Article

Political economy analysis of the dissemination and use of seasonal weather forecasts and services in Zimbabwe

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Abstract: Weather and climate services are essential tools that help farmers make informed choices, such as choosing appropriate crop varieties. These services depend considerably on the availability of adequate investments in infrastructure related to weather forecasting, which are often provided by the State in most countries. Zimbabwean farmers generally have limited access to modern weather and climate services. While extensive attempts have been made to investigate farmers' socioeconomic factors that influence access to and use of weather and climate services, comparative political economy analysis of weather and climate service production and use is limited. To address this knowledge gap, this study examines the production, dissemination, and usage of modern seasonal weather services through a political economy analysis perspective. The findings of this study highlight considerable discrepancies in access and use of seasonal weather forecasts between male and female farmers, those who practise African Traditional Religions versus Christians, and the minority group (Ndau tribe) and the majority group (Manyika tribe). This result suggested the presence of social marginalization. For example, minority Ndau members living in remote areas with limited radio signals and a weak mobile network have limited access to modern seasonal weather forecasts, forcing them to rely much more on indigenous weather forecasts. Further, due to unequal power relations, a greater proportion of male farmers participated in agricultural policy formation processes than their female counterparts. To promote inclusive development and implementation, deliberate efforts need to be made by State authorities to incorporate adherents of African traditional religions, members of minority tribes and female farmers in agricultural policymaking processes, including seasonal weather forecast delivery policies. Further, the study suggests the relaxation or elimination of international sanctions on Zimbabwe by the European Union, United Kingdom and the United States of America, given that they are considerably affecting marginalized groups of farmers in their climate change adaptation practices, including the use of modern weather and climate services. The vast majority of these marginalized farmers never benefitted from the land reform programme and were also not responsible for the design and implementation of this programme which triggered these sanctions.

Keywords: climate services; marginalization; social exclusion; weather forecasts; Zimbabwe

1. Introduction

1.1. Background

Weather and climate services are valuable tools needed to adapt to climate change impacts through information for farmer decisions to enhance their production activities (Bruno Soares et al., 2018; Paparrizos et al., 2021; Radeny et al., 2019; Tesfaye et al., 2023). Weather and climate services refer to the production, translation and dissemination of weather & climate forecast information and other related services

for use in farming decision-making (Hewitt et al., 2020; Hewitt and Stone, 2021; Hossain et al., 2021; Vaughan et al., 2019; Webber, 2019). Weather and climate services enable farmers to make more informed farming decisions and implement optimal risk reduction and coping strategies (Amegnaglo et al., 2017; Leal Filho and Jacob, 2020; Warner et al., 2022). Such farming decisions and risk reduction strategies include selecting optimal crop varieties, scheduling land preparation activities and planting dates among others (Amegnaglo et al., 2017; Chiputwa et al., 2022; Gadzirayi et al., 2020; Muema et al., 2018). The use of weather and climate services among smallholder farmers in Zimbabwe remains low despite their potential benefits in improving farming decisions and strengthening resilience against climate change (Grey, 2019). This is partly due to the very limited capacity of the Zimbabwe Meteorological Service Department (ZMSD) to produce and disseminate context-specific seasonal weather forecasts to farmers (Grey, 2019; Meque et al., 2021). The ZMSD is the public meteorological institution in charge of the production of climate and weather information and its free dissemination to the public in Zimbabwe through the mass media. The use of the English language in disseminating weather forecasts in Zimbabwe, like in many other African countries, is also a barrier for farmers to decode and use weather forecast information (Grey, 2019; Naab et al., 2019; Vaughan et al., 2019). As a result, most smallholder farmers make farming decisions devoid of State-produced weather forecasts as they are not able to comprehend and translate weather forecast information into action (Mugiyo et al., 2021; Saropa et al., 2015).

Addressing these challenges requires a comprehensive approach that considers the underlying political economy landscape in which the seasonal weather forecasts are being produced, disseminated and used. This will help to support policy design, learning, and enabling actions or reforms to maximise access and use of weather forecast services by farmers. This is also pertinent given that like other countries around the world, the Zimbabwe government is currently seeking practical ways to increase investments in meteorological services and ensure equitable access to early warning systems in line with the United Nations' Early Warning for All Initiative (Marchezini, 2023). Although prior studies provide insights into the overall importance of seasonal weather forecasts, insufficient emphasis was placed on the political economy analysis that addresses the influence of poverty, marginalization, and social exclusion on access to and use of weather forecast services (Grey, 2019; Meque et al., 2021; Mugiyo et al., 2021; Mujeyi et al., 2021). As such, this study aims to bridge this knowledge gap by analysing the production, dissemination and use of modern seasonal weather services through the political economy analysis lens; thus, identifying the gaps in the broader political economy that are hindering equitable access and use of seasonal weather forecasts among maize farmers in Zimbabwe.

The analysis of real-world human behaviour and policy-making processes is complex, necessitating the application of various political economy theories rather than just mainstream neoclassical economic theories (Abubakari et al., 2022; Edwards et al., 2024). As a result, political economy analysis is resurfacing as a critical theoretical and analytical framework for addressing the limitations of neoclassical economic analysis. This is because political economy analysis blends multiple schools of thought and analytical methodologies, ensuring in-depth and more pragmatic examination of societal challenges thus providing a more sophisticated analytical lens

to undertake research useful for policy making and decisions. Concurrently, it allows for discussion of the three superstructures that have substantial influences on the production, dissemination, and usage of seasonal weather services, viz. markets (individual behaviour), community, and the state; an area that has received scant attention from prior studies. Thus, the analysis of the structural components linked to the history of the country or issue under discussion, including social/ethnic groups, religious preferences, power relations, and power structures among social groups is pursued in this study. The production and dissemination of seasonal weather services cannot be separated from the political, economic, social, and cultural factors that shape the broader setting in which weather forecasts are being produced and utilised (Bruno Soares et al., 2018; Mubaya and Mafongoya, 2017; Munoz-Carrier et al., 2020; Tanner and Allouche, 2011). For instance, the language and communication channels can either enable or restrict farmers' access and use of these services as well as interpretation of weather forecasts (del Pozo et al., 2024; Grey, 2019; Makuvaro et al., 2023; Zvobgo et al., 2023).

The religious preferences and power dynamics between farmers and producers of weather forecasts as well as local governance structures also determine the use of weather forecasts (Bruno Soares et al., 2018; Guye et al., 2022; Mugi-Ngenga et al., 2021; Patt and Gwata, 2002; Saropa et al., 2015; Zvobgo et al., 2023). As such, to fully understand the institutional environment within which the seasonal weather forecasts are produced and utilised requires taking into account the broader political, economic, social and religious factors (Di Gregorio et al., 2019; Mubaya and Mafongoya, 2017; Ruth, 2010; Vaughan et al., 2018). In our study, the political economy analysis involves the examination of issues around marginalization, the role of religion, social classes as suggested by Marxian analysis, and perceptions about the governance system including the participation of local communities in national decision-making. To that end, the primary research question for this study is whether there is a difference in access to and/or the use of seasonal weather services between female and male farmers, between adherents of African Traditional Religions (ATR) and Christians, and minority Ndau tribal members versus the majority Manyika tribal members. Disaggregating the analysis based on these three main political economy variables (ethnicity and tribe, sex, and religious preferences) associated with marginalization and social exclusion helps to understand the differences that exist between these groups of farmers and, as a result, reveals the areas that require attention to ensure inclusivity as far as access to and usage of seasonal weather services is concerned.

