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Africa Center of Excellence for Climate Smart Agriculture and Biodiversity Conservation - HARAMAYA UNIVERSITY

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To: Horn of Africa Regional Environment Centre and Network (HoA-REC&N)
Addis Ababa University, Addis Ababa

Subject: Letter of support and confirmation

Mr. Dinku Balcha, an Ethiopian nation, is one of PhD candidates currently enrolled in the regional programs at Africa Center of Excellence for Climate Smart Agriculture and Biodiversity Conservation (Biodiversity and Ecosystem Management Stream) at Haramaya University, Ethiopia. The Center works in close collaboration with scholars in the eastern and southern African region and beyond in teaching and advising postgraduate students that are enrolled in the regional postgraduate programs.

Mr. Dinku has successfully completed the coursework and has developed his PhD dissertation research proposal on "Agricultural investment coalition with ecosystem management at Ethio-South Sudan border: The case of Gambella-Boma National Parks". However, he has not obtained any grant other than the one provided by the university. Besides, the budget allotted by our university is not enough for the completion of his PhD dissertation research work. We believe that the financial support given by your institution will play a significant role to conduct a high quality research in his area of specialization. Being his supervisor and training and research head of the center, I am writing to support his application to successfully undertake his PhD dissertation research work as per the schedule.

We look forward to working with you!

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HARAMAYA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

African Center of Excellence (ACE) for Climate Smart Agriculture and Biodiversity Conservation (Climate SABC)

Agricultural Investment Coalition with Ecosystem Management at Ethio-South Sudan border: The case of Gambella-Boma National Parks

PhD Grant Research Proposal

Dinku Balcha

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Haramaya University, Haramaya

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1. INTRODUCTION

1.1. Background

Establishing and managing protected areas is one of the biodiversity conservations approaches that has long been served as a cornerstone for ecosystem management (IPBES, 2021; Redford *et al.*, 2015). These protected areas are playing a significant role in addressing biodiversity loss and climate mitigation and adaption. However, current human use and transformation of ecosystem, exploitation of organisms, pollution and the introduction of invasive species have resulted in the rapid and wide spread decline of biodiversity and the degradation of ecosystem worldwide (IPBES, 2021). In Africa, the extent of protected areas has almost doubled in the last decades but effectiveness of protected areas is poor in many areas due to a combination of factors, such as: climate change, overexploitation, civil conflicts, and encroachment from local populations to sustain their livelihoods, and inadequate park design and administration (Walters, 2018). Within the same fashion the protected areas of Ethiopia operate at a level substantially below its potential. At the time where world worry about the ecosystem found outside protected area, it is so shame to improperly handle the designated protected area on our hands specially developing world. Quite a number of the protected areas in Ethiopia are effectively “paper parks” (Van Zyl, 2015).

Gambella National Park is found in Gambella region, which is the second largest protected area in country next to Bale Mountain National. This region has huge potentials of agricultural investment due to its favorable climatic conditions and geographical suitability. High amount of rainfall received per year, the wetness nature of the land, and other many related natural phenomena made the region selective (Fakana & Mengist, 2019). The region is biologically highly diversified and share boarder with Boma National Park of South Sudan. Wildlife management is a part of the measures which are necessary for fulfilling the objectives of certain protected areas. They operate within ecosystems whose boundaries do not to coincide with administrative nor national borders. (Gabreta & Janík, 2020; Krhoda, 2018). The transboundary ecosystems connected with biodiversity corridors for migratory large mammals are important aspect in the context of sustainable management of the whole ecosystem goods and services associated with the ecological regions and enhance sustainable ecosystem management.

However, a key challenge for the management of protected areas is to find strategic ways in which to enable successes, including benefits beyond species and ecosystems management. Despite all the challenges, the presence of rich biodiversity, mosaic of shared cultural and ecological attributes would bring opportunities to bring about harmonized development, peace and security (Abera & Prof, 2018; Walters, 2018).

