ProSafeNet

International Journal of Disaster Risk Management • Vol. 7, No. 2 • https://doi.org/10.18485/ijdrm.2025.7.2.30

Publisher: Scientific-Professional Society for Disaster Risk Management

International Journal of Disaster Risk Management

Article

The Impacts of Upstream Damming of the Omo River on Flood-Retreat Agriculture and Food Security Among Dassanech Agro-pastoralists, Lower Omo Valley, Ethiopia

Seid Ahmed[1]

[1] Hawassa University, Ethiopia; seidahmedSOSW@gmail.com.

* Correspondence: seidahmedSOSW@gmail.com.

Received: 19 September 2025; Revised: 1 November 2025; Accepted: 7 December 2025; Published: 30 December 2025.

ABSTRACT

The Omo River is mainly considered a lifeline for the Southern Ethiopia lower Omo valley pastoral and agro-pastoralist communities of the Dassenech, whose food security and livelihood system totally depends on it. The seasonal flooding and subsequent flood-retreat cultivation of the river basin provide a new, stable crop-harvesting season for both household consumption and market sales. This is why most scholars argued that the entire social, economic, livelihood, and socio-cultural practices of Dassenech villagers depend on the rise and fall of the Omo River. Despite this, upstream Omo River damming and associated large–scale agricultural investment, in the face of climate variability and change, as well as the commercialization of Dassenech agro-pastoralist land and water source ecosystems, have become critical concerns for their flood-retreat agriculture and livelihood systems. Throughout the study, the researcher employed an interpretativist epistemological paradigm along with a qualitative research method to explore and understand the phenomena from the study participants' or actors' own perspective, and to examine the world they experienced via key informant interviews, in-depth interviews, focus group discussions, and a case study with nearly 68 participants. So, this article aims to assess and analyze the impacts of upstream damming of the Omo River on flood retreat agriculture and food security among the Dassenech agro-pastoralists of the Lower Omo Valley in detail, and how it affects local agro-pastoralists' survival systems in the face of harsh agro-ecology and climate change. However, the study findings reveal that the destruction of Dassenech pastoral and agro-pastoral communities, flood retreat agriculture swiftly produces and intensifies major humanitarian disasters, including drought, and recurrent occurrences of flooding disasters in the area, with widespread conditions of starvation, disease, and spiraling interethnic armed conflict between the tri-nation border region of the lower Omo valley region. This increased their vulnerability to the effects of food insecurity, due to the loss of their seasonal sources of grain products - flood retreat crop cultivation, as well as livestock grazing areas. Therefore, to ensure the well-being of human development in the area, maintaining the sustainability of local ecosystem functions is vital for local communities' survival and resilience-building.

KEYWORDS

Lower Omo Valley; agro-pastoralist; food security; flood-retreat Agriculture.

Ahmed, S. (2025). The Impacts of Upstream Damming of the Omo River on Flood-Retreat Agriculture and Food Security Among Dassanech Agro-pastoralists, Lower Omo Valley, Ethiopia. International Journal of Disaster Risk Management, 7(2), 529–550. Retrieved from https://internationaljournalofdisasterriskmanage-ment.com/index.php/Vol1/article/view/225

1. Introduction

Across the world, flood-based farming systems account for over 15-30 million hectares (IGAD, 2014). It supports nearly 75 million of the most vulnerable segments of society worldwide. In countries like Ethiopia, it is widely practiced in areas such as the Omo Ghibe River basin, the Raya valley, Kobe, the Fogera/Lake Tana, Baro Akobo, Wabishebele, the Upper Awash/Becho Plains, etc. Arid and semi-arid areas mostly practice flood–based farming systems, which represent a unique option for managing scarce water resources in support of agricultural production and the livelihoods of marginalized populations. Spate irrigation and zero-tillage farming are two traditional farming practices employed by farmers and agro-pastoralists to supplement their livelihoods. It mainly occurs in lowland areas (IGAD, 2015). These ephemeral streams are sources of fertile sediment, characterized by deep, fertile soil suitable for flood-recession agriculture, resulting from alluvial deposition. In the country, it is practiced in many parts; thus, the lowland of the Omo Ghibe basin is the one practiced by the Omo river, surrounding downstream agro-pastoralist communities of the lower Omo valley region.

The Lower Omo Valley is home to numerous indigenous groups, predominantly pastoralist and agro-pastoralist or flood-retreat cultivators. Their identity, culture, and livelihoods are intimately linked to the plains and the snaking Omo River – relying significantly on its annual flood recession for crop cultivation, fishing, and livestock grazing (Kimberly, 2023). In areas where seasonal floods retreat, agricultural practices have been a means to ensure food security for centuries. Flood-retreat agriculture is an agricultural practice that relies on residual moisture left by receding floodwaters to grow crops (Adams, 1993; Saarnak, 2003). In which poor and vulnerable communities living around the Omo River and Lake Turkana wetlands use flood-retreat farming as a strategy to sustain and ensure their livelihoods and food security (Motsumi et al., 2012). Most of the agricultural system of the lower Omo valley downstream pastoralist and agro-pastoralist communities predominantly relies on livestock herding, flood-retreat farming, fishing, and small-scale irrigation systems. In this context, the innovative agricultural water management system of the indigenous local communities enabled the Dassenech of the Lower Omo Valley to ensure their food security for centuries. Seasonal Omo River floods bring fertile nutrients and increase residual soil moisture, making flood-prone areas favourable for productive agricultural activities, particularly for the production of several stable crops, most importantly sorghum.

Increasing energy potential through Gibe III and the associated establishment of large-scale irrigation plantations, comprising massive sugarcane plantations and associated factories, which were initiated in 2006, have severely deteriorated the livelihoods and food security of the lower Omo Valley indigenous communities' ability to make a living. This leads to widespread hunger in the lower Omo region, wiping out livestock and flooding crop cultivation. This has led to massive displacement over the last few years (Kimberly, 2023) and has affected the flood-retreat agriculture of the villagers in the lower Omo Valley. One of the most severe consequences of upstream damming is the loss of annual or seasonal Omo River flood-retreat agricultural practices. For centuries, the flood has been the core source of food. Since the establishment of the upstream dam project, local communities have increasingly depended on the fickle rain for crop cultivation and on the sale of their livestock assets to buy grain. This forced resettlement and abandonment of the practices of flood-retreat cultivation and mass herding of livestock. Those were essential to their food security and livelihood system. However, this article aims to assess and analyse the impact of Omo River upstream damming on downstream pastoral and agro-pastoral communities' seasonal flood-retreat agricultural practices, while ensuring their food security and livelihood systems. This study intends to address theoretical and methodological limitations in previous research in the field of disaster risk reduction and food security in the pastoral and agro-pastoral communities through constructing a causal chain of flood retreat agriculture and food security with the Omo River flooding disaster. That necessarily determines the choice of methodological design as well as the interpretation of the estimated impacts of upstream damming of the Omo River on Dassenech flood-retreat agriculture and food security. Therefore, this study contributes to a greater understanding of the mechanisms and trends at play in disaster risk management, with due consideration of changing social, economic, and environmental realities in the downstream pastoral and agro-pastoral communities of the Dassench people in the

Lower Omo Valley. It also has significance for methodological approaches, including theoretical and conceptual knowledge, in assessing the impact of Omo River upstream damming on local communities' resilience-building from the systematic review tradition, and suggests approaches that will help future reviewers carry out successful reviews. Additionally, the study maps out existing and new knowledge on disaster risk reduction in ways that enable more informed future research.

2. Methods

2.1. Description of Study Area

The South Omo Zone is found in the Southern region of Ethiopia, and is bordered on the south by Kenya, southwest by South Sudan, west by Bench Maji, northwest by Kefa, on the north by Konta, Gamo, Gofa, and Basketo, northeast by Dirashe and Konso, and the east by the Oromia Region.

This area is named for the Omo River, a river that flows south into Lake Turkana on the western side. Mago National Park and Tama Wildlife Reserve are located on the eastern bank of the Omo River. There is Lake Chew Bahir surrounded by the Stephanie Wildlife Sanctuary located at the eastern border of this area. Notable high points include Mount Smith (2560 meters) and Mount Mago (2538 meters). West of the Omo is the most sparsely populated part of Ethiopia, inhabited by Pastoralist and agropastoralist ethnic groups. The infrastructure of the Zone is "weak and for the most part non-existent; this is a disadvantage inherited from historical neglect of a typical marginal region (ibid)." It also observed that the South Omo Zone is "one of Ethiopia's socially most diverse zones. It contains at least 12 distinct ethnic groups, and possibly as many as 21. Social diversity, therefore, compounds the existing problems of isolation, acute shortage of basic infrastructure, as well as scarcity of professional and technical manpower."

South Omo has 462 kilometers of all-weather roads and 412 kilometers of dry-weather roads, for an average road density of 37 kilometers per 1000 square kilometers. Based on the (2007) Census conducted by the CSA, this Zone has a total population of 573,435, of whom 286,607 are men and 286,828 women; with an area of 21,055.92 square kilometers, South Omo has a population density of 27.23. While 43,203, or 7.53%, are urban inhabitants, a further 25,518, or 4.45%, are pastoralists. A total of 125,388 households were counted, resulting in an average of 4.57 persons per household and 121,309 housing units.

According to a May 24, 2004, World Bank memorandum, 4% of the inhabitants of South Omo have access to electricity, this zone has a road density of 22.7 kilometers per 1000 square kilometers (compared to the national average of 30 kilometers), the average rural household has 0.4 hectare of land (compared to the national average of 1.01 hectare of land and an average of 0.89 for the former SNNPR) the equivalent of 1.5 heads of livestock. 11.5% of the population is in non-farm-related jobs, compared to the national average of 25% and a regional average of 32%. 37% of all eligible children are enrolled in primary school, and 7% in secondary schools. 77% of the zone is exposed to malaria, and 61% to tsetse flies. The memorandum gave this zone a drought risk rating of 348. This Zone was selected by the Ministry of Agriculture and Rural Development in 2004 as one of several areas for voluntary resettlement for farmers from overpopulated areas; no specific Zones woredas were identified in this program. The lower Omo Valley downstream pastoral and agro-pastoral communities include the Dassenech, Hamer, Nyangatom, Bena-Tesmay, and Selamago Woredas. This study has been undertaken in Dassenech Woreda, which has been vulnerable to the Omo River flooding disaster and its multifaceted effects for a decade.