1.2. Literature review

1.2.1. The political economy of governance in Zimbabwe

Zimbabwe became an independent nation on 18 April 1980. The country had evolved as a mix of several independent black African kingdoms covering a period of 10,000 years before 1980. There are two distinct periods in Zimbabwe's political economy history: before and after independence. Political independence signalled the historic change from white-minority rule (British colonialism) to a government led by a democratically-elected black majority (Yates, 1980). Colonial rulers drove black Zimbabweans off their land before the country gained its freedom. Land ownership

during the colonial era was racially biased and unjust (Mkodzongi and Lawrence, 2019; Moyo and Chambati, 2013). During this time, the majority of Zimbabweans were restricted to unproductive fields and cheap labour, while only around 6,682 commercial white farmers and a small number of foreign-owned agro-industrial estates controlled the fertile lands, water, wildlife, forests, and mineral resources (Moyo and Chambati, 2013; Munemo et al., 2022; Yates, 1980).

To redress this discriminatory racial land ownership imbalance, the new government embarked on a willing-seller and willing-buyer land reform initiative after independence between 1980 and 1999. However, this did not occur as predicted, causing frustration, particularly among those who campaigned for independence. This led to a radical and violent Fast Track Land Reform Programme (FTLRP) in 2000, with the government intending to speed up land acquisition and redistribute it to black Zimbabweans (Moyo and Chambati, 2013). In general, the government took a socialist strategy following independence, intending to achieve economic growth while correcting colonial injustices (Munemo et al., 2022). Despite igniting political disputes in several international fora, the land reform process was largely successful in addressing colonial land ownership inequalities while accommodating and balancing the demands of various domestic groups and reorganising labour relations (Mkodzongi and Lawrence, 2019; Moyo and Chambati, 2013).

Nonetheless, the United Kingdom, European Union, and United States (US) of America imposed economic sanctions on Zimbabwe because of FTLRP; these measures have remained in place since 2000. The sanctions eroded an inherited strong economic base in 1980, as the country was prevented from getting International Monetary Fund credit and assistance (Dendere, 2022). Despite calls from the African Union and Southern Africa Development Community for unconditional lifting of sanctions in Zimbabwe, the sanctions remain in effect as of the time of writing.

From 2009 to 2015, the multi-currency system functioned properly, and the country witnessed economic growth as a result of dollarisation, which helped to reverse inflation and stabilise the banking sector (Chidakwa and Munhupedzi, 2017; Imam, 2022). However, because the US dollar remained the dominant currency in the country, Zimbabwe commodities became uncompetitive in the region, resulting in a major fall in exports and, as a result, a decline in economic growth between 2016 and 2019 (Imam, 2022). In a bid to promote industrialization and economic growth in 2019, the government reintroduced the local currency (Imam, 2022). Due to a lack of trust in local currency, a scarcity of US dollars, and the effects of the COVID-19 pandemic, the country had financial challenges, and the monetary authorities maintained the usage of both the US dollar and Zimbabwe dollar. Following a sharp depreciation of the Zimbabwean dollar, the country launched a new gold-backed currency called Zimbabwe Gold (ZiG) on 5 April 2024, to trade alongside the US dollar. This new currency is backed by gold and foreign currency reserves. However, as the new currency finds its footing, the US dollar remains the most preferred and dominant currency in the economy at the time of writing.

These times of macroeconomic instability, combined with deteriorating political and socioeconomic conditions, resulted in a decline in the delivery of public goods and services, including seasonal weather and climate services (Meque et al., 2021; Muchadenyika, 2017; Nhongo and Tshotsho, 2021). Even though the National Climate

Policy crafted in 2017 underlined the necessity to establish the National Climate Fund, it has yet to materialise to finance climate change adaptation activities and strengthen the delivery of weather forecasts. Tensions within the ruling party, as well as opposition party influences, continue to contribute to the overall political economy configuration and deterioration of public service delivery (Muchadenyika, 2017). Political ideologies, elite interests, and interests of major ethnic groupings have all influenced policy direction in recent decades. As a result, the marginalization of minor ethnic groups (tribes) has grown and has been exacerbated by the establishment of a multi-party electoral governing system.

In general, due to instances of political patronage, ethnic groups associated with the ruling elites receive more attention in terms of the delivery of public goods and services. Rural areas occupied by smaller ethnic and less powerful groups, on the other hand, have long been marginalized (Tawodzera, 2022). For example, the Ndau sub-ethnic group in Chipinge and Chimanimani districts of Manicaland province have felt marginalised because the majority of them did not benefit from the land redistribution programme (Musanga, 2022). Concurrently, despite substantial efforts toward rural electrification since independence, access to electricity from the national grid is extremely limited in such rural areas (Dube, 2001; Mhandu and Mary Longe, 2022). Some remote rural areas also have weak telecommunication infrastructure (Gwaka et al., 2018; Nhongo and Tshotsho, 2021). As a result, making or receiving phone calls in remote locations is difficult, and the national radio or television signals are also weak in these areas. Most minority ethnic groups in rural areas regard social exclusion as politically deliberate to keep them as inferior members of society (Musanga, 2022; Ndhlovu, 2022).

Based on these political economy dimensions, it is worthwhile to examine how ethnicity, gender, religious preferences, and remoteness affect access to and use of weather and climate services. Even though weather and climate services are often indivisible and non-excludable (non-rival in consumption), access to State-produced public services is related to the quality of infrastructure, including the power grid and telecommunications infrastructure. As previously stated, it is hard to receive or make phone calls in some remote areas of the country, and national radio or television signals are weak in these areas, making it difficult for individuals to acquire weather forecast information. This is expected to reduce farmers' access to and use of weather and climate services. At the same time, the delivery of weather and climate services is interlinked with the language used for broadcasting weather forecast messages. Because English is the most often used language for disseminating seasonal weather and climate information, this has a detrimental impact on farmers' comprehension and use of weather forecasts, as farmers prefer to get weather predictions in their local language dialects (Grey, 2019; Hounnou et al., 2023; Makuvaro et al., 2023).

1.2.2. Theoretical framework

In line with the political economy analysis of development, which entails the integration of various perspectives in research to improve our understanding of societal phenomena, this study's integrated theoretical framework consisted of a mix of two related theories. The analysis of real-world behaviour and policy-making

processes is complicated, necessitating the use of multiple political economy theories rather than just one school of thought. As a result, political economy analysis is emerging as a crucial theoretical and analytical framework for addressing the limits of neoclassical analysis (Abubakari et al., 2022). The political economy analysis of development allows for an examination of the institutional environment in which seasonal weather forecasts are produced and used, considering political, economic, social, and religious issues.

