Using Gender-Land Rights to Increase Climate Resilience Among Smallholder Farmers in The Least Developed Countries (LDCS)

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Abstract

Land-driven climate change is worsening the food crisis and affecting the livelihoods of smallholder farmers in the Least Developed Countries (LDCs). Several studies have shown that changes in land conditions dampen effective climate change adaptation and deepen poor land management. Therefore, increasing the vulnerability and susceptibility of smallholders and their farmlands to climate change, respectively. Women whose access to land rights are limited by customary laws influenced by gender norms are disproportionately affected and adapt blindly. However, studies on how access to gender land rights enables smallholder farmers to cope with climate change remain inadequate. In this study, I looked at the use of gender land rights to increase climate resilience. I adopted a quantitative design and retrieved data from the Food and Agricultural Organization (FAO) dataset of the World Agricultural Census (WAC). I used descriptive statistics for data analysis and presented in tables, graphs, and charts. I found that gender norms that drive institutions and entitlements limit women's access to land rights. As temperature changes increase over land, women who are at the intersection between gender and climate change receive additional stressors. I concluded that women's adequate access to land rights is a critical factor in building climate resilience.

Keywords: Gender; Land Rights; Climate Change; Climate Resilience; Smallholder Farmers.

1. Introduction

Gender inequalities in smallholder-based land rights are emerging because of the worsening threats of climate change on food security. Relevant stakeholders have held several discourses on gender and environment as a catalyst for food security. They have achieved some multilateral agreements on this catalytic approach [1,2]. Therefore, it is no longer groundbreaking that gender inequalities and climate change are altering smallholder-based land conditions and use, therefore posing a food crisis globally. Built around the Intergovernmental Panel on Climate Change (IPCC) summary for policy-makers that climate change has reached above a preindustrial level with increasing impact. A statement that coherently merges with several studies that climate change will hit harder on the marginalized groups [3]. Trends in smallholder-based agro-climatic variables have pointed to these facts in the Least Developed Countries (LDCs). Thus, putting most LDCs at the center of debates on the nexus between gender and sustainable climate development. The Food and Agricultural Organization (FAO) attributed the gender inequalities existing in smallholder-based agriculture to temperature change and decrease in agricultural lands across a time scale. Failure to address these challenges has increased temperature change from 0.5^{o}c in 1984 to nearly 1.5^{O}c in 2021 in the LDCs. These are experienced in both crop and irrigation land areas managed by smallholder farmers [4,5].

Climate change has degraded nearly half of the smallholder-based land area in most LDCs. This has underlined failures to scale up its ambitions for gender and environment justice drew from several

international treaties and conventions [3]. Although the longstanding food crisis in the LDCs has shifted the attention of international communities to the human-environment couple system. However, efforts to achieve its gender eco-development component agriculturally have faced diverse challenges in program design and implementation [6]. Besides this, there is also stagnation of policies and strategies required to transit to climate-smart agriculture (CSA). In countries where relevant policies and strategies were developed, there were failures to transform these policies and strategies into action. According to FAO, there are approximately over 4.7 billion hectares of agricultural land area worldwide, which include cropland and those equipped for irrigation. Yet, most smallholder farmers, especially women, faced difficulties and limitations in access to land rights. This is peculiar to all LDCs who did not lack available agricultural lands, but socioeconomic problems in its distribution and use [6,7]. Failure to recognize the potentials and contributions of women smallholders might also be self-evident. Many studies have shown that land remains a key asset-based resource, which is critically enhancing the adaptive capacity of smallholders to build climate resilience. Despite women consists more than half of smallholders in the LDCs, they do not have equal land rights as men. Land rights, viz., the ownership, control and use of smallholder-based lands, offer opportunities for climate change adaptation [7]. This is pertinent in that gender land rights are at the center of concern for climate resilience.

The legally recognized documentation and perceived land security are the two indicators for measuring men's and women's rights to land. Although the legal recognized documentation which are land title and certificates of smallholder-based lands are rarely identified in most LDCs [8,9]. Thus, an inference on the gender disaggregation of land rights by legal documentation cannot be drawn. However, perceived land rights which are based on lack or inadequate access or systematic or coerced bequeath of lands are evidence in the LDCs. Perceived smallholder land rights are intermittently acquired by customary laws co-founded by gender norms [10]. This is also inextricable to climate vulnerabilities and resilience. The customary laws are often gender discriminatory, typically against women in most LDCs. Envisioned by the agricultural census data by FAO, women in the LDCs do not have up to 30% of land rights [9]. Both unequal gender land rights and the disproportionate impact of climate change are metaphorical that women bear the brunt. Some reasons for the gender gaps existing in land rights in the LDCs lie in the long patriarchal history of smallholder-based societies. In most of these societies, women only had secondary access to lands. They did this through man's relatives (husbands or sons) [11]. In few cases where women have acquired access to land, maybe in the event of her husband's demise. Such lands are controlled by her husband's relatives until her son(s) grow up to inherit them. Where the woman chooses to remarry, she loses complete access to the land. Even where they hold secondary access to land, they are rarely allowed to decide and create adaption strategies to combat climate change. Despite that, women have more access to indigenous climate knowledge and information than men. According to the IPCC, indigenous climate knowledge and information is key to climate science [3]. However, adaptation measures and strategies are often masculinized in the LDCs.