2.1.1. Lower Omo River Valley

The Lower Omo River Valley in Southwestern Ethiopia is a semi-arid region with extraordinary biodiversity and a large number of distinct, indigenous pastoral, agro-pastoral, and fishing communities reside (Avery, 2013). However, over the last two decades, the lower Omo River valley has been

experiencing the expansion of large-scale commercial agriculture, infrastructure such as the Gibe Dam, and human settlement (International Rivers, 2011). While the protected areas in the lower Omo valley are increasingly facing challenges associated with land-cover change, this is endangering the future of these unique landscapes (Enawagw et al., 2011). Chiefly, agricultural expansion, livestock grazing, human settlement, and infrastructure development remain problematic, often resulting in the loss of natural habitat critical to ecosystem services for pastoral and agro-pastoral livelihoods and food security on which they rely.

Pastoralism and agro-pastoralism in the lower Omo River Valley usually imply an interdependent relationship between local ecology, livestock, and people (and their social institutions) in a resource-scarce, dry climate and highly variable conditions (Behnke et al., 1993; Nori et al., 2008; Reid et al., 2008). This interdependency represents a complex form of natural resource utilization and management involving a dynamic yet continuous ecological balance among pastures, livestock, and people (Nori et al., 2008; IFAD, 2009). To sustain their livelihoods and food security, the pastoralist and agro-pastoralist villagers have traditionally demonstrated pragmatic adaptive responses to climate and environmental changes (Behnke et al., 1993; Birch & Grain, 2008; and Nori et al., 2008). This livelihood option of the lower Omo valley is mostly considered an economically, culturally, and socially viable system for maintaining the well-being of communities and the environment because it can simultaneously provide secure livelihoods, conserve ecosystem services with honor cultural value and traditions (PFE et al., 2010; Lind et al., 2020). At the same time, the future agronomic potential and economic viability of this system will be directly dependent on the sustainable management of the natural resources base that is its foundation, constantly under pressure from the expansion of state activities, including Omo River hydro-power upstream damming and related large-scale sugar plantations. In which, particularly affected, important flood-retreat crop cultivation activities of pastoral and agro-pastoral villagers of the Dassenech.

These changes in the socio-environmental system are further expected to cause increased food insecurity and shocks among the Dassenech people, including frequent drought, malnutrition, and disease outbreaks. Thus, communities in the lower Omo Valley have been subjected to land tenure changes, ranging from occupation to disposition, due to upstream damming and the associated massive sugar plantation along the flood retreat and grazing lands. These changes, combined with political-economic marginalization, have made it increasingly difficult for villagers to sustain their flood-retreat-based livelihood system and fundamentally challenge their adaptive capacity to climate change and food insecurity.

Dassenech Woreda is found in the South Omo Zone of the southern regional state in Southwest Ethiopia. It is 860 km away from Addis Ababa and 205 km from Jinka. The woreda is bounded by Hamer woreda to the North and east, Kenya to the south, and Nyangatom woreda to the west and Northwest. The woreda covers a total area of 234,274 ha, with elevation ranging from 275 meters to 400 meters above sea level, and is found at a latitude and longitude of 4°48′N 35°58′ECoordinates: 4°48′N 35°58′E. It has only one Agroecological zone - Kolla (100%). The mean annual rainfall of the Woreda is about 350 mm. The annual mean temperature ranges from 30 °C to 40C (Dassenech Woreda Pastoral Development Office, 2024).

The Dassanech are the people who speak an East Cushitic language and live on the Ethiopia-Kenya border, on the northern shore of Lake Turkana, and further north along the Omo River. The population is estimated at 48,067 (CSA 2007 p. 84), and according to the Woreda Health Centre, the Dassenech population is currently estimated at 80,000. According to unpublished data from the South Omo Zone Administration, the Dassenech land area is 2,575 sq km. Until 2006, the area was part of the Kuraz woreda. Following the 2006 administrative restructuring, Dassenech land was elevated to a District (Woreda) level with its capital at Omorate, some 852 km south of Addis Ababa. The Dassanech Woreda is divided into 40 units called kebele.

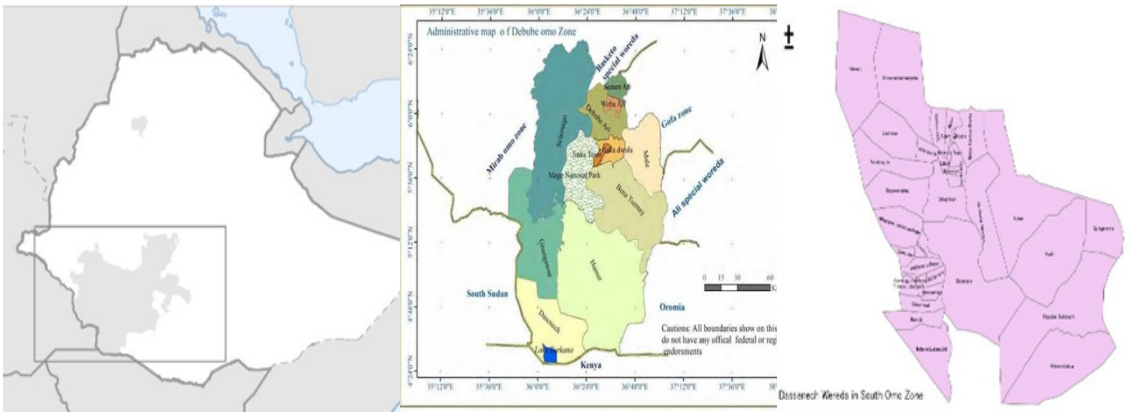

Figure 1: Dassenech Woreda Map at the right edge

2.2. Methodological Paradigm

In social science research, there are three major theoretical paradigms: positivism, phenomenology, or interpretativist, and pragmatism. Among these phenomenological or interpretivists, there is a long history in philosophy and sociology (Berger & Luckmann, 1967; Bruyn, 1966; Husserl, 1962; Psathas, 1973; Schutz, 1962, 1966). As Jack Douglas (1970) wrote, "The 'forces' that move human beings, as human beings rather than simply as human bodies . . . are 'meaningful stuff.' They are internal ideas, feelings, and motives" that important reality is what people perceive it to be. In which the interpretativist seeks to understand through qualitative methods, such as participant observation, in-depth interviewing, and others, that yield descriptive data (Vanderstoep & Johnston, 2009). Therefore, to understand social phenomena from the study participants' or actor's perspectives and points of view and to examine the world they experienced while exploring the trends and patterns of flooding disasters, impact of Omo River upstream damming on downstream pastoral and agro-pastoral communities, and the Dassenech seasonal flood-retreat agricultural practices while ensuring their food security and livelihood system from communities of Dassenech people perspective and experiences, the researcher employ phenomenological or interpretative epistemological paradigm.

2.2.1. Study Approach and Design

As Glaser and Strauss (1967), "grounded theory", theory may be said to be grounded to the extent that it is derived from and based on the data themselves. Therefore, due to the exploratory nature of this study, the researcher used a qualitative research design and employed participatory rural appraisal tools and techniques to address gaps in the proposed data collection methods. The merit that qualitative research design and participatory rural appraisal tools and techniques have towards this study critically enables the development of concepts, insights, and understanding about the study area of emphasis in this research paper. As well as to analyze, theorize, or build theory rather than collect data to assess preconceived models, hypotheses, or theories with the assumption that knowledge is constructed. Therefore, to explore and describe the phenomena under study in this research in a narrative fashion, the researcher adopted the perspective of the study target population, which taps into their interpretations and experiences regarding flood disaster risk management, social resilience, and coping strategies of the Dassenech people.

2.2.2. Sampling Procedure and Sample Size

Qualitative researchers are skeptical that any conclusions can be broadly generalized to a large population because any effort to generalize extrapolates the characteristics of a sampling unit beyond the context that gives it meaning (Vanderstoep and Johnston, 2009). There are several sampling

design methods that researchers may employ when sampling target populations in study areas. The design will likely differ by research type. Considering the purposes of this study and the major themes, the researcher employs a purposive sampling strategy. This enabled for in-depth understanding of the study area emphasis of this research, and offers greater flexibility, efficiency, and depth insight on the study population segments who are most relevant to the research questions as to ensures collected data is rich and directly pertinent to the study objective, as well to reveal meaningful and focused findings. As well as to best represent the study population. Indeed, Sample size is usually determined by the level and type of study analysis planned. However, the key is to sample enough rare groups to have meaningful responses for the study. Go for a sample size that gives meaningful results for the study that has been carried out.

However, for this study, the sample size is determined by the major themes under exploration. Therefore, the researcher tried to select an equal representation from the identified sample respondents of the study which includes; community leaders and elders, development agents; government entities representatives, such as pastoralist development affairs offices, Agriculture and natural resource development offices, pastoral productive safety net program (PSNP), Disaster response and resilience management (DRMM) sectors, Woreda Administrative Offices, Woreda health Offices, and livestock and fishery resource development offices. As well as representatives of non-governmental organizations currently active and operating in the study area, and Ghibe-III dam-related or concerned representatives. Which is constructed based on the data collection tools as described under each of the data collection instruments section of this research thesis. Therefore, the researcher purposively selects sixteen (16) key informants, twelve (12) in-depth interviewees, thirty-two (32) participants for the case study, and eight (8) focus group discussion participants, respectively.

2.2.3. Source of Data

The researcher used primary and secondary sources of data for the study. Indeed, the primary sources of data have been collected through key informant interviews, in-depth interviews, Focus group discussions, and case studies. Previous research papers related to pastoralists and agro-pastoralist issues especially about the study area and topic, unpublished research, reports, journal articles, and literature on historical, socio-economic, cultural, political, and ecological data, and project Intervention reports by GO and various NGOs working in the area have been used as secondary data. In addition, various research reports related to lower Omo Valley communities, specifically Dassenech communities, carried by individual researchers and local and international institutions, were critically reviewed. Then, the data from both sources have been used as background information and as building blocks to strengthen the presentation of the study findings and analysis.