The first theory guiding this study is the structuralism theory. Structuralism theory suggests that economic and social outcomes differ between classes and groups due to the dominant groups' influences on the economic structure (Arndt, 1985; Peters and Besley, 2014). Applying the structuralism theory in this study helps to analyse how less powerful groups such as female farmers and those belonging to the Ndau ethnic group access weather forecasts in Manicaland province compared to the majority groups such as males and the Manyika ethnic group. Understanding how structural issues of marginalization and social exclusion affect access to seasonal weather forecasts is crucial for making informed social inclusion policy decisions. Social exclusion or marginalization is both a condition and a social process in which certain groups of individuals, communities, and small tribes are made peripheral, and their contributions, welfare, and access to services (such as allocations of State administrative districts and facilities) are generally ignored (Peters and Besley, 2014; Sanusi and Spahn, 2020; Anaman and Bukari, 2021; Anaman and Shaibu, 2024). In the scenario used for this study, access to weather forecasts is typically tied to the quality of infrastructure, such as radio and telecommunications systems. We argue here that farmers living in remote rural locations with poor telecommunications infrastructure are more likely to have restricted access to seasonal weather forecasts. As a result, marginalised groups residing in remote areas are less likely to receive and use modern weather forecasts compared to the majority groups living in well-developed farming areas. Remoteness also affects access to extension services and farmer's participation in farming groups. This weakens their social capital and hence access to weather forecasts. This is because farmer-based organisations or farming groups and extension agents play an important role in disseminating weather forecasts in Zimbabwe (Ebhuoma, 2022; Makuvaro et al., 2023).

The second theory adopted in this study is the intersectionality theory of gender which further points out that social exclusion and marginalization take several forms that intersect and these forms include gender identity and gender, class and race (Robinson, 2016). We argue that female farmers are less likely to have access to weather forecasts than their male counterparts due to the prevailing social and cultural fabric, given the patriarchal structures that exist in Manicaland province and Zimbabwe as a whole (Munemo et al., 2022). Further, there are other characteristics of farmers, beyond the sex of the person, which accentuate or amplify marginalization and social exclusion. Hence, for this study, access and use of seasonal weather forecast services is evaluated through the intersectionality perspective. This approach is useful in identifying paths to equal access to these services to guide farming decisions in a changing climate. To that end, the analysis of access and use of seasonal weather forecasts is explored based on the interacting terms of ethnicity and religious preferences as well as sex and ethnicity and through sex, ethnicity and religious

preferences in a three-in-one combination. The religious preferences and power dynamics between farmers and producers of weather forecasts as well as local governance structures determine the use of weather forecasts (Bruno Soares et al., 2018; Guye et al., 2022; Mugi-Ngenga et al., 2021; Patt and Gwata, 2002; Saropa et al., 2015; Zvobgo et al., 2023). Thus, integrating these theories in line with the political economy analysis allows for a deeper examination of issues around marginalization, the role of religion, and social classes as suggested by Marxian analysis. This includes an analysis of the perception of the governance system such as the participation of local communities in national decision-making.

Based on these political economy dimensions, this study examined how ethnicity, gender, religious preferences and remoteness affect access to and use of weather and climate services. As previously stated, due to the poor quality of infrastructure, it is hard to receive or make phone calls in some remote areas of the country, and national radio or television signals are weak in these areas, making it difficult for individuals to acquire weather forecast information. This is expected to reduce farmers' access to and use of weather and climate services. Thus, even though weather and climate services are often indivisible and non-excludable (non-rival in consumption), access to State-produced public services is related to the quality of infrastructure, including the power grid and telecommunications infrastructure. It is therefore worthwhile to understand the production, dissemination and use of seasonal weather forecasts through the political economy analysis lens, a focus of this study.

The remainder of the paper has five major sections. Aside from this introductory section, the second section of the paper outlines the materials and methods employed for the study. The third section presents the results of the study while the discussion of the findings is provided in the fourth section of the paper. The conclusion and recommendations, including suggestions made to strengthen inclusiveness in the delivery of weather and climate services, are provided in the final section. The list of cited references is provided at the end of the paper.

2. Materials and methods

2.1. Study area

The study was conducted in the Manicaland province in Zimbabwe, mainly in the Mutare Rural, Chipinge, Chimanimani, Makoni and Buhera districts (**Figure 1**). The province is inhabited by people who follow the patriarchal inheritance system. The major ethnic group is the Shona with Manyika, a subgroup or tribe of the larger Shona ethnic group being the most dominant in the area. Although English is the official language for business, mainly in urban areas, Shona is the major local language with local dialects like Manyika and Ndau being the most common in the province. The name of the province is derived from the biggest tribe, the Manyika. The major economic activity in the province is agriculture; maize is the chief staple crop among smallholder farmers. Tobacco, timber, bananas, tea, and coffee production are also key agricultural enterprises in the province. Mining also plays a key role in the province with diamonds in the Marange area and gold in areas like Penhalonga of Mutare rural district being the major minerals produced in the province (Chipangura, 2019). Tourism is an important economic industry in the province with Manicaland with

