Impact of Livestock biodiversity in poverty reduction and welfare change in rural Sudan

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SUMMARY

The livestock production offers many benefits to millions of farmers in the developing world. These animals are integral to rural livelihoods and culture, providing food, materials (wool, hide, horns, etc.), income, and mechanical power for pulling carts or plowing fields.
This study attempts to investigate the role of agro-biodiversity concentrating on livestock production in poverty reduction in rural Sudan and to evaluate the biodiversity of livestock species and its effects on ecological sustainability.

The study focuses on the problem of rural farmers from a broader perspective, among agricultural farming systems in rural Sudan, named as traditional rainfed, irrigated and mechanized rainfed farming system.
The results show that livestock biodiversity of the all farming systems is differed and concentrated in types of livestock practices, no aquatic fisheries was practices in all farms. Majority of the livestock species is in the hands of the rural farmers that are residence in the northern

parts of the selected regions. A few percentages of the farmers grow the forage legumes. Livestock keeping is practice as it is prestigious to own some and it also serves as source of income and family consumption. Results also proved a significant correlation between livestock biodiversity indicators with ecological sustainability in the livestock species. Livestock reduction is associated with low income and low manure which respectively; affects the improvement of farmer's welfare and farm agro-biodiversity through nutrient recycling, particularly in the irrigated farms.

N.B. *Biodiversity, livestock, poverty, income.*

INTRODUCTION

Food and livelihood of the poor farmers depend on cultivated crops and domestic animals. Globally, 20 million pastoral families depend on livestock as sole source of income (LEAD, 2005) and 675 million rural poor depend on livestock for some or all of their food and income (FAO, 2005). Livestock production (meat, milk, eggs, fibers, hides, etc) accounts for 40 % of the value of world agricultural output (FAO 2005[a]). Livestock biodiversity is integral to our culture, history, environment, economy and, most importantly, our future. Thousands of livestock breeds, from relatively small genetic pools, have evolved over time to suit particular environments and farming systems. Livestock provide a number of wider ecological services. It has always been the case that animals, including in recent millennia domesticated animals, have contributed to the functioning of the ecosystems of which they form a part – nutrient cycling, seed dispersal, etc.

Sudan is characterized by climatic, ecological and economical diversity. The long span of 18 degrees of latitude has given the country its characteristic variation in environment and rich bio-diversity (Bennett, 1948). The vast Majority of the population is poor, with an average per capita income estimated to be US$ 300 which puts it among the least developed countries of the world (Sudan Bank, 2006). Sudan has the second largest livestock inventories in Africa after Ethiopia. The natural pastoral cover about 24 millions hectors while nomadic pastoral sector amount for more than 90% of the huge animal population. Within the agricultural sector, livestock accounts for 38 percent and (FAO, 2005[b]).

In Sudan livestock distribution is governed by ecological diversity with the result that camels and small ruminants are found in the north where as cattle are concentrated in the Western, Central and Southern parts of the country, and approximately 90% of cattle population is in the traditional sector e.g. nomads and trans-humane (FAO, 2005). The total livestock population is estimated at 135 million heads in 2006 (MAR, 2008). The rural communities own 80% of the livestock and the nomadic tribes own 90% of the rural holdings with livestock playing a central role in their livelihoods (Musa *et al.*, 2005). Western Sudan has the most livestock (40%), followed by southern Sudan (27%) and central Sudan (23%). Majority of breeds are raised within tribal groups and often carry the name of the tribe. They are well adapted to the harsh environment and often trek long distances in search of feed and water. Productivity is low but can be improved with good management in more favourable conditions.

Basic Concepts and Important of Biodiversity, Agro-Diversity and Sustainability:-