As a part of the Ethiopian government initiatives to tap the resources in the region and enhance the livelihoods of the local people, Gambella has been identified as one the regions suitable for large-scale agricultural investment in the country (Kussia et al., 2020) and impaired with improper strategy and management which imposed serious problems on livelihoods of thousands of local communities with their indigenous knowledge who live harmony with nature. Recently, the pressure of human population on the ecosystem has increased for the need of food security, energy and other related development goals such as agro-industries in the last two decades in Ethiopia (Degife & Mauser, 2017).

This large agricultural investment expansion by leasing became common fashion to national and international private investors in the last few years in Ethiopia and went serious step towards grabbing millions of hectares of fertile lands especially in western parts of the country specifically Gambella region (Becker & Wittmeyer, 2013; Degife & Mauser, 2017). Rather than investment, the region has been facing tremendous deforestation problems since last three decades due to resettlement programs, refugees' migration from the neighboring South Sudan and occurrence of frequent wild fire and seasonal movement of semi-nomadic cattle breeding tribes (Berta, 2013). This continuous trends of encroachment by agricultural investment and local community devastates the ecosystem goods and services which are supporting millions of living organisms including human races.

Therefore, this huge ecologically rich resource needs transboundary ecosystem management collaboratively through legal and policy frame work within involvements of local community and other concerned stakeholders. Unless otherwise the fate of this protected areas may fail under unsustainable use of both or either side the community and adversely affect the effectiveness of the entire ecosystem function and composition.

1.2. Statement of the problems

The ever-increasing transformation of land use land cover due to human demand for ecosystem goods and services has negatively impacted the ecosystem functions and finally resulted in degradation of large-scale biodiversity loss. The change in ecosystem at local level accumulates and exacerbates the change of ecological composition and functions at regional and continue to global level depending on the scale of pressure exerted from human population. The potentials of current ecosystems have multiple benefits by being zero emitter of carbon dioxide and sequestering huge amount of atmospheric carbon dioxide. As an example, the study shows that the current carbon sequestration potential of Gambella National Park is about *394.85±24.34ton/ha* (Berta, 2013) even though the park is in the state being rapid declining in its coverage. The size of Boma National Park of South Sudan is more than five folds of Gambella National Park and does the same ecological function. Boma-Gambella National parks are protected areas found at the international borders of Ethio-South Sudan hosting large mammals migration next to Serengeti National Park through biodiversity corridors and contributing to establishing connection of both protected areas resulting in adaptive ecosystem management, and improved livelihoods of local people (Legas & Taye, 2019). During dry season some animals move to Ethiopia by crossing international borders which makes more favorable conditions for migratory large mammals and widen the habitats of most animals in sustainable manner.

However, the current complication with both governments impaired with unclear land use policy accompanied by vast agricultural investment resulted in further potential damage on both protected areas. Armed conflicts, agricultural expansion, settlement and other many artificial anthropogenic crises are going to break mosaic shared of culture, indigenous knowledge and ecological attributes of these regional large ecosystems. The large-scale agricultural investment in the Gambella region seems drama as such terrifying situation of clearing virgin lands of many thousand hectares for doing nothings to the communities and left the areas. Land governance system is characterized by unresponsiveness to the voices, concerns, and benefits of the local people; non-transparent and unaccountable structures; rent-seeking and corruption; rule of man; and absence of supervision and evaluation mechanisms (Kussia *et al.,* 2020).

This shows there is a less concerns about ecosystem Service management and livelihoods of local communities. Therefore, this area needs great attention in making harmony of agricultural investment with ecosystem management for facilitating good quality of life for local livelihoods of community and future fate of the region as a whole.

1.3. Scope of the study

This study is bounded to ecosystems found with Ethio-South Sudan of international borders where rich in biodiversity with multiple functions is gaining from ecological diversity that supports millions of organisms and indigenous local community for a long period of time. Technically, the study is delimited to ecosystem management related with migratory large mammals' movement between these protected areas and associated risks currently devastating the biodiversity of the region as a whole. There are a number of activities like large scale agricultural investment, protected area encroachment, illegal hunting and settlement which needs serious attention to save the ecosystem and support the sustainable livelihoods for both human being ecosystem of the area. The study will be carried out both by field survey and in depth understanding of current situation from available data. High resolution of geo spatial data will be acquired from different internationally recognized webs. Further, structured and semi structured interviews will be carried out with local communities and key informants for detailed gap finding to come with solution best fit to the current socio-economic situations.