Nyanga, Chimanimani and Vumba Mountains as well as Mutarazi and Nyagombe Falls being key tourism attraction destinations (Gohori and van der Merwe, 2022).
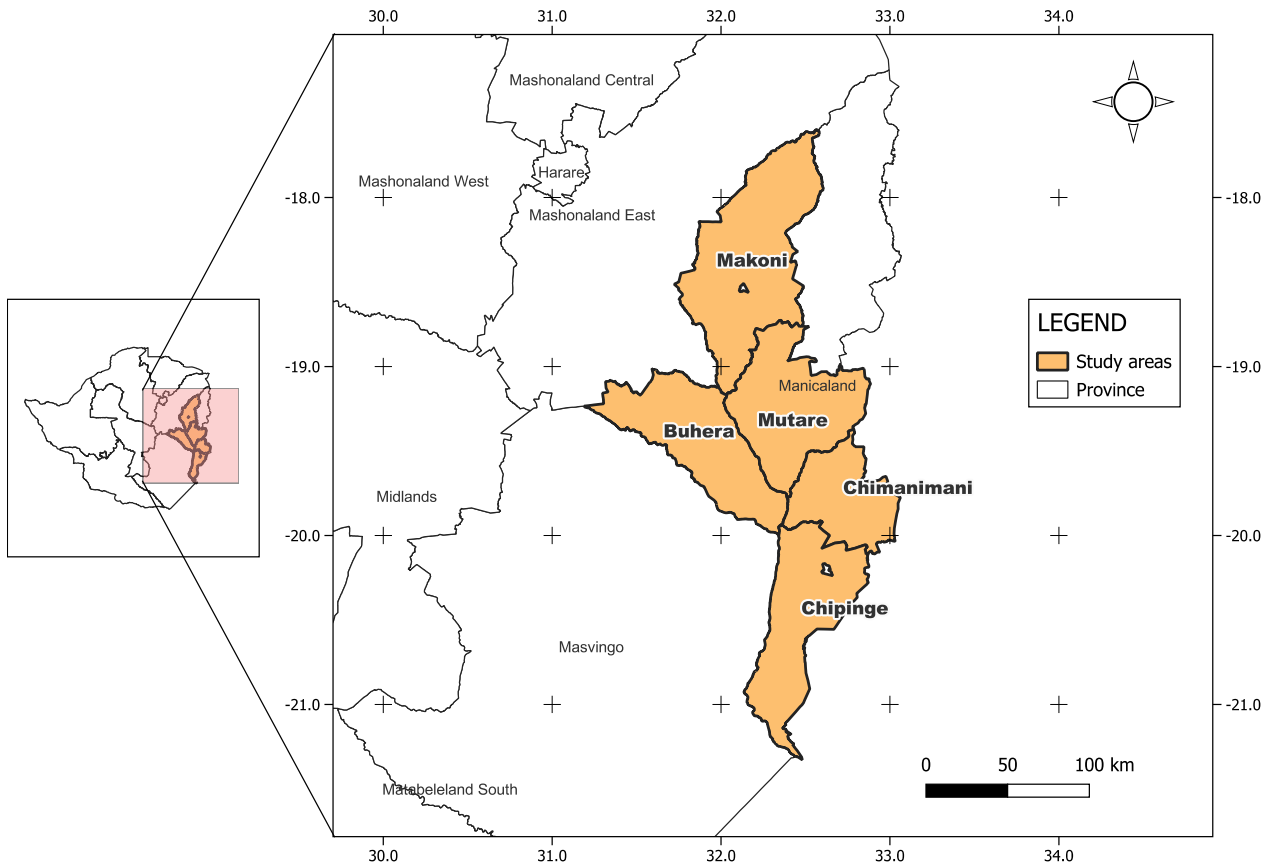
Figure 1. Map of study areas.

Source: Developed by the authors from several Zimbabwe Government archival sources.

2.2. Data and data collection methods

The target population for this study were smallholder farmers in the Mutare Rural, Chipinge, Chimanimani, Makoni and Buhera districts engaged in maize production. From the list of farmers provided in each district, a total of 502 farmers were randomly selected and interviewed for the study. Data were collected through a household questionnaire as the main instrument. Eight enumerators were trained to help administer the survey questionnaire, which was deployed using KoBo Collect software. Although the questionnaire was written in English, the enumerators interviewed farmers in their preferred language (either English or a local dialect such as Ndau) to ensure clear communication. In cases of local dialect, the enumerators translated the responses into English and entered them into the Kobo Collect survey tool.

A pre-test survey was conducted before data collection, and the responses were used to refine the data collection instrument. This helped to make the survey data collection questions easily understood by farmers. Verbal consent to participate in the study was requested before each household head or designated household head was interviewed confidentially. The interviews of household heads were conducted at the

times of choice of the heads and their suggested places of convenience for the interviews. Permission to conduct the data collection was also granted by all the responsible authorities including the senior management of the Ministry of Lands, Agriculture, Fisheries, Water and Rural Development in Manicaland Province and district development coordinators.

2.3. Methods of analysis

Data cleaning and analysis were done with the aid of Microsoft Excel and STATA (version 18) computer software. The descriptive statistics of mean and percentage distribution were used to analyse and disaggregate access to and use of seasonal weather forecasts based on three main political economy variables associated with marginalization and social exclusion. These variables are sex: analysis between female farmers and male farmers; religious preferences: analysis of the data between adherents of African Traditional Religions (ATR) and Christians; and ethnicity and tribe: analysis between the minority Ndau members and the majority Manyika members. Understanding the differences that exist between these groups of farmers helps to reveal the areas which need attention to ensure inclusivity as far as access to and use of seasonal weather forecasts is concerned. As such, this allowed the presentation and description of the intricacies and nuances that may constrain individuals' and groups' access to and use of seasonal weather forecasts through the lens of political economy focusing on ethnicity and tribe, sex, and religious preferences.

3. Results

3.1. Farmers' demographic and socio-characteristics

Most of the interviewed farmers were female-headed households (63%) with an average age of 52 years old. The results also indicated that a slight majority (51%) of the respondents had received secondary school education with an average monthly income of 75 United States Dollars (US$75). The average household size was six and most of the farmers (86%) were Christians. All 502 respondents belonged to the Shona broad ethnic group; 77% of them belonged to the Manyika tribe while the remaining 23% were from the Ndau tribe. On average the respondents owned 14 indigenous chickens, two cattle and four goats; and these are livestock types kept by the interviewed farmers. With regards to information and communication technology assets ownership, most of the respondents owned mobile phone (93%) with 54% of them owning smart phones. Further, most of the respondents (68%) owned radio sets and a minority (27%) owned television sets (refer to **Table 1**).

Table 1. Farmers' demographic and socio-economic characteristics.

Variable	Variable description	
Categorical variables		Percentage
Sex	Sex of household head (male headed households)	37%

Table 1. (*Continued*).

Variable	Variable description	
Education level completed		
No Schooling	Household heads with no schooling	7%
Primary level	Household heads completed primary level	36%
Ordinary level	Household heads completed ordinary level	51%
Advanced level	Household heads advanced level	2%
Tertiary	Household heads tertiary level	4%
Religious preferences		
African Traditional Religions Only	Household subscribe to African Traditional Religions only	3%
African Traditional Religions and Christianity	Household subscribe to African Traditional Religions and Christianity	10.4%
African Traditional Religions and Muslim	Household subscribe to African Traditional Religions and Muslim	0.6%
Christian Only	Household subscribe to Christianity only	86%
Ethnic group		
Shona	Household belongs to Manyika tribe	77%
	Household belongs to Ndau tribe	23%
Information and Communication Technology Assets		
Mobile phone	Mobile phone ownership	93%
	Smart phone	54%
Radio	Radio ownership	68%
Television	TV ownership	27%
Continuous variables		Mean
Age	Age of household head in years	52
Household size	Total number of members of household	6
Monthly household income	Average household monthly income	US$ 75
Livestock ownership		
Cattle	Average number of cattle	2
Goats	Average number of goats	4
Indigenous chickens	Average number of indigenous chickens	14
Broilers	Average number of broilers	8

Source: Authors' computation.

Most of the respondents (89%) also had use rights to the land that they farmed with 72% of the farmers operating their farms under communal land ownership. Access to public extension services was high with 82% having access. Membership of farmer-based organizations was low with only 27% belonging to such organizations.

