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**IMPACTS OF CLIMATE CHANGE AND VARIABILITY ON THE
SUSTAINABLE LIVELIHOOD OF LOCAL COMMUNITIES OF UM
JAWASSIR, RIVER NILE STATE, SUDAN**

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ABSTRACT

Mean global temperatures are predicted to increase which will affect many human systems – particularly agriculture, water sources, industry and human health. The objectives of the research are: 1) to investigate the coping mechanism at the study area, 2) to investigate the natural resource based conflicts, if any at the study area, 3) to explore the enabling factors behind the success to cope with climate change, and 4) to assess the constraints and measures of risks confronting the resilience of local communities at the study area. Two types of data were collected for this research; primary and secondary data. The primary data was collected through face-to-face interview, Participatory Rural Appraisal (PRA) and observation. While, the secondary data was collected from relevant studies and reports. Um Jawassir Community in the River Nile State, Sudan was selected for this research where the community is historically nomads and settled in the study area for more than a decade. The main finding of the research are; the climate of the state which is semi arid with low rainfall is not suitable for sustainable livelihood where rains are erratic in nature with recurrent drought. Agriculture is the main source of income. Although the local people rear animals, they never market their animals and they keep them for prestige and social values. Rain fed agriculture could hardly succeed, supplementary irrigation is needed to guarantee satisfactorily crop production. The main impact on the resilience of local communities is represented in migration and natural resource-base conflicts. Different types of land tenure exist in the study area although all the settled members were provided with equal parcels of land. Forest resources are meager and subjected to irrational use. One of the coping mechanism to adapt to climate change is to store the surplus agricultural crops at houses or outside houses in traditional stores. The main conclusions drawn from this research are; recurrent drought and fluctuating rainfall are determinant factors for the sustainable livelihood of local communities in the study area.

Keywords: *Drought, rainfall, migration, adaptation, resilience, livelihood.*

INTRODUCTION

Communal lands in Africa support the majority of the rural population, many of whom live below the poverty line. Recent studies have demonstrated that land and natural resources within these multiple-use communal systems play a significant role in the livelihoods and household economies of rural dwellers (Koli, 2010; Eltahiret *et al.*, 2010; Shackleton *et al.*, 2000; Badri, 2012). Few would disagree that communal areas provide land for arable production, fodder for livestock, and an array of biotic and abiotic resources for direct household provisioning and sale. These habitats now are vulnerable to climate change and variability particularly in the least developed countries where adaptation options are limited (Neil *et al.*, 2008).

The semi-arid zone of the Sudan extends between latitudes 14° and 17° N and the low rain fall woodland savannah extends between latitudes 10° and 14° N and these two zones are the



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most densely populated zones and the most vulnerable to deforestation impacts, causing forest cover decline and increase the vulnerability of the ecosystem to desertification processes leading to a serious threats to the woodlands (Elsiddig, 2007). On other hand, the dry lands are faced with serious environmental and socioeconomic problems such as drought, deforestation, desertification, poverty, famine and migration (Kheiry, 2007).

Sustainable livelihoods can fill the practical and conceptual gap that exists between local vulnerability to climate change, desertification and national/intergovernmental policy Processes. More specifically, Just as the term sustainable livelihoods is used to describe both an approach to human development and a framework for analysis; it hypothetically consists of two elements: First, that the sustainable livelihoods approach can respond, on the ground, to climate change and desertification adaptation needs of the most vulnerable groups, and second, that the sustainable livelihoods framework can facilitate the process of adaptation assessment, policy making and implementation. However, data on the contribution these land-based activities make to a diverse and dynamic livelihood base have until recently been limited. Only recently, with the shift to more integrated, people centered approaches, the emerging interest in natural resource valuation, and the formulation of new conceptual frameworks for understanding poverty and livelihoods, has there been increased appreciation of land-based livelihood activities and common pool resources (Osman and Sanjak, 2009).