The word ‘biodiversity’ is an abbreviation of the term ‘biological diversity’ and its usage in this form was first popularized by the ecologist Edward O. Wilson (Wilson, 1988). In essence, biodiversity is a multidimensional and multifaceted concept that refers to the diversity (in terms of both the variety and variability) of all organisms and their habitats, as well as the inter-relationships between organisms and their habitats, in other word it is the sum of all life on Earth. When we talk about biodiversity, we refer to the diversity itself, the components of that diversity (plants, animals and genes) and the interactions between them. This diversity is commonly divided into three levels: Genetic Diversity: The variation of genes both within and between populations of specific plant and animal species. Species Diversity: The variety of different plant and animal species within a given area. Ecosystem Diversity: The range of habitats, species populations and ecological

processes that occur in a region (ESA, 1997, Duelli, 1997, DEFRA, 2007 and DEFRA, 2007a), and their ecological interactions (Duelli, 1997), is a necessary precondition for achieving sustainable agriculture. Biodiversity plays a central role in regulating ecosystem processes in ways that ensure the provision of a wide variety of ecosystem goods and services. The understanding

of agricultural biodiversity has developed during the last decades from the recognition of the importance of genetic diversity, particularly for crops and livestock. Cassman *et al.*, (2005) reported that agricultural biodiversity refers to all diversity within and among species found in domesticated systems, including wild relatives, interacting species of pollinators, pests, parasites, and other organisms. Domesticated biodiversity (livestock, crops, trees and aquaculture fish), is a consequence of deliberate human intervention, serving both as a production component and as a source for genetic improvement.

The relationship between agriculture and biodiversity is often called agro-diversity. Thrupp (1998) indicated that the links between agriculture and biodiversity have changed over time. Agricultural or planned diversity is deliberately incorporated into the system by the producer (Vandermeer *et al.*, 1998). Livestock biological diversity encompasses both phenotypic as well as genotypic variation (Drucker *et al.*, 2005). Agro-ecosystems comprise poly-cultures, mono-cultures, and mixed systems, including crop-livestock systems, agro-forestry, agro-silvo-pastoral systems, aquaculture as well as rangelands, pastures and fallow lands. Their interactions with human activities, including socio-economic activity and socio-cultural diversity, are determinant.

Biodiversity provides the sustainable balance and equilibrium in agro-ecosystems (Damghani *et al.*, 2007). For example, it can provide species that can act as natural enemies for biological control or genes for increasing crop resistance to biotic and a biotic stresses. Sustainability' means different things over different timeframes and to different stakeholders (Bell and Morse, 1999).

In the short term, over say one or two seasons, making agriculture more sustainable could be defined as increasing production without any negative effects on farm families' social, human, physical, financial and natural asset base (Cromwell *et al.*, 2001). Hansen (1996) identified two broad interpretations of agricultural sustainability. The first one focuses on a normative approach in response to concerns about negative impacts of "conventional" agriculture. This approach relies on the implementation of "alternative" agriculture (ecological agriculture, conservative

agriculture, etc.), as an ideological option to achieve a set of values that should characterize this sector. The second meaning follows a positive approach, and it is focused on the ability of agricultural systems to satisfy different demands through time.

Problem Statement:-

Sudan is divided into five distinct ecological zones: the desert, semi-desert, woodland savanna, flood region and montane vegetation. Even though Sudan is rich in its

diversity of ecosystems, habitats, species and genetic resources, no coordinated comprehensive surveys have been carried out. However, indicators and observations show that there is a declining trend and diversity loss in many components (UNDP, 2005). Before the emergence of modern industrial agriculture, farms everywhere were richer in biodiversity than they are today. Generally Sudan has suffered a number of long and devastating droughts in the past decades, which have undermined food security and are strongly linked to human displacement and related conflicts. The vulnerability to drought is exacerbated by the tendency to maximize livestock herd sizes rather than quality, and by the lack of secure water sources such as deep boreholes that can be relied on during short dry spells. In natural ecosystems, the widespread application of agrochemicals in agro-ecosystems in form of fertilizers and pesticides has led to a decrease in the diversity of fauna and flora. There has been a considerable reduction in the number of varieties cultivated, which has affected in particular the main cereal crops. A similar loss of biodiversity has occurred among domestic animals. Soil erosion is causing substantial costs to crop and livestock production and these problems are contributing to low productivity, poverty and food insecurity (FAO, 2005). The rural poor report distress that stems not only from low consumption but also from ill health and vulnerability. Livestock species diversity can perhaps be neglected, particularly in rural areas because most of livestock are faced by many constraints of the production.