1.4. Rationale of the study

The current feasible global climate change is the result of accumulated effects from local degradation of ecosystems which developed to regional scale. This study is therefore helpful in that, the ecological stability of ecosystem harmonized with indigenous knowledge will save the natural environment that adds values for local communities in terms of income, food and other many related benefits. On the other hands, the improvement of this ecosystem has high implication regionally in protecting indigenous knowledge of community how to manage ecosystem and by storing large amount of carbon. But, due to improper implementations of agricultural intensification at the costs of natural environment and the livelihoods of local community damaged the connectivity of the social, culture and ecosystem. So, the study fills gaps by improving current ecosystem management. This enhances ecological balance and reduces greenhouse gas emissions from degradation and deforestation. The socio-economic importance of the ecosystem management will be clearly improved because healthy functioning of the natural resources is a big asset for local community and the entire living organisms associated with the resources found in the region. Further, the biodiversity corridors for migratory animals have multiple benefits by improving ecosystem function, increasing ecosystem goods and services for local community and save animals from being extinct. Again, the study forwards the best ecosystem management approach that fits regions for future socioecological balance for protected areas.

1.5. Objective

1.5.1. General objective

To identify mechanisms and approaches for improved synergy and harmonization among agricultural investment and trans-boundary ecosystem management in Gambela and Boma National Park.

1.5.2. Specific Objectives:

The following will be the specific objectives of the research proposal

- To quantify land cover change due to agricultural investment on Gambella-Boma National Parks of Ethio-South Sudan Boarder
- Assess habitat suitability for transboundary large mammals' movement across the two parks of international boundary
- To quantify ecological carrying capacity and ecological security the areas to guide the sustainable development and transboundary ecosystem management programs
- To assesses and mapping of ecosystem services that contributes to positive synergies and co-existence between indigenous communities, development projects and transboundary ecosystem management

- To develop strategies that contributes to positive synergies and co-existence between indigenous communities, development projects and transboundary ecosystem management;

2. MATERIALS AND METHODS

2.1. Descriptions of the study area

Gambella national park is located at 850 km west of Addis. Its Coordinates is 34^{o} 0.00' East 7^{o} 52.00' North. The Park area is home to the Nuer and the Anuak people and it is said to be "a land of least disturbed and intact ecosystem" as compare to other part of the National Parks of the country. The climate of the region comes under the influence of the tropical monsoon from the Indian Ocean, characterized with high rainfall in the wet period from May to October and dry period from November to April which is recorded highest temperature. Agro-climatically, it is classified as Kolla and the climate is hot and humid High temperatures are recorded just before the onset of rains in May. Annual mean temperature is with a minimum and maximum of 18.09 and 39.34 C^{o} respectively. The lowest rain fall is recorded in November to April whereas highest rainfall is May to October. Annual rainfall is estimated to around 69.7mm in the plains. Landscape of Gambella national park is low and flat with altitude ranging from 379 to 507 m asl which is the lowest altitude in the region and the average altitude is around 443 m asl.

