

Sokoine University of Agriculture



MSc Dissertation

**Stakeholders' Perceptions, Monetary
Valuation of Ecosystem Services and
Implications on Attainment of the
Sustainable Development Goals on the
Mount Kilimanjaro Ecosystem in Moshi
Rural District**

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**STAKEHOLDERS' PERCEPTIONS, MONETARY VALUATION OF
ECOSYSTEM SERVICES AND IMPLICATIONS ON ATTAINMENT
OF THE SUSTAINABLE DEVELOPMENT GOALS ON THE MOUNT
KILIMANJARO ECOSYSTEM IN
MOSHI RURAL DISTRICT**

**This dissertation is submitted in fulfilment of the requirements for
the Master Degree of Science in Ecosystem Science and
Management to Sokoine University of Agriculture, Morogoro**

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EXTENDED ABSTRACT

Mountain ecosystems are of significant ecological value, providing diverse ecosystem services (ES) that contribute to the well-being of human populations residing in mountain regions and neighbouring lowlands. Also, these ecosystems also supply a multitude of ecosystem services that enhance the achievement and attainment of the Sustainable Development Goals (SDGs) which are formulated with the aim of integrating and achieving favourable outcomes across societal, economic, and environmental dimensions. The objectives of this study were to: (i) identify and map key stakeholders of provisioning ecosystem services, (ii) identify key provisioning ecosystem services and assess the value perceptions of different stakeholders on the identified provisioning ecosystem services (iii) determine the monetary value and contribution of the provisioning services to household welfare through attainment of Sustainable Development Goals (SDGs). The study employed a descriptive and cross-sectional research design involving, a sample size of 90 households. Data were collected through household questionnaire survey and focused group discussion.

Qualitative data from the livelihood activities and organizations linked to ecosystem services and identification of provisioning ecosystem services were analysed through content analysis while quantitative data from identification of provisioning services were analysed through Statistical Package for Social Science (SPSS). The comparison between the most and least important provisioning services was analysed using a matrix ranking. Monetary value of provisioning services was determined by economic analysis using the choice experiment method while the monetary value average and household proportions was computed through Microsoft Excel for average economic contribution of identified service to the overall well-being of a community. Total of seven key provisioning services, including clean water, food, and medicinal plants, firewood, honey and poles, were identified. These provisioning services address several important SDGs including SDG 1, SDG 2, SDG 3, SDG 6, SDG7, SDG 8 and SDG 15. Water was the highest-ranked provisioning service, with a perception score of 35, highlighting its critical importance to the local community. Food was ranked second, with a score of 18, followed by fodder with a score of 12, and firewood with a score of 10. Medicine, honey, and poles were ranked as the least important provisioning services, with

scores of 8, 5, and 2, respectively. The total economic value (TEV) of the most important provisioning services in Kibosho East Ward amounts to an impressive 543.5 million (currently US\$ 226,445). The value of provisioning ES is apparently contributing substantially to the local economy on the Kilimanjaro ecosystem. The findings also show a comprehensive understanding of the ecosystem's resources and their associated benefits with potential to contribute to the attainment of the SDGs. Consequently, the study recommends to invest in capacity building initiatives to empower stakeholders with the knowledge, skills and resources needed for effective participation in ecosystem management processes. It also suggests the establishment of integrated management approaches that consider the economic significance of provisioning services.

KEY WORDS

Mountain Ecosystems, Provisioning Services, Livelihood Patterns, Total Economic Value

IKISIRI KUU

Mifumo ya milima ya kiikolojia, hutoa faida mbalimbali za mazingira ambazo zinasaidia katika ustawi wa jamii za binadamu wanaoishi katika maeneo ya milima na maeneo yaliyo jirani. Hivyo, kuelewa thamani ya faida hizi hutoa taarifa kwa wapanga sera ili kudumisha faida za kiuchumi pamoja na usimamizi endelevu wa mazingira. Mifumo ya milima pia inatoa huduma mbalimbali za mazingira zinazosaidia kufikia Malengo Endelevu ya Maendeleo, ambayo yanakusudiwa kuunganisha na kufikia matokeo mazuri katika mihimili kijamii, kiuchumi, na mazingira. Lengo la utafiti huu lilikuwa: (i) kutambua na kuainisha wadau muhimu wa faida za mazingira, (ii) kutambua faida muhimu za mazingira na kutathmini thamani kutoka kwa wadau mbalimbali kuhusu faida za mazingira zilizotambuliwa, na (iii) kutambua thamani ya kifedha na mchango wa huduma za mazingira kwa ustawi wa kaya kupitia kufikia Malengo Endelevu ya Maendeleo. Utafiti huu ulitumia muundo wa utafiti wa maelezo na uchambuzi wa majadiliano, ukihusisha sampuli ya kaya 90. Data zilipatikana kupitia utafiti wa maswali kwa kaya na majadiliano ya kikundi. Shughuli za kimaisha na wadau wanao jihusisha na huduma za mazingira yalikusanywa ili kutambua na kuainisha wadau muhimu wa faida za mazingira. Taarifa kutoka kwenye mifumo ya kimaisha na mashirika yanayohusiana na uhifadhi wa mazingira, pamoja na kutambua faida zinazotokana na mazingira, zilichambuliwa kupitia uchambuzi wa maudhui wakati taarifa kiasi kutoka kutambua faida za utoaji zilichambuliwa kupitia Pakiti ya Takwimu za Jamii.

Utafiti huu ulitumia muundo wa utafiti wa maelezo na uchambuzi wa majadiliano, ukihusisha sampuli ya kaya 90. Faida hizi za utoaji zinashughulikia malengo muhimu ya Maendeleo Endelevu ikiwa ni pamoja na lengo endelevu 1, lengo endelevu 2, lengo endelevu 3, lengo endelevu 6, lengo endelevu 7, lengo endelevu 8, lengo endelevu 11 na lengo endelevu 15. Jumla ya thamani ya kiuchumi ya faida muhimu zaidi za mifumo hii ya ikolojia inafikia kiwango cha kuvutia cha milioni 543.5 (sasa ni dola za Marekani 226,445). Thamani ya faida ya mifumo hii ya ikolojia inaonekana kuchangia kwa kiasi kikubwa katika uchumi wa eneo la ikolojia ya Kilimanjaro. Kupitia tathmini ya thamani ya faida za mazingira zinazotolewa katika mfumo wa mlima Kilimanjaro, utafiti huu unatoa ushahidi wa kihisia wa thamani ya kiuchumi inayotolewa na huduma za utoaji, huku ukitoa uthibitisho wa

umuhimu wao katika mchakato wa kufanya maamuzi. Aidha, utafiti huu unatoa uelewa wa kina wa uhusiano uliopo kati ya ustawi wa binadamu na afya ya mazingira.

Matokeo ya utafiti ni muhimu kwa wapangaji wa maamuzi katika kuipa kipaumbele juhudi za uhifadhi na kutenga rasilimali kwa ufanisi kwa kuzingatia mahitaji mbalimbali na maslahi ya wadau siyo tu katika mfumo wa mlima Kilimanjaro bali pia katika mifumo mingine muhimu ya milima. Aidha, utafiti unachangia katika kushawishi sera na hatua zinazosaidia kukuza uhifadhi wa mazingira, ustawi wa binadamu na kusaidia kufikia Malengo Endelevu ya Maendeleo.

MANENO MUHIMU: Ikolojia ya milima, Faida za ikolojia, Mifumo ya maisha, Tathmini ya kiuchumi

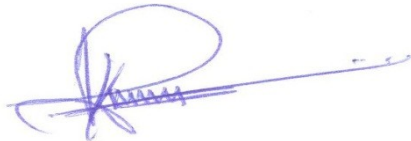
DECLARATION

I, **AGNESTA J. BUYEKWA**, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

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Date

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(Supervisor)

Date

Prof. Felister F. Mombo
(Supervisor)

Date

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DEDICATION

I dedicate this work to my beloved family, especially my parents, Mr. and Mrs. Julius Buyekwa. Your firm support, encouragement, and love have been the foundation of my journey. Thank you for being my source of strength and inspiration.

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LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS

SDGs	-	Sustainable Development Goals
ES	-	Ecosystem Services
TZS	-	Tanzania Shillings
TFS	-	Tanzania Forest Service
KINAPA	-	Kilimanjaro National Park
LGAs	-	Local Government Authorities
Epinav	-	Enhancing pro-poor Innovations in Natural Resources and Agricultural Value- chains

CHAPTER ONE

1.0 GENERAL INTRODUCTION

1.1 Background Information

Mountain ecosystems have tremendous ecological value and provide diverse ecosystem services (ES) contributing to the well-being of humans living in mountain regions and adjacent lowlands (MEA, 2005); (Immerzeel *et al.* 2020). Being diverse, Mountain ecosystems play an important role in sustainable development, providing benefits and values that contribute to rural communities' livelihood. According to (MEA, 2005), ecosystem services are the benefits that people obtain from nature. These services are categorized into four broad streams of benefits, which are provisioning services, regulating services, cultural services and supporting services. However, many of the benefits and economic values supplied by nature are undervalued by the market, so policymakers and conservationists pay less attention to them Mombo *et al.* (2013).

Humans value ecosystem services based on the benefits they obtain from the environment. However, the values of these services are undervalued in commercial markets and decision-making processes (Schmidt *et al.*, 2016). Ecosystem services valuation is a major discussed topic, yet it is ultimately stated that quantifying ecosystem services in monetary terms aligns conservation measures with economic goals, fully informs decision- makers (Schmidt *et al.* 2016). Number of monetary valuation methodologies have been developed and improved throughout time to evaluate the economic values of targeted ecosystem services for the elicitation of various value categories (Pandeya *et al.* 2016a). When estimating the economic value it is considered that, the willingness to pay for a given service represents the value that the public holds (Just *et al.* 2005a). Economic values are estimated using either market transaction values of intended ecosystem services, some type of parallel market transactions that are indirectly related to the ecosystem services to be valued, or value estimation based on consumers' willingness to pay for the ecosystem services-related goods and services in the absence of such values (Pandeya *et al.* 2016a). Thus, the supply, delivery, the contribution to well-being, and values are required to be measured and monitored in

order to completely comprehend worth of ecosystem services (Tallis *et al.* 2012a).

The stakeholders who benefit from ecosystem services determine the values that are assigned to them (Hein *et al.*, 2006). There is a mutual and dynamic link between ecosystem services and stakeholders hence the services provided by ecosystem identify the relevant stakeholders, and the stakeholders decide the relevant ecosystem services (Hein *et al.*,2006). Different stakeholders groups are anticipated to perceive differently on various categories of values provided by ecosystem services (Vermeulen and Koziell, 2002). Stakeholders' perceptions of the value and identification of ecosystem services have a significant impact on the monetary value since preferences dictate the level of service a person receives from a particular ecosystem service (Martín-López *et al.* 2012). Thus, identification of the primary and appropriate ecosystem services and proper appraisal of their values are made possible by the participation of stakeholders in valuation (Cohen-Shacham *et al.* 2015).

Biodiversity and ecosystems, along with the benefits they offer, are the foundation of various aspects of human, societal, cultural, and economic welfare (Folke *et al.*, 2016; Millennium ecosystem assessment, 2005; Naeem *et al.*, 2012).The SDGs are formulated with the aim integrating and achieving favorable results across societal, economic, and environmental domains (Wood *et al.*, 2018). The concept of ecosystem services plays a crucial role as an integrated framework in the field of sustainability science (Liu *et al.*, 2015) .To accomplish the aims of the SDGs, it's crucial to manage ecosystems properly. This ensures that nature is protected, and the benefits and services they provide are available fairly and sustainably (DeClerck *et al.*, 2016). Therefore, this study will assess stakeholders' perceptions, monetary valuation of ecosystem services and implications on attainment of the Sustainable Development Goals on the Mount Kilimanjaro Ecosystem in Moshi Rural District that will lead to a well-informed decision about the management of provisioning ecosystem services.

1.2 Problem Statement and Study Justification

Mountains, as one of the largest and most diverse land resources on the globe on which the livelihood of many people directly and indirectly

depends (Immerzeel *et al.*, 2020a) are degraded due to different factors (MEA, 2005). Environmental systems provide material and empirical benefits that contribute directly to human wellbeing, and it is meaningful and important to quantify these benefits in an understandable manner (Howarth and Farber, 2002). Despite their importance as sources of ecosystem services supporting the livelihoods of millions of people, mountain ecosystems have been changing into other land use systems over the past decades across the world (MEA, 2005). While changes in mountain ecosystems have been thoroughly studied in diverse ecological contexts around the world, our understanding of perceived values and, consequently, the monetary pricing of these ecosystem services is limited, particularly in Afromontane ecosystems (Solomon *et al.*, 2019). Several studies have been conducted on the valuation of ecosystem services in Eastern Arc Mountains (Fisher *et al.*, 2011), Eastern Usambara (Kaczan and Swallow, 2013), and the Uluguru Mountains (Kagata *et al.* 2018).