2.2.4. Method of Data Collection

The backbone of every research is the collection of data that a researcher has identified as worthy of analysis (Papachroni & Lochrie, 2015). Interviews, survey questionnaires, publically available information, and audio-visual material are all potential sources of data for a researcher. However, collecting data can be a daunting experience, either because there is too little data or because what looked like a rich dataset has turned into a nightmarish sense of data overload (A. Papachroni and S. Lochrie, 2015). It is therefore helpful for evaluating data sources, saving valuable time and resources while also leading to better analysis and more robust results. What constitutes good practice when collecting data is very much dependent on the research tradition within which the study is placed either of qualitative or quantitative data collection tools, while considering the nature, purpose, and objective of this study the researcher employed qualitative data collection methods such as key informant interview, in-depth interview, focus group discussion, and case study.

2.2.5. Key Informant Interview

Key informant interviews are qualitative interviews with people who have knowledge and understanding of the specific topics of the study or problem being addressed in the community. According to Mikkelsen (2005), the representatives of key informant interviews were ordinary people, not necessarily specialists, and better educated than those in power or the officials. While, according to Julie Laforest et al (2009), key informants from the community under study are " privileged witnesses, people who, because of their position, activities or responsibility, have a good understanding of the problem to be explored. Therefore, to collect detailed data on the impact of Omo River Flooding and on Communities' Vulnerability, Livelihood resilience, and coping mechanisms, the researcher purposively selected four at most Omo River flooding disaster-affected clusters (Rate – Borkonoch, Kelem Cluster, Libemuket, and Delegnmur cluster). Indeed, the researcher conducted key informant interviews with 16 people, including purposively selected kebele community leaders, elders, representatives of social institutions, and development agents.

2.2.6. *In-depth Interview*

An in-depth interview is a proper qualitative data collection technique for a variety of purposes, including needs assessment, program refinement, issue identification, and strategic planning. According to Lisa et al. (2011), in-depth interviews are most appropriate when the researcher wants to ask open-ended questions that elicit in-depth information from relatively few people (as opposed to surveys, which tend to be more quantitative and are conducted with large numbers of people).

To collect and explore detailed information on proposed major themes under in-depth interview (i.e vulnerability to the effects of disastrous events, mode of adaptation in the past and today, and government development programs, policies, and strategies), the researcher purposively selects twelve (12) respondents through the purposive sampling method. Which includes selected government entity representatives, such as pastoralist development affairs offices, Agriculture and natural resource development offices, the pastoral productive safety net program (PSNP), the Disaster response and resilience management (DRMM) sectors, Woreda Administrative Offices, Woreda health Offices, and livestock and fishery resource development offices. As well as four (4) non-governmental organization representatives who are currently active and operating in the study area. Despite planned in-depth interviews with Ghibe-III dam respective or concerned representatives not being carried out due to time and cost limitations. Even though data collected via in-depth interviews helped the researcher address issues not covered in FGDs and key informant interview questionnaires, the data provided detailed elaboration. Throughout the process, the researcher developed in-depth interview data-collection guidelines and theme-based questionnaires to ensure data quality.

2.2.7. Focus Group Discussion

Focus groups are considered a reasonable alternative to conduct several individual interviews with participants in the discussion, which is used to generate qualitative insights or produce direct quotes that can represent the view of the group under study, as well as to fill the gaps of other data collection tools, which have been used for this study while accessing the view of those who would not be will or able to speak up at larger, group meetings. This is possible because FGD groups can be comprised entirely of people from specific disadvantaged groups who would not find it easy to discuss their particular opinions in a mixed setting (INTRAC, 2017). Therefore, for this study, the researcher brings together a group of eight (8) community members. The sampling of these selected group members was random; intentional decisions were made to achieve the best group composition in light of the study themes and probing questions. Then, under the guidance of an FGD moderator, the researcher engaged in a group question–and–answer discussion. As a result, nearly four (4) focus group discussions have been conducted. And each group consisted of eight (8) participants, and 32 people in total were selected who live alongside the downstream Omo River Valley villages

of the Dassenech communities (i.e., Rate, Kelem, Arikol, and Seremret kebeles). Indeed, focus group discussions with these kebeles provided immense qualitative data or information about villagers' adaptation and coping strategies to the effects of hazardous events (drought, flooding, disease outbreak i.e human and livestock, conflict, etc), effectiveness and impacts of government disaster risk management policy, government pastoralist, and agro-pastoralist resilience building program intervention has been the major themes of the discussion.

2.2.8. Case Study

There are several types of case studies. A researcher may choose to conduct a single case study or a collective case study. According to Scott W. and Deirdre D. (2009), a collective case study involves comparing several related cases. A case study can also be focused on one person, called a biographical case study, or on one event, called a critical incident study. This method of data collection enabled the researcher to explore and describe the nature of Omo River flooding and its impact on pastoral and agro-pastoral households' livelihood processes and strategies, as experienced by the Dassenech people of the lower Omo Valley.

Throughout, the data collection processes of this study, the researcher purposively selected four (4) villages. This is based on their vulnerability and exposure to the effects of floods, while mitigating those effects. Then villagers asked about the impact of flooding disaster management on local government. Details of the subjective aspect, such as feelings, beliefs, impressions, or interpretations, enabled an in-depth understanding of the villagers' flooding disaster experience. Semi-structured interviews have been administered to collect detailed data from selected villagers. The types of livelihoods, vulnerability context, and coping strategies related to flooding disasters, as well as trends in access to and use of disaster risk management systems, have been the major themes explored in the case study of this research.

Table 1. Summary of key data collection tools used and number of participants

SN	Types of Data Collection tools	Key Informant Interview	In-depth Interview	Focus Group Discussion	Case Study	Total
1	Number of participants per tools	16	12	32	8	68

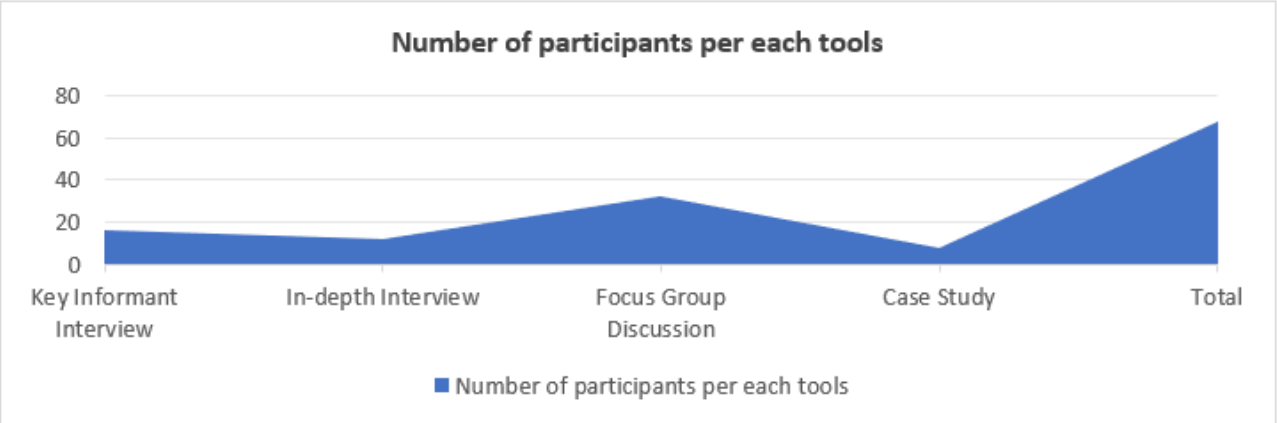

Figure 1. Graphical description of key data collection tools used and number of study participants

2.3. Data Analysis and Interpretation

The data gathered through the above qualitative data collection tools were organized in line with the objectives of this research study via employing qualitative analytical procedures. The data was

categorized logically, based on identified patterns within and between the concepts. Therefore, the research used content analysis guided by the grounded theory approach. The transcribed data was then categorized according to the themes that guided the discussions of this study; finally, all collected qualitative data were analyzed using thematic analysis. Connections and reflections between theory and practices on the ground have been discussed using the early warning system conceptual Framework Analysis, which guides the drawing up of conclusions and recommendations regarding the study.

3. Results

3.1. Flood Retreat Agriculture

Flood-recession farming is mainly practiced in arid and semi-arid areas. It is a unique form of water resources management that often uses water from ephemeral streams for various agricultural activities. It is climate-smart agriculture that can be widely applied to crop production, agroforestry and rangeland management, and domestic and livestock water supply. While flood retreat farming can be expressed through; spate irrigation – direct diversion of flashy floods in to the downstream command area; flood inundation and recession – river overflow their embankments and flood adjacent areas; flood spreading weirs – direct division/storage of flashy flood in to the upstream side command area (Erkossa et al., 2021). Across the world, flood-based farming systems account for 15-30 million hectares (IGAD, 2014). According to IGAD (2014), it supports around 75 million of the most vulnerable segments of society worldwide. These ephemeral streams are also sources of fertile sediment, which is characterized by deep, fertile soil suitable for flood-retreat agriculture as a result of alluvial deposition. Mostly spate irrigation found in the middle East, North Africa, West Asia, East Africa, and parts of Latin America (IGAD, 2014). In some countries it has long history – more than 5000 years like Yemen, Pakistan, and Iran (Steenbegen et al, 2011). Indeed, it covers over 1.5 million hectares in Ethiopia and borders Kenya; its potential could be higher (IGAD, 2014). In Ethiopia, it is widely practiced in areas such as the Omo Ghibe River, the Raya Valley, Kobe, the Fogera/Lake Tana, Baro Akobo, Wabishebele, the Upper Awash/Becho Plains, etc. Arid and semi-arid areas of Ethiopia mostly practice flood-based farming systems (IGAD, 2015). It mainly occurs in areas with flat, lowland terrain.

