Assessment on food system drivers of Majang Zone, Gambella, Ethiopia: Their implication on food security outcome

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ABSTRACT

The aim of study was to identify key food system drivers and their role in determining the food security outcome in the study area. The assessment revealed undiversified and less productive agriculture that gives little emphasis to modern technologies; little to no value-chain development of the major commodities; unemployment coupled with poor alternative income-generatingresources; an activities; open and illegal access to natural resources; incidence of incurable and chronic diseases such as HIV/AIDS; overloading population due to both high birth rate and the influxof people to the area; underperforming education sector; poor governance and unresponsive leadership; few and malfunctioning institutions; poor development of infrastructures; ineffective policy formulation and implementation were some of the factors identified. As a way forward, besides the currently implemented responses by the government and development partners, the initiation of land certification, the implementation of legally defined clarity of the ownership and management of the natural resources, strengthening the link between the research and extension sectors, improving the local food systems via the development of a value chain for selected high-value agricultural commodities, building the capacity of institutions and strengthening infrastructure, working on the harmony and integration of the plan, and the implementation of government and partner activities for sustainable outcomes are all crucial in improving food security.

Keywords: Food system, food security, assessment, drivers, Majang zone

Introduction

The most fundamental human need and human right for leading a healthy, active life is food. Nevertheless, since beginning of life, people have worried about how to ensure their access to food. Due to widespread anxiety this situation caused, the term "food security" was first used in middle of the 1970s during the World Food Conference of 1974, which was organized in response to then-current global food crisis (Clay, 2002). Since 1970s, notion has continuously included additional dimensions and degrees of analysis; this reflects the broader acknowledgement of its complexity in research and public policy challenges. According to the FAO, "food security is a situation that exists when all people at all times have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2006).

Ethiopia and other developing nations, particularly those in Sub-Saharan Africa, continue to face pervasive food insecurity annually despite the unwavering efforts that have been made. (Chege *et al.*, 2023) reported that of the six food system driving indicators examined, two have declined and one has remained constant in Ethiopia during last ten years. Therefore, even though foreign direct investment, annual population growth, and improved technological innovations regarding input utilization to boost production and productivity have changed positively, the effects of climate change and urban population growth are still worsening, and the export sector has not changed. The major drivers, as described by several authors, are generally grouped into biophysical and environmental; innovation, technology, and infrastructure; political and economic; sociocultural; and demographic components (Chege *et al.*, 2023; Traore, 2021; Kennedy *et al.*, 2020; FAO, 2018). Evidently, population growth, low total factor productivity

(efficiency of capital and labor use) (UNDP, 2022), a low adult literacy rate (52%), overreliance on traditional food retail markets, climate change in terms of weather variability (Chege *et al*., 2023), decreased public investment and ineffective policy interventions, a large financing gap between long-term investment and short-term emergency food assistance needs, harvest and postharvest losses, and less integrated research and innovations (Bizikova *et al*., 2022) are among key drivers challenging Ethiopian food system. For instance, understanding trends in population size is critical to estimating future demand for food (Godfray *et al*., 2010) and sectors that absorb active working force (employment opportunities).

The food and nutritional security concepts are ingrained in broader concept of food system as one of immediate outcomes. According to (Capone et al., 2014), the food system idea is a comprehensive system approach that incorporates a variety of players that make up varied collection of institutions, technologies, and behaviors that control how food is accessible, processed, transported, and consumed. According to definitions and descriptions of numerous scholars, the food system consists of an intricate web of interconnected parts, processes, and outcomes. Grubinger *et al*. (2010) characterized it as an interconnected web of people, resources, and activities. This network can be recognized at several scales and is a reflection of and response to social, cultural, political, economic, health, and environmental situations. It spans all domains involved in sustaining human nourishment and health. Food systems include the entire range of actors and their interconnected value-adding activities involved in production, consumption, and disposal of food products, as well as parts of larger economic, societal, and natural environments in which they are embedded (FAO, 2018).

The FAO's sustainable food systems concept and framework document described a sustainable food system as "a food system that delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised". Lomax (2018) illustrated it as a system that incorporates all the components (environment, people, inputs, processes, infrastructure, institutions, etc.) and activities related to production, processing, distribution, preparation, and consumption of food, as well as the results of these activities, such as socioeconomic and environmental outcomes. In addition, Lomax (2018) described it further as a system that includes all the elements (people, infrastructure, processes, inputs, distribution, and so on) and activities associated with food production, processing, distribution, preparation, and consumption, as well as the outcomes of these activities, including socioeconomic and environmental consequences.

Efforts to provide sustainable food and nutritional security depend on a particular food system operating at peak efficiency while taking into account influences of environment, population, technology, politics, economy, society, and culture (Chege *et al*., 2023). Kennedy *et al*. (2020) state that strategy specifically takes into account facilitating innovations and connections across food ecosystems, supply chains, consumer behavior, and related forces. These components call for the involvement of all stakeholders through concerted efforts, including a range of disciplines and levels of competence, to develop long-term solutions to both current and future difficulties.

A sustainable food system promotes food security, maximizes the use of natural and human resources, is accessible and acceptable in all cultures, is environmentally sound, equitable, and commercially successful, and offers consumers food that is safe, healthy, and reasonably priced for present and future generations (Capone *et al*., 2014). Furthermore, as a conceptual tool for comprehending fundamental drivers of food and nutritional outcomes, the food systems approach has drawn increased amounts of attention (Kennedy *et al*., 2020). This reality makes it necessary for nations to acknowledge and implement system to enhance food and nutritional security using a more comprehensive systems approach. This strategy has already been adopted by several international organizations and is beginning to be recognized by national governments as well (Traore, 2021). Most recently, the government of Ethiopia included the strategy as a subcomponent in the implementation of the Agricultural Growth Program II (AGP II) throughout the entire country.
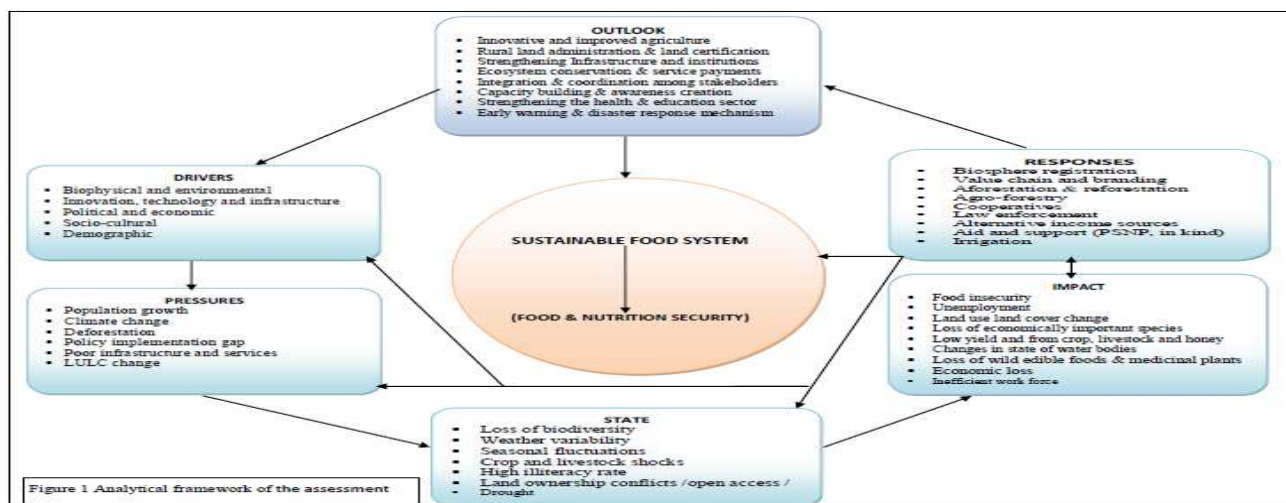
Fig 1. Analytical framework of the assessment