Additionally, with notable exception from Mount Kilimanjaro, (Masao *et al.*, 2022) assessed stakeholder perspectives on nature, people and sustainability using Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) framework. However, the ecosystem services values basing on stakeholders' perceptions on mountain ecosystems is poorly taken into account, which would inform decision-makers for better conservation of these ecosystems. There is therefore limited information and knowledge on how different stakeholders perceive and value ecosystem services apart from the tangible benefits they derived from mountain ecosystems that make a substantial area contribution to the household welfare at local scale. Therefore, the aim of this study is to assess the ecosystem service values basing on stakeholders' perceptions and contribution to SDGs on Mount Kilimanjaro ecosystem in Moshi Rural District in Tanzania.

Findings from this study will contribute to the sustainable management of Mount Kilimanjaro ecosystems through local stakeholders who depend on the ecosystem services for wellbeing. Furthermore, the findings of this study will assist the government in becoming aware of the ecosystem services provided by Mount Kilimanjaro ecosystems, their monetary values, and contribution to achievement of SDGs allowing mainstreaming of ecosystem services into policy formulation

that encourage human activities that benefit Mount Kilimanjaro ecosystems ecologically and socio-economically.

1.3 Objectives

1.3.1 Main objective

To assess stakeholders' perceptions, monetary valuation of ecosystem services and implications on attainment of the Sustainable Development Goals on the Mount Kilimanjaro ecosystem in Moshi Rural District

1.3.2 Specific objectives

- i. To identify and map key stakeholders of provisioning ecosystem services
- ii. To identify key provisioning ecosystem services and assess the value perceptions of different stakeholders on the identified key provisioning ecosystem services.
- iii. To determine the monetary value and contribution of the provisioning services to household welfare through attainment of SDGs

1.4 Limitations of the Study

During the data collection phase, the study encountered significant limitations arising from the geographical characteristics of the study area and financial constraints;

- **Resource Allocation:** The financial resources and time allocated for the data collection phase constrained the ability to cover a broader range of geographical locations and stakeholders.
- **Limited Mobility:** In certain instances, the topography of the study area hindered vehicular access, compelling the data collection team to navigate on foot. This mode of transportation, while necessary, posed limitations in terms of reaching a wider sample of households
- **Weather-Related Delays:** Rainfall and adverse weather conditions further posed the challenge of accessing specific areas. The rough terrain, combined with rain, rendered certain locations impassable, causing delays in data collection efforts.

1.5 Dissertation Structure

This dissertation is organised into five distinct chapters and is structured as a series of publishable manuscripts. The first chapter provides the general introduction to the study, including background information, the problem statement, study objectives, and limitations of the study. Chapter two focuses on identification and mapping of key stakeholders of provisioning ecosystem services. Chapter three presents key provisioning ecosystem service, monetary value and contribution of the provisioning services to household welfare through attainment of SDGs. Chapter four is a general discussion of the study's findings, and Chapter five provides a summary of the key contributions, conclusions, and recommendations for future research.

CHAPTER TWO**MANUSCRIPT ONE****2.0 Key Stakeholders' of Ecosystem Services and their Value
Perceptions of Provisioning Ecosystem Services on Mount
Kilimanjaro Ecosystem¹****Agnesta J Buyekwa^{1*}, Pantaleo K.T Munishi¹, Felister F Mombo²****Institutional Addresses**

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Abstract

The perception on ecosystem services underscores the essential link between ecosystems and human societies, highlighting how human well-being depends on healthy ecosystems. Managing these services involves various stakeholders who influence the utilization and conservation of ecosystems and ecosystem services (ES). By identifying and mapping key stakeholders, their priority, concerns, and preferences regarding ecosystem services can be grasped, enabling their insights to be incorporated into decision-making processes. Qualitative data from the collected information were analyzed through content analysis to obtain the list of key stakeholders of provisioning ecosystem services while the comparison between the most and least

important provisioning services was analyzed using a matrix ranking, to understand the perceptions of different stakeholders on the identified provisioning ecosystem services whereby the identified provisioning services were ranked according to priority based on users' perceptions. Different stakeholders were identified including; local community and government agencies as key players, NGOs and research and training institutions as subjects, and private sectors as context setters. However, none of the stakeholders were found to have low levels of both influence and interest in ecosystem conservation. Water was the highest-ranked provisioning service, with a perception score of 35, highlighting its critical importance to the local community. Food was ranked second, with a score of 18, followed by fodder with a score of 12, and firewood with a score of 10. Medicine, honey, and poles were ranked as the least important provisioning services, with scores of 8, 5, and 2, respectively. The study revealed that while some stakeholders recognized the importance of ecosystem services for their livelihoods and well-being, others had limited awareness on their value. These findings emphasize the significance of diverse stakeholder perspectives in ecosystem service management and offer useful insights for policy formulation. Thus, the study recommends to invest in capacity building initiatives to empower stakeholders with the knowledge, skills and resources needed for effective participation in ecosystem management processes.

Keywords:

Mountain Ecosystem, Ecosystem Services, Livelihood patterns, Stakeholders mapping, Stakeholder's perceptions

2.1 Introduction

Ecosystem services as benefits humans receive from ecosystems play a vital role in supporting human well-being and sustainable development (M. E. A. Millennium ecosystem assessment, 2005). The concept of ecosystem services recognizes the fundamental linkages between ecosystems and human societies, highlighting the dependence of human populations on healthy and functioning ecosystems (Costanza *et al.*, 1997). The management of ecosystem services involves various stakeholders who interact and influence the utilization and conservation of natural resources (Braat & De Groot, 2012). Stakeholders is defined as individuals, groups, or organizations that have an interest or influence in a particular issue or system, play a critical role in the management and governance of ecosystem services (Reed *et al.*, 2009); (Plieninger *et al.*, 2015). Aaltonen *et al.* (2008) propose that stakeholders in a project can be classified into different roles, including the client, members of the local community, NGOs, media outlets, lobbying organizations, and government agencies. This categorization helps to identify the various groups of people or organizations that have a stake in a project and may be affected by its outcomes.

Stakeholder analysis is a process that recognizes the diverse groups of people involved in the utilization and conservation of natural resources and provides tools that can be used to identify and resolve trade-offs and conflicts of interest among these groups (Prell *et al.*, 2009). Stakeholder analysis has been centered on the process of identifying and describing stakeholders, categorizing them according to their level of interest and influence, creating a visual representation of the connections between stakeholders, and comprehending their potential impact (Nuga *et al.*, 2009). Thus, stakeholder analysis allows for the evolving needs, priorities, and interests of stakeholders to be taken into account over the course of a project and beyond (Mekuria *et al.*, 2021).

Stakeholders mapping and identification play a crucial role in identifying key actors who are involved in decision-making processes and can influence the management of ecosystem services (Agrawal, 1999). It is a widely used approach to identify and analyze stakeholders in a specific context (Reed *et al.*, 2009). It provides insights into the diverse actors and their interests, power relations, and potential influence on resource management decisions. Also, through identifying and mapping key stakeholders, it becomes possible to understand their

perspectives, concerns, and preferences related to ecosystem services, and to integrate their knowledge and experiences into decision-making processes (Epstein & Gramling, 2013). Failure to engage with stakeholders can result in opposition to the project, lack of support, and ultimately failure to achieve the project objectives (Mitchell *et al.*, 1997).

The way stakeholders perceive things significantly influences the strategic choice of interventions (Asah *et al.*, 2012). Recognizing the significance of local knowledge and perceptions has been highlighted as a fundamental approach in making policy decisions for the preservation of ecosystems, sustainable management of resources, and improving livelihoods (Parrotta *et al.*, 2016). Also, People's perceptions of ecosystem services and management typically shape ecosystem modeling and management decisions, particularly in terms of determining which ecosystems are most significant and for whom (Elwell *et al.*, 2018). It also, compares how individuals view the state of the ecosystem in relation to its perceived importance to their wellbeing, as well as how they perceive management interventions at improving environmental conditions (Elwell *et al.*, 2018). Thus, understanding the perceptions of stakeholders towards ecosystem services is essential for effective natural resource management and conservation efforts (Agrawal, 1999).

In the context of Mount Kilimanjaro ecosystem, an area known for its rich biodiversity and multiple ecosystem services, identifying and mapping key stakeholders involved in ecosystem services management is critical for informed decision-making and sustainable resource management. However, there is a lack of comprehensive studies on stakeholders mapping and identification, and their perceptions related to ecosystem services. Additionally, there is a limited stakeholder engagement, including local communities, policymakers, and resource managers, in the valuation process, which could affect the relevance and applicability of the findings. Therefore, this study aims to map and identify key stakeholders and evaluate their perceptions on ecosystem services. Specifically, this study aimed to i) identify and map key stakeholders of provisioning ecosystem services ii) assess the perceptions of different stakeholders on the identified key provisioning services. Findings of this study will inform decision-makers and practitioners in developing more inclusive and sustainable

approaches for managing ecosystem services, taking into account the diverse perspectives and interests of different stakeholders.

2.2 Materials and Methods

2.2.1 Study area

This study was conducted in Mount Kilimanjaro ecosystem in Moshi Rural District, specifically in Kibosho East Ward, with an approximate population of 14 148 people. Kibosho East is a division within Kibosho ward in Moshi Rural District, situated between latitude $3^{\circ}11'41''$ S and longitude $37^{\circ}20'30''$ E, at an elevation of 2013 m above sea level. Data was collected from Singa, Sungu, and Mweka villages, which are part of Kibosho East division. Kibosho East Ward was deliberately chosen due to its location in a mountain block close to Kilimanjaro National Park, encompassing both forest (Protected Area) that local communities heavily depend on, albeit under strict protection, and agro-ecosystems that supply most of the daily livelihoods, but face increasing population pressure and potential degradation. Capturing information on Ecosystem Services from both the perspective of a protected area and agro-ecosystems was crucial in understanding the wide range of ecosystem services derived from mountain ecosystems, many of which are associated with protected areas and may affect local perceptions of their values.

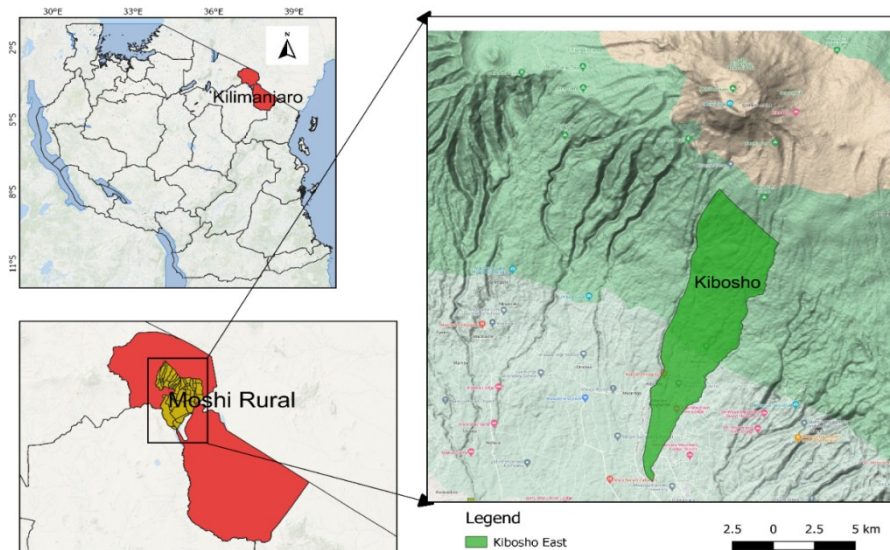


Figure 2.1: A map showing the location of study area

2.2.2 Sampling design

This study employed a descriptive and cross-sectional research design, where data was collected at one point in time. This design was deemed appropriate for describing population characteristics and investigating the relationships among variables at a specific moment (Kothari, 2004). The target population for the study involved communities that relied on the mountain ecosystem.

2.2.3 Data collection

2.2.3.1 Primary Data Collection

Data were collected using socio-economic surveys employing various techniques, including direct observation, Focus Group Discussions (FGD), key informant interviews with different groups of stakeholders. In this study, eight groups of seven people each participated in the Focus Group Discussions (FGD). Key informants, including ward leaders, District personnel, Council management team, park staff, and relevant beneficiaries of the mountain ecosystem such as government and non-governmental organizations (NGOs). The Focus Group Discussions (FGD) was conducted prior to the questionnaire survey to

better map and identify key stakeholders of ecosystem services. Participants were requested to hold discussions and collaboratively rank ecosystem services within various service types, considering their significance for their livelihoods. The questionnaires were structured to reveal information on the key stakeholders' and perceptions of different stakeholders regarding the identified key provisioning services basing on users' priority.