The Omo River basin in Southwestern Ethiopia is one of the potential areas for flood-retreat agriculture in Ethiopia. Downstream pastoral and agro-pastoral communities in the lower Omo Valley practice flood-retreat farming to supplement their livelihood systems and ensure food security. The type of flood-retreat farming that is extensively practiced along the narrow strips of the Omo River is flood recession agriculture, where these areas are irrigated by overflooding of the banks and river deltas. The total area under flood recession is set at 11,037 ha, but this includes riverine woodlands, open bush land and bare soil as well (Nederveen, 2011; IGAD, 2015). In a water resources study on the Omo Ghibe River Basin, flood recession is a land-use class associated with the river delta. It is also reported to occur in narrow bands along the banks of the Lower Omo Valley (Woodroofe and associates, 1996). The fluctuation of the flood size over the years makes it difficult to precisely quantify the flood recession area. However, it is estimated that 100,000 people depend on the system (Woodroofe and associates, 1996). With the developmental intervention along upstream of Omo river basin - the Omo Ghibe I, II, III hydropower development dam projects and associated large scale irrigation schemes, the flood recession agriculture have been affected seasonally. As a result, the agro-pastoralist is unable to cope with the changing nature of the Omo River Basin and its associated impacts, including food insecurity and social displacement. Even though, following Omo River flooding, Dassenech pastoral and agro-pastoralists seasonally engage in flood-recession agriculture to cultivate cereal grains (i.e., sorghum) as well as to secure pasture for their livestock. Despite recent decades, the situation has changed due to government intervention upstream of the Omo River Basin.

3.2. Internal Displacement

As widely known, disaster consequences depend not only on the socio-economic conditions of the affected communities but also on the institutional preparedness and capacity to manage such events (ICPAC, 2023). Thus, to be able to predict when events will happen and the impacts they are likely to have on the ground is of extreme importance for building strong institutional responses. According to the IGAD Climate Prediction & Applications Centre (ICPAC, 2023), severe drought and flooding have contributed to extensive displacement over the last fifty years. Displaced persons from disasters can be particularly vulnerable to rights violations, including a lack of access to essential security, basic needs, community life, education, and other basic amenities. Vulnerable groups, including socially marginalized population, children, older persons, and those with disabilities especially at risk. For governments, both short-term and protracted displacement pose serious socio-economic challenges to basic service provision, social cohesion, and individual and collective well-being. High levels of displacement moreover prejudice sustainable development and have the potential to undermine broader developmental gains, particularly if the needs of these affected are not adequately addressed (ICPAC, 2023).

Disaster displacement is inherently multi-casual and occurs with spectrum of scenarios in which natural hazards combines with other factors to produce disaster situation. Disaster displacement is a consequence of the interaction between a hazards, exposure and vulnerability (PFDD, 2020). The flooding disaster caused the Omo River to overflow, not only damaging social service-providing institutions but also creating large-scale internal displacement among pastoral and agro-pastoral villagers of the Dassenech people. Which disrupt the socio-economic and livelihood systems and the provision of social services in nearly 28 kebeles of the district. According to the District Early warning and Disaster risk reduction development Office (2024) a total of 16,648 households have been displaced, which aggravate their vulnerabilities to the effects food insecurity, disease epidemic etc.

3.3. Impact on Pastoralist and Agro-pastoralist Livelihood

The Gibe III dam and the irrigated agricultural enterprises it enables would usher in massive-scale indigenous livelihood and natural resource destruction in the lowermost Omo Basin, Kenya's Lake Turkana region, and overall in the tri-nation border region. The dam radically reduced the Omo River's downstream flow volume by at least 60–70% and caused a precipitous decrease in inflow to Lake Turkana during the reservoir-filling period and beyond (Claudia, 2017). Such loss of river flow volume would destroy critical fishery reproductive and life-cycle conditions and desiccate riverine and Omo Delta habitats for flood-recession agriculture, livestock watering, and last-resort livestock grazing of the Dassenech people. It would also eliminate the pristine Omo riverine forest, which is the last of its type in sub-Saharan Africa and one of the richest remaining wildlife areas of Ethiopia. As well low-lying locales for recession agriculture along annually flooded riverside sand spits and waterside flats. Thus, environments are vital to the survival of the indigenous residents of the Dassenech pastoralists and agro-pastoralists. This destruction was significantly worsened by dams, enabling large-scale irrigated agricultural enterprises, such as sugar factories, to plant along the Omo River basin. The catastrophic level of impact would have already occurred by even the end of the Dam's closure for reservoir filling. Even though artificial flood program espoused as a solution after the filling period, it would be entirely inadequate to prevent the recurrent occurrence of flooding disaster among pastoral and agro-pastoral communities' who resides at the lower Omo valley. Despite it causing massive damage and worsening the crisis of the people of the Lower Omo Valley, specifically the Dassnech. pastoral and agro-pastoral communities.

The damage of pastoral and agro-pastoral livelihoods of the Dassenech swiftly produce major humanitarian disasters including recurrent occurrences flooding and drought in the area, with widespread conditions of starvation, disease and spiraling interethnic armed conflict in the tri-nation border region as groups desperately compete for vanishing livestock grazing natural resources. Policies affecting the Gibe III dam and attendant irrigation agriculture violate the UN-recognized human right to adequate water and its associated right to a livelihood for thousands of indigenous

residents (Claudia, 2017) in the lower Omo Basin. Additionally, the central abstraction of river water for these large-scale, commercial irrigated farms along the Omo River would both multiply and indefinitely extend the radical impacts of the natural Omo flow pattern. In combination, these two significant sources of water denial to downstream communities and the emanation of the natural bases of the Omo River's annual flooding, which are vital for the livelihoods and survival systems of downstream pastoral and agro-pastoral communities. As result most of the Dassenech pastoral and agro-pastoral communities that have been expropriated from their traditional land along the lowermost Omo have no option but to take refuge within (or nearby) the modern Omo delta and border area of lower Omo valley region. This involuntary movement into the delta region considerably worsens the already crowded conditions in the border region, specifically for the Kenya Turkana pastoralists.

3.4. Implication of Flood-Retreat Agriculture on Food Security

The reduction of poverty and achievement of sustainable food security are the major challenges in the semi-arid areas of East Africa (Devereux and Maxwell, 2001; Challinor et al., 2007). The prevalence of food insecurity and related vulnerability is generally high in rural part of Ethiopia, where 84% of population live (Sileshi et al., 2019). This is due to the level of vulnerability and food insecurity mainly depends on the performance of agriculture in which largely depends on a combination of both natural and man-made factors including rainfall patterns, land degradation, population density, climate change, low level of rural investment, drought, flooding and etc (Gelaw and Sileshi, 2013). In addition, access to resources and institutional factors, such as land and labour, infrastructure, technologies, and geographic suitability, also affect the level of communities' vulnerability to food insecurity through the channels of agricultural production and rural incomes. Even though the effort made to reduce the prevalence of poverty and vulnerability to food insecurity (VFI), both chronic and transitory persist at the household level and millions of people are still vulnerable due to the recurrent occurrences different shocks and stresses (FAO, 2015; Sileshi et al., 2019), across arid and semi-arid areas of East Africa.

Different literature indicate that poverty and vulnerability to food insecurity in Ethiopia remains very high, on average 32 – 40% of the Ethiopia's population are undernourished and consume less than the recommended daily calories (IFPRI, 2015). Moreover, FAO (2016), indicates that more than 10.2 million people needed food assistance, and the severity of food insecurity become among the worst globally, with record-breaking food assistance driven by the impact of prolonged drought, ongoing insecurity, and multiple environmental hazards (WFP, 2023). As a result, multiple areas of the country face the potential for more extreme outcomes associated with high levels of acute malnutrition, hunger-related mortality, and the need for scaled-up and sustained food assistance (WFP, 2023), most severe in the lower Omo region of Southwestern Ethiopia.

The ecological zone of the lower Omo Valley region of Southwestern Ethiopia has intermittently experienced food insecurity, with an increasing frequency of extreme weather events, including drought, disease outbreaks, and flooding. In this region, the agro-pastoral communities of the Dassenech have been regarded as a food insecure area due to frequent occurrences multifaceted environmental and climate change effects. However, flood-retreat agriculture along the Omo River has been the primary and most reliable source of food, particularly during the dry season. Up to 85% of the total annual sorghum crop, the main agricultural staple in the area, came from these sources (Tebbs et al., 2019). As a result of the Omo River upstream damming impact, the primary source of stable crop, flood-retreat agricultural practices, has become no longer available due to changes in the river flood-regime, as well as affecting a wide variety of coping strategies that agro-pastoral communities of the Dassenech have utilized. Upstream induced multiple environmental challenges have hindered their effectiveness. Despite communities already receiving some support in the form of PSNP and food aid, this change made upstream of the Omo River Basin intensified the impacts of multiple environmental shocks, which exacerbated communities' experiences of food insecurity.

"The live and livelihood of the Dassenech pastoral and agro-pastoral communities entirely depends on Omo River. Even though, over the last 6 – 7 years, the situation has changed and it has become a disaster rather than a valuable natural resource for pastoral (agro) villagers. As result caused severe damage on nearly 28 villagers of Omo River surrounding kebeles. Much of such a change occurred mainly due to government development intervention programs in the upstream of the Omo River basin.

This has totally altered the natural and seasonal flow patterns of the Omo River and the benefits it has brought to the communities (i.e., flood-recession crop cultivation and fresh pasture for livestock). The consequences of flooding disaster contributed to extensive internal displacement, but also affected District institutional preparedness, and capacity to manage the situation. Even though non-governmental organization able to provide humanitarian aid support, both immidate and short-term, protracted displacement posed serious socio-economic challenges in-terms of access to basic services provision, social cohesion, and individual and collective well-being of the pastoral and agro-pastoral villagers of the Dassenech people".

Figure 2. Asnakech Wakshum – District Disaster risk reduction team leader – in-depth interview participants, (2024)

3.4.1. Adaptation and Coping Strategy

Most frequent and severe extreme climate events have caused both economic and non-economic losses and damage to local communities in most disaster prone areas (Paudel et al., 2025). Particularly those with limited resilience capacity to adopt through various coping and adaptation strategies in the aftermath of disasters (Paudel et al., 2025) emerge as the most vulnerable social group and often demonstrate vulnerability during non-flood years or seasons due to their marginal socio-economic status and subsistence livelihood system. Even though adaptation measures taken by local villagers through their indigenous knowledge system and practices have helped to prevent human causalities, despite mitigating livelihood system losses remains a challenge as flooding disaster continue to devastate their farm, and grazing land which underscored the need for improved flood management strategies to safeguard rural communities livelihoods systems (Paudel et al., 2025).