Objectives of Study:-

The general goal of this study is to evaluate the economical situations of the rural farmers in various farming systems in terms of the agro-biodiversity practices focusing on the livestock productions. The specific objectives set of the study are to:

- Identify the livestock distribution, function and it's economical and social magnitude to the rural communities.
- Evaluate the agro-biodiversity of livestock species and its effects on ecological sustainability.
- Investigate the role of livestock biodiversity in poverty reduction and change of the farmer's welfare in rural Sudan**.**

Research Methodology:-

This study is based mainly on primary data collected from the household survey using questionnaire and group discussion methods (agricultural season 2005/2006) The study covered three production domains from rural Sudan; these are traditional rainfed farms, mechanized rainfed farms and irrigated farms, as these farms rapidly become obvious with dire poverty. Accordingly, the study is planed to cover three States, Kordofan State represents the traditional farms, Blue Nile State represents the mechanized farms and Gezira State represents the irrigated farms.

The data is collected by professional numerators under researcher's supervision using stratified multistage simple random sampling technique to select 600 farm households, the criteria of selection included: From each State 200 households were selected, the researcher's interview with farmers in the livestock agro-ecosystems data. Such data include; various species of livestock rearing in the farms, their uses and values, numbers of heads, average income of the farmers, indicators items of livestock

sustainability (gross margin, labour use and availability of water), livestock management, animal feeds and etc…

The indicators of agro-biodiversity of the farms are dissimilar from country to one and from farming systems to another, due to variation in natural resources and climate. The indicators used by each country do not have to be the same. Moreover, different countries have a range of ecological, climatic and geophysical differences which may preclude using the same indicator. However, while it may not be possible to have identical indicators at different levels and scales, compatibility is important so that measurements are comparable at these different levels. Damghani *et al.*, (2007), used the forage legume growing, green manure application, crop diversity, mean number of cultivated crops and livestock presence in the farm as main indicators of the study conducted in Iran.

This study considered with species diversity of the livestock. In this study the indicators used for livestock biodiversity are present of livestock in the farms, forge legume, livestock diversity, application of livestock manure, and control of livestock diseases vectors, introduction of new livestock types, crop residues management and livestock management.

Livestock diversity in this study is different according to the nature of the main animals which are dominated in the different types of farms. In the irrigated farms it means the percentage of farmers who raise other livestock than cattle and goats, in traditional farms it means the percentage of farmers who raise animal other than cattle and sheep. And those in the mechanized farms it means the percentage of farmers raise other animal than cattle. Moreover the other indicators such as gross margin of livestock products, total amount of labour used and variability of water were used to develop livestock sustainability index, act as economical, social and environmental sustainability; respectively. Each indicator of livestock biodiversity had a score ranging from zero to a maximum value. The highest and lowest scores represented the most favorable and the worst conditions, respectively. The derived data were tabulated and the explanatory analysis was used in addition to correlation coefficient to show the strength of the relation between biodiversity indicators and sustainability of the livestock in various farming systems. Additionally the correlation between the household's income and livestock diversity indicators was analyzed.

RESULTS AND DISCUSSIONS

Livestock Species and Functions:-

The study reveals that all the farms owned the local breeds of animal. The raising of the cross breed in the rural farms are exceptional in the private sectors. Various types of livestock are found in farms, included cattle, sheep, goats, donkeys, camels, horses and local breeds of home poultry. There is no fish activity practiced in all farms. In the irrigated farms there are various sources of water and the environment of fish production is good, however the fish industry is practiced by labour in the farms.

80% and 75% of farmers have more than one kind of livestock in the traditional and mechanized farms; respectively. In the irrigated farms the percentage of farmers owned the

livestock are little low than others two former farms (68%), 73% of farmers have more than one kind of livestock, as clear in **Table 1,** the common animal found in the irrigated farms are goats (98%). The most of farmers in the traditional farms owned 89% and 86% of the local poultry and goats, respectively.
The northern State of the all farms comprised higher percentage of livestock than the southern parts of the same State.

Table 1. Distribution of Livestock Species (% of Farmers).