2.2.3.2 Secondary Data Collection

Secondary data was collected through desk (documentaries) review. Desk study was done using relevant published and unpublished documents from a range of sources, both online and offline sources.

2.2.4 Data analysis

2.2.4.1 To identify and map key stakeholders in Moshi Rural District

Qualitative information obtained from focused group discussion and household interview for stakeholder identification and mapping were

subjected to content analysis and stakeholders analysis. Specifically, the analysis aimed to characterize the main stakeholders based on their livelihood patterns and various organizations that are associated with these livelihoods, and their relationship with the mountain ecosystem, as well as their interest and influence towards mountain ecosystem.

2.2.4.2 To assess the perceptions of different stakeholders on the identified key provisioning services

Analysis of the comparison between the most and least important ecosystem services was done using a matrix ranking understand the identified provisioning services, Beneficiaries' preferences for specific provisioning, where the identified ecosystem services were ranked according to priority based on users' perceptions.

2.3 Results and Discussion

2.3.1 Livelihood patterns as linked to the Mount Kilimanjaro ecosystem

The findings highlight the livelihood patterns (Figure 2.2), their importance and their impact on the local economy and communities.

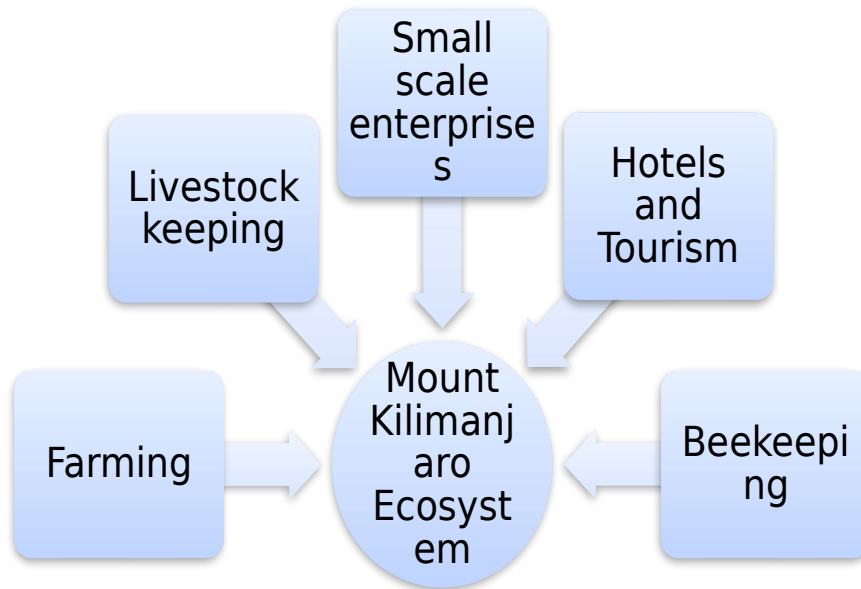


Figure 2.2: Livelihood patterns as linked to Mount Kilimanjaro ecosystem

Farming, as in many other parts of Tanzania, was a vital livelihood activity that played a significant role in the local economy and sustenance of communities. Kibosho East Ward was known for its favorable climate, fertile soils, and suitable topography, which made it conducive for various types of agricultural practices. Small-scale subsistence farming was commonly practiced where households cultivated crops for their own consumption and sold any surplus in local markets. Crops grown included staple food crops such as maize, beans, and vegetables, as well as cash crops such as coffee, bananas, and avocados. Maize, in particular, was a major staple food crop that was widely cultivated and consumed by local communities in Kibosho East Ward. Coffee was the main cash crop, where most farmers intercropped coffee with food crops in an average of 1-2 acres. While farmers typically employed traditional farming methods, some also adopted modern farming practices with increasing access to modern agricultural inputs such as improved seeds, fertilizers, and pesticides.

Besides, the local community actively participated in livestock keeping as an important economic activity. The main animals that were reared included cattle, goats, sheep, pigs, and chickens. These animals provided a source of income through milk production and sales. Almost every household in the community engaged in cattle farming, with an average daily milk production of 2-6 liters per household. The availability of fodder from the mountain ecosystem played a crucial role in supporting the livestock rearing activities in the community. The availability of fodder for livestock largely depended on the mountain ecosystem, which provided pasture for livestock.

Furthermore, the presence of Kilimanjaro National Park had also influenced the local small-scale enterprises in the area. Villagers had taken advantage of the tourism opportunities created by the park, engaging in businesses such as traditional curved materials, restaurants, and art galleries that catered to tourists. These small businesses provided services and products to tourists visiting the park, including Kwa Masika Eco Tourism Centre and Kilimanjaro Art Gallery. This diversification of livelihood activities beyond farming and livestock keeping had been driven by the proximity of Kibosho East to Kilimanjaro National Park and the opportunities it presented for tourism-related enterprises. Thus, it was important to recognize the role of these small enterprises in the local economy and include them in decision-making processes related to development planning and the sustainable use of natural resources.

Hotels and tourism were also vital livelihood patterns, as they provided employment opportunities, contributed to the local economy through the multiplier effect, and supported the development of local businesses. The presence of Kilimanjaro National Park and the establishment of big hotels in the area had created opportunities for the local community to benefit from the tourism industry, generating income and sustaining livelihoods. In addition, the presence of the park had led to a steady stream of tourists interested in climbing Mount Kilimanjaro, resulting in the establishment of big hotels in the area, such as Dual Mountain View Lodge, Kilimanjaro White House Hotel, Weruweru Hotel that provided accommodation and services to tourists.

Nevertheless, beekeeping was a significant livelihood pattern, with local households often practicing small-scale beekeeping to generate supplemental income and diversify their livelihoods. The favorable natural environment in the region, including the diverse vegetation and abundant floral resources, provided a conducive setting for beekeeping activities. Beekeeping served as an important source of income for local households, and the sale of honey and other bee products provided additional income to supplement household budgets, improving the economic well-being of local communities. In addition, beekeeping also contributed to environmental conservation in Kibosho East ward by supporting the pollination of local flora and ensuring the continued availability of floral resources for bees and other pollinators.

2.3.2 Stakeholders' identification, roles and responsibilities

Based on a thorough content analysis, it was observed that several organizations are closely linked to the provision of ecosystem services that are directly linked to the livelihood patterns in Mount Kilimanjaro ecosystem. These organizations include local government authorities, non-governmental organizations (NGOs) working on conservation and sustainable resource management, governmental agencies responsible for environmental protection and natural resource management, and other relevant stakeholders involved in promoting sustainable livelihoods in Mount Kilimanjaro ecosystem.

2.3.2.1 Local Community

In the context of the mountain ecosystem local community pertains to the residents who dwell in close proximity to the mountain ecosystem. As delineated in this analysis, the local community encompasses various groups and individuals whose livelihoods are intricately entangled with the ecosystem's resources. Their well-being is primarily impacted (either positively or negatively) by the results of the management efforts (Fitsum *et al.*, 2020). This includes residents who rely significantly on the ecosystem for their sustenance. Their actions, primarily focused on activities such as agriculture, animal husbandry, beekeeping, and tourism, demonstrate the extent of their reliance on the advantages provided by the mountain ecosystem. According to (Fitsum *et al.*, 2020) local community participate in resource in resource conservation. This complex web of interactions underscores the ecosystem's vital role in supporting and shaping the local community's well-being. It acts as the basis on which livelihoods are established,

illustrating the intricate connection between the ecosystem and the individuals whose lives are closely connected to its resources.

2.3.2.2 Kilimanjaro National Park (KINAPA)

Kilimanjaro National Park as a government agency plays a significant role in local livelihoods, with its impacts ranging from tourism, conservation and natural resource management, to research and education. According to (Zella Adili & Ngunyali Robert, 2016), Kilimanjaro National park beside from its primary role of conservation it provides valuable revenue used to support wildlife research, education, livelihood of local communities nearby the parks and helps to generate international awareness of conservation issues. The park generates income and employment opportunities through tourism-related activities, preserves local cultural heritage, conserves biodiversity and natural resources and provides opportunities for research and education. These diverse roles of the park contribute to the well-being of the local community and supporting economic, social, and environmental sustainability.

2.3.2.4 Tanzania Forest Services (TFS)

This is a government agency responsible for the management, conservation, and sustainable use of forest resources. TFS works to implement forest policies and regulations, conduct forest inventory and monitoring, and promote sustainable forest management practices. The TFS mission is to responsibly oversee the management of the National forest and bee resources, aiming to support the social, economic, ecological, and cultural requirements of both current and future generations (Rosa *et al.*, 2018). In Kibosho East, TFS collaborates with local communities to support community-based forest management initiatives, promote reforestation and afforestation efforts, and provide technical support for sustainable forest use. The TFS plays a vital role in ensuring the conservation and sustainable management of forest resources in Kibosho East, contributing to livelihoods and environmental sustainability in the Kilimanjaro region.

2.3.2.5 Machare Estate

Machare Estate is a privately-owned coffee farm, operated by a private investor. As the largest coffee farm in Kibosho East, Machare Estate plays a significant role in supporting the local community. Through a range of sustainable initiatives, such as tree planting, livestock fodder provision, and responsible resource management, Machare Estate actively promotes environmental protection and sustainability practices. Additionally, their provision of employment opportunities contributes to economic development and poverty alleviation in the area. The Estate's commitment to promoting sustainability, environmental protection, and social inclusion has a positive impact on the local community and fosters sustainable socio-economic development. The findings align with the study conducted by (Fitsum *et al.*, 2020), which reveals that the private sector actively engages in, or provides funding for, resource management activities.

2.3.2.6 AFRICADO

This is a private company that specializes in avocado farming in Tanzania, and it plays a significant role in supporting the livelihoods of the local community in Kibosho through various activities. The company provides training and capacity-building programs to local farmers, equipping them with modern avocado farming techniques, which can improve their agricultural practices and increase their yields. This contributes to the development of local farming capabilities and enhances the livelihoods of the farmers in Kibosho East Ward. Moreover, Africado promotes sustainable farming practices, including environmental conservation and biodiversity protection, which have positive impacts on the ecosystem services and natural resources in the Kibosho East Ward.

2.3.2.7 EPINAV

This innovative agricultural firm is on a mission to revolutionize the traditional small-scale and often unreliable agribusiness and horticultural industry. Their dedication to transforming the small-scale agriculture and horticulture sectors and beyond is poised to elevate them into prominent economic hubs for growth not just in Tanzania but across the entire African continent. Their ambitious goal is to contribute to the alleviation of hunger, poverty, and malnutrition in Africa through cutting-edge agricultural practices and innovation. They are committed

to taking the lead in introducing practical agricultural innovations that can make a real difference. One of their key roles is helping local businesses with the introduction and development of their products in the African market. Furthermore, they play a crucial role in establishing vital connections that link Tanzanian and African produce to the global market, thereby enhancing economic opportunities and market access for local farmers in Moshi Rural District and the broader African region. This not only benefits the farmers but also promotes sustainable agricultural practices and economic growth in the region.

2.3.2.8 Tanzania Agriculture Association (TAA)

The Tanzania Agriculture Association (TAA) plays a crucial role in the agricultural community of Tanzania. As a prominent organization dedicated to the advancement of agriculture, TAA actively engages in various roles that contribute to the sustainable development of agriculture. TAA serves as a platform for farmers, providing them with opportunities for education, training, and capacity building. Through workshops, seminars, and skill development programs, TAA equips farmers with the knowledge and tools they need to enhance their agricultural practices, increase productivity, and improve their livelihoods. In addition, TAA plays an important role in promoting sustainable natural resource management and environmental conservation practices among farmers in Kibosho. Through awareness campaigns, training programs, and community mobilization efforts, TAA educates farmers on the importance of sustainable land use, water management, and conservation of biodiversity.

2.3.2.9 Local Government Authorities (LGAs)

Local Government Authorities (LGAs), play a fundamental role in advancing sustainable agriculture and local development, with a direct linkage to ecosystem services and livelihood patterns. LGAs are responsible for overseeing and implementing initiatives aimed at sustainable management of natural resources. LGAs enforce regulations related to environment and natural resource management, ensuring adherence to sustainable practices that protect ecosystem services and promote resilient livelihood patterns. Through robust community engagement, LGAs ensure that local perspectives are considered in decision-making processes related to local development initiatives.

2.3.2.10 Research and Training Institution

Research and Training Institutions, including Sokoine University of Agriculture and College of African Wildlife Management, play a pivotal role in promoting sustainable use of natural resources. These institutions conduct research to understand the ecological dynamics of natural resources, including water, soil, and forests, and develop strategies for their sustainable management. Furthermore, these institutions play a key role in promoting forest conservation efforts, including research on biodiversity, ecosystem services, and community-based forest management approaches. (Smrekar *et al.*, 2020) labeled these groups as Knowledge Providers. Through their research, training, and outreach efforts, these institutions provide valuable knowledge and expertise to policymakers, practitioners, and local communities, informing policy development and implementation for sustainable natural resource management. The findings align with (Fitsum *et al.*, 2020), showing that research and training institutions play a role in conducting studies, training, and sharing biodiversity information with relevant groups.