The survival and coping strategies of trans-boundary ethnic groups in the Lower Omo Valley downstream pastoral and agro-pastoral communities have emerged from centuries of indigenous knowledge and highly adaptive survival strategies. The ethnic groups mostly heavily dependent on the Omo River in the lower Omo river basin, includes the Mursi, Bodi, Kwegu, Suri, Kara, Nyangatom and Dassenech (Claudia, 2017). This long-standing indigenous survival system of the pastoral and agro-pastoral communities in the face of disaster enables them to cope with the effects of Omo River flooding by adapting to the agro-ecology and environment to meet their needs through managing the relationships between their social and livelihood systems and the environment. This enables the pastoral and agro-pastoral villagers to build adaptation strategies for their social and livelihood needs. At the same time, furnish, maintain, and renew itself through a traditional knowledge system and recovery mechanisms to minimize the risk and damage from seasonal Omo River flooding. According to Claudia (2017), these Ethnic groups in the trans-boundary region of the Omo River Downstream pastoral and agro-pastoral communities have historically been emphasized, at least until recently, when huge numbers of them have had to rely heavily on agriculture, mainly livestock herding and flood recession crop cultivation. Like pastoral peoples throughout semi-arid Africa, they have survival systems that comprise strategies for both risk minimization and recovery from livelihood setbacks. Adaptability is key to the survival of these indigenous groups throughout the lower Omo Valley region. This is especially true in the context of the trans-boundary area's wide range of environments and periodic principal stresses, including prolonged drought, livestock and

human disease epidemics, severe crop loss, and shifting regional exchange relations and interethnic hostilities. Pressure on each group's capacity for adaptation is heightened by multiple decades of problematic government policies and especially change brought by the government of anticipated Gibe III dam, along with its linked agricultural and energy transformation enterprises which affect the social and livelihood survival system of pastoral and agro-pastoral villagers of the area

Further, the livelihood systems of these lower Omo Valley pastoral and agro-pastoral groups also incorporate strategies for both risk minimization and recovery from economic or livelihood losses caused by the Omo River flooding disaster. These general characteristics include the maximum accumulation of capital, livestock historically being dominant as 'capital' for meeting both immediate subsistence and long-term food security needs, and high mobility of livestock herds and village settlement. Complex and flexible seasonal movements between upland pain environments and riverine or lake zones during Omo River flooding provide the ability to respond to changing environmental and social conditions. Diversification of livestock types (cattle, small stock – goat and sheep), economic diversification to alternative production activities, including:- flood recession agriculture (the only agricultural practices possible in the lowermost Omo basin) on low flats along the Omo river and modern delta lands low enough to receive annual flood waters, and fishing along the Omo river using primarily rafts and other minimal local equipment's. Such strong and pervasive social reciprocity and relationship within their social and livelihood system whereby material, labor and other forms of social exchange among villager provide precautionary as well as recover measures while flooding disaster occur in the area.

These relationships are generally rooted in age-set-based authority systems, as well as clan/lineage and affinal (in law) relationships. From this complex set of pastoral and agro-pastoral survival strategies, the most common means of villagers recovery from livestock loss due to drought, disease, conflict and other hazards like;- temporary movements of herds into peripheral lands in search of pasturage and water, short-term barter of small stock with the same or neighboring ethnic groups to meet immediate food needs, exchange or sale of animals, farm and fishing products, raiding of neighboring ethnic group herding camps and villages for livestock seizure, use of social exchange network (for loans, gifts, and labor cooperation) meet household needs and rebuild livelihood systems, and temporary reliance on subsidiary livestock production activities.

3.4.2. *Institutional Response*

In building resilience to disasters, there is the need to fully understand, manage, and disseminate foundation of disaster risks reduction (Dukiya and Oghenah, 2021). Though to deal with the impact disastrous event the leadership should establish a national culture of resilience, a full and clear commitment to disaster resilience by government and non-government development entities. As risk management is a continuous process that identifies the hazards facing local communities, assesses the risk from these hazards, develop and implement risk management strategies, re-evaluate in the context of changing socioeconomic and demographic characteristics of a community play vital role to build the resilience capacity the most vulnerable social groups (Dukiya and Oghenah, 2021). An effective disaster risk management system can only be achieved if disaster management is mainstreamed into every sectoral development plan, including at the grassroots level. So Disaster risk management shouldn't be considered a cutting issue; rather, it is the responsibility of multiple sectoral institutions, and thus concerned bodies must implement it by integrating it into their regular development activities. Despite this, attention has not yet been given to early mainstreaming. Thus, it is not being implemented unless disaster risk management is considered integral to the development plans and programmes of sectoral institutions. Unless it can be ensured, continued and sustainable development at national, regional, and local levels can be difficult.

3.4.3. Omo River flooding Based Livelihood System

Effective Disaster Risk Management system can only be achieved if disaster management is mainstreamed into every sectoral development plan including at grass-root level. Disaster risk management is a cross-cutting issue and the responsibility of multiple sectoral institutions, and thus concerned bodies must implement it by integrating it into their regular development activities. Despite attention not yet being given to early warning mainstreaming, it is not being implemented unless disaster risk management is considered integral to development plans and programmes of sectoral institutions. This can make it difficult to ensure continued and sustainable development at national, regional, and local levels. In the lower Omo Valley, the Omo River rises during the rainy season. It overflows its banks, flooding the plains downstream of the KORO cluster (i.e., Diba, Abaloka, Andigur, Gaguto, Bangara, Nigkol, among others). Which permits crops to grow on these soil moisture flood-recession cultivation lands after the floods recede. Further upstream, where the valley slopes are too steep to allow large-scale flooding, areas of recession crops are grown on the riverbanks, especially where silt has been deposited at river bends. Flood recession cropping is important for the downstream cluster communities, more specifically for the Koro/libemuket and Delegnmur agro-pastoralist communities, which supplement their livelihoods from the Omo River. Grain, more specifically sorghum two rounds produced (i.e 9 – 15 Quntial of sorghum products) from flood recession cultivation, which is sufficient for 3 – 6 months for household consumption as well as for market sales. Thereafter, they depend on livestock products, small scale irrigation, fishing, and non-farm business activities. In addition to flood recession crop cultivation, seasonal Omo River flooding enables these villagers to access fresh pasture for their livestock, which significantly enhances livestock production and productivity in the area. These livelihood activities related to the Omo River seasonal flooding make them more food-secure than other clusters in the district and less vulnerable to the effects of recurrent droughts.

Except sorghum, which is critical for meeting both subsistence and exchange needs, other crops have been grown primarily for household consumption. As per respondents' sorghum has lower water requirements than maize and it is well suited to shifting Omo River seasonal flood recession conditions-certainly by comparison with maize. Moreover, in a good flood year, villagers can produce two round sorghum crops. Beyond its importance as a household food staple, sorghum is widely traded for small stock (Goat and sheep), even cattle – both within the clusters of villagers' economies and in the broad arena of interethnic exchange. Sorghum yields are determined by multiple factors, including the type of sorghum planted in the flood-recession area, the extent and duration of the Omo River flood, soil type, and land-use practices. These agro-pastoral villagers cultivated up to fifteen or twenty distinct types of sorghum, depending on the duration and flood-recession practices of the villagers. Labor for flood-recession agriculture is highly variable across cluster communities. Some have pervasive cooperation across most phases of farming, while others have relatively sharp household delimitation of plots, accompanied by limited cooperation – primarily for land preparation and harvesting. Crop diseases are sometimes exacerbated, especially by insect infestation. Knowledge and management of these conditions have been key to the sustainability of these systems – in contrast to unsustainable ones introduced by government and other entities.

In addition, wild food gathering is critical for villagers' survival, especially during harsh times. These include periods of prolonged drought when livestock milk and other products are reduced, or when the Omo River seasonal flood is insufficient for flood-recession crop cultivation or successful fishing. The poorest of the cluster villagers, those without livestock and farm plots, rely on this food source much of the time, particularly in recent times. Most wild food gathering is done in the riverine and delta zones in the cluster – precisely the environment most in line for desiccation from the destroyed from the effect of the Gibe III dam and irrigated commercial agricultural enterprises. In the cluster, villagers fish as part of their livelihoods, with thousands of households engaging in flood-recession agriculture. Since 2012, Omo River flooding has had a devastating impact on the livelihoods of the cluster villagers, mainly due to government development interventions upstream of the Omo River basin.

4. Discussion

4.1. River Basin Development – Development Versus Disaster

Many disasters are exacerbated by climate change, including increased intensity and frequency of extreme weather event. Flooding disaster risk reduction strategies significantly contributes to climate change adaptation efforts. Adapting to climate consequences protects local communities, their livelihood systems, infrastructure, and natural ecosystems, especially for the most vulnerable social groups with the fewest resources to cope with flooding disasters in the pastoral and agro-pastoral communities of the Lower Omo Valley region. Even though few development initiatives in Sub-Saharan Africa have the economic and political importance to river basin development, whether in terms of the sheer scale of the undertaking or the magnitude of social, climate, and environmental transformation. The impact on the future of entire nations, or controversy regarding the beneficial versus destructive outcomes of Omo River upstream damming, has further become a critical concern for the lower Omo Valley pastoral and agro-pastoral villagers. For a nation-state like Ethiopia, the nearly unparalleled capital intensity of major dam and physical infrastructure projects, along with linked agricultural and industrial development, requires major infusions of international capital—nearly always. According to Claudia (2017), the lower Omo River basin and Lake Turkana region are one of Sub-Saharan Africa's most culturally diverse areas – home to at least 13 distinct ethnic groups speaking languages of Cushitic, Eastern Nilotic, Omotic, and Afroasiatic origin. Those indigenous groups nearest the tri-notion border area – the Dassenech, Nyangatom and Northern Turkana are primarily pastoral and agro-pastoral by tradition and have remained so far centuries, although with many adaptations. The harsh semi-arid climate in which they reside has contributed to their complex and flexible survival strategies for coping with changing climate, environmental and social conditions. The Omo River and Lake Turkana are core components of the survival systems for much of the regions indigenous groups, most of whose livelihood system are trans-boundary in nature. The survival of more than 500,000 of the region's pastoralists and agro-pastoralist require access to adequate water and living resources from the Omo River and Lake Turkana. The trans-boundary ethnic groups are linked together by a network of interethnic material and social exchange relations – a system essential to the survival of each groups. In recent years, however, nearly all trans-boundary groups have had to cope with a sharp decline in their capacity to sustain pastoral and agro-pastoral livelihoods. This stress has reverberated across all groups in the lower Omo valley as a result of flooding-induced climate change.