Several gender and agricultural scholarships have demonstrated the impact of climate change on women smallholders to a varying degree of acceptance globally. They have also established significant standpoints on the potentials of women and their contributions to CSA [11]. However, studies on the praxis of opportunities available to men and women with access to land rights to increase climate resilience have remained inadequate. This study examined the use of gender land rights to increase climate resilience among smallholders in the LDCs. Charting a climate resilient smallholder-based agriculture requires closing the gender gaps in land rights. A wide-reaching study in men's and women's access to land rights are necessary to coherently overlap the nexus between gender land rights and climate resilience [12]. Since land rights involve two complementary indicators, and these include legal land documentation and perception of land security. There is no substantial data on legal smallholder-based land documentation to measure gender land rights in the LDCs. However, men and women perceive smallholder-based land security differently. This perceived land rights tracks how men and women experience the systems that afford them access to land rights [10].

2. Materials and Methods

This study adopted a quantitative method design to examine the opportunities for increasing climate resilience in the LDCs using gender land rights. According to the United Nations (UN), the LDCs comprise 46 countries with over 880 million people, making up 12% of the world's population. Despite their population status, the LDCs account for less than 2% of the world's gross domestic products (GDP). Climate change disproportionately affected them because of their socio-demographic characteristics. I selected only 14 out of the 46 countries as characterized by the UN to represent the LDCs as an entity or specific group. These countries include Bangladesh, Gambia, Haiti, Lao, Lesotho, Mozambique, Nepal, Niger, Senegal, Togo, Uganda, and Tanzania, and Vanuatu. It used a cluster purposive sampling technique to select these countries. These countries were selected on the basis of their data uniformity across variables and timescales.

This study used mainly secondary quantitative data. I collected the data from the World Agricultural Census (WAC) for 2000 and 2010 from the FAOSTAT dataset. Although the data for each of the countries under study was independent of each other. However, they had significant similarities throughout the procedures of data collection, storage, and management. Thus, was indeed relevant for this study. I used mainly secondary data for this study. This study analyzed its data using descriptive statistics, and I presented the data in table, graph and charts.

3. Results

3.1. Impact of climate change over unequal gender land rights

1. Observed changes in agricultural land

Figure 1 below showed the observed changes in agricultural land in some LDCs. In 2010, total agricultural land in the LDC was over 800,000 ha, this is over 17% of the global agricultural land. There was an increase in the agricultural land increased by over 70,000 ha in a decade (2000 to 2010). Crop lands and lands equipped for irrigation increased by over 50,000 ha and 3,000 ha from 2000 to 2010, respectively. The table 1 below showed the observed changes in agricultural land in 14 LDCs. While Niger had the largest agricultural land area in all census years (37000 in 2000 and 43982 in 2010*).* Vanuatu had the smallest land area in all census years (175 in 2000 and 187 in 2010). They observed the highest increase in land area in Niger, with about 6982, while Gambia experienced the lowest increase with about 119. Decrease were observed in Bangladesh, Lesotho and Nepal from 9400, 2334, and 4249 to 9241, 2325, and 4126, respectively. I observed the highest decrease in Bangladesh with about 159, and I observed the lowest decrease in Lesotho with 9.

