiage, L. M. (2013). Perspectives on the assumed causes of land degradation in the rangelands of Sub-Saharan Africa. Progress in Physical Geography: Earth and Environment, 37(5), 664– 684. https://doi.org/10.1177/0309133313492543

Land, T. H. E., & Planning, U. S. E. (2007). the United Republic of Tanzania Act Supplement the Land Use Planning Act, 2007. 10.

Li, L., Zhang, X., & Liu, G. (2018). Impacts of land use change on soil erosion in the hilly region of China. A case study of Yanhe River basin Sustainability, 10(11), 4202.

Mbulu District Council (2007). Social Economic Profile in Mbulu District. Retrieved from MBULU DISTRICT COUNCIL (mbuludc.go.tz) (Accessed: February 28, 2023).

Mung'ong'o, C.G. and Jengo, R.D. (1991). Babati District in Perspective: An Annotated Bibliography of Environmental Reports written on the district up to 1990: For the Land Management Programme (LAMP), Babati, April 1991.

Article DOI: https://doi.org/10.37284/eajenr.6.1.1198

National Bureau of Statistics (NBS) [Tanzania] 2017. National Environment Statistics Report, 2017 (NESR, 2017), Dar es Salaam, Tanzania Mainland.

Nkonya E, Anderson, W., Kato, E Koo, J., Mirzabaev, A., Braun, J and Meyer, S. (2016) Global Cost of Land Degradation. In: Nkonya, E., Mirzabaev, A., von Braun, J. (eds) Economics of Land Degradation and Improvement – A Global Assessment for Sustainable Development. Springer, Cham. https://doi.org/10.1007/978-3-319-19168-36

Nkonya, E., Gerber, N., Baumgartner, P., von Braun, J., De Pinto, A., Graw, V., Kato, E., Kloos, J & Walter, T. (2011). The Economics of Desertification, Land Degradation, and Drought Toward an Integrated Global Assessment, ZEF- Discussion Papers on Development Policy No. 150, Center for Development Research, Bonn, May 2011, pp. 184.

Olsson, Å, Persson, L., & Olsson, S. (2019a). Influence of soil characteristics on yield response to lime in sugar beet. In Geoderma (Vol. 337, pp. 1208–1217). https://doi.org/10.1016/j.geoderma.2018.11.020

Olsson, L., Barbosa, H., Bhadwal, S., Cowie, A., Delusca, K., Flores-Renteria, D., ... & Stringer, L. (2019b). Land degradation: IPCC special report on climate change, desertification, land 5 degradation, sustainable land management, food security, and 6 greenhouse gas fluxes in terrestrial ecosystems. In *IPCC Special Report on Climate Change, Desertification, Land 5 Degradation, Sustainable Land Management, Food Security, and 6 Greenhouse Gas Fluxes in Terrestrial Ecosystems* (p. 1). Intergovernmental Panel on Climate Change (IPCC).

Prager, K., Schuler, J., Helming, K., Zander, P., Ratinger, T., & Hagedorn, K. (2011). Soil degradation, farming practices, institutions, and policy responses: An analytical framework. *Land Degradation & Development*, *22*(1), 32–46. https://doi.org/10.1002/ldr.979

Rooshdi, R. R. R. M., Majid, M. Z. A., Sahamir, S. R., & Ismail, N. A. (2018). Relative Importance Index of Sustainable Design and Construction Activities Criteria for Green Highway. *Chemical Engineering Transactions*, *63*, 151–156. https://doi.org/10.3303/cet1863026

Savari, M., Yazdanpanah, M., & Rouzaneh, D. (2022). Factors affecting the implementation of soil conservation practices among Iranian farmers. Scientific Reports, 12, 8396. https://doi.org/10.1038/s41598-022-12541-6

Singh, C., Iyer, S., New, M., Few, R., Kuchimanchi, B., Segnon, A. C., & Morchain, D. (2021). Interrogating 'effectiveness' in climate change adaptation: 11 guiding principles for adaptation research and practice. *Climate and Development*, *14*(7), 650– 664. https://doi.org/10.1080/17565529.2021.1964937

Singh, R., Srivastava, S., Dubey, S. K., & Srivastava, P. (2021) Prioritising the land degradation drivers in Jharkhand state of India: An AHP approach. Geoderma Regional, 24, e00438.