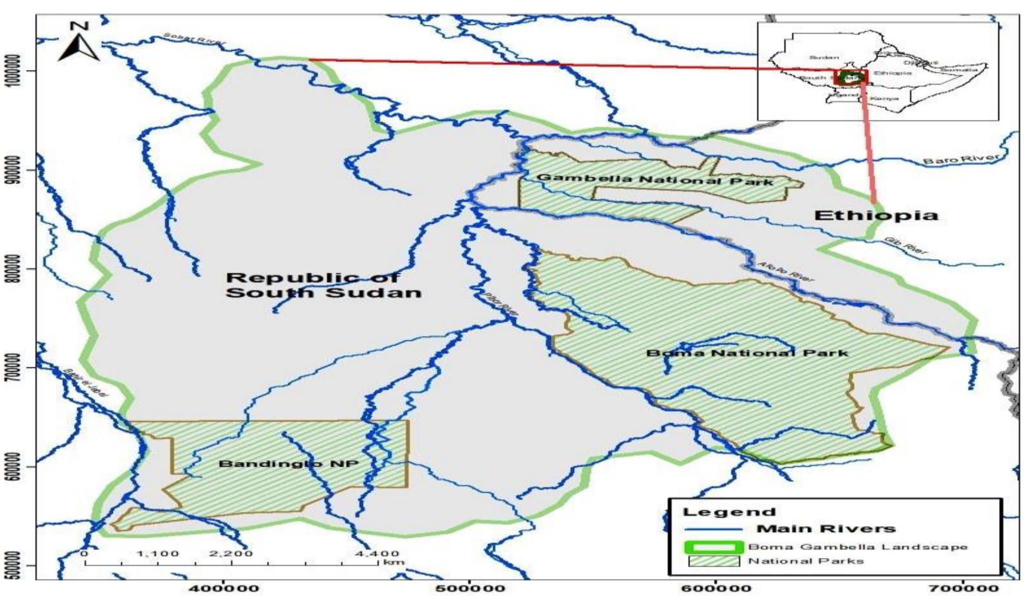

Figure 1: Map of the study area Adapted from (Abera & Prof, 2018)

2.2. Methodologies and their descriptions

This research proposal contains five objectives. The first, addresses land use land cover change (henceforth, LULCC) and its impact projection of Gambella-Boma National parks. Further this objective distinguishes and classifies the different LULCU types, quantify rate and magnitude of change, and to investigate the major factors driving LULCC in the study area The second, determines the habitat suitability for seasonal migratory mammals between the two international transboundary ecosystems. The third assesses the ecosystem services derived from protected areas that compatible with indigenous communities, development projects and enhance transboundary ecosystem management. The fourth intends to quantify the ecological carrying capacity and ecological security level to maintain both sustainable livelihood development and transboundary ecosystem management program. The last but not the list objective goes to develop strategies that synergistically holds the three opposing entities namely indigenous community, development projects and transboundary ecosystems. In the following sections the objectives with its respective data sources, methods and data analysis employed are described briefly.

2.3. Data sources and data collection method.

2.3.1. Quantification of land cover change

In order to differentiate LULCC multispectral satellite imagery of Landsat, arial photographs, ground truth data from GPS (Geographical Positioning System) records, and related literatures will be used. Both primary data from ground survey and secondary data from satellite image, arial photographs and tomographs will be used in order to reduce errors and clearly classify the LULCC type, trends, rate, magnitude of change, driving force and future projection (Tewabe & Fentahun, 2020). The ground truth data will be collected in the form of reference data points by GPS. After data acquisition, satellite image pre-processing before change detection phenomenon is very important in order to establish a more direct affiliation between the acquired data and biophysical phenomena (Bufebo & Elias, 2021).

Satellite image data will be imported to ENVI 5.2 software in an image format for geometric correction. Then the images are geo-referenced and mosaicked to its subsets on the basis of Area of Interest (AOI). After that supervised classification will be performed by applying maximum likelihood algorithm on the images. It is the type of image classification which is mainly controlled by the analyst as the analyst selects the pixels that are representative of the desired classes. To perform accuracy assessment for the classified images random any random sample points for each land use will be created ground control points recorded by using a hand-held GPS will be used as the reference data to evaluate the results. Since large agricultural investment intensification has begun 2000s, the LULCC mapping and classification will be begin from the year of 2000-2020 from Landsat 7 and Landsat 8 (Degife & Mauser, 2017).