The concept of 'livelihoods' has moved analysis away from narrow parameters of production, employment and income to a much more holistic view which embraces social and economic dimensions, reduced vulnerability and environmental sustainability, all within the context of building on local strengths and priorities. This recognizes that households pursue a range of livelihood strategies based on the assets (natural, financial, social, human and physical capital) they have to draw on and the livelihood outcomes they wish to achieve. However, much of this new understanding remains within the domain of scholars, donor agencies and NGO practitioners. Little has filtered through to government policy- and decision-makers, planners and extension agents, so that rural development, land reform and agricultural policies and practices often remain focused only on monetized activities. The result is an underestimation of the value of communal lands. Despite tremendous progress in the science surrounding climate change scenarios, it is not currently possible to rely upon existing scenarios for Sudan to confidently assess the impact of climate change on vulnerable of communities. Several factors contribute to this like lack of early warning techniques regarding weather forecast for the long run besides the deterioration of environmental aspects of life (soil degradation and frequent drought cycles). Local communities develop their own adaptation measures to cope with different environmental changes for sake of sustainable livelihood under the light of the complete ignorance of the central and district governments.

The starting premise of this study is to explore the impact of climate change and variability on a newly settled community at Um Jawassir at River Nile State, Sudan.

The broad objective of the research is to investigate the impacts of climate change and variability on the sustainable livelihood of Um Jawassir community and the adaptation options adopted to mitigate the impacts. More specifically to:

- Investigate the coping mechanism (locally driven or intervention) at the study area.
- Investigate the natural resource based conflicts, if any at the study area.
- Explore the enabling factors behind the success to cope with climate change.
- Assess the constraints and measures of risks confronting the resilience of local communities at the study area.

MATERIALS AND METHODS

Study area

The study area (Um Jawassir) is located in southern part of Marawy province (River Nile State) between altitude 31-35 N and latitude 16- 56 N, and west northern direction of Sherian road about 184Km from Umdorman. The rural areas in the River Nile State are among the poorest parts of Sudan. Figure (1) shows the map of the study area.



Fig(1): Map of the study area

Two types of data were collected for this research, namely; primary and secondary data. The primary data was collected through different methods; interviews, Participatory Rural Appraisal and observations. The primary data was collected through two site visits. In the first site visit the target group was familiarized with the nature of the research and to investigate the validity of the constructed questionnaire for data collection, while the second site visit devoted for data collection. A random sample of 60 respondents representing the primary stakeholders was subjected to face-to-face interviews. Participatory Rural Appraisal was conducted after the process of data collection from the primary stakeholders.

RESULTS AND DISCUSSION

General characteristic of respondents.

Table (1) shows the main characteristics of the respondents at the study area. Males are dominant among the respondents (61.7%). Although females were representing of 38.3% of the respondents, still taboos restrict the participation of females with males in any activity. As far as age groups are concerned, all the batches of age groups were represented in this study (less than 20 years, 20 – 40 years, 41 – 60 years and more than 60 years). The majority of the respondents are married (91.7%) and the rest are either single or divorced.

Table (1). General characteristics of the target groups.

Age	Geder (%)		Marital status (%)			Education level (%)		
	Male	Female	married	single	Divorce	Illiterate	khalwa	University
<20	100	-	100	-	-	100	-	-
20-40	53.3	46.7	90	10	-	76.7	20.0	3.3
41-60	59.1	40.9	95.5	-	4.5	86.4	13.6	-
>60	100	-	100	-	-	100	-	-

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Total	61.7%	91.7%	6.6%	1.7%	83.3%	15.0%	1.7%
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As far as the education level is concerned, the majority of the respondents are illiterates (83.3%). This high level of illiteracy is attributed to marginalization like other rural areas of the country.

Climate change and variability at the study area.

