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Indigenous farming Practices: A path for green food production in Sudan

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Abstract: ***Adoption of modern agricultural technologies in Sudan was proved to be disastrous and resulted in food insecurity. This can be easily attributed to vast clearance of virgin forests, excessive use of chemicals as pesticides and fertilizers, mechanical ploughing and use of high yielding verities which are intolerant to the prevailing climatic conditions, soil and water pollution and erosion, etc...***

The finding of recent study showed that 13 % of the population in north Sudan suffers from chronic food insecurity and 37% of the population in the North suffers from transitory food insecurity.

This paper is an attempt to highlight the impact of modern agriculture in Sudan on food security and exploring the merits of adopting the traditional indigenous knowledge of the cultivation in Sudan.

The root causes behind food insecurity in Sudan which is one of Sub-Saharan African countries can be summed as follows: environmental degradation, economic and social set – backs, agricultural policies sector bias. However the adoption of traditional farming practices will result in sustainable agricultural production and consequently food security. These indigenous knowledge include a wide range of farming practices such as knowledge of rainy season, periodization of rain fall and adjustment of farming season accordingly, indigenous seeding knowledge, traditional weeding practices, traditional crop rotation, wide spacing and low crop density, improved seeds, seed dressing, fallow periods, agro forestry, traditional farming tools, traditional harvesting techniques and traditional storing techniques

Keywords: Green food production, indigenous farming practices, Agro-forestry, Threats**.**

1. Introduction

Agriculture, which is the largest economic sector in Sudan, is at the heart of some of the country's most serious environmental problems: land
degradation in its various forms, riverbank erosion, invasive species, pesticide mismanagement, water pollution, and canal sedimentation.
The significance of land degradation in Sudan cannot be underestimated: not only is 15 percent of the population partly or wholly dependent on
imported food aid, but the population is growing by more than 2.6 percent per annum and per hectare crop yields are declining. In addition,
conflict linked to competition over scarce agricultural resources continues in Darfur[1].
Without major action to stop the wave of degradation and restore land productivity, the natural resource base will simply continue to shrink, even as demand grows. Resolving this issue is thus central to achieving lasting peace and food security.

2. Objectives:

1.To identify threats to Green production in Sudan
2. To draw a road map for attaining sustainable food production through application of indigenous cultural practice

3. Methods

This study is based mainly on critical review of the available literature and personal experience. Sources of the literature are: UNEP documents, text books, University of Khartoum Publications and M.Sc. and Ph.D. Theses. They cover the period from nineties up to date.

4. Results and Discussion

4.1 Threats to green food production:

According to **the** previously mentioned farming systems these threats are as follows:

Mechanized rain fed agriculture

Generally speaking, the development of mechanized agriculture in Sudan has been accompanied by large-scale destruction of the environment mainly by excessive removal of natural forests. Not only does the sector have major environmental problems of its own, but its uncontrolled expansion and replacement of other forms of agriculture have triggered a wide range of negative impacts in other sectors as well.
The core of the issues related to mechanized agriculture can be found in the lack of control and planning that accompanied the rapid development of the sector during the last half of the 20th century. The mechanization of rain-fed agriculture was initiated by the British in Gedaref in 1944 to meet the food needs of