2.3.2. Assessment of habitat suitability for transboundary large mammals' movement

Field survey using GPS for collection of species presence points will be used as a primary data. While satellite image, bioclimatic, topographic vegetation and anthropogenic variables will be used as a source of secondary data (Su et al., 2021). For mapping and modelling of habitat suitability, maxent software will be used. The following procedures are used during mapping and modelling of habitat suitability for all possible mobile large mammals across the international transboundary protected areas (Debela *et al*., 2021; Mushet et al., 2012; Su *et al*., 2021; Zhang *et al*., 2018).

i. Land cover map will be prepared from Landsat 8 image (cloud-free operational land image data), which will be downloaded later from the United States Geological Survey (https://glovis.usgs.gov/). Image resolution of 30 m and an image subset for the study area will be clipped from the Landsat 8 scene by using a vector shapefile (administrative boundary.
ii. Topographic variables which highly affects terrestrial mammals such as aspect, elevation and slope will be extracted by using 30-m resolution digital elevation model (DEM) from the Japan Aerospace Exploration Agency's (JAXA) (https://www.eorc.jaxa.jp/ALOS/en/aw3d30/data/index.htm) to calculate slope and

aspect. Finally, the resampling tool will be subsequently employed to convert the spatial resolution of the elevation, aspect, and slope to 100 m.

iii. Bio-climatic variables (annual time series with annual means, seasonality, and extreme or limiting temperature and precipitation) which fits the study area will be downloaded later from the WorldClim historical database (http://worldclim.org/). Version 2.0 of this database provides a set of 19 global bio-climatic variables derived from over 4,000 weather stations, which are averaged between the years 1970 and 2000, and with a spatial resolution of approximately 1 km. For this study, the spatial resolution of all 19 bio-climatic variables will be resampled to 100 m using ArcGIS.

iv. Vegetation data from Global Forest Change 2000-2019 (https://earthenginepartners.appspot.com/science2013globalforest/download_v1.5.html) will be used to model the habitat of the target species. This data covers results from time-series analysis of Landsat images in characterizing global forest extent and change from 2000 through 2019.

v. Anthropogenic variables shapefile of paths and settlements inside the study area will be downloaded from the Geofabrik (http://download.geofabrik.de/asia/nepal.html) and then rasterized. Further, locations of settlement (if any) will be surveyed by the researcher for ground truth checkup.

vi. Finally, Maxent (http://biodiversityinformatics.amnh.org/open_source/Maxent/) version 4.1 to model suitable habitat of all possible mobile large mammals across the two transboundary natural resources will be run.

2.3.3. Quantification of ecological carrying capacity and ecological security

2.3.3.1. Ecological carrying capacity

Ecological carrying capacity modelling has been categorized into basic general concepts based on the impacts of socio-economic development on the natural environment and generally summarized to some limited perspectives due to its elastic nature as environmental change, human impacts on ecosystems and the holistic ecosystem. (Qian et al., 2017). For this objective holistic ecosystem perspective is selected purposely because it integrates the ecosystem and complexity of humans, society and nature There are tremendous number of factors governing ecological carrying capacity that helps calculate the above listed methods which hasn’t been listed here (Chapman & Byron, 2018).

Even though there a number of ecological carrying capacity modeling tools, energetic ecological footprint model will be selected purposefully. It is derived from introducing energy theory to the ecological footprint method. To assess ecological carrying capacity the flow of energy in an ecological economy system is transformed into an area of productive lands that provide ecological services according to the ecological footprint method. The ecological carrying capacity model that involves energy theory can compensate for the disadvantages of the ecological footprint method, which is only based on land productivity, but without considering the demand of other systems on the ecosystem, so that it can more accurately reflect the ecological carrying capacity and ecological footprint demand of human production and activities the improved energetic ecological footprint model takes non-renewable resources and stored energy inside the natural ecosystem into account, thereby further improving the calculation accuracy of the ecological carrying capacity and enabling the application of this method to more complex disciplines. (Qian et al., 2017). The calculation is as follows:

$$ec = E / P1$$

$$ef = C / P2$$

where, ***ec*** is the ecological carrying capacity per capita; ***E*** is the solar energy value per capita for renewable resources; ***P*1** is the global average energy density; ***ef*** is the ecological footprint per capita; ***C*** is the sum of energy value per capita for various resources; and ***P*2** is the energy value density.