3.2. Access and use of seasonal weather and climate forecast services

Table 2 provides summary information on the access and use of weather and climate forecasts by the interviewed farmers. Most of the interviewed farmers (58%) used indigenous weather forecasts to select suitable maize varieties, schedule planting dates and land preparation. All the farmers in the study areas who were aware of

indigenous weather forecasts accessed these weather forecasts by travelling to the source of production of the forecasts. The main sources of indigenous seasonal weather forecasts were elders in the village (70%) followed by fellow farmers (14%). Farmers also accessed indigenous seasonal weather forecasts from traditional and religious leaders. The main indigenous seasonal weather forecast indicators were observing the flowering of specific trees, the behaviour of certain birds and high temperatures at night.

With regards to modern seasonal weather forecasts, 92% of interviewed farmers indicated that they accessed forecast information during the 2022/23 farming season with most of them accessing the forecasts through radio (79%). This finding is similar to those from previous studies which indicated that most farmers in Zimbabwe access weather forecasts through radio (see for example, Grey, 2019). Three (3) main national radio stations (with national coverage): Radio Zimbabwe, National FM, and Star FM were identified as the major sources of modern seasonal weather forecasts. Community radio stations also play an important role in communicating seasonal weather forecasts to farmers particularly Chimanimani FM (which only covers the Chimanimani district) and Diamond FM (which covers the whole province). Agricultural extension officers, fellow farmers and non-governmental organisations were also important in disseminating weather forecasts to farmers.

Among the farmers with access to modern seasonal weather forecasts, 96% used the forecast information to implement anticipatory actions in maize production, selection of suitable maize varieties (82%), scheduling planting (59%) and land preparation dates (39%).

3.3. Results of political economy analysis

3.3.1. Disaggregating by sex, religious preferences and ethnicity

This section gives the results of farmer characteristics disaggregated by three main political economy variables associated with marginalization and social exclusion. These variables are sex: analysis between female farmers and male farmers; religious preferences: analysis between adherents of African Traditional Religions (ATR) and Christians; and ethnicity and tribe: analysis between the minority Ndau tribal members and the majority Manyika tribal members. Thus, apart from presenting the statistical difference in socio-economic characteristics across these groups of individuals, the intricacies and nuances that constrain access to weather and climate services through the lens of political economy focusing on ethnicity and tribe, sex, and religious preferences are elaborated.

Information summarized in **Table 2** indicates that a larger proportion of male farmers subscribe to ATR compared to females with a difference of 17% ($p < 0.01$). Concurrently, a larger proportion of male farmers own radio and participate in agricultural policy formulation processes compared to their female counterparts. Male farmers are better off compared to their female counterparts in terms of asset ownership, participation in policy processes, educational level, farming experience and land size, among other indicators.

Table 2. Disaggregating socio-economic characteristics of farmers by sex.

Variable	Percentage	Sex		
	All farmers	**Male**	**Female**	**Difference**
Religion				
Subscribe to African Traditional Religions (1—yes, 0 otherwise)	14%	25%	8%	17%***
Ethnic group				
Ndau ethnic group (1—yes, 0—Manyika ethnic group)	23%	22%	24%	2%
Information and Communication Technology Assets				
Mobile phone (1—yes, 0—no)	93%	94%	92%	2%
Radio (1—yes, 0—no)	68%	72%	66%	6%*
Television (1—yes, 0—no)	27%	26%	28%	−2%
Social capital				
Access to public agricultural extension services (1—yes, 0—otherwise)	82%	83%	82%	1%
Membership in a farming group (1—yes, 0—otherwise)	27%	27%	26.8%	0.2%
Participation in agricultural policy processes (1—yes, 0—otherwise)	7%	10%	4%	6%***
Land ownership status				
Own the land (1—yes, 0—otherwise)	89%	90%	87%	3%
Education level				
Years of education completed (years)	9	9.4	8.8	0.6**
Age and income				
Age (years)	52	53	51	2
Monthly household income (US$)	75	78	73	5
Remoteness				
Distance to nearest town (kilometres)	39	41	37	4**
Experience				
Maize farming experience (years)	21	22	20	2*
Land size				
Total landholding (hectares)	2.2	2.5	2	0.5***
Farm equipment ownership				
Number of farm implements/equipment	2	2	1	1***
Use of indigenous seasonal weather forecasts		Percentage		
Use indigenous seasonal weather forecasts (1—yes, 0—otherwise)	58%	59%	57%	2%
Use of modern seasonal weather forecasts				
Use modern weather forecasts in maize production (1—yes, 0—otherwise)	88%	87%	88%	−1%
Use modern weather forecasts for non—farm activities (1—yes, 0—otherwise)	83%	82%	82%	1%
Willingness to pay decision and amount				
Willing to pay for modern seasonal weather forecasts (1—yes, 0—otherwise)	68%	70%	67%	3%
Willingness to pay amount/month (US$)	1	1.04	0.96	0.08

Source: Authors' computation.

Disaggregating based on religious preferences indicated that farmers who subscribe to ATR are older, with more farm assets and bigger land sizes compared to their Christians counterparts (refer to **Table 3** for detailed results). Although not

statistically significant, a higher number of farmers who subscribe to ATR (58%) use indigenous seasonal weather forecasts than those who solely practice Christianity. This is probably because farmers who subscribe to ATR understand better the importance of indigenous seasonal weather forecasts as compared to Christians.

Table 3. Disaggregation of socio-economic characteristics of farmers by religious preferences.

Variable	Percentage	Religious preferences		
	All farmers	ATR	Christianity	Difference
Ethnic group				
Ndau ethnic group (1—yes, 0—Manyika ethnic group)	23%	27%	23%	4%
Information and Communication Technology Assets				
Mobile phone (1—yes, 0—no)	93%	95%	92%	3%
Radio (1—yes, 0—no)	68%	67%	68%	−1%
Television (1—yes, 0—no)	27%	24%	28%	−4%
Social capital				
Access to public agricultural extension services (1—yes, 0—otherwise)	82%	90%	81%	9%**
Membership in a farming group (1—yes, 0—otherwise)	27%	25%	27%	−2%
Participation in agricultural policy processes (1—yes, 0—otherwise)	7%	6%	7%	−1%
Land ownership status				
Own the land (1—yes, 0—otherwise)	89%	86%	89%	−3%
Education level	Mean			
Years of education completed (years)	9	8	9	-1%
Age and income				
Age (years)	52	57	51	6***
Monthly household income (US$)	75	80	74	6
Remoteness				
Distance to nearest town (kilometres)	39	40	38	2
Experience				
Maize farming experience (years)	21	26	21	5***
Land size				
Total landholding (hectares)	2.2	2.6	2.1	0.5**
Farm equipment ownership				
Number of farm implements/equipment	2	3	2	1***
Use of indigenous seasonal weather forecasts		Percentage		
Use indigenous seasonal weather forecasts (1—yes, 0—otherwise)	58%	58%	54%	4%
Use of modern seasonal weather forecasts				
Use modern weather forecasts in maize production (1—yes, 0—otherwise)	88%	85%	89%	-4%
Use modern weather forecasts for non—farm activities (1—yes, 0—otherwise)	83%	82%	83%	-1%
Willingness to pay decision and amount				
Willing to pay for modern seasonal weather forecasts (1—yes, 0—otherwise)	68%	72%	68%	4%
Willingness to pay amount/month (US$)	1	0.97	1	−0.3

Source: Authors' computation.