their army in East Africa. Following independence in 1956, the government adopted a policy to expand mechanized farming and encouraged the private sector to invest in new schemes [2].
Today, mechanized agriculture occupies a swathe of the clay plains in the high rainfall savannah belt estimated to be 6.5 million hectares, extending
from the Butana plains in the east to Southern Kordofan in central Sudan. This area covers parts of the states of Gedaref, Kassala, Blue Nile, Sennar, White Nile, Upper Nile and Southern Kordofan.
The principle crops cultivated are sorghum, sesame, groundnuts and, to a lesser extent, cotton and sunflower.
Threats of Mechanized farming can be summarized as follows:
1. Vast removal of natural forests since millions feddans of these forests had been removed for cultivation
2. Expansion of mechanized schemes at the expense of traditional farmers which became causal labour or enforced to migrate into the nearer urban areas.
3. Herders and their animals had been squeezed from their traditional grazing site.
4.The majority of scheme owners are outsiders i.e. they are not local inhabitants therefore they are not interested in participating in any development of schemes living environment or improving the essential infra structure found in these areas
However, the impact of mechanized farming on natural environment can be summed up into: Environmental degradation because of:
5. unsecured tenancy,
6. Soil depletion because of continuous mono-cropping . Absence of fallow periods and continuous mono-cropping have resulted in yield collapse,
7. Desertification and abandonment of Schemes,
8. Enhancement of rural urban migration due to lack of essential community's services and lack of means of living with dignity and respect.
It is worth to mention that Mechanized agriculture schemes have traditionally used neither fertilizers, nor organized crop rotation or fallow systems. The inevitable and well documented result has been a collapse in per hectare yields. In Gedaref state, for example, sorghum and sesame yields in 2002 had reportedly, dropped by about 70 and 64 percent respectively from 1980 levels in established areas [2].
Given the region's wide climatic variations and patchy agricultural data, more detailed analysis is required, but a general trend of diminishing
Harvests are evident. As a direct result of this decline, sponsors of mechanized schemes have been forced to expand the total area under cultivation just to maintain output [3].
The final stage of mechanized agriculture as it is practised in Sudan is the abandonment of land due to yields dropping below economic limits.
The total area abandoned to date is unknown. Abandoned land is enerally found in the northern part of the mechanized scheme belt. Desertification is clearly apparent in such regions, particularly in Khartoum state, Kassala and Northern Kordofan.
In a country with massive food insecurity and ongoing conflicts over land, such waste of natural resources is tragic and raises the spectre of the intensification of existing problems.

A) Traditional rain – fed agriculture:

Shifting cultivation is practiced by large proportion of cultivators. This system is characterized by the following: only small areas are used to be cleaned by removal the vegetation cover, hand tools are used, no chemicals are used and land will be left after drop in yield for a number of years too retain its fertility. Regardless of the fact that this system is a sustainable system of food production but it **is f**aced by**:**

1- Population pressure enforcing the farmers to cultivate their lands without any resting periods and expanding in more fragile lands to compensate for the sustainable reduction in crop production.
2-Poor infrastructure development and deterioration of existing community services.

C. Mechanized irrigation Sector

The mechanized irrigation sector is associated with a range of environmental hazards, including:
1. Ongoing use of pesticides and a legacy of obsolete pesticide stocks;
2. Water pollution from sugar factories;
3. Potentially unsustainable expansion plans into desert regions; and
4. Canal siltation, soil salinization and yield reduction.
These issues are considered to be significant, but potentially more manageable than those related to mechanized rain-fed schemes.
The bulk of pesticide application in irrigated schemes is carried out by aerial spraying under the command of the respective scheme administrations.
The Gezira Board has reported that an estimated 125,000 to 205,000 hectares of cotton and 62,000 hectares of wheat fields are sprayed annually. Past studies have revealed widespread pollution of surface waters and irrigation canals due to extensive aerial spraying, and it is likely that this remains a problem today.
Aerial spraying of pesticides is a particular issue in the Managil extension, where the irrigation supply canal is also the main source of drinking water [1].
There is no pesticide monitoring programme or any regular surveillance system to analyze the environmental fate of pesticides in water, soil or
food. Most studies date back to the early 1980s and there is a major information gap regarding the current situation. Previous analysis has shown that DDT and its derivatives were the most widespread contaminants. Moreover, residues on food products, such as goat milk were found.

1. Obsolete pesticide stockpiles: a major hazard

Sudan has very large stockpiles of obsolete pesticides that are stored in very hazardous conditions across the country. A preliminary inventory by the Plant Protection Directorate (PPD) in the early 1990s estimated
the expired stock at 760 tonnes and 548 m3 of contaminated soil [8.16]. A survey completed in 2006 under a GEF-POPs project found this stock
to have increased to 1,200 tonnes of obsolete pesticides and 16,000 m3 of contaminated soil . These figures do not include several hundred tonnes of expired dressed seeds and containers.
. In addition, a visit to the Port Sudan commercial harbor revealed a large stock of expired pesticides and other chemicals. While storage conditions were overall very poor, three sites in close proximity to inhabitations (Hasahesa, El Fao and Gedaref) were considered dangerous toxic 'hotspots'.
Obsolete pesticides constitute a severe environmental and public health threat and must be treated as hazardous waste.

Now that an inventory of the stockpile has been completed (except for Southern Sudan and Darfur), the first step should be to collect all the materials – with a special emphasis on persistent organic pollutants (POPs) and contaminated soil – for storage in one central location[1].