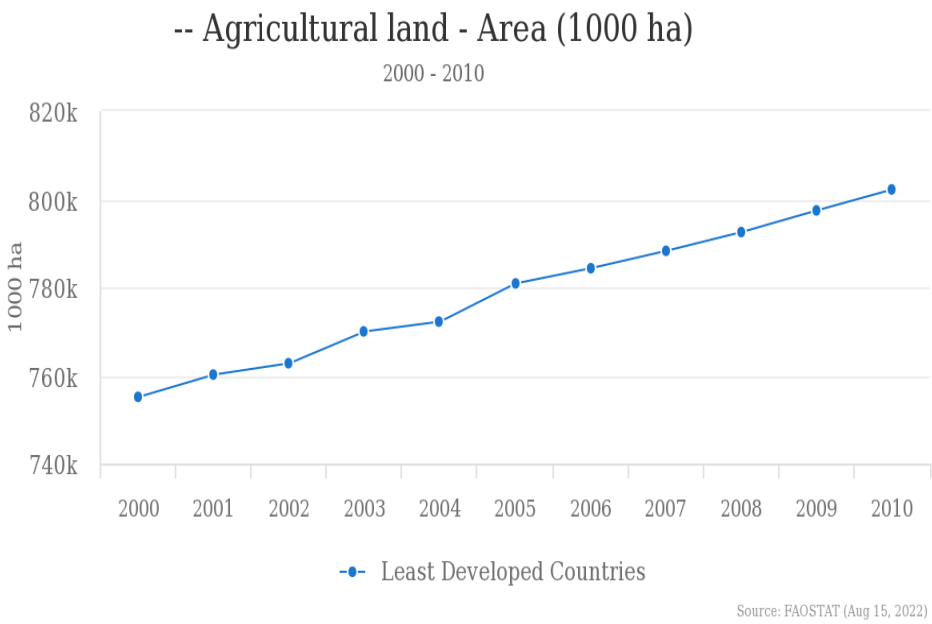


Figure 1: Observed changes in agricultural land area. Source; FAOSTAT, 2022

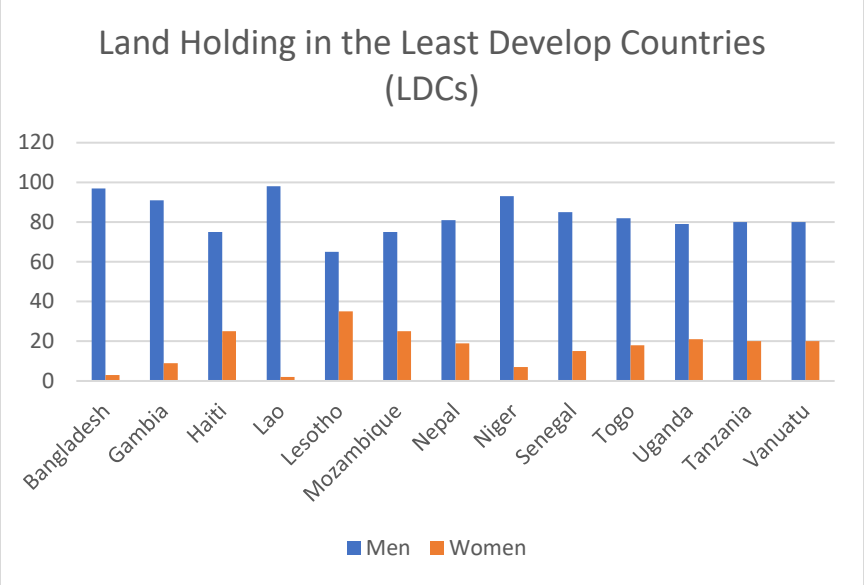
Table 1: Changes in land area in 2000 and 2010

Countries	**2000**	**2010**
Bangladesh	9400	9241
Gambia	552	615
Haiti	1690	1870
Lao	1806	2220
Lesotho	2334	2326
Mozambique	37450	39666
Nepal	4249	4126
Niger	37000	43982
Senegal	9027	9458
Uganda	12512	14265
Tanzania	34000	37399
Vanuatu	175	187

Source; FAOSTAT, 2022

2. *Gender dynamics in agricultural land rights*

Figure 2 below has indicated that women held less than 30% of lands in the 2000 and 2010 agricultural census year. In 2010, there were approximately 3%, 9%, 25%, 2%, 35%, 25%, 19%, 7%, 15%, 18%, 21%, 20% and 20% of women land holders in Bangladesh, Gambia, Haiti, Lao, Lesotho, Mozambique, Nepal, Niger, Senegal, Togo, Uganda, Tanzania, and Vanuatu, respectively. While their men counterparts held 97%, 91%, 75%, 98%, 65%, 75%, 81%, 93%, 85%, 82%, 79%, 80% and 80%, respectively.



Figue 2: Land holding by gender Source; FAOSTAT, 2022

3. Observed temperature changes over lands

Figure 3 below has indicated changes in the mean temperature over land. In 2010, the temperature over land observed in Bangladesh, Gambia, Haiti, Lao, Lesotho, Mozambique, Nepal, Niger, Senegal, Togo, Uganda, Tanzania, and Vanuatu, were 0.849°c, 1.377 °c, 1.277 °c, 1.405 °c, 1.205 °c, 0.871 °c, 1.214 °c, 1.754 °c, 1.418 °c, 1.304 °c, 1.006 °c, and 0.832 °c, respectively. While in 2000, 0.209°c, 1.09°c, 0.919°c, 0.102°c, 0.314°c, 0.351°c, 0.045°c, 0.879 °c, 0.956 °c, 0.345 °c, 0.571 °c, and 0.53 were experienced over land in each of these countries, respectively. There were no observed changes in the decrease of temperature over land in any of these countries. They observed the highest change in increase in temperature over land in Lao at approximately 1.303 °c. They observed the lowest change in increase in temperature over land in Vanuatu at approximately 0.302 °c.