Disaggregating analysis by ethnicity and tribe (see **Table 4**) indicated that a larger proportion of the majority Manyika tribal members participated in agricultural policy formulation processes compared to the minority Ndau tribal members. This suggests unequal power dynamics between the minority groups and majority groups as far as participation in policy formulation processes is concerned. As such, the minority groups are not fully participating in social, economic, and political life as enjoyed by the larger society due to unequal power relations compared to the majority groups. This has a negative impact on climate literacy, and access to and use of weather forecast services, as limited participation in policy processes may reduce the likelihood of understanding the benefits of using seasonal weather forecasts as an adaptation measure to reduce the impacts of climate change.

Table 4. Disaggregation of socio-economic characteristics of farmers by ethnicity and tribe.

Variable	Percentage	Ethnicity and tribe		
	All farmers	Ndau	Manyika	Difference
Religion				
Subscribe to African Traditional Religions (1—yes, 0 otherwise)	14%	16%	13%	3%
Information and Communication Technology Assets				
Mobile phone (1—yes, 0—no)	93%	96%	91%	5%**
Radio (1—yes, 0—no)	68%	67%	69%	−2%
Television (1—yes, 0—no)	27%	39%	24%	15%***
Social capital				
Access to public agricultural extension services (1—yes, 0—otherwise)	82%	70%	85%	−15%
Membership in a farming group (1—yes, 0—otherwise)	27%	50%	20%	30%***
Participation in agricultural policy processes (1—yes, 0—otherwise)	7%	1%	8%	−7%***
Land ownership status				
Own the land (1—yes, 0—otherwise)	89%	98%	86%	12%***
Education level	Mean			
Years of education completed (years)	9	10	9	1***
Age and income				
Age (years)	52	50	53	−3**
Monthly household income (US$)	75	83	73	10
Remoteness				
Distance to nearest town (kilometres)	39	42	27	15***
Experience				
Maize farming experience (years)	21	23	21	2
Land size				
Total landholding (hectares)	2.2	1.2	2.5	−1.3***
Farm equipment ownership				
Number of farm implements/equipment	2	1	2	−1***
Use of indigenous seasonal weather forecasts		Percentage		
Use indigenous seasonal weather forecasts (1—yes, 0—otherwise)	58%	71%	54%	17%***
Use of modern seasonal weather forecasts				

Table 4. (*Continued*).

Variable	Percentage	Ethnicity and tribe		
	All farmers	Ndau	Manyika	Difference
Use modern weather forecasts in maize production (1—yes, 0—otherwise)	88%	87%	91%	−4%*
Use modern weather forecasts for non—farm activities (1—yes, 0—otherwise)	83%	81%	91%	−10%**
Willingness to pay decision and amount				
Willing to pay for modern seasonal weather forecasts (1—yes, 0—otherwise)	68%	42	76	−34%***
Willingness to pay amount/month (US$)	1	0.40	1.10	−0.7***

Source: Authors' computation.

More Ndau tribal members also indicated that they owned the land they were currently cultivating. Manyika members owned an average of 2.5 hectares of land, which is 1.3 times larger than the average land size owned by Ndau members. The majority of Manyika members own more farm equipment compared to Ndau members. Surprisingly, Ndau members had more years of education than the majority of Manyika group members. Nonetheless, the Manyika members were older than the Ndau members, implying that the majority of the interviewed Manyika group members were unable to attend school due to their participation in the anti-colonial liberation struggle, as opposed to the interviewed Ndau members, who were born only six years on average before independence in 1980.

The Ndau people also reside in distant places, an average of 42 km from the nearest town. This is 15 km further than the average distance from the nearest town, where the majority of Manyika members live. This constrains their access to and use of seasonal weather forecasts to inform their farming decisions.

A larger proportion of the Ndau group members use indigenous seasonal weather forecasts compared to the Manyika members. On the other hand, most of the Manyika group members use modern weather forecasts both in maize production and planning social activities and as a result they are willing to pay to receive modern weather forecasts compared to the Ndau members.

3.3.2. Disaggregating by interactions or combinations of sex, religious preferences and ethnicity

Disaggregating analysis by the interactions of sex and ethnicity shows that Ndau female farmers have less access to agricultural extension services, and few participated in agricultural policy formulation processes as compared to their male counterparts and Manyika tribe farmers (refer to **Table 5**).

Although the Ndau female farmers own the communal land they cultivate, they have smaller land holdings than their male counterparts and Manyika tribal farmers. They also live 41 km away from the district capital (nearest town) and perceive that the mobile network in their areas is poor compared to their male counterparts and Manyika tribe farmers. Due to a lack of radio sets, most of the Ndau female farmers rely on indigenous seasonal weather forecasts and are less willing to pay for modern seasonal weather forecasts than their male counterparts and Manyika tribal members.

Table 5. Disaggregation of socio-economic characteristics of farmers by the interactions of sex and ethnicity.

Variable	Percentage	Sex and Ethnicity		
	All farmers	Female Ndau farmers	All other groups	Difference
Religion				
Subscribe to African Traditional Religions (1—yes, 0 otherwise)	14%	11%	15%	4%
Information and Communication Technology Assets				
Mobile phone (1—yes, 0—no)	93%	94%	92%	2%
Radio (1—yes, 0—no)	68%	60%	69%	−9**
Television (1—yes, 0—no)	27%	39%	25%	14%**
Social capital				
Access to public agricultural extension services (1—yes, 0—otherwise)	82%	74%	84%	−10%**
Membership in a farming group (1—yes, 0—otherwise)	27%	59%	21%	38%***
Participation in agricultural policy processes (1—yes, 0—otherwise)	7%	1%	7%	−6%**
Land ownership status				
Own the land (1—yes, 0—otherwise)	89%	100%	87%	13%***
Education level				
Years of education completed (years)	9	9	9	0
Age and income				
Age (years)	52	52	52	0
Monthly household income (US$)	75	78	74	4
Remoteness				
Distance to nearest town (kilometres)	39	41	27	14***
Perceive mobile network to be strong (1—yes, 0, No)	63%	41%	67%	−26%***
Experience				
Maize farming experience (years)	21	25	20	5**
Land size				
Total landholding (hectares)	2.2	1.2	2.3	−1.1***
Farm equipment ownership				
Number of farm implements/equipment	2	1	2	−1***
Use of indigenous seasonal weather forecasts		Percentage		
Use indigenous seasonal weather forecasts (1—yes, 0—otherwise)	58%	69%	55%	14%**
Use of modern seasonal weather forecasts				
Use modern weather forecasts in maize production (1—yes, 0—otherwise)	88%	88%	91%	−3%
Use modern weather forecasts for non—farm activities (1—yes, 0—otherwise)	83%	81%	90%	−9%**
Willingness to pay decision and amount				
Willing to pay for modern seasonal weather forecasts (1—yes, 0—otherwise)	68%	39%	73%	−34%***
Willingness to pay amount/month (US$)	1	0.28	1.06	−0.78***

Source: Authors' computation.