As a result, identifying, describing, and synthesizing the key drivers of the local food system can serve as a source document for understanding the overall food system situation, prioritizing challenges, and proposing and undertaking scientific and development interventions. According to Traore (2021), modifications are important for creating more inclusive, sustainable food systems because Ethiopian food systems are currently ineffective. The academic community, researchers, policymakers, local governments, and development actors operating in and out of the Majang zone can benefit from this assessment's knowledge addition and practical recommendations, especially in areas such as this one where there are plenty of resources for the food system but little has been done to fully realize its potential. Thus, the assessment was conducted to pinpoint the primary causes of the food system's results in terms of nutrition and food security, as well as to develop and advocate long-term corrective actions. Methodologically, focus groups, key informant interviews, and a questionnaire were used to collect primary socioeconomic data from ten randomly chosen villages in the two districts. Secondary data were gathered from published papers and articles as well as from in-depth studies of evaluations, reports, and media sources. The following framework (Fig. 1) was adopted to analyse the assessment.

1. *General Overview of the Study Area*
   1.1. *Agro-ecologic and climatic characteristics*
The zone is divided into the districts of Godere and Mangeshi, which are located between 800 and 2100 metres above sea level and have broader agroecology. The terrain is mostly flat to gently sloping, with a few rocky, steep, and deep valleys found on hills and along significant streams. Several tiny streams that flow into the Gilo River, one of the principal tributaries of the Nile, drain the Majang zone. The borders of the zone with its neighbours are also indicated by main streams such as Godere, Saki, and Beko. The majority of the streams are perennial and release a considerable amount of water; nonetheless, rural populations are concerned that deforestation is reducing amount of water flow. Mangeshi is a lowland agroclimatic zone district dominated by the Majang population. The agroclimatic conditions of Godere woredaare mostly found in the highlands and mid-latitude regions, with a small amount occurring in the lowlands. The region has a hot, humid environment. Ethiopian rainfall maps indicate that this area is the wettest in the nation. Because there is no weather station close to the forest, the average yearly rainfall is thought to be approximately 2100 mm. The average temperature ranges from 20 to 33°C. The region's soils, which are primarily DystricNitosols, are described as reddish-brown to dark brown. The majority of these soils have a high capacity for cation exchange and are somewhat acidic, making them ideal for productive agriculture.

1.2. *Population*
The Sheka and Majang people make up the majority of the zone's population. While other ethnic groups, such asSheka, Kafa, Oromo, Amhara, Sheko, and Tigre, dominate the Godere district, the Majang are primarily found in the

Mangeshi district. These groups are often referred to as "highlanders" by native Majang communities and are thought to have immigrated from other parts of the country in recent decades. Illegal settlements and immigration still occur. It appears that the area's population density is increasing, which has a significant impact on the state of the forestlands and forest resources. CSA (2007) estimated that approximately 59,227 people were living in the area overall, with 20,464 living in Mangeshi districts and 38,763 living in Godere. A total of 91,407 people were listed as inhabitants in the predicted population figures for 2023, with 62,917 residing in the Godere district and 28490 residing in the Mangeshi district. Most people live in rural areas and rely on subsistence farming, making up approximately 88% of the population.

1.3. Economic activities
The agricultural industry is primarily responsible for the livelihood of the zone in general and for food security in particular. The community relies heavily on agriculture, beekeeping, and livestock production for its survival. They also made honey and engaged in hunting and harvesting of wild edible plants from woodlands. The Majang culture places a high value on forest resources, which has helped with conservation in several ways. Approximately 19% of the entire land area is used for agriculture, which significantly helps the community meet its food needs. In addition, it is thought that households' main coping strategies consist of increasing working hours, selling more assets than usual, borrowing food and money, and gathering wild foods. Honey and coffee are the major sources of cash income and employment opportunities for local communities. Other sources of income include *bulla* and *kocho* from *the ensets* and livestock. The major crops grown in the area include maize, sorghum, *Enset*, various root crops, and fruits such as papaya, sugarcane, avocado and banana.

1.4. Land use/land cover types
The major land use and land cover types in the Majang Zone are agriculture, grazing land, forest, settlement, wetland, infrastructure, and wasteland. Perennial crops, including coffee and other fruits, occupy more than 70% of the land used for agriculture. The Majang Zone, one of the few areas of the nation still having a sizable amount of forest cover, is known for its abundant natural resources, which include lush forests. This is partially explained by the long-standing custom of the inhabitants, the Majang, looking after the forest. Many indigenous populations, such as the Majang people, rely heavily on the forest as a source of revenue. Coupled with land use management, the forest and its resources were registered as "Majang Biosphere Reserve" UNESCO heritage sites in 2017. Earlier reports by MELCA-Ethiopia (2015), a national NGO, showed that the biosphere reserve was home to 257 diverse vascular plant species representing 90 families. This forest also harbours many wild animals, such as the Colobus monkey, green monkey, bush pig, bushbuck, leopard, buffalo, and many other bird species.