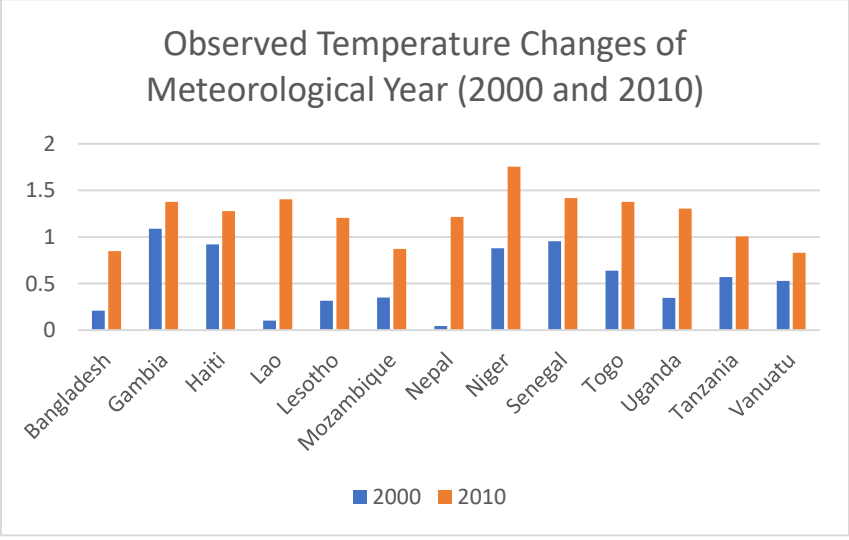


Figure 3: Observed temperature changes. Source; FAOSTAT, 2022

3.2. Gender land rights-driven climate resilient pathways

3.2.1. Gender perceived climate insecurity

Results from this study showed that climate change is increasing the prevalence of food insecurity in most LDCs. Figure 4 below showed aprroximately 265857.4 population is facing severe food insecurity in 2022 at 24.6% prevalence rate compared to previous years. More women (87692.3) are facing severe food insecurity at 26% prevalence rate than men (81579.3) at 25% prevalence rate.

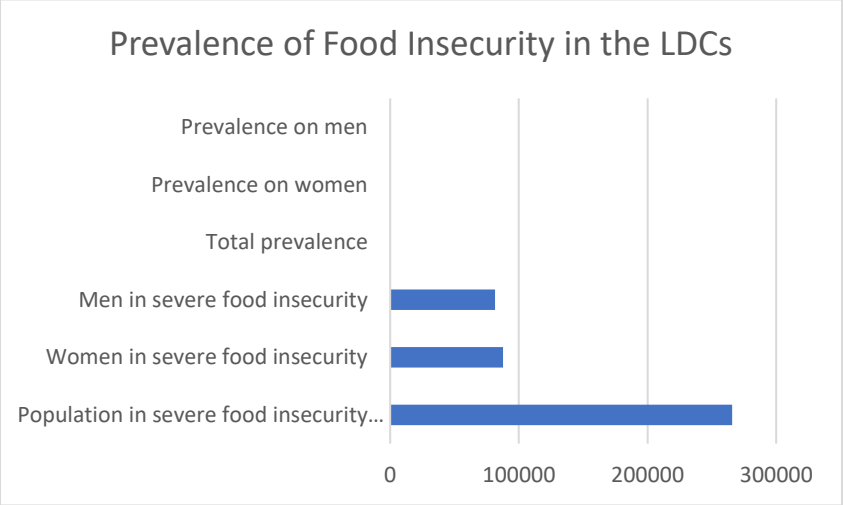


Figure 4: Prevalence of food security Source; FAOSTAT, 2022

3.2.2. Land use

1. Cropland area

Figure 5 below showed that the entire LDCs had approximately 199876 ha cropland area in 2010. The largest cropland area was in Niger (16115 ha) and followed by Tanzania 914469 ha). The smallest cropland was in Vanuatu and followed by Lesotho, at approximately 145 ha and 223 ha, respectively.

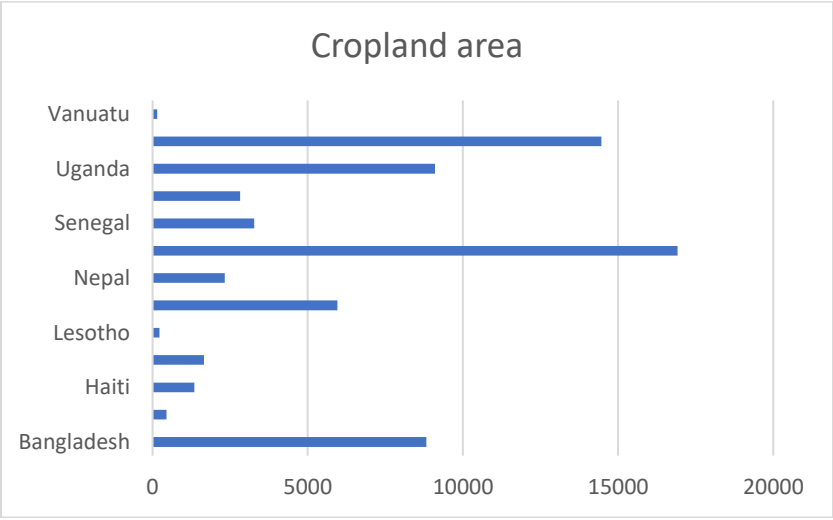


Figure 5: Cropland area Source; FAOSTAT, 2022

2. Land equipped for irrigation

Figure 6 below showed that there was an approximately 18989.16 ha of agricultural land area equipped for irrigation in the LDCs in 2010. The largest area was in Bangladesh, at approximately 5180 ha. Lesotho had the smallest at approximately 3 ha. There was no land area equipped for irrigation in Vanuatu.