Disaggregating analysis by ethnicity and ART subscription reveals that Ndau

farmers who subscribe to ATR are five years older, have smaller land sizes, and own fewer farming equipment than all other groups of farmers. The Ndau farmers who adhere to ATR also perceive that the mobile network in their vicinities is of poor quality, and they are not willing to pay for modern seasonal weather forecasts compared with other farmers (**Table 6**).

Table 6. Disaggregation of socio-economic characteristics of farmers by the interactions of ethnicity and religious preferences.

Variable	Percentage	Ethnicity and Religious preferences		
	All farmers	Ndau farmers who subscribe to ATR	All other groups	Difference
Information and Communication Technology Assets				
Mobile phone (1—yes, 0—no)	93%	100%	93%	7%
Radio (1—yes, 0—no)	68%	63%	68%	−5%
Television (1—yes, 0—no)	27%	37%	27%	10%
Social capital				
Access to public agricultural extension services (1—yes, 0—otherwise)	82%	89%	82%	7%
Membership in a farming group (1—yes, 0—otherwise)	27%	37%	27%	10%
Participation in agricultural policy processes (1—yes, 0—otherwise)	7%	0	7%	−7%
Land ownership status				
Own the land (1—yes, 0—otherwise)	89%	89%	89%	0
Education level				
Years of education completed (years)	9	10	9	1
Age and income				
Age (years)	52	47	52	−5**
Monthly household income (US$)	75	81	75	6
Remoteness				
Distance to nearest town (kilometres)	39	39	30	9*
Perceive mobile network to be strong (1—yes, 0, No)	63%	42%	64%	−22**
Experience				
Maize farming experience (years)	21	18	22	−4
Land size				
Total landholding (hectares)	2.2	1.2	2.2	−1**
Farm equipment ownership				
Number of farm implements/equipment	2	1	2	−1**
Use of indigenous seasonal weather forecasts		Percentage		
Use indigenous seasonal weather forecasts (1—yes, 0—otherwise)	58%	58%	47%	11%
Use of modern seasonal weather forecasts				
Use modern weather forecasts in maize production (1—yes, 0—otherwise)	88%	88%	89%	−1%

Table 6. (*Continued*).

Variable	Percentage	Ethnicity and Religious preferences		
	All farmers	Ndau farmers who subscribe to ATR	All other groups	Difference
Use modern weather forecasts for non—farm activities (1—yes, 0—otherwise)	83%	82%	89%	−7%
Willingness to pay decision and amount				
Willing to pay for modern seasonal weather forecasts (1—yes, 0—otherwise)	68%	42%	69%	−27%**
Willingness to pay amount/month (US$)	1	0.89	1.00	−0.11

Source: Authors' computation.

An analysis of the differences in farmers' socioeconomic characteristics further shows that Ndau female farmers who subscribe to ATR have smaller land sizes (1.2 hectares less), less farm equipment, perceived mobile network to be poor in their villages and are not willing to pay for modern seasonal weather forecasts compared to all other groups of farmers combined (refer to **Table 7**). This result brings to the forefront the revealing nature of the application of the intersectional gender theory that allows the analyst to identify peculiar features of the weakest of the marginalized people. A clear result summarized in **Table 7** deals with infrastructure related to the perceptions of poor telephony and mobile network signals. The 38% difference recorded as the difference between female Ndau farmers who subscribe to ATR and all other groups of farmers was the highest as compared to the comparable figures of 26% in **Table 5** and 22% in **Table 6** when clustering of farmers was limited to only two groups.

Table 7. Disaggregation of socio-economic characteristics of farmers by the interactions of sex, ethnicity and religious preferences.

Variable	Percentage	Sex, Ethnicity and Religious preferences		
	All farmers	Female Ndau farmers who subscribe to ATR	All other groups	Difference
Information and Communication Technology Assets				
Mobile phone (1—yes, 0—no)	93%	100%	97%	3%
Radio (1—yes, 0—no)	68%	63%	68%	−5%
Television (1—yes, 0—no)	27%	37%	27%	10%
Social capital				
Access to public agricultural extension services (1—yes, 0—otherwise)	82%	82%	88%	6%
Membership in a farming group (1—yes, 0—otherwise)	27%	50%	27%	23%
Participation in agricultural policy processes (1—yes, 0—otherwise)	7%	0	7%	−7%
Land ownership status				
Own the land (1—yes, 0—otherwise)	89%	100%	88%	12%
Education level				
Years of education completed (years)	9	9	9	0
Age and income				

Table 7. (*Continued*).

Variable	Percentage	Sex, Ethnicity and Religious preferences		
	All farmers	Female Ndau farmers who subscribe to ATR	All other groups	Difference
Age (years)	52	52	52	0
Monthly household income (US$)	75	80	75	5
Remoteness				
Distance to nearest town (kilometres)	39	38	28	10
Perceive mobile network to be strong (1—yes, 0, No)	63%	25%	63%	−38%**
Experience				
Maize farming experience (years)	21	19	21	-2
Land size				
Total landholding (hectares)	2.2	1	2.2	−1.2**
Farm equipment ownership				
Number of farm implements/equipment	2	1	2	−1**
Use of indigenous seasonal weather forecasts		Percentage		
Use indigenous seasonal weather forecasts (1—yes, 0—otherwise)	58%	58%	50%	8%
Use of modern seasonal weather forecasts				
Use modern weather forecasts in maize production (1—yes, 0—otherwise)	88%	82%	88%	−6%
Use modern weather forecasts for non—farm activities (1—yes, 0—otherwise)	83%	81%	82%	−1%
Willingness to pay decision and amount				
Willing to pay for modern seasonal weather forecasts (1—yes, 0—otherwise)	68%	25%	69%	−44%***
Willingness to pay amount/month (US$)	1	0.35	1.00	−0.65

Source: Authors' computation.

The study also reveals some commonalities between female and male farmers; adherents of ATR and Christians; minority Ndau members and majority Manyika members. For example, female and male farmers do not differ statistically in terms of mobile phone ownership, income levels, or farming group membership. This also applies to farmers who subscribe to ATR and Christians. In addition, there is no statistically significant difference in income levels between Ndau ethnic group members and Manyika ethnic members. However, access to infrastructure and related mobile telephony facilities are some of the key indicators that establish statistically significant differences among the three comparative groups of interest in this study.

4. Discussion

The analysis of farmers' socioeconomic characteristics through the lens of political economy underscored some significant differences between male and female farmers; those who subscribe to ATR versus Christians; and minority groups (Ndau ethnic group) and the majority (Manyika ethnic group). This demonstrates evidence of some degree of social marginalization which could prevent groups and individuals from gaining access to resources and full participation in social, economic, and

political life in the wider society as advanced by Sanusi and Spahn (2020).