2.3.2.11 Umoja wa Vijana Mweka Ndo

This is a local youth organization in Kibosho that plays a crucial role in promoting community engagement, youth empowerment, and sustainable development, including tree planting initiatives. The organization actively involves young people in tree planting programs, which contribute to environmental conservation efforts, including reforestation, habitat restoration, and climate change mitigation. Through their tree planting initiatives, Umoja wa Vijana Mweka Ndo promotes awareness about the importance of trees for biodiversity conservation. The organization also educates local communities about sustainable tree planting practices, such as selecting appropriate tree species, planting techniques, and maintenance strategies.

2.3.2.12 Roots and Shoots groups

Roots and Shoots is a comprehensive environmental education program that equips teachers and students with the necessary resources, tools, and training to engage in practical learning experiences centered on biodiversity and climate change. By facilitating collaborative projects such as tree planting, school gardens, and

community clean-ups, Roots and Shoots actively promotes student participation and engagement in practical environmental conservation efforts. The mission of Roots and Shoots is to cultivate respect and compassion for all living entities, advance comprehension of various cultures and beliefs, and inspire every individual to take proactive steps in creating a better world for humanity, animals, and the environment (Gorczyca, 2009). Through its school-based initiatives, Roots and Shoots encourages a sense of environmental stewardship among young people, empowering them to be informed and responsible. Thus, the Roots & Shoots organization holds the view that by offering students education and training in natural resource management, these students will gain the ability to influence the environmental practices of their families (Gorczyca, 2009).

2.3.2.13 Tanzania Tour Operator

Companies such as Kilimanjaro Tanzanite Safaris and Abercombie and Kent are notable examples of tour operators that operate in Kibosho East and actively engage in sustainable tourism practices, community empowerment, and conservation efforts. Tour operators have been identified as key participants and have demonstrated an essential and notable function within the diverse group of stakeholders in ecotourism (Pasape & Mujwiga, 2017). These tour operators promote education among tourists and local communities, implement sustainable practices such as waste management and ethical wildlife encounters, engage with local communities for cultural exchange and community-based tourism initiatives, provide economic opportunities through employment and support to local businesses, and contribute to conservation efforts.

2.3.3 Stakeholders' interest and influence

The study adopt stakeholders categorization by (Reed *et al.*, 2009), who categorizes stakeholders into four groups based on their level of interest and influence in a particular phenomenon: key players, context setters, subjects, and the crowd. Key players are those who possess both high interest and high influence, context settlers have high influence but little interest; subjects are stakeholders who have high interest but low influence, while the crowd refers to those with little interest and little influence over desired outcomes.

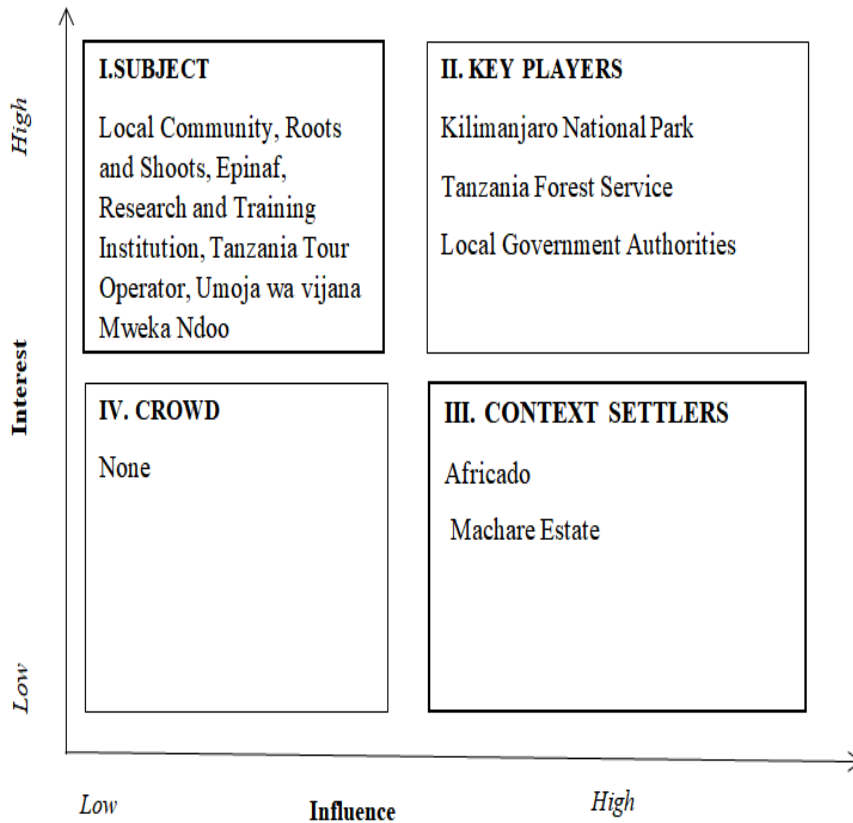


Figure 2.3: Stakeholders interest and influence

The findings revealed that stakeholders in Quadrant I (subject) in figure 2.3, including the local community, and NGOs such as Roots and Shoots, and EPINAV, and Research and Training Institutions and Tanzania Tour Operators, Umoja wa vijana Mweka Ndoo have low influence but high interest in promoting ecosystem services conservation. In line with the previous findings, Aapaoja & Haapasalo (2014) highlighted that local community members are stakeholders who are informed about the management of resources, but have low impact and no power to control it, despite their interest. Also, the findings is consistent with previous study by Ritabulan *et al.* (2015) that found NGOs to have low influence but high interest in the utilization of mangrove forests. For NGOs, Smrekar *et al.* (2020) identified these stakeholders as Civil Society, which acts as a representative for the

interests of individuals, citizens, civil society organizations, and right holders while Hailu *et al.* (2019) observed that some of these stakeholders are highly involved in advocacy, policy prescriptions, and political interests. Reed *et al.* (2009) suggested that these stakeholders are often supportive; their lack of impact on their own may make them less effective in driving decisions. Nevertheless, forming alliances with other stakeholders can increase their influence and enable their participation in decision-making processes. Therefore, to promote effective conservation efforts in Kibosho East, it is necessary to develop strategies that involve empowering the local community and increasing their participation in decision-making processes related to conservation issues. This can be achieved by collaborating and forming alliances among different stakeholders, including NGOs, research and training institutions, tour operators. Such partnerships can enhance the influence of these stakeholders and enable them to participate more effectively in driving conservation decision

Stakeholders in Quadrant II (key players) in figure 2.3, such as government agencies including Kilimanjaro National Park, Tanzania Forest Services, Tanzania Agriculture Association, Local Government Authorities have high influence and high interest as they have both significant power or influence and are highly invested in conservation of ecosystem services. These stakeholders possess both significant power or influence and a high level of interest in conservation, making them important actors in decision-making processes related to the management of mountain ecosystem. The study by Darradi *et al.* (2006) emphasizes that government agencies are considered as stakeholders who hold significant influence in policy-making and decision-making related to the management of wetland resources. Therefore, it is essential to engage with these stakeholders and involve them in conservation efforts, as their support and active participation that have a significant impact on conservation outcomes. Reed *et al.* (2009) suggest that stakeholders who have both high interest and high influence are valuable and they should be nurtured.

Stakeholders in Quadrant III (context setters) in figure 2.3, mainly private sectors including AFRICADO and Machare Estate have high influence but low interest since they have significant influence over ecosystem services but are not much interested in conservation activities. Cohen-Shacham *et al.* (2015) claimed that private sectors are

merely focused on developing their projects to maximize profits. Meanwhile, (Hailu *et al.*, 2019) noted that the private sector, despite having a relatively low level of involvement in contributing to resource management, still wields a significant influence in accessing resources and influencing public stakeholders. This influence is often subtle and unspoken, but nonetheless holds a considerable amount of power in decision-making processes related to natural resource management. Therefore, Reed *et al.* (2009) suggests that stakeholders who possess significant influence but little interest in a particular phenomenon are considered high-risk and require close monitoring and management to mitigate potential negative impacts.

However, none of the stakeholders identified in the analysis were found to have low levels of both influence and interest in ecosystem conservation, which would place them in Quadrant IV (crowd) in figure 2.3. This finding is significant as it indicates that all stakeholders in the study area have some level of interest and influence in ecosystem conservation. This is important because it suggests that there is potential for collaboration and cooperation among stakeholders to work towards sustainable development goals. The absence of crowd stakeholders implies that there are no stakeholders who are disinterested or lacking in power, which is a positive sign for the promotion of ecosystem services conservation. Thus, it is important for all stakeholders to recognize their role and responsibility in promoting sustainability and work together to achieve this goal.

2.3.4 Perceptions of different stakeholders on the identified key provisioning services

The study assessed the perceptions of local stakeholders and priority on key provisioning services provided by Mount Kilimanjaro ecosystem based on the benefits that they would have to their livelihoods (Figure 2.4). The study finding is in agreement with Acharya *et al.* (2019) who suggested that the degree of emphasis placed on ecosystem services could be heavily influenced by the tangible benefits that users derive from them. Similarly, (Gouwakinnou *et al.*, 2019) found that identifying provisioning services is easier than recognizing other services, due to their direct link to societal well-being. The ranking of these services was determined based on the direct benefits on their livelihoods. The results indicated that water was the highest-ranked provisioning service, with a perception score of 35, highlighting its critical importance to the local

community. Food was ranked second, with a score of 18, followed by fodder with a score of 12, and firewood with a score of 10. Medicine, honey, and poles were ranked as the least important provisioning services, with scores of 8, 5, and 2, respectively.

The results of the study highlight the significance of different provisioning services and their importance to the local community. The results confirmed (Elwell *et al.*, 2018) findings, who discussed that people's perceptions differed along with their understanding of wellbeing. Water was ranked as the highest provisioning service, which underscored its critical significance for human survival but also essential for meeting basic needs such as drinking, cooking, sanitation, livelihoods, and ecosystem health. This finding emphasizes the need for sustainable management practices and climate resilience measures to ensure the continued availability of water for current and future generations. Food was the second-ranked provisioning service, indicating the reliance of the local community on ecosystem services for their food needs. This indicates that people in the area recognize the importance of ecosystem services in providing food for their wellbeing and livelihoods. The recognition of fodder as a critical provisioning service highlighted the importance of ecosystem support for livestock production and sustaining local livelihoods since the availability of fodder directly affected the survival and well-being of livestock, which, in turn, influenced the livelihoods of local communities' dependent on livestock rearing. The outcomes align with the research conducted by (Acharya *et al.*, 2019), where it was discovered that individuals prioritize fodder as a significant provisioning service. This is because nearby users heavily rely on and need substantial quantities of forage, making fodder and grasses their top priority. The recognition of fodder as a critical provisioning service highlights the importance of ecosystem support for livestock production and sustaining local livelihoods.

The study also found that firewood, medicine, honey, and poles were other provisioning services valued by the local community in Kibosho East Ward. The perceptions of stakeholders towards firewood as a provisioning service highlights the recognition of its importance for meeting energy needs in Kibosho East, and the challenges associated with limited access to forests for firewood collection. According to the FAO, a staggering 2.4 billion people worldwide depend on fuelwood for

cooking, boiling water, and heating needs (FAO, 2018). However, limited access to forests for firewood collection posed challenges to local communities in meeting their energy needs, leading to the higher ranking of firewood as a provisioning service. The findings supported (Hall *et al.*, 2008) assertion that as things become scarce, people tend to perceive them as more valuable. Also, the study supports the study by (Gouwakinnou *et al.*, 2019) in northern Benin where he found that the local community relied on firewood as a primary source of energy, considering it an essential commodity. The use of gas as an alternative source of energy had been driven by the restricted availability of firewood and the need to find alternative solutions. It emphasized the need for sustainable management of forests, efficient firewood collection practices, and exploring alternative sources of energy to ensure the availability of firewood and to address the challenges associated with limited access to forests for firewood collection. The importance of medicinal resources from ecosystems was recognized as having cultural, economic, and health significance, emphasizing the need to consider traditional knowledge and practices of the local community when managing these resources. Honey was ranked as the second least important provisioning services due to its importance compared to other staple foods that were more nutritionally dense and necessary for meeting basic dietary requirements. However, this indicated that the local community recognizes the value of honey and other bee products as important provisioning services and its contributing to food production and as a source of income. The findings supports the study by (Nyangoko *et al.*, 2020) in the Rufiji Delta, who found that beekeeping in mangroves was a common economic activity and it served as an important source of income to sustain local livelihoods. The recognition of honey and other bee products as provisioning services highlighted the importance of protecting and managing bee populations and their habitats in Kibosho East. Finally, poles were perceived as a least important provisioning service compared to other services mentioned, likely because they were not as essential for meeting basic human needs as compared to food and water and were relatively easier to substitute compared to food and water.