The climate of the state is classified as semi arid. Average annual rainfall ranges between 75mm and 150mm. this amount of rainfall is not sufficient for irrigation. Supplementary irrigation is needed to guarantee satisfactorily crop production. Analysis of standardized time – series of annual rainfall and mean temperature for the period (1960-2006), expressed as standardized anomalies are shown in Figures 2 & 3. Bars represent yearly standard anomalies index (SAI) and lines represent the nine polynomial fitting graph trend line. From the SAI figures, it seems that, the trend line of rainfall shows a long wet period and the temperatures are almost below normal during the period 1941 – 1970. The situation is almost reversed during the last three decades of the twentieth century (1971-2000), where the SAI values for rainfall and temperature are below normal and above normal respectively.

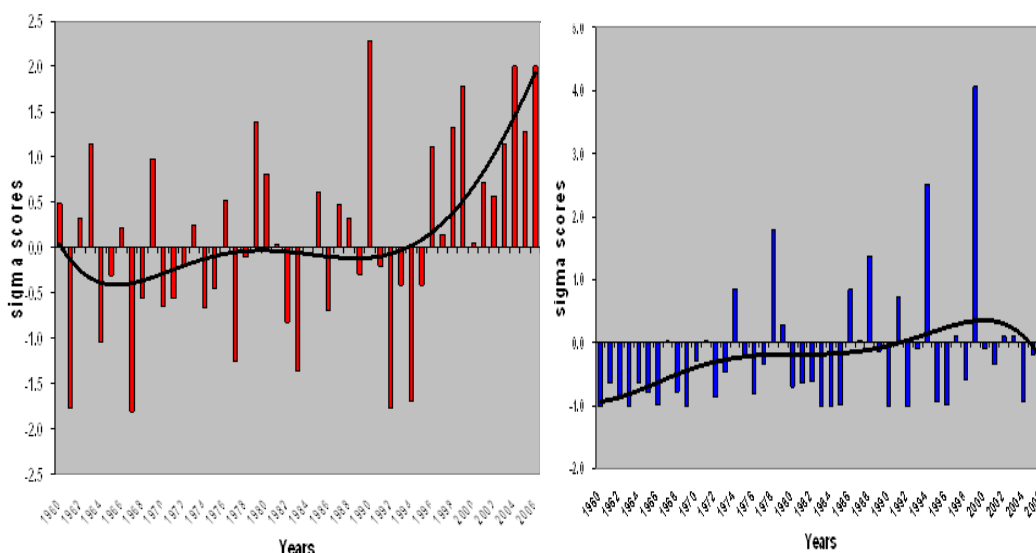


Fig (2). Annual Temp. anomalies& trend. Fig (3). Annual Rainfall Anomalies & trend.

This situation necessitates the importance of artificial irrigation method to guarantee successful agricultural season. The organization managed to offer pumps for all the farmers. This action contributed significantly to the resilience of the local communities.

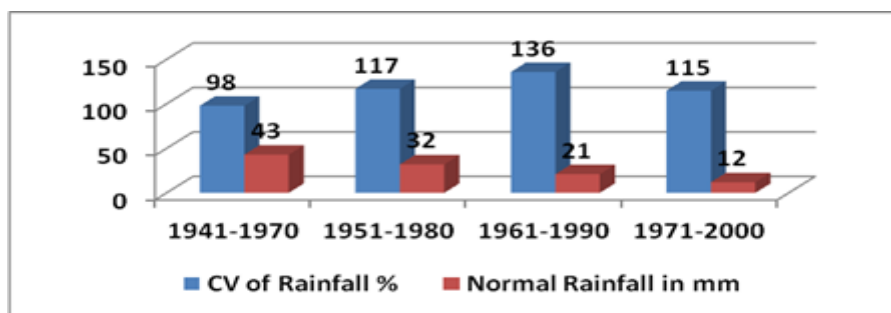


Fig (4): Coefficient of variation and normal rainfall in the study area.