Farms	Cattle	Sheep	goats	Camels	Donkeys	Camels	Horses	Poultry
Traditional	80	85	86	10	76	10	50	89
Mechanized	75	72	85	6	75	6	20	92
Irrigated	63	50	98	0	98	0	15	90

Source: Field survey, 2006/2007

The numbers of livestock owned by the farmers is associated by farms and households size, so the larger the farms and family members the more feed available and more animal are kept. There is no land specification for livestock production in all farms. In such farms, animal are fed on food crop by-products like maize stover, sorghum stalk, cotton stem, wheat straw, weeds, groundnut hay, and leaves of some vegetables. The goats are usually grazing at roadsides or home side and feed on household scraps, autumn grass, fruits leaves, crop wastes and household scraps. In case of cattle animal within the herd structure only 67%, 55% and 34% of farmers have one to two mature cows in traditional, mechanized and irrigated farms; respectively and the rest have either heifer, a bull, calves or traction animal particularly in traditional. About 50 % of the world's population uses animal power to cultivate its croplands (Wilson, 2001). However this study reveals that no animal are used for cultivation purposes, except a few percentage of farmers in the traditional farms (13%) used the animal for land preparation. In traditional farms, animal traction is largely confined to ploughing and is usually based on stall-fed cattle usually kept within the compound.

The cattle used for traction may be combined with fattened cattle or dairying herds. Animal traction is usually integrated with rainfed cereal cultivation systems, based on sorghum, millet, groundnut and vegetables.

Poultry are contributed in improvement of family nutrition through providing of regular supply of eggs and meats production for home consumption, particularly for kid's diet. In the irrigated farms poultry and their eggs regularly sold during daylight to meet the insignificant domestic needs, especially the school stationary.

The ruminants, sheep and goat are kept for meat and sales during the agricultural season. The goat's meat in irrigated farms is not cherished. The dairy goats mainly kept for milk production in all farms.
The value of animal traction and manure (as fertilizer and a source of fuel) has been shown to be significant in a number of studies (Barrett 1992; GFA, 1987; Danckwerts 1974; Scoones 1990; Steinfeld 1988). The manure output is slightly low in all farms and negligible. The poultry mature are low in all farms, because they spread in home as they feed around, usually have no control to collect, but some farmers used their manure for the

home trees like citrus (47% in irrigated, 25% in traditional and 15% in mechanized farms). Furthermore the cattle and goats manure are used for home painting in all farms and sometimes they are used as cooking fire particularly in the field and home. About 23% of farmers in mechanized farms used the animal manure for field fertilizers. No manure is added to farm in the irrigated farms. The farmers normally use inorganic fertilizers for their farms, as they thought that animal manure is contaminated with diseases.

Economical and Social Importance of Livestock:-

The larges effect on farmers, mentioning by many interviewed farmers, is the decreasing amount of money to be made by farming. Many farmers are earring income from other sources than farming, such as on- farm income versification, taking second job or depending on the relative's income.

The income generated from small ruminants provide for major domestic needs such as daily expenses, school clothes, purchase of fertilizer and seeds and labor costs.

In the traditional and mechanized farms the livestock play a big role in economical and social aspects of the household life. In the mechanized farms the farmers take the cattle animal as ceremonial animal (62%). The brides offered the cattle animal during weeding day to their husbands.

Milk and bull calves are sold to generate income for the household's consumption and to purchase houses and fill the gap of some ceremony fees, like marriage of males. Bulls and sheep are slaughter during Islamic ceremonies and marital occasions. Dairy income is used to purchase other of variables inputs like seed, pesticide, feed, payment of the labor cost. Sale of cows has been taking place to pay for food, education expenses (e.g. school fees, clothes, etc…) or meet medicinal care, when crops income is not available.

Ownership of dairy cattle and indeed other livestock species contribute to household food security directly as food and indirectly through the revenue which can be used for food. Livestock also enhances the welfare and the status of the household, the wealthier farmers usually are those owned animals practically the cattle animal. Camels, horses and donkeys are used for transportation, where majority of farmers in the irrigated farms depend on donkeys for transportation of people (67%), field products and inputs (87%), carrying water for home consumption (66%) and marketing of milk (56%).

Biodiversity Indicators of Livestock Species in the Farming Systems in Sudan:-

Livestock diversity of the livestock species of the all farms is shown in **Table 2.** About 32% of the farmers in the irrigated farms are reared others animal than cattle and goats (12% sheep, 10% donkey and 2%horses). Majority of farmers in the traditional farms (40%) reared animal other than sheep and cattle (20% horses, 10% donkeys and 10% camel). In mechanized farms (42%) kept others animal than the cattle (12% sheep, 20% goats and 10% horses).