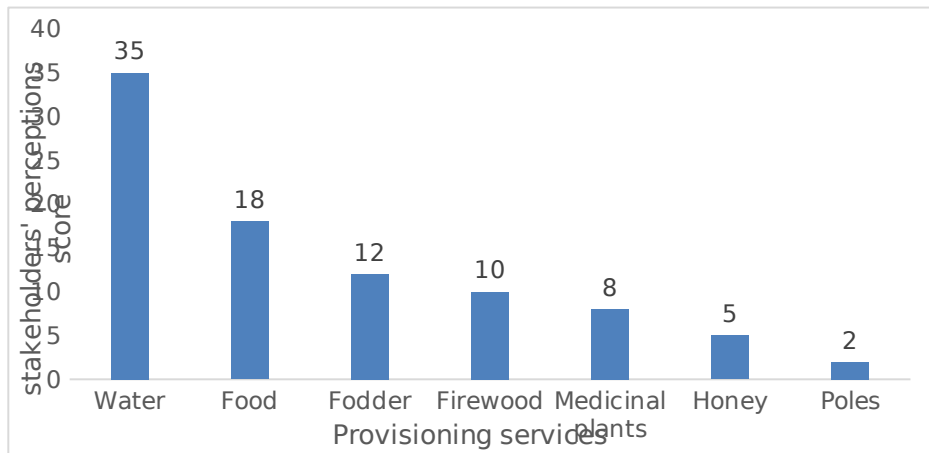


Figure 2.4: Showing value perceptions of stakeholders' for identified provisioning Ecosystem Services on Mount Kilimanjaro Ecosystem

2.4 Conclusion and Recommendation

2.4.1 Conclusion

- The findings of this study provide valuable insights into the mapping and identification of key stakeholders of ecosystem services, as well as their perception of these services. Through a systematic approach, the study identified various stakeholders, including local communities, government agencies, non-governmental organizations, and private actors, who play critical roles in the management and utilization of ecosystem services in the area.
- The study revealed that stakeholders' perception of ecosystem services is influenced by multiple factors, including socio-economic, cultural, and institutional dynamics. While some stakeholders recognized the importance of ecosystem services for their livelihoods and well-being, others had limited awareness or underestimated their value.
- The findings also highlighted the need for inclusive and participatory approaches in ecosystem service management, which consider the perspectives and preferences of various stakeholders. Collaborative efforts among stakeholders, including local communities, government agencies, and non-

- governmental organizations, are crucial for sustainable management of ecosystem services in Moshi Rural District. Furthermore, the integration of local knowledge and traditional practices in decision-making processes can enhance the effectiveness of ecosystem service management.
- Overall, the findings underscore the importance of considering diverse stakeholder perspectives in ecosystem service mapping and management, and provide valuable information for policymakers and practitioners to design appropriate strategies for sustainable ecosystem service management.

2.4.2 Recommendation

Based on the findings, the study recommends:

- To establish regular and meaningful engagement mechanisms with diverse stakeholders, including local communities, government agencies, private sectors, NGOs, and academic and research institutions, in ecosystem management processes. This can involve participatory approaches such as stakeholder workshops, consultations, and collaborative decision-making processes to ensure that all stakeholders are actively involved and their perspectives are considered.
- To invest in capacity building initiatives to empower stakeholders with the knowledge, skills and resources needed for effective participation in ecosystem management processes. This can involve training programs, workshops, and capacity-building activities tailored to the needs of different stakeholders, including local communities, government agencies, private sectors, NGOs, and academic and research institutions.
- To foster collaborative partnerships among stakeholders to promote coordinated and integrated efforts towards sustainable ecosystem management. This can involve establishing formal partnerships, sharing responsibilities, and promoting collaborative actions among stakeholders to achieve shared goals and outcomes.

- Further research and actions towards fostering stakeholder engagement, awareness, and cooperation are necessary to ensure the long-term sustainability of ecosystem services and the well-being of local communities in Mount Kilimanjaro ecosystem.

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CHAPTER THREE

MANUSCRIPT TWO

3.0 Key provisioning ecosystem services, their monetary valuation and implications on attainment of the Sustainable Development Goals on Mount Kilimanjaro ecosystem²

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Abstract

Mountain ecosystems are of significant ecological value, providing diverse ecosystem services (ES) that contribute to the well-being of human populations residing in mountain regions and neighboring lowlands. Understanding the monetary value of provisioning services informs decision makers to balance economic gains with ecological sustainability. However, a notable gap exists in localized valuation studies which comprehensively assess how stakeholders value ecosystem services at their disposal and their monetary value in

specific ecosystems. The study employed a descriptive and cross-sectional research design involving, a sample size of 90 households. Qualitative data from the collected information were analyzed through content analysis and quantitative data were analyzed through SPSS to identify key provisioning ecosystem services. The monetary value of provisioning services was determined using the choice experiment approach while the monetary value average and household proportions was computed through Microsoft Excel for average economic contribution of identified service to the overall well-being of a community. Seven key provisioning services, including clean water, food, fodder, firewood, honey, medicinal plants and poles, were identified as important in sustaining livelihoods of communities on the Mount Kilimanjaro ecosystem. The total of 7 SDGs out of the 17 SDGs were addressed and attainable through the use of identified provisioning ecosystem services including SDG 1, SDG 2, SDG 3, SDG 6, SDG 7, SDG 8, SDG 11 and SDG 15. Accessibility to these services depended on climate, socio-economic factors, infrastructure, and proximity to the identified services. The total annual economic value (TEV) of Mount Kilimanjaro ecosystem amounts to an impressive 543,411,640 TZS (currently US\$ 226,445). This underscores the significance of these services in supporting local livelihoods, economic development, and overall well-being of communities on the Mount Kilimanjaro ecosystem. The mountain ecosystem contributes substantially to the economy of local communities and attainment of some of the SDGs. The value of provisioning ES is apparently contributing substantially to the local economy on the Kilimanjaro ecosystem.

Keywords Mountain Ecosystems, Provisioning Services, Monetary Valuation, SDGs

3.1 Introduction

Mountain ecosystems are of significant ecological value, providing diverse ecosystem services (ES) that contribute to the well-being of human populations residing in mountain regions and neighboring lowlands (Millennium ecosystem assessment, 2005); (Immerzeel *et al.*, 2020). These ecosystems, with their rich diversity, play a crucial role in sustainable development by offering benefits and values that support the livelihoods of rural communities. Ecosystem services are defined as benefits that ecosystems provide to human well-being are classified into different categories, including provisioning services, regulating services, cultural services, and supporting services (TEEB, 2010).

Among these services, provisioning services hold utmost importance as they directly contribute to human livelihoods and well-being by supplying essential goods and products like food, water, timber, and other natural resources (Fisher *et al.*, 2009). The significance of these provisioning services becomes evident in their pivotal role in supporting the livelihoods of the local population, who heavily rely on natural resources for subsistence, income generation, and cultural practices (Fisher *et al.*, 2009). Despite their critical role, the benefits and economic values provided by nature are often undervalued in commercial markets and overlooked by policymakers and conservationists (Mombo *et al.*, 2013). Moreover, a mounting body of research suggests that a lack of understanding and appreciation for the economic value of ecosystem services, and their profound impact on people's lives and the local and national economy, stands as a primary factor contributing to the inadequate management of the areas responsible for providing these essential services (Sharma *et al.*, 2015).

Understanding the monetary value of provisioning services helps to inform decisions on land conversion for agriculture and forestry to help balance economic gains with ecological sustainability (Förster *et al.*, 2019). Also, it raises awareness about the need for sustainable resource management practices to ensure the long-term availability and benefits of provisioning services for future generations (TEEB, 2010). In addition, understanding the monetary value of provisioning services and their link to Mount Kilimanjaro ecosystem, a natural resource-dependent area, is vital for sustainable resource management and decision-making

Numerous valuation methods have been developed and refined over time to assess the economic values of targeted ecosystem services across various categories (Pandeya *et al.*, 2016). When estimating economic value, it is important to consider that the willingness of the public to pay for a particular service represents the value they place on it (Just *et al.*, 2005). Economic values can be estimated using market transaction values of intended ecosystem services, parallel market transactions indirectly related to the ecosystem services being valued, or by estimating the willingness of consumers to pay for goods and services associated with ecosystem services in the absence of market values (Pandeya *et al.*, 2016). Thus, measuring and monitoring the supply, delivery, contribution to well-being, and values of ecosystem services are crucial for a comprehensive understanding of their worth (Tallis *et al.*, 2012). Furthermore, ecosystem services can also be valued based on their contribution to the achievement of the Sustainable Development Goals (Palacios *et al.*, 2021)

Biodiversity and ecosystems, along with the benefits they offer, are the foundation of various aspects of human, societal, cultural, and economic welfare (Folke *et al.*, 2016; Millennium ecosystem assessment, 2005; Naeem *et al.*, 2012). The SDGs are formulated with the aim integrating and achieving favorable results across societal, economic, and environmental domains (Wood *et al.*, 2018). The concept of ecosystem services plays a crucial role as an integrated framework in the field of sustainability science (Liu *et al.*, 2015). To accomplish the aims of the SDGs, it's crucial to manage ecosystems properly. This ensures that nature is protected, and the benefits and services they provide are available fairly and sustainably (DeClerck *et al.*, 2016).

In the context of Moshi Rural District, within the Mount Kilimanjaro ecosystem, a region well-known for its rich biodiversity and multiple ecosystem services, the identification and assessment of provisioning services' monetary value are of highest importance. However, a notable gap exists in localized valuation studies focused on Moshi Rural District, which comprehensively assess the monetary value of provisioning services while considering the unique ecological, socio-economic, and cultural contexts of the area. This gap primarily stems from the lack of local data on market prices of provisioning services and the limited engagement of stakeholders, including local communities,

policymakers, and resource managers, in the valuation process (Bagstad *et al.*, 2013).

This study aimed to identify and assess key provisioning services, their monetary value and contribution to attainment of the SDGs and household welfare. Specifically, to i) identify key provisioning ecosystem services ii) assess the monetary value and contribution of the provisioning ecosystem services to household welfare through attainment of SDGs.

3.2 Materials and Methods

3.2.1 Study area

This study was conducted in Moshi Rural District, specifically in Kibosho East Ward, located in Kilimanjaro Region, with an approximate population of 14,148 people. Kibosho East is a division within Kibosho ward in Moshi Rural District, situated between latitude 3°11'41" S and longitude 37°20'30" E, at an elevation of 2013 m above sea level. Data was collected from Singa, Sungu, and Mweka villages, which are part of Kibosho East division. Kibosho East was deliberately chosen due to its location in a mountain block close to Kilimanjaro National Park, encompassing both forest (Protected Area) that local communities heavily depend on, albeit under strict protection, and agro-ecosystems that supply most of the daily livelihoods, but face increasing population pressure and potential degradation. Capturing information on Ecosystem Services from both the perspective of a protected area and agro-ecosystems was crucial in understanding the wide range of ecosystem services derived from mountain ecosystems, many of which are associated with protected areas and may affect local perceptions of their values.

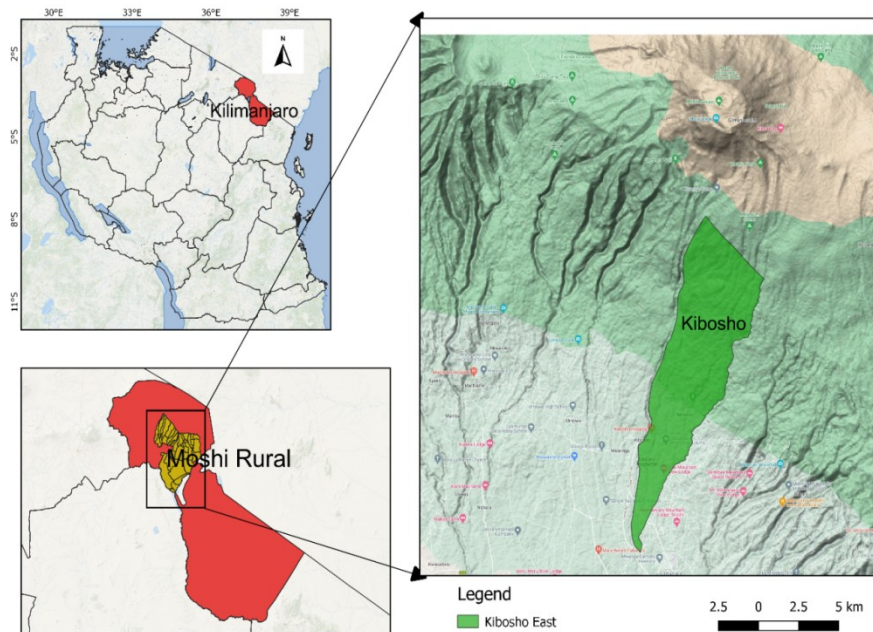


Figure 3.1: A map showing the location of study area

3.2.2 Sampling design

This study employed a descriptive and cross-sectional research design, where data were collected at one point in time, involving sample size of 90 households. This design was deemed appropriate for describing population characteristics and investigating the relationships among variables at a specific moment (Kothari, 2004). The target population for the study involved communities that relied on the mountain ecosystem.