2. Drivers of the Local Food System
The local food system drivers of the Majang zone emanate from major contextual changes, such as direct changes; the expansion of coffee plantations, towns, and agriculture;and logging, forest fires, and local wood consumption, which are driving the rapid shift in the food systems of the zone.Indirect drivers included the issue of forest encroachment by investors for crop production and other commercial crops, the nature of settlements due to shifting cultivation and influx, inappropriate forest management, poverty, institutional instability and lack of capacity, policy gaps, population pressure, low community awareness of proper resource utilization, and inadequate land management systems. The primary drivers influencing this situation include deforestation, agricultural growth, urbanization, inadequate agricultural production and management techniques, and inadequate infrastructure. These factors affect the reservoir of the food system by causing nutrient depletion and land degradation, changing land cover and use, and ultimately reducing the sustainable productivity of the social, economic, and environmental spheres. Climate change, the slow progress of technology, ineffectual legislation, inadequate infrastructure, a dearth of jobs outside of agriculture, disease, limited access to markets and credit services, inadequate access to sanitary facilities and drinking water, and rising food prices are other factors. According to the 2015 MELCA-Ethiopia and DRMFSS-WDRP assessments, 84% of the community experienced drought and livestock and human diseases as a result of increased immigration and illegal settlement on population density.

2.1. Sociocultural drivers

Food security is significantly impacted by sociocultural elements such as women's employment, gender inequality, food preferences, customs, and beliefs. The Majang have a custom known as "Jang" that has allowed them to claim ownership of substantial tracts of forest, which has allowed them to maintain the forest for centuries. The Majang people lived in the forest for all of the recorded times, relying on it for shelter and food. The Majang have always made their living from the woodlands. Their livelihood consisted of honey production, hunting, and gathering nuts and fruits from woodlands. The Majang culture placed a high value on forest resources, which has helped with conservation in part. They have traditionally used natural boundaries, such as rivers, valleys, or hills, to divide forests among their tribes. However, ownership has slightly evolved into a more community type since the revolution of 1974, and immigration from many ethnic groups across the nation has increased. Furthermore, in the early 1980s, plantations of palm trees and coffee were brought to the region. All of these factors have had a significant impact on how the Majang people now view the forest in their traditional practices. Coffee plantations are among the permanent agricultural activities in which the majority of Majang people today have started in and near the forest.

Furthermore, a great deal of resource loss from deforestation results from the open access and commercialization of the forest, which is caused by a lack of integration and attention given to certain kinds of priceless traditional customs. Even though some Majang communities still follow their ancient cultural customs, community leaders and elders are treated with less deference and responsibility than they were in the past. Given that they have lived in and depended on the forest for many generations, it is evident from the group discussion involving elders, community members, professionals, and local authorities that locals understand the necessity of maintaining the forest. They have ensured the protection of resources by using their cultural knowledge to responsibly exploit forest products (honey, wild fruits and nuts, game meat). They understand that they will be impacted by the destruction of the forests. The impact has become increasingly apparent to many people, particularly in light of the decrease in honey output and the scarcity of huntable wild animals.

2.2. Biophysical and environmental drivers

The planning of rural development initiatives, the monitoring of food security and land use, and studies related to climate change depend on an analysis of LULC change (Girma & Muluneh, 2021). Two human-related factors, proximal and underlying causes, lead to LU/LC alterations according to the literature of Teshome*et al.* (2019). Economic, institutional, technological, cultural, and demographic changes are cited as indirect forces that accelerate the effect of proximate drivers on natural resource use. The proximate drivers, or direct drivers, are linked to the direct action of humans and include infrastructure development, unsustainable exploitation of forest resources, and agricultural expansion. In a similar vein, the study area's primary direct drivers were identified as agricultural land expansion, resettlement or villagization; demand for firewood and construction materials; and institutional structure, economic activity, policy, and population pressure, while other factors were identified as indirect drivers (Girma & Muluneh, 2021).

The magnitude of land use and cover change caused by deforestation resulted in the expansion of agriculture and settlement by 108.1% (8339 ha), the reduction of dense forest by 26.4% (44969.9 ha), and the emergence of a new land use/land cover type, a mosaic or mix of managed coffee and open forest, according to MELCA-Ethiopia's (2015) project baseline assessment report. A constant declining trend (1.42% and 1.55% each year in the first and second periods, respectively) was revealed by the land use/land cover change trend analysis. The change statistics matrix also revealed that most of the increases in all the other land use types occurred at the expense of dense forest, except for savanna woodland.

Similarly, in study of Girma & Muluneh (2021), which covered the years from 1985 to 2018 in the first study period (1985), the landscape was dominated mainly by forest (70%), followed by agricultural lands (17.3%), settlement areas (5.5%), water bodies (2.2%), and shrub/grasslands (5.6%). Their findings showed that after ten years (in 1996), land use changed to 62% forestlands, 23.3% agricultural lands, 8.4% settlement areas, 4.4% shrub/grasslands, and 1.9% covered by water bodies.
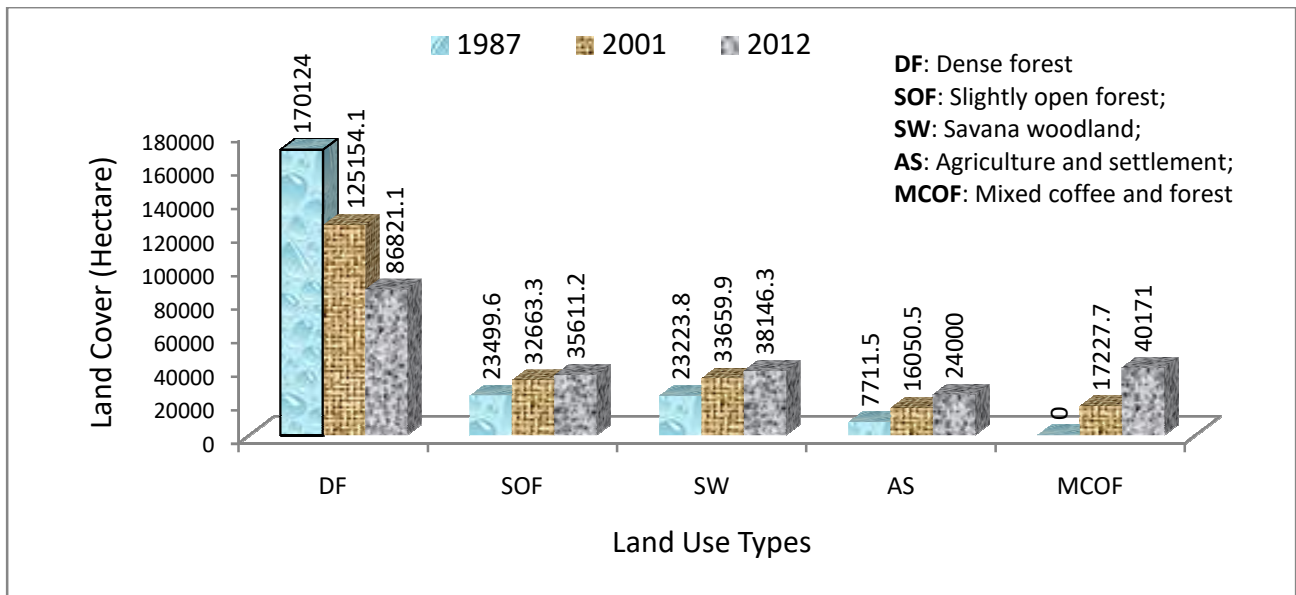
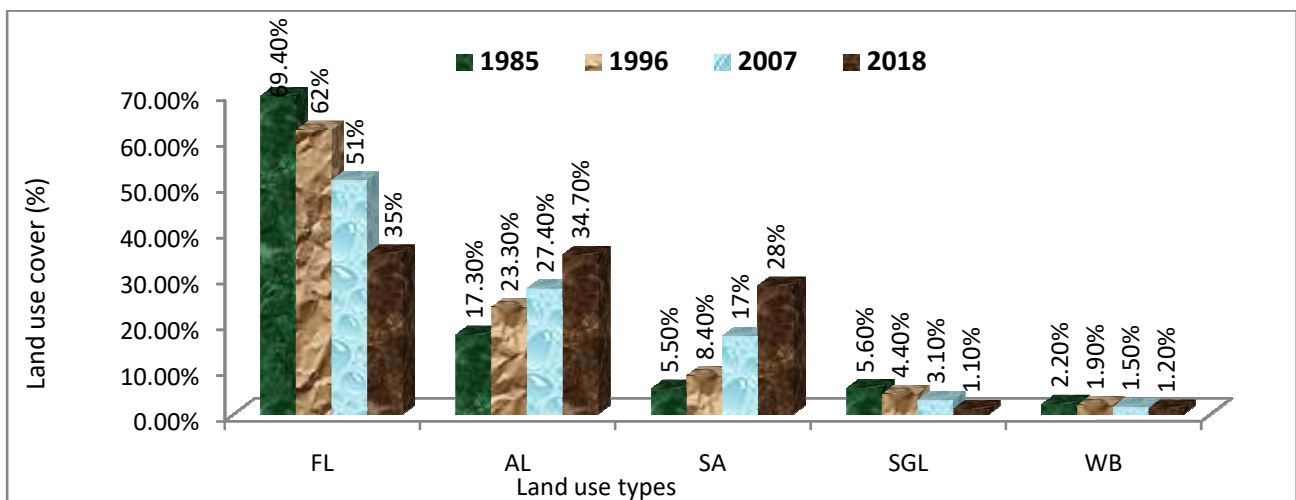**Fig 2.** LU/LC trend between 1987 and 2012 (calculated from MELCA-Ethiopia, 2013)