The precipitous decline of the herding economy and pastoral and agro-pastoral life, and the virtual collapse of some areas, is largely the product of the dispossession of resident groups by powerful external economic and political forces. Although they have sustained complex and flexible strategies for coping with prolonged droughts, disease epidemics, social conflict, and other hardships for centuries. The region's ethnic groups no longer have the conditions necessary for recovery from these major stress periods. For individual groups, these conditions center on access to sufficient land, pasturage, and water resources to implement long-term livestock herd diversification, overall production diversification, and maintenance of strong internal reciprocity relations, among others. Whose segments of these indigenous groups have been forced to migrate along the Omo River and around the shores of Lake Turkana in recent years. Tens of thousands of Dassenech people and Nyangatom residents have settled along the Omo River, where they rely primarily on combinations of flood-recession agriculture, livestock raising, fishing, and wild-food gathering and hunting. Thousands of other Dassenech have migrated from their Ethiopian homeland to join Dassenech settlements along Kenya's extreme northeastern shores of Lake Turkana, so the group is clearly cross-border in extent and vulnerable to the effects of multiple disasters.

4.2. Risks and Opportunities of Omo River Flooding

According to the UN Sustainable Development Goals Report (2025), the global issue of hunger and food insecurity has shown an increase since 2015, a trend exacerbated by a combination of fac-

tors, including the outbreak of a pandemic, conflict, climate change, and deepening inequality. The report reveals that an estimated 8.2% of the global population faced hunger, and nearly 2.3 billion people, about 28%, were moderately or severely food insecure. A recent study shows that the occurrence of disasters underscores the importance of shifting from post-disaster emergency actions to pre-disaster mitigation. The impact of disaster not only intensify hunger and food insecurity among the most vulnerable social groups, it also seriously disrupt local communities with massive human, materials, and environmental losses, which exceed the ability of affected society to cope using their own resource.

Across the continent, dry-land areas are challenging environments where human ingenuity, traditional knowledge systems, and the efficient and careful use of natural resources are essential for survival and food security. Globally, drylands represent 45.4% of Earth's total terrestrial area, and Eastern Africa's dryland cover nearly 47% of the land, or 328 million hectares (Desta et al., 2024). In which 55% of Ethiopia's dryland areas are constantly facing an increasing number of recurrent droughts and food insecurity, leading to a decline in the potential for adaptation to shocks and risks (Davies and Bennett, 2007; OCHA, 2007). Due to the regular occurrence and cyclic nature of drought and flood in the lowland regions of the country increasing disasters have become common characteristics of large parts of the lowland pastoral and agro-pastoral population (Muller et al., 2010). Floods are widely recognized as one of the major environmental hazards and catastrophic natural disasters in Ethiopia, and their physical manifestations have increased over the years (OCHA, 2007; Amede et al., 2022).

Even though managing Omo river floodwaters for productive agricultural use is one of the flood mitigation strategies, that reduce the risks of flood hazards and simultaneously addresses food security concerns or issues of lowland environment (Gain et al., 2017; Amede et al., 2022; Zenebe et al., 2022) lower Omo valley region. However, many research findings indicate that flood-retreat farming systems are an entry point for efficiently utilizing hazardous floods for agricultural production through various agricultural practices (Mekdaschi and Liniger, 2013; Tamagnone et al., 2020). Flood retreat agriculture: Steenbergen et al. (2011) noted that it contributes to food security and provides numerous environmental benefits across a wide range of geographies by making floodwater available for agricultural use. Which is important for nutritional security and agro-pastoralist coping mechanisms during the dry season, when other food sources are depleted (Singh et al., 2021), including livestock herd size. Annual Omo river flood were important in flood-affected areas of Lower Omo valley region, where flood retreat agricultural practices have been an effective solution to meet their food security and sustain livelihood (Motsumi et al., 2012; Balana et al., 2019; Tariq et al., 2020) of the agro-pastoral communities of the Dassenech people. Therefore, informed decision-making on flood risk and flood agriculture strategies, using combined indigenous and best agricultural practices within the magnitude of suitable flood areas, revealed that flood retreat farming was an entry point for boosting agricultural production in the drought-affected and food-insecure areas of the lower Omo valley of Southern Ethiopia. In which the food crops grown in flood-retreat farmland could not sufficiently meet household food needs due to recurrent drought, which causes severe food insecurity in the area. As a result, the abilities of agro-pastoral villagers to adapt to shocks and risks decrease. Despite the opportunities for flood retreat agricultural practices, the agro-pastoralist food security and survival strategies are poorly understood, while before the establishment of Omo River upstream damming and associated large-scale sugar plantations, agro-pastoralist flood retreat and livestock grazing farmlands were located downstream.

4.3. Omo River Flooding and Ghibe –III Hydropower dam

The Omo River (in Amharic, Romanized Omo Wenizi; also called Omo – bottego) in southern Ethiopia is one of the largest rivers in Ethiopia outside the Nile Basin (ibid). It courses entirely within the boundaries of Ethiopia and empties into Lake Turkana on the border with Kenya (Ibid). The river is the principal stream of an endorhetic drainage basin, the Turkana Basin. The river basin is the famous for its large number of early hominid fossils and archeological findings such as early stone tools, leading to its inclusion on the UNESCO World Heritage list in 1980 (ibid). The Omo River forms through the confluence of the Gibe River by far the largest total tributary of the Omo River, and Wabe river, the largest left-bank tributary of the Omo at 8°19′N 37°28′E. Consequently, the whole river basin is sometimes called the "Omo-Gibe River Basin". This river basin includes part of the western Oromia Region and the middle of the Southern, Nations, Nationalities

and people's region (ibid). According to IGAD (2015), the Omo Ghibe basin is one of the most important water resource basins in Ethiopia, as it carries close to 13% of the country's annual surface water resources, next to Abay and Baro-Akobo. Moreover, the basin is one of the largest hydropower potential next to Abay. Despite these huge resource potentials, the Ethiopian people, in general and those in the basin in particular, have benefited little so far (Eyasu et al., 2015).

Even though the Omo River is mostly considered a lifeline for southwest Ethiopia's indigenous lower Omo Valley pastoral and agro-pastoral peoples, whose food security and economy depend on the river and seasonal flooding and subsequent flood-retreat cultivation of the riverbanks (Hathaway, 2009). The lower Omo valley is home to an estimated 500,000 people, many of whom practice traditional pastoralist and agro-pastoralist livelihoods (Hathaway, 2009). At least eight distinct indigenous communities in the isolated lower Omo valley depend on the river flood cycle: the Mursi, Bodi, Muguji (Kwegu), Kara, Hamer, Besheda, Nyangatom, and Dassench. Although many keep livestock, cultivation is essential to local livelihoods as grasslands are becoming more degraded and herding more vulnerable as a result of recurrent droughts.

Despite the government having invested huge resources in the Gibe III hydropower dams, it has not adequately considered either the rights of these indigenous communities or the risks that the Dam poses to them. According to Hathaway (2009), there are concerns that hydropower dam projects have and will continue to result in violations of human rights outlined in Ethiopia's constitution and the 2007 UN Declaration on the Rights of Indigenous Peoples. If the Omo River's seasonal flood is reduced, as well as the consequent occurrence of flooding disasters, it disrupts the entire subsistence economy and livelihood system of the Lower Omo Valley communities. Not only food security but trans-boundary regional peace and security are severely threatened as well. Mitigation and compensation measures related to the dam's impacts are wholly inadequate, undermining the existing subsistence economy and impoverishing a politically vulnerable of the Dassenech pastoral and agro-pastoral population as Hathaway (2009) described and argue that;

> "The rise and fall of Omo River is the heartbeat of the lower Omo valley more than any other factors, the river determine everyday economic practices of the region". "If the dam reigned in the seasonal Omo river floods, the entire economy and way of life would be just as eroded as the river banks. Livelihood will be fundamentally transformed, from a wide-ranging independence to dependence on external dynamics. It will alter tribal life in so many ways that it is difficult to imagine a positive outcome". The Dam will destroy the basis of several cultural identities".
>
> Terri Hathaway (2009)

4.3.1. Effects of Upstream Damming and Associated Sugar Plantation

The Gibe III dam and irrigation agricultural enterprises would usher in massive-scale destruction of indigenous livelihoods and natural resources in the lowermost Omo Basin. The dam radically reduced the Omo River's downstream flow volume by at least 60–70% and caused a precipitous decrease in inflow to Lake Turkana during the reservoir-filling period and beyond (Claudia, 2017). Such loss of river flow volume would destroy critical fishery reproductive and life-cycle conditions and desiccate riverine and Omo Delta habitats for flood-recession agriculture, livestock watering, and last-resort grazing of the Dassenech people. It would also eliminate the pristine Omo riverine forest, which is the last of its type in sub-Saharan Africa and one of the richest remaining wildlife areas of Ethiopia. As well low-lying locales for recession agriculture along annually flooded riverside sand spits and waterside flats. Thus, environments are vital to the survival of the indigenous residents of the Dassenech pastoralists and agro-pastoralists. This destruction was greatly worsened by dams, enabling large-scale irrigated agricultural enterprises, such as sugar factories, to plant along the Omo River basin. The catastrophic level human destruction would have already occurred by even the end of the Dam's closure for reservoir filling. Even though the artificial flood program was espoused as a solution after the filling period, it would be entirely inadequate to prevent massive livelihood destruction among pastoral and agro-pastoral communities residing in the lower Omo valley; rather, it caused massive damage and worsened the crisis of the people of the lower Omo valley, specifically the Dassnech. pastoral and agro-pastoral communities livelihood system.

Policies affecting the Gibe III dam and attendant irrigation agriculture violate the UN-recognized human right to adequate water and its associated right to a livelihood for thousands of indigenous residents (Claudia, 2017) of the lower Omo basin communities. As well, major abstraction of river water for these irrigated large-scale commercial farms along Omo River would both multiply and indefinitely extend the radical reduction of the natural Omo flow volume and Turkana lake inflow during the Gibe III reservoir filling period. In combi-

nation, these two major sources of water denial to downstream communities and the emanation of the natural bases of Omo River's annual flooding, which is vital for the sustenance of downstream pastoral and agro-pastoral communities' survival systems, create catastrophic losses to their livelihood systems – more importantly, the flood recession agriculture. As result most of the Dassenech pastoral and agro-pastoral communities that have been expropriated from their traditional land along the lowermost Omo have no option but to take refuge within (or nearby) the modern Omo delta and border area of lower Omo valley region. This involuntary movement into the delta region greatly worsens the already crowded conditions region.