2.3.3.2. Ecological security

Various approaches have been applied to evaluate the state of ecological security, such as the pressure-state-response, landscape ecology, material/substance flow analysis, ecosystem services, and ecological footprint. Among which, the ecological footprint method is the most widely used. It is defined as a bio-productive land area that maintains human living needs while absorbing pollution caused by human activities. The primary advantages of this method are that it is easy to apply, repeatable, and simple to understand. Therefore, based on the result of above energetic ecological footprint model ecological security model can be calculated (Guo & Wang, 2019). The formula is as follows.

$$EF = N \times ef = N \times \sum_{i=1}^{n} (aa_i \times r_i) = N \times \sum_{i=1}^{n} \left(\frac{c_i}{p_i} \times r_i \right)$$

In the formula above: EF is the total ecological footprint (ha); N is the total population; i is the category of items consumed by a certain population (i = 1,2, : : : , n); aai is the ecologically productive area from the ith consumption item; p_i is the average productivity of the ith item in a certain area (kg/ha); c_i is the per capita quantity of the ith item (kg/ha) affected by the productivity and trade balance amount; r_i is an equivalence factor, which describes the ratio of the productive capacity of a certain type of bio-productive land to the productive capacity of all the world's bio-productive land.

2.3.4. Assessment and mapping of ecosystem services

Ecosystem services will be identified and assessed using semi-structured interviews. The results semi-structured interviews will be triangulated using other methods such as direct observation, transect walking, focus group discussion, expert opinion and image analysis. Ecosystem User Groups representing various groups related in age, gender, caste, education, occupation and economic status will be identified. During the interview process, the respondent will be requested to rank the ES from the list, as ‘‘low important”, ‘‘medium” or ‘‘highly important” based on their contribution to the livelihoods and wellbeing of the community.

Both spatial and nonspatial data will be used in assessing and mapping ecosystem services of the area. Ecosystem accounting model will be used which was developed UN Statistics Commission (Remme *et al*., 2014): the System for Environmental Economic Accounts Experimental Ecosystem Accounting (SEEA EEA). In this system of modelling ecosystem service accounting, the following key elements will be used and below is the general framework for ecosystem service account (Atkinson *et al*., 2017).