Fig 3. Land use-land cover change trend between 1987 and 2012 (calculated from Girma*et al.*, 2021)
NB: FL-forestland, AL-agricultural land, SA-settlement area, SGL-Savanna grass land and WB-water bodies

In 2007, the land use indicated further change, in which the magnitudes of forest, agricultural lands, settlements, water bodies, and shrubs/grasslands were computed to be 51%, 27.4%, 17%, 1.5%, and 3.1%, respectively. In the last study period, 2018, almost two-thirds (62.7%) of the study area was under agricultural lands and settlement areas, while the shares of forest lands, shrub/grasslands, and water bodies decreased to 35%, 1.1%, and 1.2%, respectively. Overall, between 1985 and 2018, there were large decreases in forestlands, shrub/grasslands, and water bodies of 49.7%, 80%, and 42.3%, respectively, while agricultural lands and settlement areas rose by 100.6% and 413%,

respectively. The majority of the observed changes, according to the study, are attributable to population increases that were followed by relocation initiatives and the influx of individuals.

2.3. Innovation, technology and infrastructure
The zone's poor and inadequate socioeconomic, institutional, organizational, political, infrastructural, and service-providing sectors continue to be its principal constraints. According to evaluation reports, households need two hours and 45 minutes to travel to the closest paved road and urban center, respectively, demonstrating the degree of physical accessibility challenges. It is often known that market accessibility is limited,

mostly because of distance and a lack of transportation. Poor credit utilization was also noted in the area, where just 1.1% of households borrowed money, mostly from friends and family. Just 0.3% of the households were in communities with electricity, indicating a lack of access to electricity; 98% and 91% of the households reported not using any kind of pesticide or fertilizer, respectively; only 32% of the households used improved varieties of seeds; 40% of the households had received agricultural extension services; and 78% and 83% of the households reported having poor access to livestock drugs and veterinary services, respectively. According to DRMFSS-WDRP (2015), almost 95% of the families did not use any form of agricultural input, 92% of the farmers used manual tillage, and 95% of the farmers did not own oxen. According to 78% and 83% of the respondents, respectively, there was poor access to veterinary facilities and livestock drugs in the same research.

The other important aspect that has the greatest impact on how the food system develops is the education sector. According to reports, a zone's educational situation requires urgent fixes in the areas of technological installation, human resources, service delivery, and the provision of supplies and equipment. According to data obtained from the Regional Bureau of Education, while the number of second-cycle schools doubled from seven to sixteen during the same period, the number of secondary high schools, which presently stands at eight, has not increased for eight years (2013/14–2020/21). For a zone with 35 villages, these schools are too few to accommodate students who are promoted from first-cycle schools. First-cycle school enrollment increased during the years for which data were gathered, at least in terms of numbers (36 to 50) (Figure 9). In addition, practically all categories—from the first cycle to preparatory schools—have shown rare growth in the number of registered students over the research period (Figure 9). Preparatory class enrollment decreased from 322 in the 2013–14 academic year to 239 in the 2020–21 academic year. Figure 9 provides disaggregated statistics on the number of students who are terminated from school, the net enrollment rate, the literacy rate, and the student-to-class ratio. These data serve as evidence of responsibilities that government and

stakeholders must fulfill. The number of children who dropped out of school climbed from 570 to 1525 between 2013 and 14 and 2020 and 21, defying projected goal of lowering dropout and school termination rates at all levels, from district to federal.Implicitly, the challenges to education sectors include challenges to development of food security and food systems as well.

One of key factors determining effectiveness and efficiency with which a certain food system advances sustainably is health sector. Numerous elements, both man-made and natural, surround the zone's health sector. The problems that have been faced for a long time include pandemic and epidemic diseases, infrastructure and services, human capital development, stakeholder cooperation, and similar bottlenecks. One of the main causes of health shock in this zone is the prevalence of chronic illnesses such as HIV/AIDS, TB, diabetes, and malaria. This zone is known to have the highest rate of HIV/AIDS incidence in the nation (4.7% in 2021) (Figure 12). As demonstrated, little progress has been made in terms of HIV/AIDS prevention and drug coverage. Similarly, from 2018 to 2021, there was a decrease in the cure rate of tuberculosis (TB) despite a higher diagnosis rate (Figure 13).