For example, as a condition, female-headed households are constrained to access weather forecasts due to a lack of radio sets, which in this case, is a key media channel for receiving weather forecast information. Likewise, minority Ndau members who live in remote areas with weak mobile networks have limited access to modern seasonal weather forecasts, forcing them to rely more on indigenous weather forecasts. An in-depth analysis of the interaction between sex and ethnicity further showed that more Ndau female farmers subscribe to ATR and use indigenous seasonal weather forecasts compared to their male counterparts and farmers belonging to the Manyika ethnic group. Generally, farmers who subscribe to ATR are more likely to seek indigenous seasonal weather forecasts compared to their Christian counterparts. Similar findings were also noted in the literature, for example, in Ethiopia and other African countries (Guye et al., 2022; Leal Filho et al., 2022). Concurrently, the Ndau female farmers and Ndau farmers who subscribe to ATR also perceived that the mobile network in their villages was poor. This reflects that the minority Ndau members live in rural remote areas with limited access to radio signals and weak mobile networks (Musanga, 2022; Nhongo and Tshotsho, 2021). This constrains their access to and use of seasonal weather forecasts to inform their farming decisions. As a result, the minority Ndau members (both female and those who subscribe to ATR) are not willing to pay for modern seasonal weather forecasts compared to the Manyika tribal members and those who adhere to Christianity.

As a process, the findings showed that due to the presence of social marginalization, a larger proportion of the majority Manyika tribal members participated in agricultural policy formulation processes compared to the minority Ndau tribal members. This echoes the fact that due to unequal political power dynamics; fewer members of the minority Ndau group participate in policymaking processes compared to the majority Manyika group. None of the Ndau ethnic members who subscribe to ATR participated in agricultural policy formulation processes. As such, deliberate efforts must be made by State authorities to incorporate Ndau people more into agricultural policy-making processes such as budget consultation workshops to ensure inclusive policy development and implementation.

Since more Ndau tribal members own the communal land, they are currently cultivating, this reinforces the earlier findings that the Ndau members occupy most of the communal land and few of them benefited from the land redistribution programme, which triggered the economic sanctions from the European Union, United Kingdom and the United States of America, as compared to the majority of Manyika tribal members (Musanga, 2022). Most Manyika ethnic members cultivate vast tracts of land under the Government's 99-year lease programme because most of them benefited from the land reform programme.

Male farmers are generally more educated and own the land that they cultivate compared to their female counterparts regardless of tribe. This highlights that female farmers are more marginalized and this further reinforces the existing evidence that due to gender norms males are generally advantaged in education and land ownership, among other aspects, as compared to their female counterparts (Bello et al., 2021; Munemo et al., 2022). To promote inclusion, it is therefore essential to incorporate these unequal characteristics into the design and execution of policies and initiatives

that aim to enhance access to and use of seasonal weather forecasts.

This paper, like many studies, has limitations. Due to financial and time constraints, the scope of this study was restricted to Manicaland province. Further research could be conducted on the subject matter in the remaining provinces of the country. Future research could also use longitudinal or panel data to investigate how inequalities in accessing weather forecasts have evolved; this is a shortcoming of the current study which relies on cross-sectional data.

5. Conclusion

This study examined access and use of modern seasonal weather services through a political economy analysis perspective. Most farmers received seasonal weather forecasts through radio and used the forecasts mainly to select suitable maize varieties.

The study also uncovers the effects of marginalization and social exclusion on the access and use of seasonal weather forecasts and information in Zimbabwe. Significant differences in access and use of seasonal weather forecasts were established between male and female farmers; those who subscribe to African traditional religions versus Christians; and minority groups (Ndau ethnic group) and the majority (Manyika ethnic group). For example, female-headed households were more constrained in accessing weather forecasts due to their inadequate ownership of radio sets considered to be the main source of weather forecast information in the study areas. It is therefore important to consider the utilisation of multi-channels of seasonal weather forecasts including community meetings and school children to reach a wide audience of female farmers.

Further, a larger proportion of male farmers participated in government agricultural policy formulation processes which dealt with issues including access and use of modern seasonal weather forecasts and services as compared to their female counterparts. In line with the gender and social inclusion concepts, more efforts are required to deliberately engage female farmers in agricultural policy-making processes, especially those concerning weather forecast access and uses.

The minority Ndau tribal members, who tended to live in remote areas, had significantly poorer mobile telephony network signals than the majority Manyika tribal members. This limits their ability to receive modern seasonal weather forecasts, forcing them to rely more on indigenous weather forecasts. Co-producing seasonal weather forecasts with farmers could help to integrate indigenous weather forecasts, leading to increased use of modern forecasts by less powerful groups such as the Ndau ethnic group and female farmers. Furthermore, due to unequal power relations, fewer members of the minority Ndau tribe were engaged in the government's agricultural budget and policymaking processes than the majority Manyika tribe.

These findings provide additional impetus for Zimbabwean policymakers to strengthen social inclusion processes and activities that make more determined efforts to reach marginalised and socially excluded farmers and people so that they can benefit from economic development and poverty reduction programmes. As a result, the State's priority should not only include increasing financial and manpower resources for ZMSD but also it needs to improve electricity supply and telephony infrastructure throughout Zimbabwe to reach the country's most remote areas.

Given that countries around the world are making major investments in weather forecasting, the findings of this study could help to address inequalities that different social groups face when designing early warning systems. This is especially critical for regional countries in Southern Africa, which are currently grappling with the effects of severe weather events such as droughts and cyclones. Taking into account inequalities faced by different social groups, such as women, in the design of early warning systems, is also consistent with the United Nations' Early Warning for All Initiative, which aims to ensure that every person on the planet has access to early warning systems by 2027.

Finally, the international geopolitical issues surrounding the study relate to the severe impacts of economic sanctions imposed on Zimbabwe by the European Union, United Kingdom and the United States of America arising from the controversial land resettlement programme enacted by the post-independence government. The economic sanctions have seriously affected the government of Zimbabwe reducing its ability to provide extension services and other support programmes for much of the agricultural population. The most severely affected are the marginalized such as the Ndau people. Our study shows that the Ndau people are severely constrained concerning the use of government-provided modern climate services to deal with climate change. Yet, these people were not involved in the political decisions related to the land settlement programme. Further, they have not benefitted from this programme as only a few got redistributed land parcels.

Given that climate change was not caused by these marginalized people, the issue of economic sanctions needs to be revisited by the international actors. We propose the relaxation or elimination of international sanctions on Zimbabwe as they are considerably affecting marginalized groups of farmers in their climate change adaptation practices including the use of modern weather and climate services. Based on the principle of potential Pareto improvement of programmes, which indicates the presence of winners and losers, an alternative suggestion is that the European Union, United Kingdom and the United States governments could establish various projects to assist the Ndau people in dealing with climate change through improved meteorological services and related services to tackle the effects of climate change.

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