Impacts of climate change on the sustainable livelihood

The entire interviewed sample asserted that the phenomenon of climate change become a reality and its impacts are felt by the local communities. The fluctuation of rainfall in terms of intensity and distribution become common at the study area, as stated by the entire respondents. Rains become sporadic in nature and recurrent droughts contributed to the vulnerability of local communities. This agrees with NAPA (2007) showing that the phenomena of migrants and displaced people is attributed to the cycles of drought and desertification which had affected Sudan during 1980s and 199s. The massive rush of migrants is to find a way to preserve their food through marginal jobs and to have an access to good services from cities and to be near the relief centers supported by the government, NGOs and the foreign agencies representing the international community. The non-loyalty of refugees and to the new hosting land caused a passive effect on the environment and society besides the stress of the displaced people on the natural resources. The climate change is one of the main factors which accelerated the limitation in the natural resources in most parts of the country with emphasis on the western and eastern parts of Sudan. The farmers – small stakeholders and the nomads are the most vulnerable groups influenced by the climate change which was evidently witnessed since the 1970s. The climate change effect. Any rational adaptive measures based on climatic change impacts. Also, the non-climatic factors that reduce the responding of the stakeholders and the most vulnerable group should be addressed. Collectively, this enhances the preservation of the natural resources and then implies to peace settlement.

Land tenure and crop production in the study area.

Land tenure is the one of the most sensitive issues concerning resilience of local communities. Usually private agricultural lands are acquired through inheritance at the study area. Wilkens (1978) showed that under the condition of inheritance, the ownership is subjected to changes in a form of reduction in land size and as a result considerable areas have to be cleared to provide a vacant lot for the family. In Sudan the dominant type of land tenure in Sudan is the customary land tenure system which is enforced by the sheikh of the village (World Bank, 1976). The state of land tenure in the study area is somehow different, where the land is allotted to the all members of the community (on household basis) almost of similar areas (3 - 4 feddans). The soil type of the study area is clay and suitable for agricultural production (arable land). The local people are provided with the necessary inputs of production (improved seeds, simple hand tools and heavy machinery). Ninety per cent of the interviewed sample asserted that accessibility to land is simple and easy. The cultivable area is liable to changes due to the continues influx of migrants to the study area. Accordingly, different types of land tenure exist at the study area. Figure (1) shows the different land tenure at the study area.

About 51.7% of the respondents are titleholder, while 23.3% as accentuated that they possessed their agricultural land through purchasement. Twenty five per cent stated different types of land tenure.

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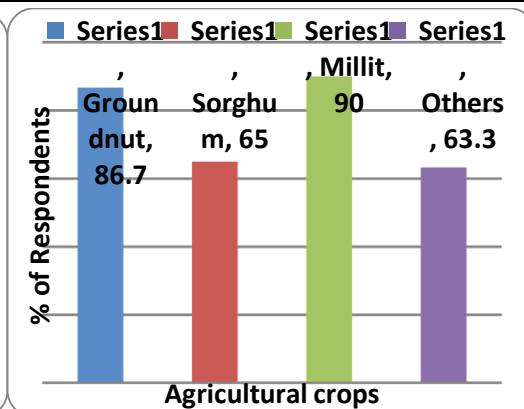
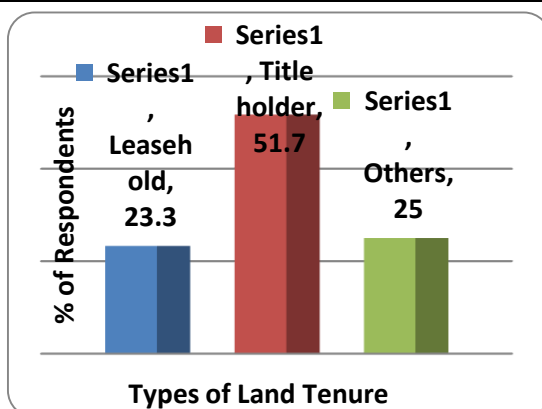


Fig (5): Land tenure.