3.0 Data Collection

Data were collected using various socio-economic survey techniques, including direct observation, Focus Group Discussions (FGD), key informant interviews (KII) with different groups of stakeholders, and questionnaires administered to randomly selected individual respondents and household heads above 18 years. In this study, eight groups of seven people each participated in the Focus Group Discussions (FGD) while key informants, included ward leaders, District

personnel, Council management team, park staff, and other relevant beneficiaries of the mountain ecosystem such as government and non-governmental organizations (NGOs). The Focus Group Discussions (FGD) was conducted prior to the questionnaire survey to better identify key provisioning services. Furthermore, relevant questions from the Focus Group Discussions (FGD) were incorporated into the household questionnaire survey to have a more detailed elicitation of the values and importance of the ES to the community. Information on the value of key provisioning services was obtained through the Choice Experiment approach. In Choice Experiment, respondents are presented with a number of options consisting of a menu of choices, consisting various possibilities and they are asked to select their preferred option from each of these options (Mombo, 2013).

3.2.3 Data analysis

The information generated from the household survey was summarized into quantities of each service obtainable for each household and trends in their supply. Qualitative data obtained from the FGD and KII were analyzed using content analysis for identification and description of these services, while quantitative data were verified, compiled, summarized, coded, and analyzed using Statistical Package for Social Science (SPSS) for quantitative quantification of their importance and a comprehensive list of key provisioning ecosystem services. The monetary estimation of the identified provisioning services was determined based on the quantities generated per year and the unit price of respective ecosystem service. Total Monetary Value of ES = quantity of ES x Price per Unit Quantity x Number of Households accessing the services in the study area (Mombo, 2013).

The computations of the monetary value average were done using Microsoft Excel for the average economic contribution of the identified provisioning ecosystem service to the overall well-being while the relevant SDGs addressed by the services were determined by the extent to which they address the different SDGS depending on their importance.

3.3 Results

3.3.1 Social Economic Characteristics of the Respondents

Table 3.1 presents the socioeconomic characteristics of the respondents. The results reveals that a significant portion of the participants were aged 41 and above, with males (62.2%) representing the majority gender, while females accounted for (37.8%) of the sample. Additionally, the majority of the respondents were married (77.8%) and had a family size of 2 members (3.3%), 4 members (22.3%), and 6 members (63.3%). The primary occupations reported by the respondents were farming (78.9%), followed by business (10.0%) and employed (8.9%). Moreover, the respondents' educational backgrounds varied, with the majority having attained primary education (53.3%), followed by adult education (17.8%), secondary education (16.7%), college/university education (5.6%), and informal education (6.7%).

Table 3.1: Social Economic Characteristics of the Respondents

Characteristics	Percentage Respondents (%)
Age	
18 – 30	10.0
31 – 40	28.9
≥ 41	61.1
Gender	
Male	62.2
Female	37.8
Occupation	
Farmer	78.9
Business	10.0
Employed	8.9
Others	2.2
Education Level	
Informal	6.7
Adult Education	17.8
Primary Education	53.3
Secondary Education	16.7
Tertiary (College/University) Education	5.6
Marital Status	

Single	6.7
Married	77.8
Divorced	15.6
Family Size	
2 members	3.3
4 members	22.3
6 members	63.3
Others	11.1

3.3.2 Provisioning Services from the Kilimanjaro Ecosystem

Seven provisioning services were identified as important benefits from the ecosystem (Figure 3.2). Respondents were generally more aware of some provisioning services where by access to clean and safe water was identified as the most crucial by 38.9% of respondents, followed by food mainly food crops such as maize, beans and banana. Cash crops included coffee, vegetables, and fruits (21.1%) The need for fodder to support livestock production was recognized as important by 13.3% medicinal plants by 11.1% while honey was identified as important by 8.9% of respondents. Poles were recognized as important by 5.6% of respondents, and firewood by only 1.1% of respondents

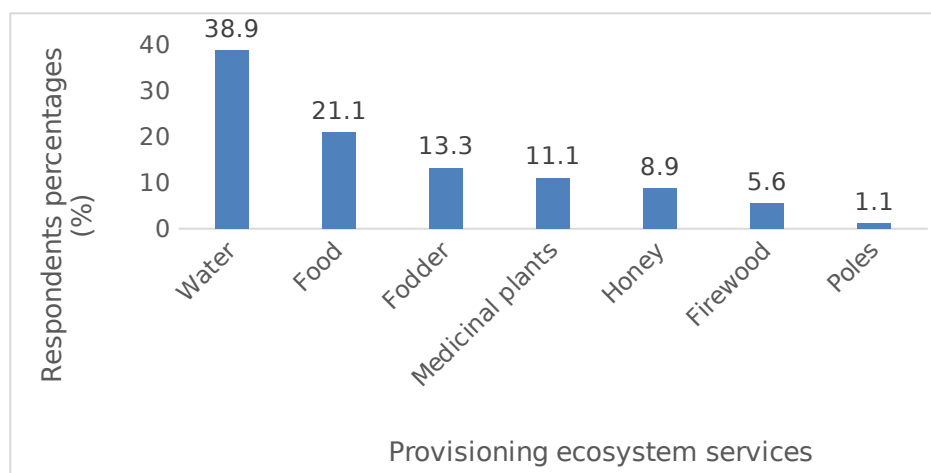


Figure 3.2: Identified Provisioning Services with community benefits from Mount Kilimanjaro Ecosystem

3.3.3 Contribution of provisioning services to the household welfare

The identified provisioning services contributed significantly to household welfare by providing tangible benefits that were essential to people's well-being. Access to clean and safe water was crucial for domestic use such as drinking, cooking and sanitation, irrigated agriculture and industrial use for city dwellers, which has positive implications on people's health and support to economic activities and development. Access to a diverse range of nutritious food crops such as maize, beans, banana and vegetables such as amaranth, cabbage and Chinese cabbage, as well as cash crops such as coffee, and fruits including avocados and peaches improved household food security and promoted good health. Medicinal plants including Ididi for livestock treatment and Ihuruka for treating skin diseases. Also, medicinal plants provided easy access to natural remedies for common ailments, reducing healthcare costs and improving well-being. Fodder supported livestock production not only enhancing soil fertility through manure but also serves as a source of both food and income through milk production and sales for households. Honey served as a valuable source of nutrition and income for households engaged in beekeeping, while poles were necessary for construction and fencing. Firewood was essential for cooking and heating in households with limited access to alternative energy sources. Coffee, banana and livestock production has been a mainstay for household income and economic development of majority of the population on Mount Kilimanjaro ecosystem for time immemorial (Mhando & Mbeyale, 2010).

3.3.4 Factors influencing access to the Provisioning Services

The study identified four main factors that affect access to these services: climatic conditions, socio-economic factors, infrastructure, and distance. The study revealed that 48.9% of respondents identified good climatic conditions as the most critical factor influencing access to provisioning services followed by socio-economic factors such as family size, individual needs and poverty (32.2%), Infrastructure mainly drainage and water taps was identified by (10.0%) of the respondents while distance to the identified services was identified by (8.9%) of the respondents.

3.3.5 Monetary Valuation of Identified Provisioning Services

3.3.5.1 The total economic value of food crops

Food crops were the primary crops grown, with banana, maize, and beans being the main staples. The amount of banana bunches that were produced were about 93 bunches and 88 and 71 buckets of maize and beans respectively. In terms of market price, bananas typically range from 10,000 TZS to 15,000 TZS per bunch, with an average selling price of 12,500 TZS while maize and beans range from 15,000 TZS to 40,000 TZS per a 20-liter bucket with an average selling price of 27,500 TZS. Based on this average, the economic value of the banana produced was approximately 1,162,000 TZS, while maize and beans have an estimated value of 2,424,000 TZS and 1,942,500 TZS, respectively.

3.3.5.2 The total economic value of cash crops

Coffee was the primary cash crop grown and many residents rely on it as a significant source of income. The market price for one kilogram of coffee in the region is around 7700 TZS, and at minimum, a farmer can produce an average of 10 kilograms of coffee annually. About 5030 kilograms of coffee were produced annually. Based on this price, the estimated economic value of coffee produced was approximately TZS 38,731,000

3.3.5.3 The total economic value of vegetables

Various vegetables are grown in the Kilimanjaro ecosystem, including cabbage, Chinese cabbage, carrot, and okra, as well as the growth of natural crops such as amaranth and watercress. These vegetables are crucial in the local diet, and each household typically consumes at least one of these vegetables per meal every day. The total amount of 496 bunches of vegetables were produced annually. In terms of market prices, one bunch of these vegetables typically costs between 50-500TZS with an average selling price of 275. Based on these prices, the estimated economic value of vegetables produced was 325,800TZS for cabbage, 300 000 TZS for Chinese cabbage, 286,200 TZS for carrot, 280 260TZS for okra, and 203 400 TZS for amaranth while the estimated value for watercress was 239 880 TZS.

3.3.5.4 The total economic value of fruits

Cultivated fruits include bananas, mangoes, avocados, passion fruits, lemons, and guavas, while natural fruits include berries and peaches. However, most of these fruits were not sold but used for household consumption. A total of 771 bunches were produced per a season. To determine their potential value, respondents were asked how much they would sell these fruits for, with prices ranging from 50-1000 TZS with an average price of 525 TZS per a season. Based on these prices, the estimated economic value of fruits produced was 37,600 TZS for bananas, 57,750 TZS for avocados, 60,050 TZS for passion fruits, 32,000 TZS for lemons, 52 950 TZS for berries, and 56,750 for peaches.

3.3.5.5 The total economic value of livestock

Various types of animals were reared in this area, including chickens, goats, sheep, cattle, and pigs. Each type of livestock had a distinct cost associated with it. A total of 76 chickens, 165 sheep, 141goats, 92 cattle and 38 pigs are sold annually. Chickens have a cost range of 5 000 TZS and 10 000 TZS with an average selling price of 7,500 TZS, goats and sheep vary between 15 000 TZS and 30 000 TZS with an average price of 22 500 TZS, cattle range between 400,000 TZS and 800 000 TZS with an average selling price of 600 000 TZS, and pigs have a cost range of 150 000 TZS and 300 000 with an average selling price of 225 000 TZS. Considering the current market prices, the estimated total economic value of goats was 3 713 000 TZS, sheep was 4 132 000 TZS, cattle was 55 550 000 TZS, pigs was 8,590,000 TZS and chickens was 577, 000 TZS. The estimated total economic value of livestock is 72 562 000 TZS.

3.3.5.6 The total economic value of water

Water was an essential provisioning service, originating from the mountains and flowing into various rivers such as Ng'omberi, Kyarongo, and Lombanga. The water was utilized for multiple purposes such as domestic use; irrigation, industrial uses, and power supply at Nyumba ya Mungu dam. While the economic value of water was significant, the focus of this study was solely on its value for domestic use. The amount of water used for domestic purposes varied depending on the size of the household; households with larger numbers of family members consumed between 6 to 8 buckets of 20 liters of water per day, while those with fewer family members

consumed between 3 to 5 buckets of 20 liters per day of water per day. About ,141000 liters of water were used annually. Although households do not pay for water, they were asked to indicate the amount they would be willing to pay for a 20-litre bucket. They suggested a rate of 100 TZS. The estimated total economic value of water from was 416 465 000 TZS.

3.3.5.7 The total economic value of wood energy

Firewood serves as the primary source of energy for a significant portion of households. However, accessing firewood was challenging due to restrictions on entering the forest. Consequently, people relied on firewood obtained from farms and trees near water streams. Unfortunately, the availability of firewood from these areas was insufficient, leading into some individuals selling firewood to alleviate the scarcity issue and generate income. The quantity of firewood consumed daily varies based on the number of family members, with larger families utilizing more firewood compared to smaller ones. About 92 bundles of firewood were sold annually. A bundle of firewood typically costs between 5000 TZS to 10000 TZS with an average price of 75,000 TZS per bundle. Considering the prevailing market price, the estimated total economic value of firewood obtained was 692 500 TZS.