There is just one primary hospital whose facilities and resources are limited by availability of medical supplies and equipment. There are only eight general physicians (GPs), 18 health officers, five midwives, 66 clinical nurses, 13 lab technicians, and no environmental health professionals in the zonal health office data, which suggests that the number and discipline makeup of health professionals in the area is insufficient for the level of cases and population. The peculiar limitation that health practitioners face is rationing against established national norms. A lack of access to clean drinking water—roughly 32% of households lacked a toilet, and another 65% of households used outdoor latrines—and poor sanitation—many households rely on rivers and streams as their primary source of drinking water, and the majority of them (approximately 93% of the households) use the water untreated—are signs of poor community health. Family planning (Figure 10), routine HIV and TB medication, and sanitary advocacy are among the services that are still stagnant or declining.
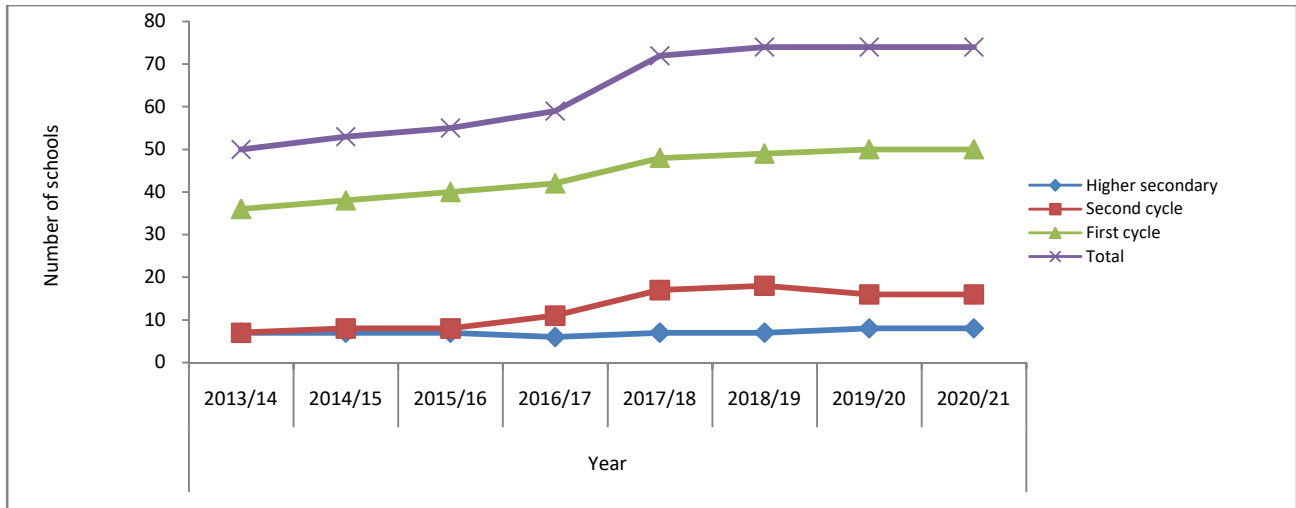
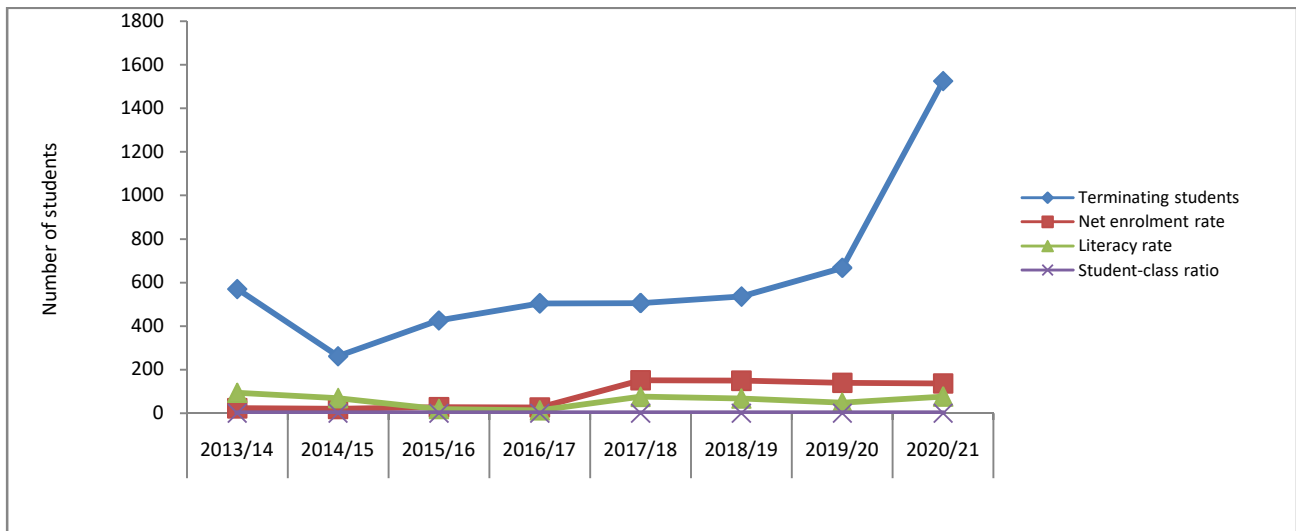Fig 4A. Zonal educational disaggregated statistics (Gambella Bureau of Education, 2021)

Fig 4B. Zonal educational disaggregated statistics (Gambella Bureau of Education, 2021)
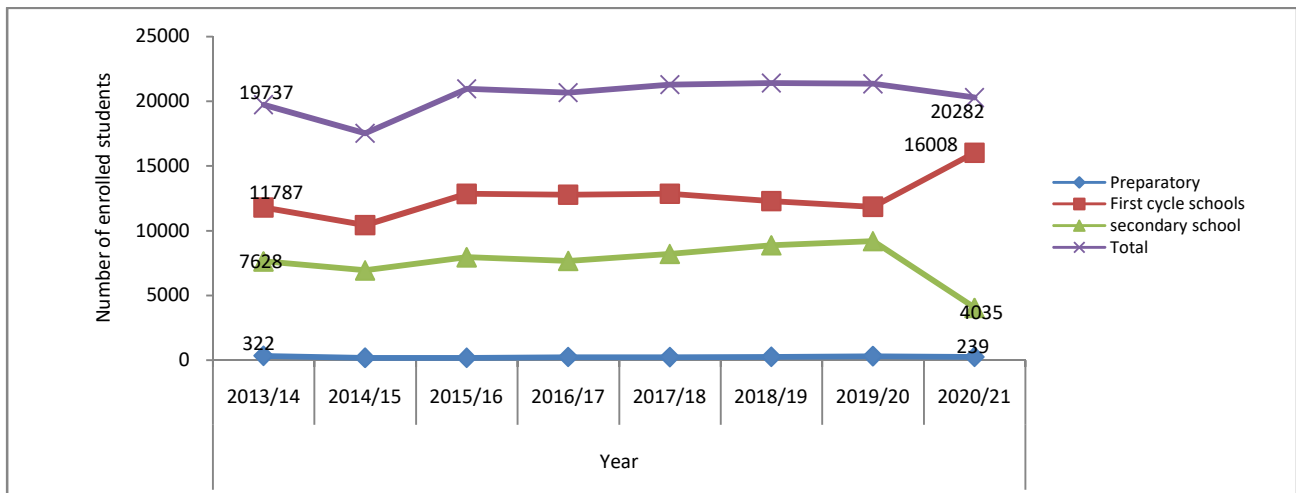