Fig (6): Agriculture crops.

Cultivation in the study area is mainly for household subsistence needs. The main agricultural crops are millet (*Pennisetum typhoides*), groundnut and sorghum (*dura, Sorghum bicolor*) as stated by 90, 86.7 and 65%, respectively (Figure (2)), while 63.3% mentioned other crops like okra (*Hibiscus esculentus*), karkadeh (*H. sabdariffa*), watermelon, sometimes lubia (*Dolichos lablab*) or sesame.

Forest resources in the study area

Acacias are the dominant genera in the vegetation cover in arid lands of the Sudan (COWIconsult, 1993). Desert encroachment is common in the study area outside the narrow strip along the Nile. A part from isolated showers, resulting in devastating the natural vegetation, and effectively destroyed the pastoral economy. A long-term climatic change with a resulting decrease in rainfall, in combination with the interaction of man and animals being suggested as the reasons for the gradual desertification of the region ((COWIconsult, 1988 and 1991). Table (2) shows the status of forests and the endangering factors of vegetation sustainability at the study area.

Table (2): The environment of the study area.

Age	Existing forest (%)		Sand creeping (%)	Accessibility to forests products (%)	
	Existing	None	High	By license	No accessibility
<20	-	100	100	-	100
20-40	3.3	96.7	100	20.0	93.3
41-60	-	100	100	13.6	99.9
>60	-	100	100	14.3	100
Total	1.7	98.3	100	16.7	96.6

The findings of this study show the evidence of degradation of the vegetation cover as indicated by 98.3%. The rest (1,7%) mentioned that forest resources exist only along seasonal water courses. The majority of the respondents (96.6%) asserted that forest resources at the study area are inaccessible and they are classified as protection forest of natural rotation due to the high rates of sand creep advancement. The entire interviewed sample asserted that the evidence of sand creep and desert encroachment are apparent at the study area.

One of the measures to adapt to the prevailing conditions is adoption of shelterbelts intervention for sake of combating desert encouragement. The organization made considerable efforts in the establishment of the windbreaks and shelterbelts through distribution of seedlings free of charge.



Sources of income generation

Generally, agriculture is the main source of income to the members of the community. Most of the small farmers used to grow subsistence or cash crops which are barely sufficient. Animal breeding is the second source of income. In the past animal breeding is the main source of income mainly through nomadism. Although the majority of the respondents expressed that the agricultural productivity of their farms is good and the prices are reasonable, 60% describe their financial situation as unstable. Because of difficulty of marketing of the crops, 95% claimed that at the end of the harvest season there is no surplus money to save for the next season. For the new season, 60% asserted that they enter in loans (borrowing) for the preparation of the new season. The farmers evaluate their loans as medium (easy to recover). The incentives provided by the project is exemplified is the easy delivery of modern tools (tractors and bulldozers) for the different operations as assured by 78.3% of the respondents.

Drought is a regular unwelcomed visitor, farmers continuously facing with nagging doubts about whether the rains will come next season and if they will have enough food to survive next year.

Agricultural productivity in the study area

Farmers with seeds of improved crop varieties, fertilizers and sometimes with pesticides. The productivity as shown in Table (3) is almost for self sufficiency. The majority of the respondents (65%) stated that agriculture is for subsistence while 8.3% asserted that they have surplus production and sell the surplus for income generation. The rest of the respondents stated that there is no surplus production of the agricultural crops.

Table (3). Crop productivity and storage facilities at the study area.