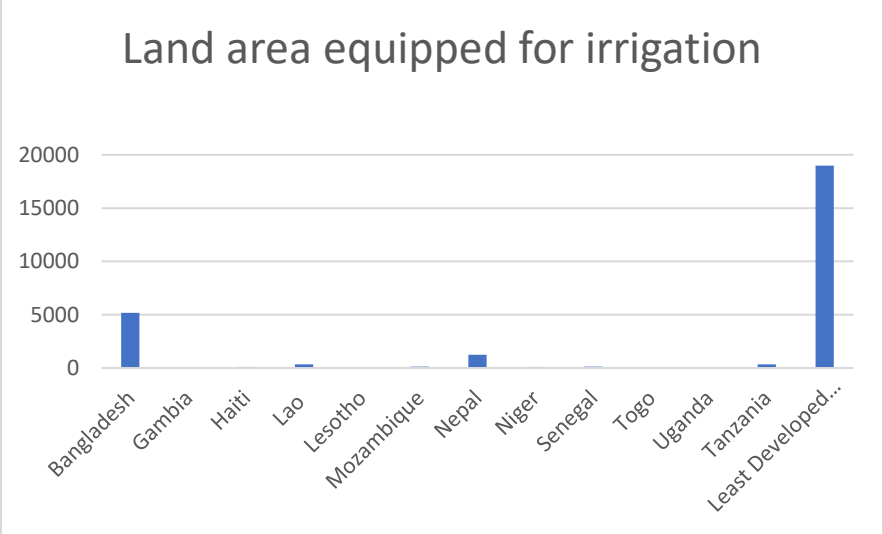


Figure 6: Land area equipped for irrigation Source; FAOSTAT, 2022

3.2.3. Climate-smart Agricultural practices

1. Adoption of livestock in agricultural lands

Figure 7 below depicted the percentages of agricultural area in the LDCs with livestock on them in 2010. I found the largest area in Bangladesh, approximately 2.4ha, while I found the smallest area in Mozambique with approximately 0.5ha.

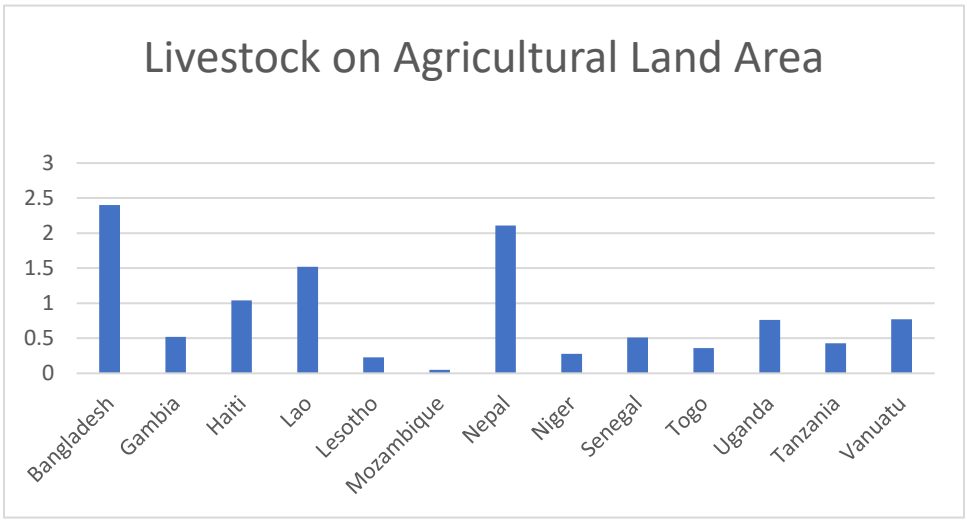


Figure 7: Livestock on agricultural land area Source; FAOSTAT, 2022

2. *Emissions from manure from crop and livestock applied to soil*

- *Emission from manure applied to soil*

Figure 8 depicted the amount of emissions from manure applied to soil on agricultural land in the LDCs in 2010. It released the highest from the swine market at 5.97E+08 g/km, while the lowest was from turkey, at 1446674 g/km.