3.3.5.8 Aggregated total economic value

The aggregated total economic value of the provisioning services in table 3.2, reveals the significant contributions of various categories obtained annually. In terms of agricultural products, the total value of crops amounts to 44,259,500 TZS, while vegetables and fruits contribute 1,635,540 TZS and 297,100 TZS, respectively. Livestock production, a vital component of the local economy, is valued at 72 562 000 TZS.

Water sources play a crucial role in domestic use, with a total estimated value of 416 465 000 TZS. This value represents the economic significance of water used for domestic purposes, including drinking, cooking, and cleaning.

Wood energy, primarily in the form of firewood, has an estimated value of 692 500 TZS. This reflects the reliance on woody biomass for cooking and heating needs.

Taking into account the value of all these provisioning services, the total economic value (TEV) amounts to an impressive 54311,640TZS. This aggregated value underscores the significance of these services in supporting local livelihoods, economic development, and overall well-being.

Table 3.2: Aggregated total economic value

Provisioning services category	Type of provisioning services	Total value in TZS
Agricultural products	Crops	44 259 500
	Vegetables	1 635 540
	Fruits	297 100
	Livestock	72 62 000
Honey		7 500 000
Water sources		416 465 000
Woody energy	Firewood	692 500
Total Economic Value (TEV)		543 411 640

3.3.6 Monetary Valuation Average and Household Proportions

Among the households surveyed, a distinguished subset, comprising 54 households, reported values that exceeded the average. These households demonstrated a higher level of benefit from the provisioning services provided in the ward. Conversely, there was another subset of households, comprising 36 households, which reported values below the average.

3.3.7 SDGs addressed by the identified provisioning services

Access to clean and safe water was an essential requirement for achieving Sustainable Development Goals (SDGs) 3 and 6, which aim to ensure healthy lives, promote well-being for all at all ages, and ensure the availability and sustainable management of water and sanitation for all, respectively. Similarly, access to a diverse range of nutritious foods was crucial to addressing SDG 1 and SDG 2, which aim to end poverty in all its forms everywhere and end hunger, achieve food security and improv nutrition, and promote sustainable agriculture. Moreover, access to medicinal plants was essential for achieving SDG 3, which is to ensure healthy lives and promoting well-being for all at all ages. Access to fodder was crucial for achieving SDG 8, which aim to

promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all. Additionally, access to honey addresses SDG 2 and SDG 8, as it contributes to ending hunger, achieving food security and improved nutrition, promoting sustainable agriculture, and promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all respectively.

Access to poles was important in achieving SDG 11 and SDG 15, which aim to make cities and human settlements inclusive, safe, resilient, and sustainable and protect, restore, and promote sustainable use of terrestrial ecosystems, respectively. Finally, access to firewood was crucial to addressing SDG 7 which focuses on ensuring access to affordable, reliable, sustainable and modern energy for all.

3.4 Discussion

The study findings offer valuable insights into the socioeconomic characteristics and provisioning services. The demographic analysis reveals a significant portion of the participants being aged 41 and above, with males representing the majority. This suggests that this age group possesses valuable experience and strong decision-making skills when it comes to managing and conserving provisioning ecosystem services. Additionally, they tend to have a deeper understanding of the long-term consequences of sustainable resource use, underscoring the significance of their participation in ensuring responsible practices. This aligns with the well-established understanding that males typically assume the role of household heads in African societies (Magembe, 2007). The age distribution within a society plays a crucial role in determining its potential productive force. According to Namwata *et al.* (2012) individuals between the ages of 16 and 64 are generally considered economically productive. This underscores the importance of implementing age and gender-specific interventions in community development efforts. It is crucial to consider the diverse household structures and potential economic disparities, as indicated by the prevalence of married respondents and varying family sizes. The study also highlights the strong reliance on farming as the primary occupation, emphasizing its agricultural dependence. This calls for targeted agricultural initiatives, improved farming practices, and access to markets to enhance productivity and income generation. To

ensure sustainable agricultural practices that promote environmental conservation, it is essential to align these initiatives with current voluntary standards and best practices on agricultural sustainability such as those promoting soil health, biodiversity conservation, and reduced use of harmful chemicals. Furthermore, the diverse educational backgrounds of the respondents indicate the need to address educational disparities and provide lifelong learning opportunities for skill development and economic empowerment. As Włodarczyk-Marciniak & Krauze (2023) argued, an increase in education level enhances awareness and fosters positive attitudes towards ecosystem services, motivating people to manage natural resources sustainably.

The study highlights the significant contribution of provisioning ecosystem services to the overall well-being of the community. Notably, the respondents demonstrated a clear awareness of these services, recognizing them as tangible and easily identifiable benefits derived from the environment. The results are in agreement with Acharya *et al.* (2019) who suggested that the degree of emphasis placed on ecosystem services could be heavily influenced by the tangible benefits that users derive from them. Also, The findings are consistent with the research conducted by López-Santiago *et al.* (2014), which emphasizes that many provisioning services possess a direct market value, making them easily recognizable by individuals. Similarly, the study by Boafo *et al.* (2014), indicated that the villages examined in the study placed a strong emphasis on provisioning services, underscoring the households' reliance on these services. Access to clean and safe water and food emerged as highly identified and crucial provisioning services, reflecting the community's dependence on these sources for sustenance. (Gouwakinnou *et al.*, 2019) found that Food security was enhanced by a diverse range of edibles, including fruits and various plant parts sourced from the forest. Moreover, the study acknowledges the importance of animal fodder for livestock production and honey for income generation. It recognizes that animal husbandry plays a vital role in sustaining local livelihoods, making the availability of sufficient animal feed a crucial factor in supporting the community's economic well-being. To align with these services, promoting sustainable animal husbandry practices such as rotational grazing and proper animal care can preserve the environment while optimizing livestock productivity.

Improving the sources of fodder would therefore enhance animal husbandry and associated livelihoods in the Kilimanjaro ecosystem especially with communities adjacent to the Kilimanjaro National Park

While it is worth noting that rural communities, as indicated by (Makonese *et al.*, 2018), still rely on firewood for basic cooking requirements due to its easier access and affordability, this study reveals a lower perception value of poles and firewood as provisioning services. This may be attributed to the limited access to the forest, resulting in reduced availability of firewood and subsequently diminishing the recognition of these resources. As a consequence of limited access to firewood due to reduced availability in forests, the study uncovers a trend of individuals turning to gas as an alternative source of energy. This indicates a shift in energy preferences and the adoption of alternative methods to meet their household energy needs. The growing utilization of gas as an energy source highlights the community's adaptability and willingness to explore alternative options and diverge from need for firewood which is advocated to be part of environmental degradation. This shows a change of perception and interest in conserving forests instead of over utilization for firewood and other energy needs.

Furthermore, the study reveals that access to provisioning services is influenced by various factors, including climatic conditions, socio-economic factors, infrastructure, and proximity. These findings align with the research conducted by Ouko *et al.* (2018), which supports the understanding that provisioning services have a direct impact on the physical, economic, and social well-being of the community. Notably, socio-economic factors such as family size, individual needs, poverty and politics play a crucial role in determining access to these services. The study further highlights the reliance on provisioning services among individuals with specific needs, larger families, and lower socio-economic status. Gouwakinnou *et al.*, (2019) argued that poverty level is a significant factor in identifying provisioning services, emphasizing that individuals in extreme poverty heavily depend on ecosystem-based provisioning services for their daily sustenance. Adequate infrastructure, including reliable water sources with proper drainage and functional water taps, is vital for ensuring access to clean water for the residents. However, the proximity between households and provisioning services presents a considerable barrier, especially for

those living in elevated areas, posing challenges in accessing these essential services. The results align with the study by (Gouwakinnou *et al.*, 2019), who found that the identification rate of provisioning services was influenced by the distance between the village and the edge of the forest in Northern Benin. In addition to the above findings, politics significantly influences access to provisioning services through resource allocation, policy decisions, and governance. Moreover, political agendas can shape environmental policies, impacting conservation efforts and the sustainability of natural resources that underpin provisioning services. The interplay between politics and provisioning services can thus have a profound impact on the well-being of communities, by either promoting equitable access. Addressing political challenges and ensuring effective governance are essential steps toward enhancing access to provisioning services and fostering sustainable development for all.

The integration of social and economic valuation methods in this study provides a suitable framework for assessing the value of provisioning services. The study aligns with (Howarth & Farber, 2002) and (Nijnik & Mather, 2008), who proposed that effective approaches should merge various theoretical frameworks while incorporating both analytical and participatory techniques. The valuation process encompassed various analytical perspectives, allowing for a comprehensive understanding of the services' worth (Grönroos & Voima, 2013). The results obtained from the monetary valuation of provisioning services provide valuable insights into the economic significance of these services for households. Understanding the economic value of provisioning services is crucial for decision-makers as it allows for a comprehensive assessment of the benefits derived from these services, facilitates comparison with alternative methods of providing similar benefits, highlights trade-offs associated with different land-use decisions, and supports the development of payment for ecosystem services schemes (Asah *et al.*, 2014). This study provides an overview of the general issues, focusing on water, livestock and agro-products mainly crops production as the provisioning service with high total economic value. As these services play a vital role in fulfilling fundamental human needs, it is essential to prioritize and integrate them into decision-making processes. This step is crucial to ensure their long-term sustainability. Therefore, the values derived from this study,

encompassing both the way these services are perceived and their monetary significance, can together contribute distinctively to supporting the management of the Mount Kilimanjaro ecosystem.

The assessment of household proportions has revealed notable variations in the distribution of monetary values derived from provisioning services among different households, highlighting the presence of disparities in their economic benefits. Notably, 54% of the surveyed households heavily depend on these provisioning services, indicating their crucial role in sustaining livelihoods. These households demonstrated a higher level of benefit from the ecosystem-provided services, underscoring their significant reliance on these valuable resources. The remaining households, comprising 36% of the surveyed population, reported values below the average, suggesting a comparatively lower level of benefit derived from the provisioning services. These households have diversified their sources of services outside the ecosystem, seeking income from other sectors such as non-farm labor. This diversity of livelihood strategies within the community reflects varying degrees of dependence on ecosystem services.

One key factor influencing these disparities is the size of households. The findings indicate that larger households tend to have a higher proportional share of the monetary values derived from provisioning services compared to smaller households. Household size plays a crucial role in determining the access and utilization of these services, potentially influencing the overall well-being of different households. Therefore, the study highlights the disparities and heterogeneity regarding the monetary value of provisioning services.

3.5 Conclusion and recommendation

3.5.1 Conclusion

- This study reveals the significance of provisioning ecosystem services for well-being of communities within the Mount Kilimanjaro ecosystem
- The value of provisioning ES is apparently contributing substantially to the local economy on the Kilimanjaro ecosystem
- The study underscores the importance of responsible resource management and sustainable development practices to ensure the long-term well-being of the ecosystem and its benefits.

- By identifying key provisioning services, the study provides a comprehensive understanding of the ecosystem's resources and their associated benefits with potential to contribute to the attainment of the SDGs
- The provisioning ES on the Kilimanjaro ecosystem address several of the SDGs among which are no poverty, zero hunger, good health and wellbeing, clean water and sanitation, affordable and clean energy, decent work and economic growth and life on land.
- The knowledge on the provisioning ES plays a crucial role in guiding sustainable development planning by integrating the economic significance of these services into decision-making processes and their integration into economic systems, such as national accounting frameworks and economic indicators.
- This integration enhances our understanding of economic performance and sustainability, fostering a balanced approach that bridges the gap between environmental conservation and economic decision-making.
- Ultimately, the integration of provisioning services into economic systems promotes a holistic approach to development that values both environmental conservation and economic well-being.

3.5.2 Recommendation

Based on the findings the study recommends the following:

- Firstly, it is recommended to establish integrated management approaches that consider the economic significance of provisioning services. This can be achieved through the development and implementation of policies and regulations that prioritize the conservation and sustainable utilization of these services.
- Secondly, Local communities should be empowered and involved in decision-making processes regarding the use and conservation of these services. This can be achieved through the establishment of participatory mechanisms, such as community-based natural resource management initiatives, where local knowledge and perspectives are considered.
- Lastly, continuous monitoring and assessment of provisioning services are crucial. Regular monitoring can provide valuable

data on the status and trends of these services, helping policymakers to identify potential threats and changes in their availability and ensure appropriate management actions are taken.

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CHAPTER FOUR

4.0 GENERAL DISCUSSION

The study highlights the significant contribution of provisioning services to the overall well-being of the community. Particularly, the respondents demonstrated a clear awareness of these services, recognizing them as tangible and easily identifiable benefits derived from the environment. The results are in agreement with (Acharya *et al.*, 2019) who suggested that the degree of emphasis placed on ecosystem services could be heavily influenced by the tangible benefits that users derive from them. Also, the study acknowledges the importance of animal fodder for livestock production and honey for income generation. It recognizes that animal husbandry plays a vital role in sustaining local livelihoods, making the availability of sufficient animal feed a crucial factor in supporting the community's economic well-being.