Table 2. Percentage of Livestock Biodiversity Indicators in the Farming Systems.

Agro-biodiversity indicators	Type of farming systems		
	Irrigated	Traditional	Mechanized
Livestock in the farms	0	17	18
Forge legume	0	16	30
Livestock diversity	32	40	42
Application of livestock manure	0	56	45
Control of livestock diseases vectors	72	60	72
Introduction of new livestock types	80	60	68
Crop residue management	78	87	80
Livestock management	70	73	62

Source: field survey, 2006/2007

In the irrigated farm no livestock are residence in farms and no forge legume is cultivated in addition no application of livestock manure is used in the farms **(Table 2).** Actually, fodder was not cultivated in the irrigated farms, in spite the claim that it has been introduce in the rotation. LID (1999) stated that about 70% of the world's rural poor depend on livestock as a component of their livelihoods. Livestock presence in the farming systems can increase the farm production and income and reduce poverty (De Koijer *et al.*, 1995). Furthermore, Caballero (1993) argued that the small size of farms is the main constraint for introducing livestock and growing forage crops in farming systems. The used of crops residue are normally associated with the owned of livestock, so majority of farmers feed their animal from crops residue. In the smallholder farms, the land is not enough to grow forages and so there is no possibility of introducing livestock in the agricultural system. The size of land holding by farmers is small (which in ranged between one feddans to 15 feddans). Additionally the crops by products are available and enough to feed animal, but nutritionally it has a low quality value, while shortages of feed between May and August are dominant. So the animal products are low and similarity the income gained from animal are lowly. In the irrigated farm approximately 78% of the farmers reported that there is no need to introduce forage crops as a part of crop rotation program of the farming system. Also there are other factor limiting the use of forage legumes and green manure in cropping systems like a deficiency or lack of information and awareness of farmers about forage legumes and green manure's ecological functions as well as their agronomic, economic and environmental benefits in agro-ecosystems.

In the irrigated farms, specifically in the Gezira scheme the main constraints facing livestock/crop interaction are the unclear and contradicting policy of Gezira Scheme management and the conflict between the animal keepers and crop farmers.

In case of traditional and mechanized farmers the situation is differed. **Table 2** illustrates that an approximately 17% and 18% are introduced and kept their animal in their farms; respectively and produced some forage legumes in their farms (16% in traditional and 30% in mechanized) so there are no rule governing the crop rotation in these areas. Table 2 reveals that majority of the farmers are controlled their livestock against main

diseases vectors (70% in irrigated, 60% in traditional and 72% in the mechanized farms) and introduced a new types of livestock during surveyed year (80% in irrigated, 60% in traditional and 68% in mechanized farms) in their farms. Also **Table 2** depictes that most of the farmers managed their livestock by themselves.

Impact of Livestock Diversity on Sustainability Indicators:-

There is a significant positive correlation between livestock species diversity with sustainability in all farming systems **(Table 3).** In case of gross margin (as an economical indicator), the control of livestock diseases vectors indicator has a positive correlation with sustainability in irrigated and mechanized farms, while it has a negative relation in the traditional farms, that mainly due to availability of finance in the irrigated and mechanized farms. The cultivation of the forage legume is a highly significantly affecting the sustainability in all farming systems **(Table 3).** Many researchers reported there are positive effects of growing legumes crops on the sustainability of agro-ecosystems (Torknezhad *et al.*, 1999, and Caballero,1993). The results of Mubarik (1999) also indicated that green manure improved soil characteristics and increased rice yield, while Damghani *et al.* (2007) found that relationship between growing green manure and sustainability was not significant. Livestock

management has significantly a positive effect on availability of water (as an environmental factor) for livestock in all farms while the labour use (as social indicator) is significantly has appositive correlation with livestock diversity in the irrigated and traditional farms **(Table 3).**

Table 3. Correlation Coefficient of Livestock Biodiversity and Sustainability Indicators in Farming Systems in Sudan.