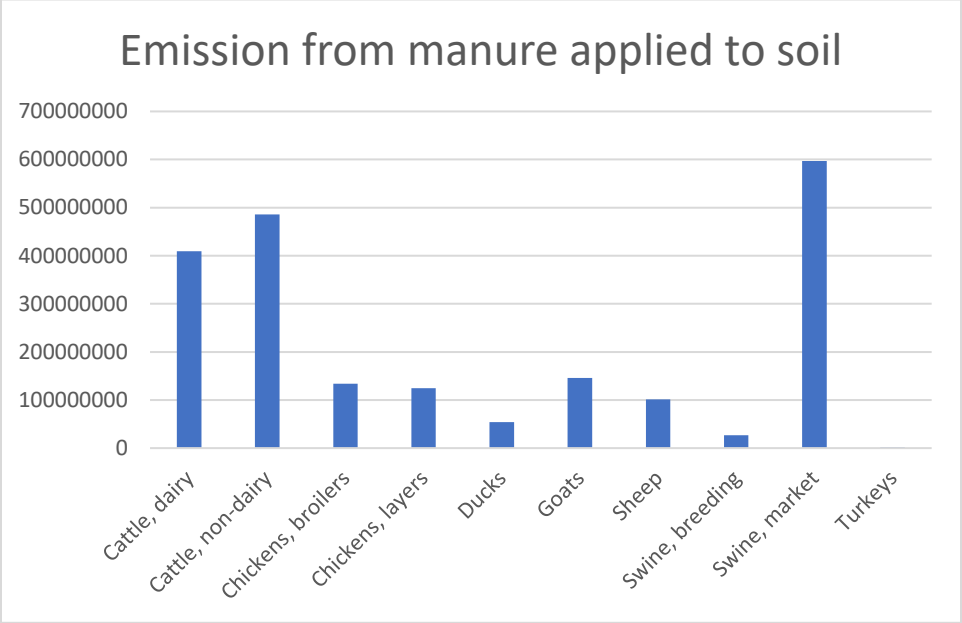


Figure 8: Emission from manure applied to soil Source; FAOSTAT, 2022

- *Emission from manure applied to soil that leaches*

Figure 9 depicted the amount of emissions from manure applied to soil that leaches in the LDCs in 2010. It released the highest from the swine market with 1.79E+08 g/km, while it released the lowest from turkey with 434002.1 g/km.

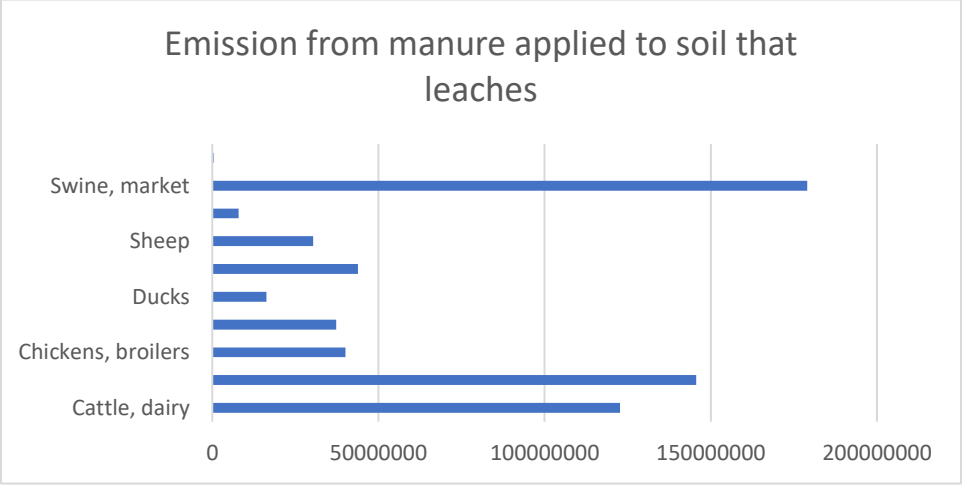


Figure 9: Emission from manure applied to soil that leaches Source; FAOSTAT, 2022

- *Emission from crop residue applied to soil*

Figure 10 depicted the amount of emissions from manure from crop residue in the LDCs in 2010. It released the highest from the rice paddy (1.49E+09 g/km), while it released the lowest from soya-beans at 17143790 g/km.