Fig 4C. Zonal educational disaggregated statistics (Gambella Bureau of Education, 2021)
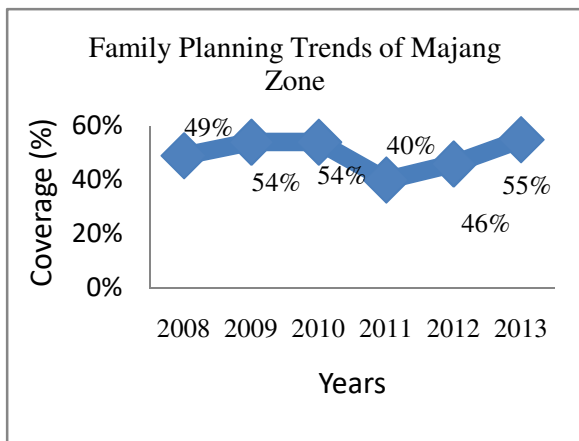
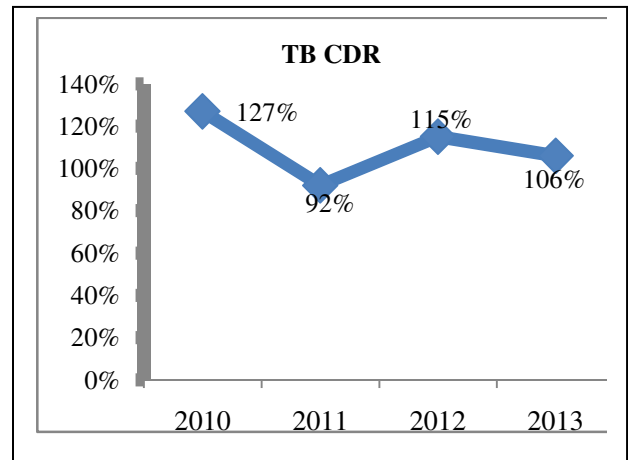Fig. 5. Family planning trends in the zone (source: Zonal Health Office)

Fig 6. HIV/AIDS prevention and medication advocacy (source: Zonal Health Office)

Fig 7. Trends of HIV/AIDS prevalence in the zone (source: Zonal Health Office)

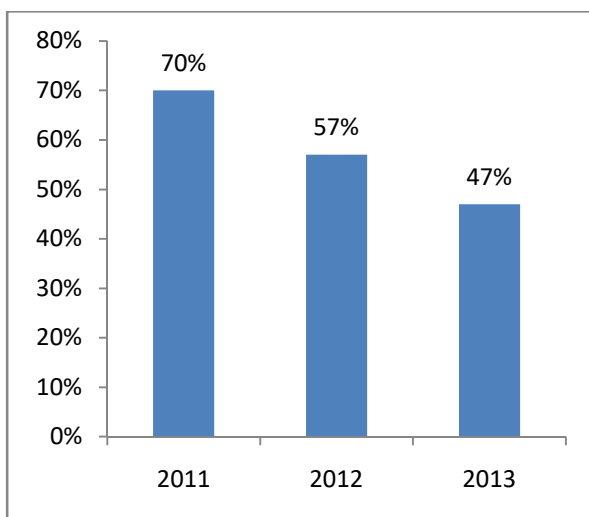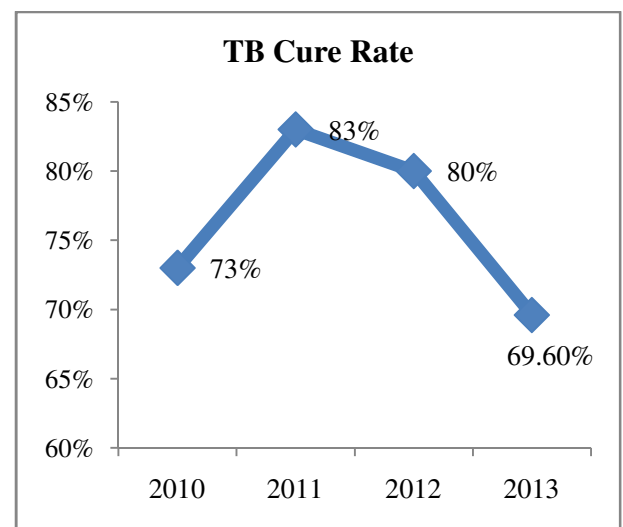Fig 8A. TB detection rate (CDR) in the zone (source: Zonal Health Office)
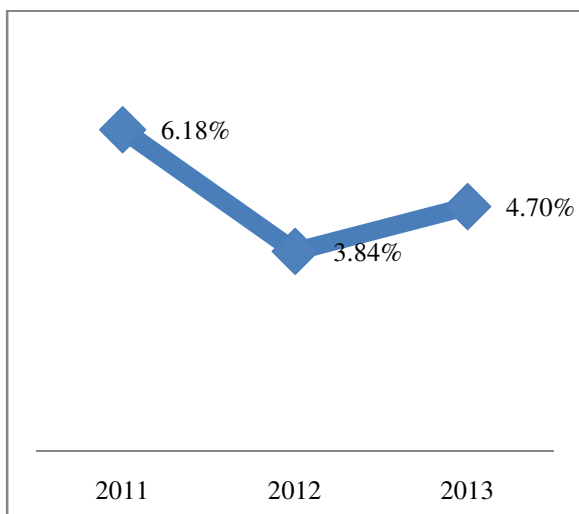

Fig 8B. TB cure rate in the zone (source: Zonal Health Office)

2.4. Political and economic drivers

The traditional method, which employs manual tillage and is further constrained by the lack of inputs, is laborintensive, and the agricultural industry in the zone is notable for its low production and productivity. The sector's productivity and production both numerically and qualitatively remained low due to several constraints, including inefficient use of inputs, poor agronomic practices, losses caused by biotic and abiotic factors, inefficient management and resource usage, and disease. It was reported that farmers do not use artificial fertilizers or crop protection, and only 30% of the surveyed ploughs used oxen. For example, nearly thirty percent of the farming households surveyed used oxen to plough their land. Additionally, compared to

nearly 35% of the potential yield wasted, on-farm and postharvest losses are far greater. Furthermore, the area allocated for grains and other consumable products has reportedly been decreasing because cash crops such as coffee and chats dominate the market. Even if raising livestock is not as common as raising crops, there are no better techniques available to assist in the production of animals. Technologies such as artificial insemination, veterinary care, feeds, and improved management techniques do not assist native bred plants. Furthermore, inadequate alternative income-generating activities have resulted in a high prevalence of youth unemployment.