Agro-biodiversity indicators	Irrigated			Traditional			Mechanized		
	GM	**LU**	**AW**	**GM**	**LU**	**AW**	**GM**	**LU**	**AW**
Livestock in the farms	0.001	0.30	0.91**	- 0.20	0.54*	0.08*	0.54*	0.55*	0.68*
Forge legume	0.013*	0.53*	0.57**	0.23*	0.46**	0.92*	0.67*	0.89*	0.59*
Livestock diversity	0.56*	0.86*	0.52*	0.66*	0.78*	0.66*	0.034**	0.054	0.52*
Application of livestock manure	0.01	- 0.31	0.61**	0.21*	- 0.67*	- 0.51*	0.34*	0.57**	0.34*
Control of livestock diseases vectors	0.75**	- 0.43*	0.023	- 0. 81**	- 0. 67**	- 0. 14	0.15*	0.13	0.18
introduction of new livestock types	0.67**	0.012	0.12	0.56**	0.89*	0.14	0.34	0.64**	0.34
Crop residue management	- 0.45*	0.56*	0.59*	0.34*	0.013	0.89**	0.12	0.34	0.71*
Livestock management	- 0.15*	0.76*	0.89*	0.44*	0.043	0.79**	0.32	0.44	0.75*

***GM**: livestock gross margin indicator as economical factor, **LU**: amount of labour use as social factor and **WU**: availability of water as environmental factor.*
** Correlation is significant at the o.o5 level (2-tailed).*
*** Correlation is significant at the o.o1 level (2-tailed).*

Impact of Livestock Diversity on Poverty Reduction:-

There is some evidence that agricultural biodiversity; particularly livestock and plant diversity is concentrated in areas of poverty. In general, there is more livestock and plant diversity in developing countries than in developed countries; further, livestock diversity tends to be concentrated in the poorest, least developed regions of countries. This has led to a view that development and agricultural biodiversity are in opposition, and that economic development should involve the 'conversion' of diverse areas to 'more productive' areas (Cromwell *et al.,* 1997).

The poor farmer in this study is determined as the farmers who spent less than one dollar during the day and the noon-poor farmers are determined as the farmer who spent more than one dollar during the day. The study reveals that the livestock diversity is more practices by the non-poor farmers in all farms (68% of the non- poor kept more than two

animal species). In the irrigated farms about 56% and 78% of the poor farmers can't kept the cattle (for financial problems). **Table 4** shows that the non-poor farmers have highly more significantly positive correlation between the livestock diversity indicators and their income than the poor farmer, exceptional for the farmers in the traditional farms in case of the livestock management in the farm..

There is a positive relationship between livestock biodiversity and household incomes; richer households tend to kept more animal of different species than poorer households whose livelihood depends on returns from animal.

Impact of Livestock Biodiversity in Farmers' Welfare Change:

Livestock recycle farm nutrients through manure application. Chemical fertilizers are too expensive for the poorest farmers, who use livestock manure and urine to fertilize their soils and grow their crops. In addition the fodder trees and forages they planted to feed their animals are also used to feed their soils. Kang'ara *et al.,* (2005) stated that the livestock role in biodiversity is affected through the nutrient cycle, since most nutrient flows from food crops to livestock in form of crop residues and weeds and back to the crop as manure. However in this study no manure had been added to the crops.

Table 4. Correlation Coefficient of the Livestock Biodiversity Indicators and Households Income in the Farming Systems in Sudan

Agro-biodiversity indicators	Irrigated		Traditional		Mechanized	
	Non-poor farmers	Poor farmers	Non-poor farmers	Poor farmers	Non-poor farmers	Poor farmers
Livestock in the farms	0.01	0.34	0.23*	0.01	0.01	0.01
Forge legume	0.023	0.011	.001	.025	.045*	.012
Livestock diversity	.89**	0.25*	.82**	0.72**	.78**	.16**
Application of livestock manure	0.25	0.33	0.13*	0.14	0.64*	0.23
Control of livestock diseases vectors	0.55*	0.15*	0.36*	0.22	- 0.11	0.12
Introduction of new livestock types	0.98*	0.24**	0.01	0.18	0.73*	0.15**

Crop residues management	0.45*	0.55*	0.44*	0.023	0.78*	0.13
Livestock Management	0.66**	0.32**	0.36**	0.21*	0.84*	0.29*

** Correlation is significant at the o.o5 level (2-tailed).*
*** Correlation is significant at the o.o1 level (2-tailed).*

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In Sudan since the fluctuation of environments (rainfall and temperatures) and failure of agricultural season, many animals have been sold to pay for urgent domestic needs which were previously easily met by crops and other agricultural practices.