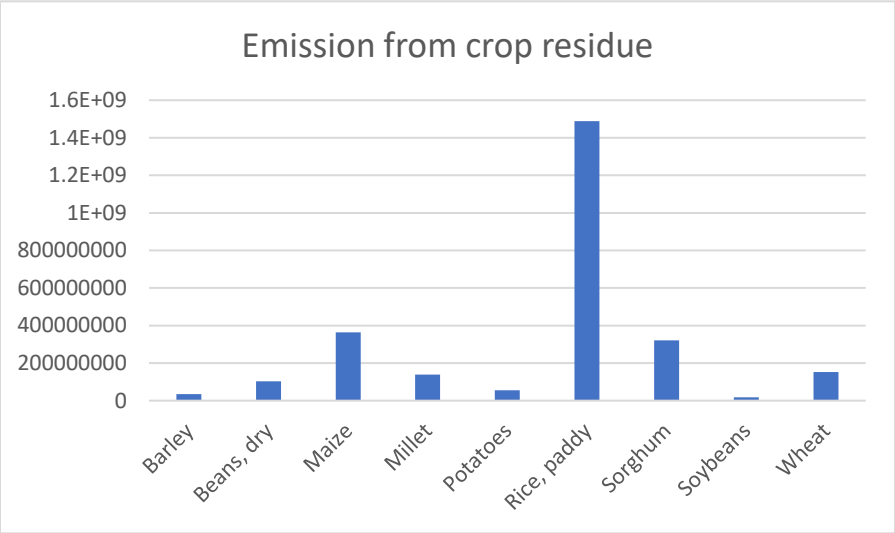


Figure 10: Emission from crop residue Source; FAOSTAT, 2022

4. Discussion

Triggered by temperature changes, this study observed an increase and decrease over agricultural land in the LDCs. It observed that the land area changed by over 70,000ha at 0.813 ◦C in the 2000 and 2010 meteorological years. This supports [13], who found that the arable land decreased significantly from 1990 to 2018 due to temperature changes over land area. These changes were seen in both cropland area (50,000ha) and land area equipped for irrigation (3,000). As this coherently merged the evidences produced by FAO and IPCC, that the global land conditions are being affected by climate change [3,9,14]. Although all LDCs have peculiar climate and land characteristics, each country has experienced unique changes in temperature and over a land area between 2000 and 2010. This corroborates with [3,14,15] who found that extreme climate events are driving land changes across different countries of the world. According to FAO, these temperature changes are associated with the rising of greenhouse gases (GHG) which affected predominantly, the smallholder farmers [14]. However, this study found that Lao experienced the maximum temperature change over land at 1.303 ◦C, but land area decreased largely in Bangladesh by 159ha. Seemingly, Vanuatu experienced the lowest temperature change over land at 0.302 ◦C, yet Lesotho observed the lowest decrease (9ha) in its land area. Resting on the idea of system thinking, it is worth pausing a moment to establish a fact that temperature changes in a country affects the entire LDCs as a system. More so, while climate change majorly caused land degradation, it further exacerbates more climate change.

The LDCs, given by their peculiar sociodemographic characteristics, share a comparable form of access to land rights. Findings from this study showed that women held less than 30% of the total agricultural land area. Even after a decade (2000–2010) of significant changes in temperature and over land area, women held 3% of land in Bangladesh compared to men with 97%. Women in Mozambique consisted a highest proportion of landholders in 2010 at 35%. This states that, although more women consist of a majority of smallholder farms, more men than women own land in the LDCs [16]. Most

smallholder-based communities in the LDCs had a patrilineal structure of land acquisition and distribution. This resonates with [17] who pointed that patriarchy remains a factor that discriminates against women in the rural areas. This structure was designed by the customary laws and influenced by the gender norms. It has denied women access to land rights in the LDCs. In some places where women have access to land rights, they often do not own the right to its ownership and control. This limits women's abilities to adopt an effective adaptation measure, but, rather adapt blindly. According to [17], this exposes them and their farmlands to more climate stressors. In a similar study, [12] found that women had more indigenous climate knowledge and information than men did. Indigenous climate knowledge and information are key to climate science [3]. As such, they tend to be more innovative than men. If women had more access to land rights, they will substantially mainstream climate actions into their farming systems. Since there are more women smallholders (over 80%) than men, [18], equal access to elements of adaptive capacity could make smallholders more climate resilient in the LDCs [12]. Inadequate access to land rights affects women's adaptation planning and major crops preferences [18]. Owning, using, and controlling lands give men and women the capacity to strategize and re-strategize. For example, women who had limited access to land rights do not also have rights to cultivate perennial crops [12]. According to [19], perennial crops offer potentials and enable effective adaptation planning.

Findings indicated that temperature changes are already conditioning the smallholder-based land conditions in the LDCs. smallholder farmers were experiencing climate-driven changes on land through degradation caused by gender-blind farming practices, overgrazing, deforestation, erosion and flooding, drought, soil salinity, among others [3]. According to [12], temperature changes and gender-blind adaptation caused are a human-environment coupled factor of food insecurity. Also noted that inadequate access to asset-based resources like land and water area for irrigation limit women's responses to climate variability. This resonates with [20,21] who found that climate change is increasing land and water demand and meeting these demands are critical to enhancing food security. It demonstrated that climate change and unequal land rights among men and women are increasing the prevalence of food insecurity in most LDCs. Approximately, 265857.4 of its population is facing severe food insecurity in 2022 at 24.6% prevalence rate compared to previous years. According to [22], climate change is affecting food productivity, therefore, causing food insecurity. This corroborates with [23,24,25] who pointed in their studies that climate change is increasing the prevalence of food insecurity by disruption of its major systems, which include land. This study found that the women were more prevalent (26%) to severe food insecurity than men. Likewise, [26,27] posited that women who were disproportionately affected and had limited resources to adapt to climate change were at the risk of confronting higher food insecurity challenges than men. Beside their higher level of contribution to food production, they ensure nutritional access to households and communities.

According to [12], enhancing food security heavily relies on men's and women's access to elements of adaptive capacity to build climate-resilience. This study found that there are approximately 199876ha of cropland area and 18989.16ha of agricultural land area equipped for irrigation in the LDCs. The largest and smallest croplands in the LDCs were found in Nigeria and Vanuatu, with approximately 16115ha and 145ha, respectively. Notably, lands equipped for irrigation were 5180ha in Bangladesh, which was the largest in 2010. Even though Lesotho occupied the smallest (3ha), Vanuatu had no land equipped for irrigation in 2010. Effective management of available cropland and land equipped for irrigation is at the core of building climate-resilience. This is because the anomalistic changes in cropland, whether an increase or decrease, further exacerbate land degradation. While [28] noted that agricultural land expansion had a negative impact on the environment, establishing a nexus, [29] revealed that it increases CO_2 emission. A study found that lands with irrigation have great potential to reduce land degradation [30]. In this regard, it confronted women who barely even have the rights to own croplands with intersectional challenges. In a study of gender-differential climate

change adaptive capacity, [12] summed up that women who are closer to nature had more knowledge and skills to manage lands equipped for irrigation than men. Besides managing lands equipped for irrigation, women also had great potential to manage cropland area than men. But, [31] posited that inequities in access to land rights which also inform decision-making puts women at the disadvantage of climate stress. In addition, [32] inferred that lack of proper management of cropland and land area equipped for irrigation put smallholders at the higher risk of climate change and food insecurity.