Nevertheless, the region is rich in natural resources, and in addition to the disparities in output and productivity, legally enacted laws, regulations, and directives have not yet been fully established according to the country's mandate. For example, the region has used federally produced legal frameworks to control and administer rural land, but it has not developed and implemented its legal frameworks for this purpose. Under the Ministry of Agriculture, the federal government has manipulated the land distribution for substantial investments (>500 hectares) (Federal Democratic Republic of Ethiopia, 2007; Reg No. 135/2007). Due to mandate overlap and conflicts of interest among the players, there is a gap in the implementation of both the planned duties and the policies. These contradictions in land administration and governance mandates, which show a lack of attention given to investment issues, have led to the allocation of 312 hectares of heavily forested land to tea plantations based on inaccurate environmental impact assessment results. This has resulted in recurrent conflicts between investors and the community, which have cost lives. Recurrent conflicts with the community were caused by agricultural investment land transfers, which demonstrated similar shortcomings in terms of the economy and natural resources. These data unequivocally show that the region is less equipped to create and carry out any policies or strategies about rural land since it was unable to create its own legal framework for managing the land under its legal authority.

In addition, where they were unable to fully participate for an extended length of time, the land registration and certification responsibilities continued to be poorly managed and administered. Land administration and governance attempts are beset with difficulties in addition to gaps in policy, employee incompetence, corruption, professional workers' lack of knowledge, lack of funding, improper leadership, inadequate monitoring and evaluation systems, insufficient sense of ownership, and conflicting interests. Low awareness, improper policy implementation, and a lack of connections between stakeholders and the community have all been noted as frequent issues in the zone in the 2015 DRMFSS-WDRP assessment report. Due to the lack of a robust and legally binding regulatory framework, corruption in the land market and land grabbing have become commonplace among local officials and property brokers. Accordingly, most court files address land-related charges according to the key informant interviews conducted as part of the study.

2.5. Demographic

The Majang zone's population trend indicates a notable increase during the previous few decades. The population of the area nearly doubled, rising from 53,000 in 1994 to 59,248 in 2007 and then to 91,407 in 2023 (Figure 14), according to data from Ethiopia's Central Statistics Agency. According to the descriptive statistics, the population of urban areas is growing at a quicker rate than that of rural provinces. Due to its smaller area and fewer communities (14) than Mangeshi (19 villages), the Godere district has experienced a greater rate of population growth (38.36%) during the past 15 years than has the Mangeshi district, which is dominated by rural villages (2.81%). This is partly because Godere is composed of more urbanely and semiurbanely characterized towns and villages, including the zonal capital, Metti town. Given that the economic, social, infrastructural, and service sectors have shown steady growth, the rapid increase in the population implies considerable implications for the food security and nutritional outcomes of traditional local food systems.

3. Current State of the Food System

The Majang forest is said to be the community's best source of livelihood security. However, the native people's way of life has been threatened by the shift in qualitative and quantitative dimensions. The zone's current situation demonstrates how unpredictable the weather can
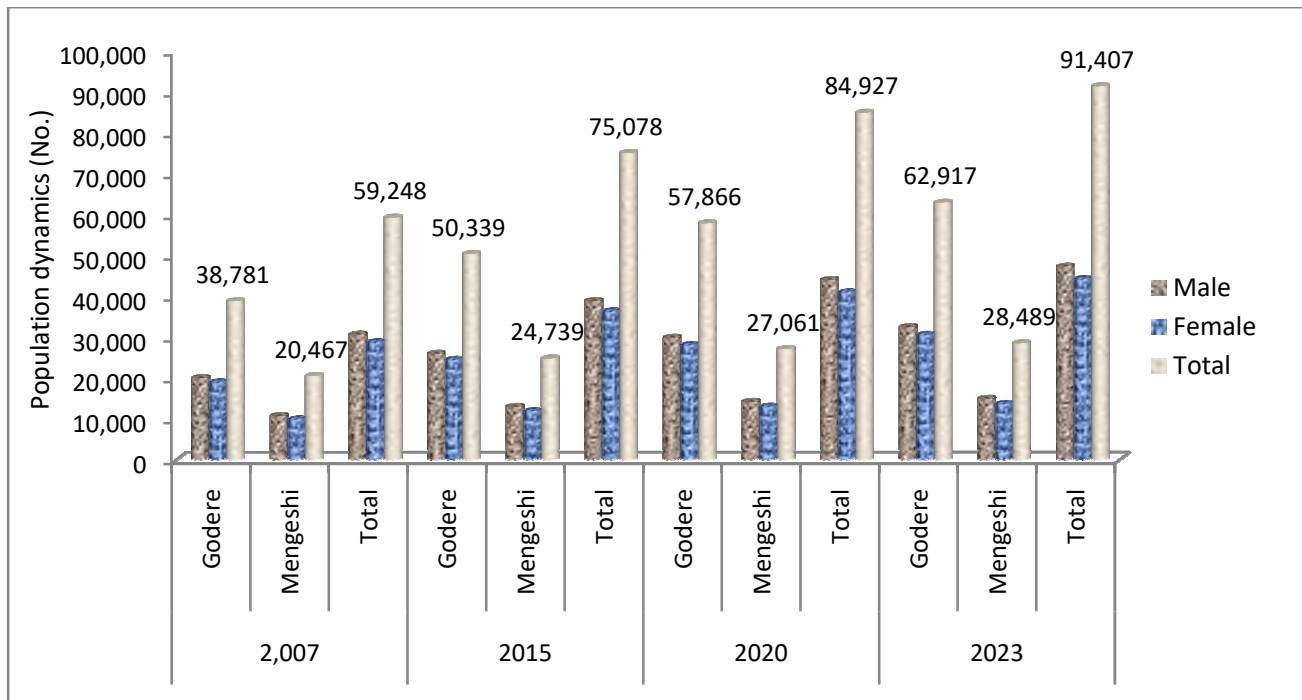
Fig 9. Population dynamics in the study area between 2007 and 2023 (source: CSA, 2007)

be, especially in regard to temperature and rainfall patterns, which greatly hinder agricultural output and food production overall. Due to the low yield per unit plot, cropland must be expanded at the expense of forestland (extensive farming). Furthermore, aquatic bodies are becoming increasingly fewer in quantity over time. The unsustainable use and management of natural resources puts agricultural varieties, animal ranges, and other adaptable species at risk.