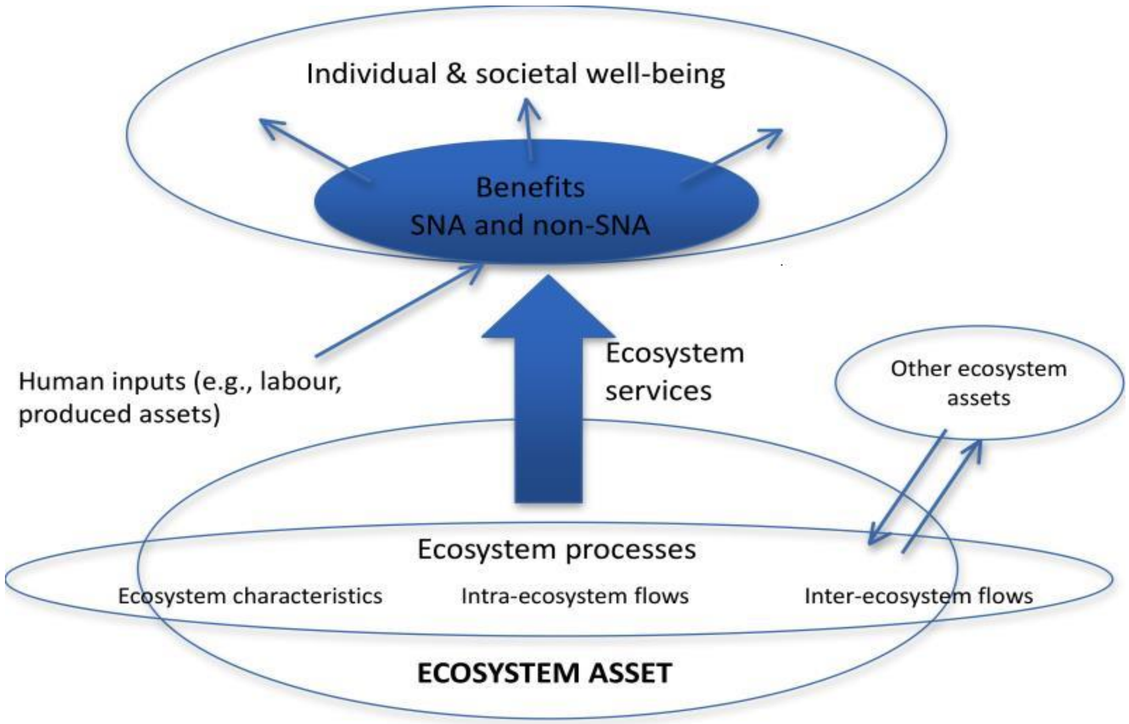

Figure 1. General ecosystem accounting framework

i. The delineation of ecosystem assets

Ecosystem accounting is focused on accounting for ecosystem assets, each delineated by a spatial area an ecosystem asset. With the understanding that each ecosystem asset should consist of a similar vegetation type and cover at a specific spatial location. From a measurement perspective, defining the spatial boundaries of ecosystem assets is fundamental

ii. Measuring the condition of ecosystem assets.

Each ecosystem asset has numerous characteristics (climate, soil, vegetation, species diversity, etc.) and undertakes various ecosystem processes. The integrity and functioning of the asset are measured by its condition. It is the decline in overall condition, in biophysical terms, that underpins the measurement of ecosystem degradation.

iii. Measuring the flow of ecosystem services.

Based on the ecosystem asset's location, condition, and how it is used a basket (or combination) of various ecosystem services will be supplied by an ecosystem asset. From an accounting perspective, the ecosystem services supplied are matched to corresponding consumption of users/beneficiaries, i.e., economic units including businesses, households and governments.

iv. Relating ecosystem services to standard measures of economic activity.

Ecosystem accounting provides a comprehensive and integrated framework for organizing information on ecosystem state and ecosystem use, developed with a direct connection to the SNA (System of National Accounts). The development of ecosystem accounting is supported by advances in bio-physical modelling and the availability of spatially explicit data.

v. The use of prices.

The ecosystem accounting framework just described reflects relationships between stocks and flows that exist without regard for the unit of measurement (although we have referred to monetary values on a number of occasions so far). Thus, in concept, accounting relationships can be reported in physical terms (for example, the stocks and changes in stocks of timber resources can be recorded in a standard asset accounting format) and in monetary units.

2.3.5. Developing strategies that contributes to positive synergies and co-existence between indigenous communities, development projects and transboundary ecosystem management

Key informants will be selected purposefully from both sides and may include, scientists, Rangers, managers and technicians from government agencies, NGOs and academic institutions in the region and adjacent areas. Open-ended interview questions focused on transboundary management, ecosystem management and interagency co-operation will be held. The non-probabilistic, purposive sampling design relied on the principle of data saturation, the point at which no new information or themes are observed in the data, to ensure the sample size will be adequate (Grant & Quinn, 2007).

The number of interviewees will be decided based on the fact that the researcher appear physically on the areas during first reconnaissance survey. The length time of interview for each key informants will no longer than 45 minutes. The questionnaire will be well developed and validated first and will be prepared in equal number with interviewees.

The second steps towards way to develop best strategy that fits the transboundary ecosystem management is using measure of compliance in the following ways (Krhoda, 2018). The term "compliance" designates the number of obligations featured in a policy intended to increase the level of cooperation and prevent disagreements including those that likely reduce habitat degradation. Policies are established by member states to help in developing institutions, legislations, strategies, and regulations on management. The level of compliance to policy was measured using the Obligation Compliance Susceptibility Index (OCSI). Shown by the formula as follows:

$$OCSI = \frac{Number\ of\ obligations\ policy\ featured\ in}{Total\ number\ of\ obligations} \times 100$$

The decision criteria will be based on OCSI ranging between 100-90% indicating excellent performance, 89- 70% which was very good, 69-50% which meant good, 49- 40% which reflected poor representation of the mean in the relevant policy and less than 39% which indicated very poor performance of the policy or the legal framework (Krhoda, 2018).