Figure 3. FGD particpants Rate-Borkonech villagers (2024)

"Before two-three decades we have had a prosperous period and have better live and livelihood. Through our flood recession agriculture, we even produce enough and surplus sorghum, which enables us to cope with the seasonal occurrences of drought and other multifaceted disaster risks. Over the past 10 years, our villages have become increasingly vulnerable to the effects of drought and food insecurity, as well as to government development intervention programs in the upstream of the Omo River basin – the Gibe III dam. Even though, as result of the most recent Omo River flooding, not only we lost our flood-retreat agricultural practices, but also every things that we have had (our home and residential places, flood recession and irrigation farm land as well small ruminates (goat and sheep) have been taken away by the river flood".

4.3.1.1. *Gibe III dam Risk to the Lower Omo Valley Downstream Agro-pastoralist*

Pastoral and agro-pastoral communities of the Dassenech people have historically faced social, economic, and political marginalization. The great majority of the people is totally dependent upon access to natural resources. This isolated resource economy, in turn, is highly dependent on the Omo River's seasonal flooding cycle. Impact has been rippling across the area, touching all those engaged in local economy. The Gibe III dam brought two types of change on the pastoral and agro-pastoral communities of the Dassenech people. First, traditional livelihood based on flood recession cultivation have been significantly eroded, and secondly create huge damage and devastation on the live and livelihood system of the people as result of artificial flooding released from the dam reservoir.

Figure 4. Asaminew Demsse – Head of ANRDO (In-depth interview respondent, 2024)

"The most and main reason for the Dassenech pastoral and agro-pastoral communities' vulnerability and exposure to the effects of Omo River flooding were caused by unanticipated government development intervention at the upstream of Omo river basin. This created and caused prolonged drought, food insecurity, and diseases epidemic in the area".

Even though, as per the informant of this study, the change in the natural patterns of Omo River flooding caused by the Gibe III hydropower dam negatively affects the downstream pastoral and agro-pastoral Dassenech Communities in the lower Omo Valley. As a result, they lost their traditional flood-recession crop cultivation system, seasonal grazing land, and disrupted the socio-economic well-being of the rural villagers. Further, more recently, Omo River flooding caused incompensable damage to the lives and property of nearly 28 kebeles in the district.

4.3.1.1.1. Livelihood Abuse on Agro-pastoralist Flood Retreat Cultivators

The Ethiopian government forcibly displaced pastoralist and agro-pastoralist indigenous communities of the lower Omo valley and make away nearly 245,000 hectares for state run sugar plantation linked to the development of upstream damming of the Gibe III hydropower (Sean, 2012). The cost of this development to the indigenous Dassenech agro-pastoralist groups of the lower Omo valley is much greater, due to the loss of their flood-retreat farmland and livestock grazing areas, which significantly affected the food security of pastoral and agro-pastoral villagers of the region. According to human rights watch (2012) "construction of Gibe-III damming and the associated sugar plantation should be undertaken in a manner that consistent with the national laws, and international human right standards". Arguing that appropriate social and environmental impact assessment in the area land title contested, which violate the rights of lower Omo valley agro-pastoral communities the right to access flood retreat and grazing farmland. While, based on the Sendai Framework for Disaster Risk Reduction 2015 - 2030, major priorities include enhancing work to reduce exposure and vulnerability of these communities, thus preventing the creation of new disaster risks, and accountability for disaster risk creation is needed at all levels. To tackle the underlying disaster risk drivers, such as the consequence of poverty and inequality, climate change and variability, weak institutional arrangement, non-risk informed policies, unsustainable use of natural resources, and declining ecosystems, efficient and effective disaster risk reduction practices need to be multi-hazard and multisectoral, inclusive and accessible to multiple entities.

The Dassenech and other indigenous groups of the lower Omo Valley suffer greatly from upstream damming of the Omo River. Thus, groups are traditional cattle herders and have a long tradition of cultivating crops along the Omo River after the seasonal floods. Even though, after the dam project was established upstream of the Omo River Basin, as well as linked sugar plantations, they were unable to practice flood-retreat crop cultivation, and the communities have lost their flood recession land, livelihood systems, and food sources to the Gibe III dam and associated sugar irrigation schemes.

"Omo river is our vital for our live and livelihood system, because it enables us to produce large amount of sorghum for household consumption and market sales, as well fresh pasture. But recently, the Omo River flooded our village for the first time, causing livestock deaths and damaging our village. Even, local government provides us small number of goats to cope-up it effect, it is not such significant as compare to what we have had before".

Figure 5. Korluk – Kelem Kebele
FGD participant (2024)

However, literature reveals that the Gibe III dam public development intervention at the upstream of the Omo River basin consultation process with the project-affected pastoral and agro-pastoral communities has been limited, selective, and violated their right to full consultation as protected under the national constitution of Ethiopia. For the last 5 – 10 years, the dam has affected the lower Omo Valley pastoral and agro-pastoral communities, flooding the crop cultivation and livestock grazing pastures, and, more recently, nearly 123,000 hectares of livestock grazing land, 20 Islands, and potential irrigation-based farmland were totally covered by Omo River flooding. Existing literature illustrates that improper development activities that accumulate risk to hazards have been shown to be the major reason for the increasing losses from disasters, in which the occurrence of disasters is directly correlated with development that increases vulnerability to natural and man-made hazards. So it is necessary to strengthen good governance in disaster risk reduction strategies at national, regional, and global levels, and to improve preparedness and national coordination for disaster response and rehabilitation. While considering government-led roles, regulatory and coordination roles should engage with relevant stakeholders in the design and implementation of policies, plans, and standards. These policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions, including vulnerability, community and asset capacity, exposure, hazard characteristics, and the environment.

5. Conclusions

Climate change and variability pose serious risks to pastoralists and agro-pastoralist communities, as they have an immediate, daily dependence on climate-sensitive livelihood systems and scarce natural resources, which aggravates the recurrent occurrence of multiple disastrous events, including flooding. Even though, if disaster management strategies are a reference in responses to human behavior and vulnerable social groups resilience capacity in the face of a disaster threat were more effective, then the strategy needs to be developed and applied into a part of human life or a group that experiences a threat of disaster in everyday life. In countries like Ethiopia, pastoral and agro-pastoral livelihood systems are the major economic activities in the lowland areas, where their survival depends heavily on livestock rearing, supported by subsistence farming.

Flood-retreat agriculture is one of the potential strategies to ensure food security and livelihoods of the drought-affected agro-pastoralist communities of the lower Omo valley. Even though, for the last few decades, these Dassenech agro-pastoralists have become extremely vulnerable to the effects of overexploitation and inappropriate state intervention upstream of the Omo River and interrelated massive sugar plantation enterprises. The destruction of agro-pastoral flood retreat agriculture livelihood system swiftly produce and intensified major humanitarian disasters including drought, and recurrent occurrences of flooding disaster which caused severe damage on nearly 28 villagers of Omo River surrounding kebeles in the area. This widespread conditions like starvation, disease and spiraling interethnic armed conflict between the tri-nation border region of the lower Omo valley. This increased their vulnerability to the effects of food insecurity, due to the loss of their seasonal sources grain product - flood retreat crop cultivation as well as livestock grazing areas. These changes, combined with political-economic marginalization, have made it increasingly difficult for agro-pastoralists to sustain their flood-retreat-based livelihood system and fundamentally challenge their adaptive capacity to climate change. So far, the socio-economic and environmental impacts associated with upstream damming of the Omo River will have long-term effects on the well-being of downstream agro-pastoralists and food security in the Lower Omo Valley. In which continuous monitoring is most important for riverine ecosystem change, with its societal relevance to villagers and the effectiveness of policies, strategies, and programs adopted to address the concerns of lower Omo Valley agro-pastoralist well-being and sustainable food security. Therefore, the study concludes that the full potential of local agro-pastoralist flood-retreat agriculture and specific technological options can be assessed through comprehensive research into the diverse aspects of flood-retreat agriculture in the area. Given this, the unpredictability of rainfed agricultural practices in the lower Omo valley region, there is a clear need for investment and adaptation of flood-retreat agriculture-based food security and livelihood strategies while mainstreaming the policy-making process for drought management and sustainable food production in the lower Omo downstream communities. To deal with the impact of the Omo River flooding disaster, government leadership should be established as a national culture of resilience, with a full and clear commitment to building disaster-resilient communities. In general, the following key recommendations have been made as insights for policymakers, environmental governance, disaster risk reduction planning, and future researchers.

- Create an enabling environment for local institutions and communities, public and private development entities to be involved in the entire pastoral and agro-pastoral livelihood and disaster risk reduction policymaking process to improve their resilience capacity to the effects of flooding disasters, with short- and long-term action plans. This will support local pastoral and agro-pastoral communities in establishing the necessary data, tools, knowledge systems, and governance structures to build resilience and plan and carry out anticipatory action.
- As an environmental risk management strategy, establish and create pastoral and agro-pastoral communities based on climate resilience and adaptive livelihood systems, and develop and implement environmental risk management mechanisms, and re-evaluate in the context of changing socioeconomic and demographic characteristics of agro-pastoral communities.
- Strengthen the ability of pastoral and agro-pastoral communities to respond to flooding disasters by ensuring their food security and social infrastructure, enhancing their skills and knowledge of hazard risks, community participation, disaster preparedness, and the setup of early action and recovery systems.

Author Contributions: This work was carried out by the author (Seid Ahmed), who designed the article, wrote the protocol, wrote the first draft of the manuscript, managed the literature search and analysis, and reviewed and edited the article.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgments: I would like to thank the Hawassa University Department of Sociology Instructors for their invaluable technical support and advice, which have enabled me to upgrade the skills, knowledge, and experience I have gained. Indeed, I would like to express my immense gratitude to my Research Advisor, Fekadu Israel (Assist. Prof.), for providing such consistent, professional, enthusiastic, and advisory mentorship and technical support.

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

Appendix A

The appendix is an optional section that can contain details and data supplemental to the main text.