In contrast to the few nonexistent wild creatures that are currently available as food sources, the forest was abundant in wild animals thirty to forty years ago, and hunting was quite popular. The yearly decrease in honey quality and quantity, which is connected to a decrease in forest cover and species and accelerates the extinction of honeybee flora, is another concern of the populace. Along with pointing out the region's altered climate patterns and frequent drought episodes, the locals explained that deforestation may have contributed to these changes. The degree of forest loss in the region may have increased as a result of changes in traditional forest ownership and management. In contrast to today, when anyone can access the forest and clear it for the spread of agriculture and coffee, three to four decades ago, forests were owned by individual people.

Furthermore, although its significance is periodically diminishing due to the depletion of the resource base, bush meat remains the primary source of animal nutrition for the Majang people. Due to the scarcity of wild animals, hunting has decreased recently. Additionally, several species that are important for tourism have moved away from the area and are no longer present. Similarly, many wild edible plant species that are utilized in traditional medicine and for sustenance are at risk of becoming extinct. The different plant species used to heal illnesses via traditional medicine are important because the introduction of health centres or clinics remains a challenge.

4. *Impact on the Food System*

Environmental effects on both humans and nature are irreversible as a result of the unsustainable use of the natural resource base. In the zone, the microlevel effects of climate change include irregular rainfall that leads to drought, a serious issue that causes agroecological changes that damage crops and livestock and result in food and income loss, problems with water quality and quantity, health issues for humans and livestock, biodiversity loss, and so on. Waterlogging, inadequate environmental sanitation, and changing climatic conditions in the area are the main causes of human health concerns. Additionally, diseases such as liver

flukes, trypanosomiasis, and blackleg, foot and mouth disease, which are frequently observed in these zones, limit the health of animals.

The traditional low-productivity, undiversified agriculture in the area is unprogressing and unable to feed the growing population. Furthermore, the community's level and strength of resilience, as well as its means of subsistence, were severely impacted by the alarming ongoing deforestation and land use change. This is demonstrated by the fact that 39%, 24%, and 19% of the communities have received food aid, faffa, and agricultural seeds and tools, respectively. Furthermore, more than 40% of the households stated that they could not raise the Birr 500 in a week, demonstrating their susceptibility to an unexpected wave of disasters due to a decline in revenue from forest-based products. One-third of the households were unable to recover from the losses they incurred during disasters.

Concerning nutrient depletion, there was also a shift in the land's productive potential. Both the quality and quantity of the food variations or diversities that were formerly obtained from the forest have declined. Similarly, the loss of significant native plant and animal species at both the micro- and macrofaematia and flora levels was caused by the destruction of plant genetic resources caused by deforestation. Disturbing the local food chain can also result from a decrease in the quantity, variety, and quality of available water sources.A shift in the food system equilibrium can occasionally be caused by an increase in the variety and frequency of plant and animal diseases. A related issue is the conflict of interest among individuals, institutions, and states due to the absence of sound policy and its implementation.

5. *Responses of the Food System*

Community, government, and nongovernmental organizations have made several attempts to reduce the risks and challenges facing local food systems, but the results do not appear to be consistent. The development of a government-implemented sustainable land management programme (SLMP) that targets reforestation and afforestation, land certification, the generation of alternate income through agro-forestry, the development of capacity, and the increase of awareness at various stages are some of the interventions that have been carried out. Sustainable resource exploitation and management have been greatly impacted by the

"Bioreserve," whose success in preserving the sustainability of the natural base is attributed to the designation of the UNESCO forest as a "Majang Biosphere Reserve" by the MELCA-Ethiopia project. Another endeavor the organization is working on is the development of alternate sources of income to lessen the strain on natural resources. TechnoServe, an NGO, has begun focusing on the branding and value-adding of goods such as honey and coffee to increase the community's income. By putting community members into cooperatives, this group also gives them credit. To promote the effective utilization and high quality of water resources, small-scale irrigation projects and stream construction are also being built in the area. It is too early to tell what effect conservation agriculture and resilient food system initiatives will have, but their execution has proved tenable.

6. *Outlook (concluding and recommending remarks)*

The first and most important issue that needs to be addressed is the legally defined clarity of who owns, uses, and manages natural resources. Strengthening sustainability can be greatly aided by implementing land certification. A multisectoral and multidisciplinary approach to the food system is needed to achieve and maintain food and nutritional security in a changing climate. This approach should take into account cross-cutting issues such as gender equality, governance, state fragility, and nutrition, as well as nutrition, agriculture, health, trade, education, water and sanitation, and social protection.

By strengthening the connections between the research and extension sectors, it will be possible to implement sustainable patterns of food production and consumption that are in line with the carrying capacities of natural ecosystems. This can help reduce total dependence on natural resources, alleviate the production and productivity gap, and increase food security. It is also important to think about improving sustainable food systems through the creation of cogent public policies that span relevant industries and cover the entire food supply chain. This will ensure year-round access to wholesome food that satisfies people's nutritional needs and encourages safe, varied diets. The branding and value addition of goods derived from natural resources need to be prioritized to maintain the ecosystem's equilibrium.

Building and operating a sustainable food system requires the fulfilment and capacity of institutional and infrastructure services. The construction of weather roads, transit access, and the fortification of formal specialized market segments—especially those associated with product development, price fixing, place (demand), and promotion—are considered essential. Payments for ecosystem services, such as carbon trade shows, should be started. To develop a more specialized value chain, credit, insurance services, and incentive systems are also crucial supplements to the practices of the conventional food system. More specifically, the following points require priority consideration:

- Livelihood diversification should be promoted, accompanied by the adoption of processing technologies to improve product quality and marketing, as part of value chain development.
- The adoption of modern beekeeping, with the introduction of transitional and modern beehives as well as processing technologies to increase production and income as well as improve the quality of the product, should be a high priority. This approach will also prevent the death and disability of farmers engaged in apiculture, which commonly occurs when trees fall.
- The skills of indigenous communities should be developed to undertake livestock and staple crop production and for off-farm employment opportunities to reduce direct dependency on natural forests.
- The capacity of government offices at different levels should be built, particularly staff development through on-the-job technical training, to enhance efforts to achieve sustainable improvement of the livelihoods of the community.
- Preparation and implementation of locally adopted and mutually accepted policies. Rural land administration and governance, investment, settlement, and villagization policies formulated by all concerned stakeholders, including the community, are key solutions to the prevailing challenges.

Carrying out applied research that targets the resilient capacity of communities and local food systems and their driving environments, especially on food and nutritional security, coping with stress and shocks, and value chain development and management segments, is important for adapting to dynamic changes in the changing world.

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