Women had more opportunities and potential to adopt climate-smart agricultural technique than men. As such, they remain key to ensuring a climate-resilient smallholding system in the LDCs. This study found that the adoption of livestock on agricultural land is a core and common climate-smart practice in the LDCs. While different countries had unique adoption of different livestock on their agricultural land, some may be anomalistic. Smallholder farmers keep livestock for food and also use their waste for soil management purposes [33,34]. This study found that manure from the swine market applied to soil, soil that leaches released more emission. Most smallholder kept swine because of their climate resilient attributes like heat tolerance and disease resistance [34]. More so, manure from cattle dairy released more emission when applied to soil that volatises. Manure from turkey released the lowest emission when applied to soil, soil that leaches and soil that volatises. While men who had access to land right kept more swine market that released more emission into the soil. Women who had limited access to land right kept duck that released lower emissions. This supports [35] who noted that men kept more swine market than women because it required large spaces for rearing. Although [36] gave a contrasting view that more women kept swine, however, the author did not indicate in their study whether it was swine market or swine breeding. Most women who kept swine did in home yards because of inadequate access to land rights. Further noting that most women keep swine breeders as a means of livelihood integration [12,37]. Cattle diary that men mostly kept produced manure that released more emission to soil that volatises. According to [38], more men kept cattle diary than women because it was more lucrative for them. Women mostly kept duck, which produced manure that leased the lowest emission. This corroborates [39,40] who found that women dominated duck rearing. Like the cattle dairy and swine market, duck is considered an enterprise for women [41].

Another common climate-smart practice in the smallholder-based system in the LDCs was the used of crop residue on agricultural land. According to [42], smallholder farmers adopt the use of residue on agricultural land as a climate-smart practice to improve soil fertility. This study showed that the residue from rice paddy released more emission than soya-beans. This supports [43] on the rice paddy emission and [44] on the soya-beans emission. in a similar study, [45] found that about 64-peered review publications found rice paddy to have the highest level of GHG emission. Also, [46] found that rice paddy residue could be replaced with milk to reduce emission. This is because [47] noted that rice cultivation has the highest level of emission and [48] revealed the potentials of soya-beans residues to produce milk. More men were found to cultivate rice and applied rice paddy residue on the agricultural land in most LDCs [49]. On the other way, most women were found to cultivate soya-beans and applied its residues on agricultural land in most LDCs [42]. According to [12], both men and women smallholders adapt blindly because of inadequate resources. The author further noted that while women adapt blindly because of limited access to asset-based like land, men did because of limited knowledge and information. This also supports [12] in a view that soil fertility replenishment is highly dependent on men and women access to extension activities that are being supported by access to land rights.

5. Conclusions

This study reconciled aims of engendering climate resilience in smallholder-based agriculture using land rights that have been at variance. Grounded in the inadequacy of gender disaggregated data

on land rights and temperature changes, this study draws an inference from seven LDCs with uniform datasets. This uniformity made an in-depth gender and climate analysis of smallholder-based land rights possible. Although this study reiterates that in all countries in the LDCs, gender-based land rights and climate change are independent of each other. However, it used a cluster sampling technique to select countries within each jurisdiction with similar experience in the LDCs. Despite this study, because of its population and geographies puts its nature in the premise of in-existentialism. The system thinking idea that what happens to a country or a gender group marks others with similar characteristic have become increasingly important. It is no longer groundbreaking that climate change has disproportionately affected smallholder farmers in the LDCs. This is because of their socioeconomic and demographic characteristics. Climate change easily disrupts their activities and livelihoods because the larger societal, economic, and environmental systems have marginalized them. Even though this found that men had access to land rights than women in most LDCs. They are mostly secondary and customarily faced limitations. Most smallholder farmers' lands, because of inadequate legal documentation, can be lose access to land rights. Most women do not have access to secondary but tertiary land rights. Thus highlighting the complex gender and social challenges women face at the intersection of gender, land rights and climate change. Since there is no country in this study provided women with at least 50% access to land rights, it infers that women have inadequate land rights in the LDCs. It is profound that women smallholders are the most vulnerable to climate change in the LDCs. In the quest to adjust, women adapt blindly, which is exacerbating more climate change. Increasing gender-access to land right recovers smallholders' capacity to cope simultaneously with climatic stress and substantially reduce its risks.

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Data Availability Statement: I accessed data used for this study via the FAO database. HTTps://www.fao.org/gender-landrights-database/data-map/statistics/en/?sta_id=1161.

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Conflicts of Interest: The authors declare no conflict of interest.

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