Prescriptions in relation to obligations.

Another level of integration was tested through the Policy Prescription Integration Susceptibility Index (PPISI) by checking the policy prescriptions in relation to the cooperation obligations. The total relevant prescriptions per obligation of each policy were converted into percentages (Krhoda, 2018).

$$PPISI = \frac{Total\ prescriptions\ per\ obligation}{Total\ policy\ prescription\ per\ policy} \times 100$$

Policy Prescription Integration Susceptibility Index (PPIS) is a measure of the number of prescriptions which address the cooperation issues targeting transboundary ecosystem management (Krhoda, 2018).

3. EXPECTED OUTPUT

After successful completion of the project the following key output will be expected

- Land cover change, its rates, and future change due to agricultural investment at Boma and Gambella National Parks will be quantified
- Suitable transboundary ecosystem for the movement of large mammals across the two parks will be identified for future transboundary ecosystem management
- Ecosystem services that contribute to positive synergies and co-existence between indigenous communities, development projects and transboundary ecosystem management will be identified and demarcated
- Ecological carrying capacity and ecological security of the area will be quantified to guide the sustainable development and transboundary ecosystem management programs.
- Strategies that contribute to positive synergies and co-existence between indigenous communities, agricultural investment and wildlife conservation will be developed to enhance transboundary ecosystem management.

4. WORK PLAN

Table 1. Time table for undertaking activity

S/N	Activity	2020/21				2021/22			
		1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q
1	Reconnaissance survey	X							
2	Selection of districts, numerators, survey work	X	X						
3	FGD, Interview		X	X	X				
4	Field survey			X	X				
5	Data organizing and checking for unfilled data		X	X	X				
6	Data encoding and checking				X	X			
7	Data analysis, interpretation and dissertation write-up					X	X	X	X

Q= Quarter

5. BUDGET BREAKDOWN

Table 2. Budget breakdown

Perdium and accommodation expenses

S/n	**Description**	**Participants**	**Working days**	**Rate Per/day**	**Total**
1	Perdium of Researcher	1	45	850	38,500.00
2	Perdium for daily laborer, scout, and field assistants	10	15	600	90,000.00
3	perdium and accommodation for advisors	3	10	1000	30,000.00
		Sub total			**158,500**

Travel expenses

S/n	**Purpose of travel**	**Units**	**QTY**	**Cost/day**	**Total**
1	Travel to research area and procurement	days	8	850	6800.00
2	For reconnaissance survey	days	10	850	8500.00
3	Car Rental for field work	days	45	4000	180,000.00
		Sub total			**195,300**

Stationery and Equipment expense

S/n	Item Description	Units	QTY	Unit Price	Total
1	Note book	Pkt	1	2500	2500.00
3	A4 paper	Pkt	4	800	3200.00
4	Pencil	Pkt	1	200	100.00
5	Pen	Pkt	1	500	300.00
6	Printing, binding and lamination	No	15	1000	15000.00

7	Clip board	No	2	100	200.00
8	GPS	No	3	22,500	67500.00
9	Digital Camera	No	1	45,000	45,000.00
10	Helmet	No	2	20,000	40,000.00
	Sub total				**173,800**

Communication expenses

S/N	**Purpose**	**Unit**	**No of days**	**Cost/day**	**Total**
1	Air Time	Day	30	200	6,000.00
2	Internet	Day	40	500	20,000.00
	Sub Total				**26,000**

Budget Summary

S/N	**Expense Category**	**Total**
1	Perdium & Accommodation	**158,500**
2	Travels	**95,300**
3	Stationery and equipment Expenses	**173,800**
4	Communication	**26,000**
	Grand Total	**453,600**

6. REREREACES

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