6. References

1. Amede, T., Van den Akker, E., Berdel, W., Keller, C., Tilahun, G., Dejen, A. (2022). Facilitating livelihoods diversification through flood-based land restoration in pastoral systems of Afar, Ethiopia. *Renew. Agric. Food Syst. 37, S43–S54*. https//doi.org/10.1017/ s1742170520000058
2. Avery, S. (2012). Hydrological Impact of Ethiopia's Omo Basin on Kenya Lake Turkana. Presented under Global program and strategies on Assessment and management Lakes and Their basin:UNEP/ILEC collaboration14th World Lake conference, Austin, Texas, USA, 3rd November, 2011.
3. Avery, S. (2013). What future for Lake Turkana and its wildlife? The impact of hydropower and irrigation development on the worlds largest desert lake. *African Studies Centre: University of Oxford.*
4. Bedru, B. (2019). Assessment of flood recession agriculture for food security in Northern Ghana: An optimization modelling approach. https//doi.org/10.1016/j.agsy.2019.03.021.
5. Central Statistical Agency (CSA). 2007. Population Census Report. The Federal Democratic Republic of Ethiopia, Addis Ababa, Ethiopia. http://www.csa.gov.et/index.php/2013-02-20-14-51-51/2013-04-01-11-53-00/census-200.
6. Challinor, A., Wheeler, C., Garforth, P., Craufurd, A. Kassam. (2007). "Assessing the vulnerability of food crop systems in Africa to climate change". *Climate Change 83: 381-399.*
7. Cherie, E,, Derbe, D., and Girma, T. (2011). Existing Challenges: Plantation Development versus Wildlife Conservation in the Omo-Tama-Mago Complex. Ethiopian Wildlife Conservation Authority.
8. Claudia, J. (2017). River Basin Development and human right in Eastern Africa - A policy crossroads.
9. Davies, J., and Bennett, R. (2007). Livelihood adaptation to risk: constraints and opportunities for pastoral development in Ethiopia's Afar region. *J. Dev. Stud. 43, 490–511.* https//doi.org/10.1080/00220380701204422.
10. Desta, G., Legesse, G., Ahmed, MI., Muluneh, A., and Birhanu, B. (2024). Assessing flood risks and exploring opportunities for flood-based farming in the dry lowlands of Ethiopia. *Front. Sustain. Food Syst. 8:1348094*. https//doi.org/10.3389/fsufs.2024.1348094.
11. Desta, G., Legesse, G., Amede, T., Rooyen, V. F., & Whitbread, A. M. (2021). Unlocking the potential of flood farming to reduce flood risks and boost dryland production in Ethiopia. Colombo, Sri Lanka: CGIAR Research Program on Water, Land and Ecosystems (WLE). 10p.
12. Devereux, S. and S. Maxwell. (2001). Food Security in sub-Saharan Africa. Oxon, UK: CAB Direct.
13. Dukiya, J., and Oghenah, B. (2021). Building resilience through local and international partnership, Nigeria. International Journal of Disaster Risk Management. DOI: https://doi.org/10.18485/ijdrm.2021.3.2.2
14. Eyasu, Y., Atinkut, M., Tesfa-alem, G., Daniel, T., and Ermias, A. (2015). Multi Reservoir Operation and Challenges of the Omo River Basin: Part II: Potential Assessment of Flood-based Farming on lower Omo Ghibe Basin.
15. FAO. (2016). Situation Report. Food and Agricultural Organization Representative, Addis Ababa, Ethiopia.
16. Gain, A. K., Mondal, M. S., and Rahman, R. (2017). From flood control to water management: a journey of Bangladesh towards integrated water resources management. *Water 9:55*. doi: https//doi.org/10.3390/w9010055.
17. Gelaw, F., and Sileshi, M. (2013). Impact of Grain Price Hikes on Poverty in Rural Ethiopia. African. *Journal of Agricultural and Resource Economics. 8 (2): 69-89.*
18. Hagos, F., Erkossa, T., Lefore, N., and Langan, S. (2014). Spate irrigation and poverty in Ethiopia. In Erkossa Teklu, Hagos Fitsum and Lefore Nicole (Eds.). Proceedings of the Workshop on Flood-based Farming for Food Security and Adaption to Climate Change in Ethiopia: Potential and Challenges, Adama, Ethiopia, *Colombo, Sri Lanka: International Water Management Institute (IWMI).*
19. IFAD. (2009). Livestock and Pastoralists. Community of Practice for pro-poor livestock and fisheries/Aquaculture development. CoP for Pro-poor Livestock Development. Need Assessment, Report on findings. Rome, IFAD Headquarter.

20. IFPRI. (2015). Global Hunger Index, Armed Conflict and The Challenge of Hunger, Washington, DC / Dublin / Bonn.
21. International Rivers. (2011). Ethiopia's Gibe III Dam: Sowing hunger and conflict. Retrieved from:https://www.internationalrivers.org/sites/default/files/attached-files/gibe3factsheet2011..
22. Jennifer, H., Shubhechchha, S., David-Paul, P., Emma, J., and Kristofer, C. (2019). Coping Strategies in Nyangatom, Ethiopia. Omo Turkana Research Network Briefing Note #4.
23. Lind, J., Sabates-Wheeler, R., Caravani, M., Kuol, L.B.D. and Nightingale, D.M. (2020). Newly evolving pastoral and post-pastoral rangelands of Eastern Africa. *Pastoralism 10(24)*. https://doi.org/10.1186/s13570-020-00179-w.
24. Michele, N., Michael, T., and Alessandra, S. (2008). Pastoral land rights, livelihoods and adaptation to climate change. Printed by: *Russell Press, Nottingham, UK.*
25. Million, S., Reuben, M.J., Khamaldin, M., and Stefan, S. (2019). Analysis of households' vulnerability to food insecurity and its influencing factors in East Hararghe, Ethiopia. DOI:https//doi.org/10.1186/s40008-019-0174-y.
26. Motsumi, S., Magole, L., and Kgathi, D. (2012). Indigenous knowledge and land use policy: Implications for livelihoods of flood recession farming communities in the Okavango Delta, Botswana. *Physics and Chemistry of the Earth, 50-52, 185-195* . http://dx.doi.org/10.1016/j.pce.2012.09.013.
27. Müller-Mahn, D., Rettberg, S., and Getachew, G. (2010). Pathways and dead ends of pastoral development among the Afar and Karrayu in Ethiopia. *Eur. J. Dev. Res. 22, 660–677*. doi: 10.1057/ejdr.2010.37.
28. Nederveen, S., Mengistu, A., Van Steenbergen, F., Alamirew, T., and Geleta, Y. (2011). Flood based farming practices in Ethiopia: Status and potential (overview paper #3) Spate Irrigation Network. (Overview Paper #3), Avaliable at: www.spate-irrigation.org
29. OCHA. (2007). Situation update no. 2: flooding in Ethiopia. Available at: https://reliefweb. int/report/ethiopia/ocha-situation-update-no-2-flooding-ethiopia-1-31-aug-2007.
30. Paudel, S. P., Khanal, S. N., Mathema, A. B., Maharjan, P., and Bhatta, S. (2025). Assessing Agricultural Vulnerability to Climate Change: A Study on Flood-Induced Loss and Damage in Rajapur, Bardiya, Nepal. *International Journal of Disaster Risk Management, 7(1), 265–282. Vol. 7, No. 1.* https://doi.org/10.18485/ijdrm.2025.7.1.15
31. PFE, IIRR and DF. (2010.) Pastoralism and Land: Land tenure, administration and use in pastoral areas of Ethiopia. Addis Ababa: PFE.
32. Reid, R.S., Galvin, K.A., and Kruska, R.S. (2008). Global significance of extensive grazing lands and pastoral societies: an introduction. In: Fragmentation in Semi-Arid and Arid Landscapes, K.A. Galvin, R.S. Reid, Jr, R.H. Behnke & T.N. Hobbs (eds), Dordrecht, etc.: *Springer*. https://doi.org/10.1007/978-1-4020-4906-4_1
33. Richard, W. (1996). Omo-Gibe River basin Integrated Development Master Plan Study Final Report Vol. III, VI Water resources Surveys and Inventories, ministry of Water Resources, Addis Ababa.
34. Rima, M.S., and Hanspeter, L. (2013). Water Harvesting: Guidelines to Good Practice.
35. Roy, B.,, and Ian, S. (1993). Rethinking range ecology implications for rangeland management in Africa.
36. Saarnak, N.L. (2003). "Flood recession agriculture in the Senegal River Valley". *Geografisk Tidsskrift Danish Journal of Geography 103 (1): 99-113.*
37. Singh, R., Patel, S. K., Tiwari, A. K., and Singh, G. S. (2021). Assessment of flood-recession farming for livelihood provision, food security, and environmental sustainability in the Ganga River basin. *Curr. Res. Environment. Sustain. 3, 100038–100016.*. doi: https://doi.org/10.1016/j.crsust.2021.100038.
38. Steenbergen, F. V., Haile, A. M., Alemehayu, T., Alamirew, T., and Geleta, Y. (2011). Status and potential of spate irrigation in Ethiopia. *Water Resour. Manag. 25, 1899–1913*. doi: https://doi.org/10.1007/s11269-011-9780-7
39. Submission process
40. Tamagnone, P., Comino, E., and Rosso, M. (2020). Rainwater harvesting techniques as an adaptation strategy for flood mitigation. *J. Hydrol. 586:124880*. doi: https://doi.org/10.1016/j. jhydrol.2020.124880
41. Tariq, M. A.., Farooq, R., and van de Giesen, N. (2020). A critical review of flood risk management and the selection of suitable measures. *Appl. Sci. 10:8752*. doi: https://doi.org/10.3390/app10238752.
42. Terri, H. (2009). Facing Gibe 3 Dam: Indigenous Communities of Ethiopia's Lower Omo Valley. International Rivers.
43. WFP. (2011). Mixed Method Impact Evaluation. The Contribution of Food Assistance to Durable Solutions in Protracted Refugee Situations: its impact and role. Final Terms of Reference, Ethiopia.
44. You can submit your paper to the following email address: disaster.risk.management.serbia@gmail.com.
45. Zenebe, M. G., Fleskens, L., Ritsema, C., and Steenbergen, F. (2022). Basin-wide productivity and livelihood analysis of flood-based agricultural systems in African drylands: a case study in the Fogera floodplain. *Agric. Water Manag. 261:107379*. doi: https://doi.org/10.1016/j.agwat.2021.107379