Age	Storage			Crop productivity		
	House	General storage	Matamer	Self-sufficiency	Marketing	Uninsufficient production
<20	-	100	100	100	-	-
20-40	43.3	93.3	100	70.0	-	30.0
41-60	40.9	77.3	95.5	59.1	22.7	18.2
>60	42.9	85.7	100	57.1	-	42.9
Total	41.7	86.7	98.3	65.0	8.3	26.7

Storage of food products is an essential element in any system aiming at food security for the population. In Sudan on-farm storage systems are traditional well developed. In the study area traditional systems of storage of millets and sorghum exists in different forms. The common or general food storage is made by the organization to safeguard against food insecurity and to maintain the prices of the agricultural crops stable and affordable to the whole members of the community. About 86.7% prefer to store their surplus of yielded in the public food stores, while 41.7% store their crops in their traditional food storage. The main traditional food storage methods are matmura (a pit in the ground lined with chaff with a capacity of about 1000kg) and sweeba (container, made on unburned mud, mixed with straw and cow dung, kept in the family hut, with a capacity of about 1200kg).

Livestock resources in the study area.

Livestock breeding is traditionally the first occupation of the local people where the majority of the respondents (68.3%) possess big herds of livestock. The reason behind the existence of big herds is the social value of the livestock in the life of the local community. Despite the

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frequent severe drought and the rangelands deterioration overstocking has not exerted negative consequence represented in conflicts between settlers. The majority of the respondents (81,7%) claimed that the nourishment of their animals is fairly good due to the availability of agricultural residues as mentioned by 83.3% of the respondents. This reflects the important of agriculture for the nomads other than provision of crops. Reliance on agricultural residues reduces the pressure on the limited natural vegetation in the study area through avoiding overstocking.

Family sizes and employment

The households in the study area are characterized by big families. The majority of the respondent (53.3%) showed that the family sizes fall within the range of 3 -7 person. This finding could be verified by the fact that farmers tends to have big families for social prestige a case that leads to polygamy. Moreover, the simplicity of marriage ceremonies and simplicity of life also contribute to the phenomena of big families. The level of migration in the study area is high where 58.8% of the respondents showed that the community is subjected to a continues seasonal migration.

Constraints and measures of risks confronting sustainable livelihood.

According to the location of the study area with the semi arid zone, it is jeopardized by desert encouragement. Land degradation, which is synonymous to desertification, has become one of the most serious environmental problems in the study area. It is a chronic problem that undermined food production. Moreover, drought is one of the major causes of desertification. Sudan’s arid and semi-arid ecology is mainly influenced by climatic factors including the total amount and distribution of rainfall. Soil type, topography and elevation also affect and determine the degree of desertification to a more limited extent.