Furthermore, this study reveals a lower identification of poles and firewood as provisioning services. This is attributed to the limited access to forests, resulting in reduced availability of firewood and subsequently diminishing the recognition of these resources. As a consequence of limited access to firewood due to reduced availability in forests, the study uncovers a trend of individuals turning to gas as an alternative source of energy. This indicates a shift in energy preferences and the adoption of alternative methods to meet their household energy needs. Moreover, the study reveals that access to provisioning services is influenced by various factors, including climatic conditions, socio-economic factors, infrastructure, and distance. These findings align with the research conducted by (Ouko *et al.*, 2018), which supports the understanding that provisioning services have a direct impact on the physical, economic, and social well-being of the community. Moreover, political agendas can shape environmental policies, impacting conservation efforts and the sustainability of natural resources that underpin provisioning services. The interplay between politics and provisioning services can thus have a profound impact on the well-being of communities provisioning services.

The integration of social and economic valuation methods in this study provides a suitable framework for assessing the value of provisioning services. The study aligns with (Howarth & Farber, 2002) and (Nijnik & Mather, 2008), who proposed that effective approaches should merge various theoretical frameworks while incorporating both analytical and participatory techniques. The valuation process encompassed various analytical perspectives, allowing for a comprehensive understanding of the services' worth (Grönroos & Voima, 2013). The results obtained from the monetary valuation of provisioning services provide valuable insights into the economic significance of these services for households. Understanding the economic value of provisioning services is crucial for decision-makers as it allows for a comprehensive assessment of the benefits derived from these services, facilitates comparison with alternative methods of providing similar benefits, highlights trade-offs associated with different land-use decisions, and supports the development of payment for ecosystem services schemes (Asah *et al.*, 2014). This study provides an overview of the general issues, focusing on water, livestock and agro-products mainly crops production as the provisioning service with high total economic value. As these services play a vital role in fulfilling fundamental human needs, it is essential to prioritize and integrate them into decision-making processes. This step is crucial to ensure their long-term sustainability. Therefore, the values derived from this study, encompassing both the way these services are perceived and their monetary significance, can together contribute distinctively to supporting the management of the Mount Kilimanjaro ecosystem.

Moreover, the findings revealed that stakeholders including the local community, and NGOs such as Roots and Shoots, and EPINAV, and Research and Training Institutions and Tanzania Tour Operators, Umoja wa vijana Mweka Ndoo have low influence but high interest in promoting ecosystem services conservation. Reed *et al.* (2009) suggested that these stakeholders are often supportive; their lack of impact on their own may make them less effective in driving decisions. Nevertheless, forming alliances with other stakeholders can increase their influence and enable their participation in decision-making processes.

Stakeholders such as government agencies including Kilimanjaro National Park, Tanzania Forest Services, Tanzania Agriculture Association, Local Government Authorities have high influence and high interest as they have both significant power or influence and are highly invested in conservation of ecosystem services. These stakeholders possess both significant power or influence and a high level of interest in conservation. Therefore, it is essential to engage with these stakeholders and involve them in conservation efforts, as their support and active participation that have a significant impact on conservation outcomes.

Stakeholders mainly private sectors including AFRICADO and Machare Estate high influence but low interest since they have significant influence over ecosystem services but are not much interested in conservation activities. Therefore, Reed *et al.* (2009) suggests that stakeholders who possess significant influence but little interest in a particular phenomenon are considered high-risk and require close monitoring and management to mitigate potential negative impacts. However, none of the stakeholders identified in the analysis were found to have low levels of both influence and interest in ecosystem conservation. This finding is significant as it indicates that all stakeholders in the study area have some level of interest and influence in ecosystem conservation

Nonetheless, the ranking of these services was determined based on the direct benefits on their livelihoods. The results indicated that water was the highest-ranked provisioning service, with a perception score of 35, highlighting its critical importance to the local community. Food was ranked second, with a score of 18, followed by fodder with a score of 12, and firewood with a score of 10. Medicine, honey, and poles were ranked as the least important provisioning services, with scores of 8, 5, and 2, respectively. Water and food were ranked as the highest provisioning service, which underscored its critical significance for human survival but also essential for meeting basic needs such as drinking, cooking, sanitation, livelihoods, food needs and ecosystem health. These findings emphasize the need for sustainable management practices and climate resilience measures to ensure the continued availability of water and food for current and future generations.

The perceptions of stakeholders towards firewood as a provisioning service highlights the recognition of its importance for meeting energy needs, and the challenges associated with limited access to forests for firewood collection. The use of gas as an alternative source of energy had been driven by the restricted availability of firewood and the need to find alternative solutions. It emphasized the need for sustainable management of forests, efficient firewood collection practices, and exploring alternative sources of energy to ensure the availability of firewood and to address the challenges associated with limited access to forests for firewood collection. The recognition of honey and other bee products as provisioning services highlighted the importance of protecting and managing bee populations and their habitats. Finally, poles were perceived as a least important provisioning service compared to other services mentioned, likely because they were not as essential for meeting basic human needs as compared to food and water and were relatively easier to substitute compared to food and water.

CHAPTER FIVE

5.0 Key Contributions, Conclusion and Recommendations

5.1 Key contributions of the study

- The study provides empirical evidence on the economic value attributed to provisioning services, offering concrete evidence of their significance in decision-making processes
- Also, the study provides a deeper understanding of the complex relationship between human well-being and ecosystem health.

5.2 Conclusion

- The findings revealed that stakeholders recognized the importance of ecosystem services for their livelihoods and well-being, others had limited awareness on their value
- This study reveals the significance of provisioning ecosystem services for well-being of communities within the Mount Kilimanjaro ecosystem
- The value of provisioning ES is apparently contributing substantially to the local economy on the Kilimanjaro ecosystem
- The study underscores the importance of responsible resource management and sustainable development practices to ensure the long-term well-being of the ecosystem and its benefits. Also, the study highlights the importance of ecosystem service mapping, valuation, and management, emphasizing the significance of taking into account diverse stakeholder perspectives

5.3 Recommendations

- Regular monitoring and assessment of provisioning services are crucial to provide valuable data on the status and trends of these services, to identify potential threats and changes in their availability and ensure appropriate management actions are taken
- The need to invest in capacity building initiatives to empower stakeholders with knowledge, skills and resources needed for effective participation in ecosystem management through valuing of ecosystem services.

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APPENDICES

Appendix 1: Household Questionnaire Protocol

STAKEHOLDERS' PERCEPTIONS, PROVISIONING SERVICES AND MONETARY VALUATION ASSESSMENT

1. Purpose

The general purpose of this Questionnaire to supplement the information in a quantitative term on the qualitative data obtained during Focused Group Discussion (FGD). The questionnaire is specifically created to collect data on a wide range of ecosystem services. The following is the questionnaire's hierarchical organization

- i. Part I: Socio economic characteristics of the respondent
- ii. Part II: Identification and mapping of key stakeholders in Moshi Rural District
- iii. Part III: Identified key Provisioning ecosystem services and their status in Moshi Rural District
- iv. Part IV: Perceived preferences of different stakeholders on the identified Provisioning services
- v. Part V: Monetary valuation and contribution to household welfare of the provisioning services in Moshi Rural District

2. INTRODUCTORY INFORMATION TO THE RESPONDENTS

My Name is Agnesta Julius Buyekwa. I am a student from Sokoine University of Agriculture, working with issues of Stakeholders' perceptions and Monetary Valuation of Ecosystem Services. I have come to your household to discuss with you some issues regarding the socio-economic aspects. Ecosystem services Respondents are guaranteed that this is only for scholarly work and no other reason. Therefore, respondent's confidentiality is guaranteed. Thank you for your contribution.

PART I: Socio economic characteristics of the respondent

1. Respondent number.....

2. Gender

Gender	Tick
Male	
Female	

3. Age

Age range	Tick
18-30	
31-40	
41 and above	

3. Level of Education

Level of Education	Tick
Informal	
Adult education	
Primary education	
Secondary education	
College/University	
Other	

4. Marital status

Marital Status	Tick
Single	
Married	
Divorced	

5. Family size

- i. 2 members
- ii. 4 members
- iii. 6 members
- iv. Others (specify).....

6. Occupation (main occupation)

- i. Employed
- ii. Farmer
- iii. Business
- iv. Others (specify).....

7. What are the socio-economic activities conducted by the local people?

.....
.....

8. What types of ecosystem services of benefit do you get from the forest?

- i.
- ii.
- iii.
- iv. 9. Factors influencing the access to provisioning services
 - i.
 - ii.
 - iii.

PART II: Identification and mapping of key stakeholders in Mountains Ecosystem services.

10. Who is the most dependent group of the mountain ecosystems (Is it the matter of livelihood or Economic advantage)

- i.
- ii.

11. What are the livelihood patterns that takes place in Kibosho East

- i.
- ii.

12. How is your socio-economic activities depend on mountain ecosystems?

-
-

13. Who are the people/ groups most knowledgeable about and capable dealing with ecosystem services

- i.
- ii.

14. What are the organizations linked to the ecosystems services in Kibosho East

- i.
- ii.

15. List of groups that have direct influence on the ecosystem services in Kibosho East

- i.
- ii.

PART III: Identification of key provisioning services and stakeholders' perception on the identified key provisioning services.

16. What provisioning services do you obtain from the mountain ecosystem?

- i.
- ii.

17. What is the local use of the identified provisioning services?

- i.
- ii.

18. What are the most important identified provisioning services obtained from the mountain ecosystems?

- i.
- ii.

19. What are the least important identified provisioning services obtained from the mountain ecosystems?

- i.
- ii.

20. Have you observed any changes in the mountain ecosystems? (Yes/ No) or no change.

- i.

21. If yes, how has the condition changed over the last 5 years?

.....

What caused this change?

What is the current condition of the mountain ecosystems in the provision of provisioning services?

How does the government help in influencing in the management of mountain ecosystems?

How are the measures by the government in influencing the management of mountain ecosystems affect the respondents' lives?

.....

Which of the identified provisioning services supported by mountain ecosystems do you mostly rely on and would you prefer to be sustained for the future?

Instruction: Please tick the appropriate response in a respective row.

1= Not preferred, 2= less preferred. 3= preferred, 4= most preferred

S/No	Provisioning services	Not preferred	Less preferred	Preferred	Most preferred
1					
2					
3					

PART IV: Monetary valuation and contribution of the provisioning services to household welfare through attainment of SDGs in Moshi Rural District

22. What is the level of your overall wellbeing?
.....

23. How has your wellbeing changed over the last 5 years?
.....

How does the obtained provisioning services contribute to the welfare of the community?

- i.
- ii.
- iii.
- iv.

24. List the quantities, uses and values of crops your household has harvested during the past 12 months.

Crop	Farm size in acreage	Unit of harvest	Total harvest (a)	Uses		Type of market	Price per unit (TZS) (b)	Total revenue (a*b)
				Own use	Sold (a)			

Appendix 2: Checklist for Key Informants

1. Name of respondent..... Date.....
2. District.....Name of the village.....
3. Age of respondent.....Sex.....
Female.....
4. Position in the village council.....
5. Population; Number of males.... Number of females.....
Total number...

6. What are the livelihood activities done by the villagers that link to mountains ecosystems?
.....
What are the provisioning services gained by the villagers?
.....
What are the villagers' preferences on the identified key provisioning services?
7. What is the extent of knowledge that the villagers have concerning mountain ecosystems?
8. Is there any government support that you receive upon management of mountain services?
.....
What are your recommendations/ suggestions on this particular matter?



Kuhusu Tasnifu Hii

Mifumo ya ikolojia ya milima hutoa manufaa mengi kwa jamii zinazoishi katika maeneo hayo. Hata hivyo, thamani ya faida zake kwa mujibu wa mtazamo wa wadau haijapewa umuhimu unaostahili. Jumla ya faida saba muhimu za mifumo ya ikolojia ilitambuliwa, ikiwa ni pamoja na maji safi, chakula, mimea ya dawa, kuni, asali na fito, zilitambuliwa. Faida hizi za mifumo ya kiikolojia zinashughulikia malengo muhimu ya Maendeleo Endelevu ikiwa ni pamoja na lengo endelevu 1, lengo endelevu 2, lengo endelevu 3, lengo endelevu 6, lengo endelevu 7, lengo endelevu 8, lengo endelevu 11 na lengo endelevu 15. Jumla ya thamani ya kiuchumi ya faida muhimu zaidi za mifumo hii ya ikolojia inafikia kiwango cha shilingi milioni 543.5 (sasa ni dola za Marekani 226,445). Matokeo ya utafiti huu ni muhimu kwa wapanga sera kuzipa kipaumbele juhudi za uhifadhi na kutenga rasilimali kwa ufanisi kwa kuzingatia mahitaji mbalimbali na maslahi ya wadau.