Sklenicka, P. (2016). Classification of farmland ownership fragmentation as a cause of land degradation: A review on typology, consequences, and remedies. *Land Use Policy*, *57*, 694–701. https://doi.org/10.1016/j.landusepol.2016.06.032

Tilauhun, E., & Zewide, I. (2021). Causes and Impacts of Land Degradation. *British Journal of Earth Sciences Research, Vol.9, No.2, pp.28-37. Print ISSN: 2397-7728*. https://doi.org/10.37745/bjesr.2013

Article DOI: https://doi.org/10.37284/eajenr.6.1.1198

URT, (1997). Tanzania National Environmental Policy. Dar-es-salaam: Vice President's Office.

URT, (2002). The Forest Act, 2002. 83(7). Retrieved from (https://www.tnrf.org/files/E-URT_LAWS_Forest_Act_2002_0.pdf (Accessed: February 27, 2023).

URT, (2007). The United Republic of Tanzania Act Supplement the Land Use Planning Act, 2007. 10. Retrieved from https://www.lands.go.tz/uploads/documents/en/1581494416- 8.%20The%20Land%20Use%20Planning%20Act,%20No.%206%20%202007.pdf (Accessed: February 27, 2023).

URT, (2010). The Mining Act, 2010. 14, 1–90. Retrieved from Retrieved from https://mem.go.tz/wp- content/uploads/2014/02/0013_11032013_Mining_Act_2010.pdf (Accessed: February 26, 2023)

URT, (2018). Land Degradation Neutrality Target Setting Programme Report; Vice President's Division of Environment; Retrieved from Tanzania LDN TSP Country Report.pdf (und. int) (Accessed: February 26, 2023)

URT, (2021). National Environmental Policy, 1–40. https://www.vpo.go.tz/uploads/publications/en- 1644923087- NATIONAL%20%20ENVIRONMENTAL%20POLICY%202021%20new.pdf (Accessed: February 26, 2023)

URT. (1999). The Village Land Act, 1999.

URT. (2002). The Forest Act, 2002. 83(7).

URT. (2010). The Mining Act, 2010. 14, 1–90. Retrieved from https://mem.go.tz/wp-content/uploads/2014/02/0013_11032013_Mining_Act_2010.pdf (Accessed: February 26, 2023).

URT. (2011). The Land Use Planning Act, 2007. 255, 1–16.

URT. (2021). National Environmental Policy, 1–40. Retrieved from https://www.vpo.go.tz/uploads/publications/en- 1644923087- NATIONAL%20%20ENVIRONMENTAL%20POLICY%202021%20new.pdf (Accessed: February 27, 2023).

Wynants, M., Kelly, C. M., Mtei, K., Munishi, L. K., Patrick, A., Rabinovich, A., Nasseri, M., Gilvear, D., Roberts, N., Boeckx, P., Wilson, G. A., Blake, W., & Ndakidemi, P. A. (2019). Drivers of increased soil erosion in East Africa's agro-pastoral systems: changing interactions between the social, economic and natural domains. *Regional Environmental Change*, *19*(7), 1909–1921. https://doi.org/10.1007/s10113-019-01520-9

Yamane, T, (1967). Statistics: An Introductory Analysis, 2nd Edition, New York: Harper and Row.

Ziadat F. M., Zdruli P., Christiansen S., Caon L., Monem A.M. &. Fetsi T. (2021). An Overview of Land Degradation and Sustainable Land Management in the Near East and North Africa, Sustainable Agriculture Research; 11(1): 11-24. https://doi.org/10.5539/sar.v11n1p11

Zvoleff, A., Noon, M., Daldegan, G., & Gonzalez-Roglich, M. (2020) Forging the path to achieving land degradation neutrality: Global patterns and drivers of land degradation at global scales. https://doi.org/10.5194/egusphere-egu2020-11497