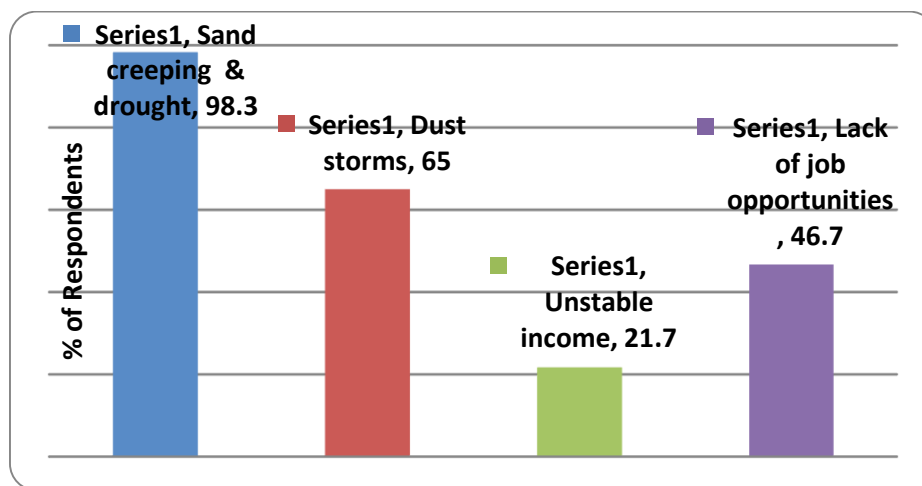


Fig (7): Constraints confronting sustainable livelihood

Fig (7) shows that 98.3% of the respondent suffers from the negative consequences of environmental degradation represented in the sand creep (wind erosion and frequent drought cycles). These problems directly influence crop production and consequently threat the sustainable livelihood. Dust storms were mentioned by 65 percent of the respondents as a serious problem that confront healthy resilience. Dust storms are responsible for the diseases of the respiratory system besides burring of the fertile agricultural topsoil. Some respondents (21.7%) showed their potentiality to cope with the environmental degradation but they lack a stable source of income. While 46.7% asserted that lack of permanent job opportunities is their main problem that restricts their existence in the study area.



CONCLUSIONS

- Climate change and variability represented in frequent drought cycle and fluctuation of rainfall become common phenomena at the study area. Farmers have nagging droughts about the prospects of farming at the study area.
- Seasonal and permanent migration of the members of the community due to environment degradation contributed to the disintegration of the communities.
- Although the land tenure is well settled at the study area, the agricultural productivity is lagging far beyond the ambition of the members of the community.
- Animal rearing is highly jeopardized due to lack or limited natural rangelands.

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الأثار الناجمة من تغير المناخ وتقلباته على سبل العيش المستدامة للمجتمعات المحلية في أم جواسر ولاية نهر النيل، السودان

أسامة بشير محمد علي

وكالة الجامعة للجودة والتطوير الاكاديمي، إدارة الدراسات والمعلومات، جامعة جازان، المملكة العربية السعودية

ارتفاع متوسط درجات الحرارة الذي تم رصده يؤثر علي انظمة سبل العيش للبشر خاصة في الزراعة ومصادر المياه والصناعة والصحة. اهداف البحث تتلخص في التالي، (1)التحقيق في آلية التأقلم في منطقة الدراسة (2)التحقيق في الموارد الطبيعية علي اساس المشكلات في حالة وجودها (3)أن يستكشف العوامل الكامنة وراء نجاح المعالجات مع التغيرات المناخية(4)لتقييم القيود وقياس الاخطار الخاصة بالمجتمعات المحليه ومدى ملاءمة المجتمعات المحلية بمنطقة البحث. المعلومات الخاصة بهذا البحث تمت باستخدام نوعان من الاساليب. النوع الاول تم عن طريق المقابلة المباشرة وجهاً لوجه واستخلاص المعلومات، النوع الثاني وفيه تم استخلاص المعلومات من الدراسات المشابهة والتقارير. مجتمع وادي الجواسر في ولاية نهرالنيل بالسودان تم اختياره لهذا البحث حيث انهم رعاة مستقرون في المنطقة منذ قرن من الزمان.الاستنتاجات الرئيسية للبحث، مناخ ولاية نهر النيل شبه جاف وامطاره قليلة غير ملائم لسبل المعيشه حيث الامطار غير منظمه والجفاف متكرر. الزراعة مصدر الدخل الرئيسي للمجتمع المحلي.الثروة الحيوانية ليس للتسويق فقط تربى من اجل التمييز الاجتماعي والقيم. الزراعة المطرية من الصعب نجاحها وتحتاج الي ري اضافي لضمان نجاحها.التاثير الرئيسي علي صمود المجتمع المحلي يتلخص في الهجرة والصراعات الناتجة من الموارد الطبيعية. توجد انواع مختلفة من التربه في المنطقة بالرغم من كل المستوطنين يتشاركون مساحات متساوية. الغابات ضئيله واستخدامها غير مرشد. واحده من صور ملاءمة تغير المناخ يتم بحفظ كمية من المحاصيل الزراعية بمخازن في منازلهم او خارج منازلهم. الاستنتاج الرئيسي لهذا البحث الجفاف المتكرر والامطار المتذبذبه هما من الاسباب المؤثره علي استدامة سبل العيش.