Since the rapid expansion of desertification, drought and spread of animals diseases during the last decays, many farmers (78% in irrigated farm, 89% in traditional farms and 55% in mechanized farms) reported that they loss various types of their animal and there is sharply decreased in animals herds and hence there are reduction in animal products which indirectly lead to reduction in income generated from animal and which have negative welfare consequences for households.

Due drought and spread of epidemic animal diseases during few lasts year, 78% of the farmers in traditional farms are suffering high rates of animal mortality during survey period and observed it caused the dropping in basic indicators of welfare such as incomes, agricultural production, and consumption. From the survey results, the homestead food production focused on a wide variety of vegetables and fruits and integrated with animal husbandry enables households to diversify and increase the quality of their diet.

Conclusions and Policy Implication:-

- Ruminant livestock are of considerable economic importance within the Sudan economy and continue to play a major role in transforming the environment. The livestock production is crucial to sustaining rural livelihoods, not only among pastoralists but also smallholders across the country. They provide not only meat and milk but crucial services in terms of traction and transport to poor households. Livestock provide

costs for inputs, constitute savings and insurance, buffering against crop failure and cyclical patterns in rop-related income, enable families to accumulate capital and diversify, and serve a range of socio-cultural roles where rural financial is not well

developed to enable farm families to smooth variation in income and consumption levels over time.

- No land specify for livestock in the farms. The presence of livestock in the agro-ecosystem can reduce the need for chemical fertilizers, because farmyard manure can be applied as an alternative for chemical inputs. The value of manure and animal power inputs into crop production have been frequently ignored, despite the fact that they can form a significant proportion of total livestock output
- There is a significant positive correlation between all livestock biodiversity indicators with ecological sustainability, particularly between livestock species diversity with sustainability. The control of livestock from diseases vectors has appositive correlation with sustainability in irrigated and mechanized farms while it reported a negative correlation in the traditional farms.
- Efficiency and sustainability of livestock production would help poor farmers rise out of poverty. Livestock biodiversity has a significant affect on poverty reduction and the improved the farmer's welfare
- Opportunities for using livestock biodiversity to reduce poverty by strengthen the extension services through awareness the farmers about using intensive technology to develop their inputs and increasing their outputs and strengthening of local institutions and universities by studying the biodiversity and its effect as major course.

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اثر التنوع الحيوي الحيواني على تقليل الفقر وتغير الرفاهية في الريف السوداني

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ملخص البحث

الإنتاج الحيواني يوفر كثير من الفوائد إلي ملايين المزارعين في الدول النامية. الحيوانات مهمة للحياة الريفية والثقافية بمدها للغذاء ، مواد التصنيع (الصوف والجلود وغيرها) ، الدخل ومد الطاقة لعربات الكارو وحرث الحقول. هذه الدراسة تحاول شرح دور التنوع الزراعي بالتركيز على الإنتاج الحيواني في إزالة الفقر في الريف السوداني وتقييم التنوع الحيوي لأنواع الحيوانات على الاستدامة البيولوجية. ركزت الدراسة على مشاكل المزارعين الريفيين بصورة عامة في النظم الزراعية في الريف السوداني، المسماة الزراعية المطرية التقليدية، المروية والمطرية الآلية.

أوضحت النتائج أن التنوع الحيوي الحيواني في كل النظم الزراعية مختلف و يتركز على ممارسة أنواع الحيوانات مع عدم ممارسة الاستزراع السمكي. معظم أنواع الحيوانات في أيدي المزارعين الريفيين الذين يقنطنون في الأجزاء الشمالية من مناطق الدراسة المختارة. نسبة قليلة من المزارعين يزرعون الأعلاف البقولية. الاحتفاظ بالحيوان يعتبر مصدرآ للتفاخر ومصدر دخل وغذاء للأسرة. كذلك برهنت النتائج ارتباط حقيقي بين كل مؤشرات التنوع الحيوي الحيواني والاستدامة البيولوجية في الإنتاج الحيواني. انخفاض الحيوانات مرتبط بانخفاض الدخل والسماد البلدي اللذان يؤثران على تحسين رفاهية المزارع والتنوع الزراعي للمزرعة على التوالي بواسطة إعادة تصنيع الغذاء بالأخص في المزارع المروية.