Elsewhere in the world, safe disposal or destruction by incineration of unwanted organic pesticides and highly contaminated soil costs in the order of USD 500 to 2,000 per tonne (not including any international transportation costs). UNEP estimates that the total cost of safely resolving the pesticide legacy problem in Sudan would exceed USD 50 million. Given this amount, a permanent solution is expected to take some time and interim measures to reduce the risks are clearly needed.

Plate (1) Corroding drums of obsolete pesticides are stored in unsuitable conditions at Port Sudan, 30 m from the water

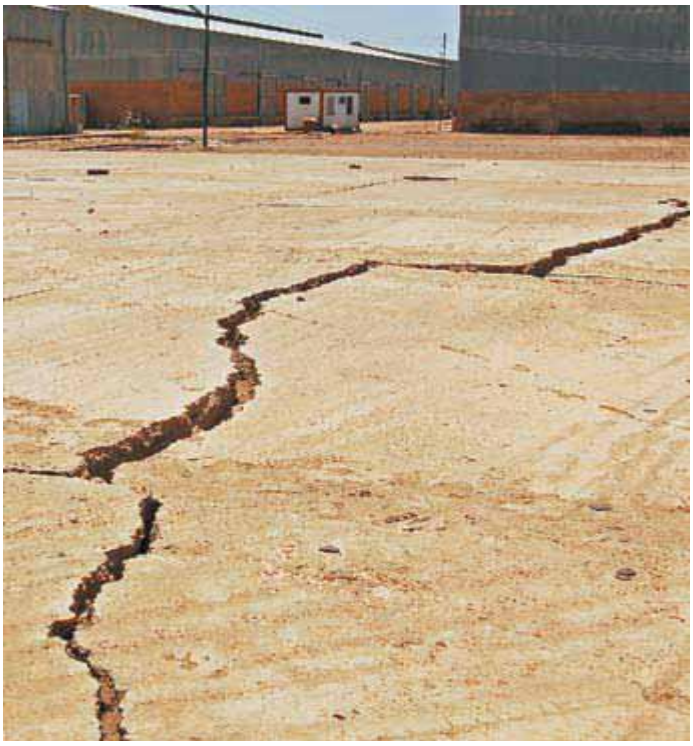

Plate (2) This cement-lined pit in Hasahesa – where an obsolete pesticide stockpile has been buried – has cracked, releasing a strong stench and exposing groundwater to a high risk of contamination. Highly hazardous and persistent heptachloride was buried in Hasahesa (inset) .An estimated 110,000 litres of very hazardous endosulfan have leaked into the ground at the main Rahad Irrigation Scheme.

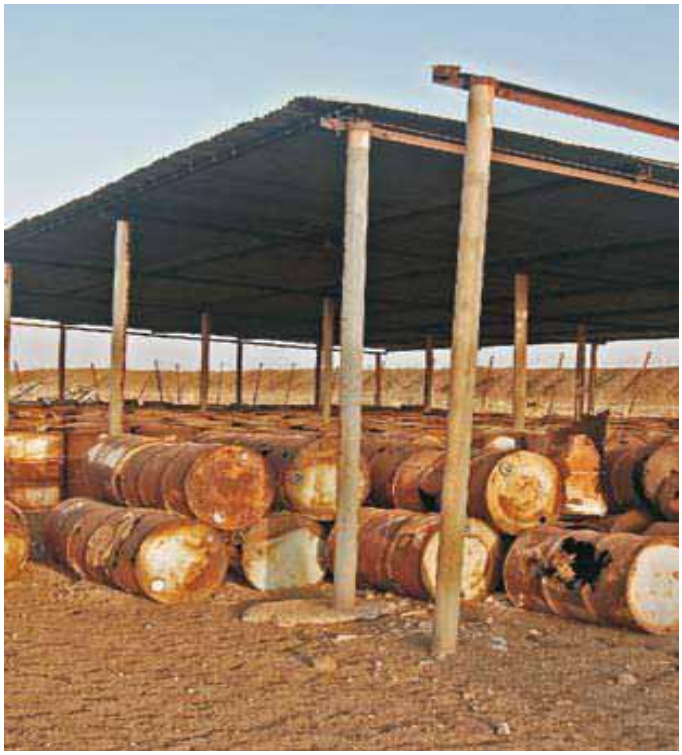

Plate (3) an estimated 110,000 litres of very hazardous endosulfan have leaked into the ground at the main Rahad Irrigation Scheme warehouse in El Fao

2. Potentially unsustainable expansion plans into desert regions

Major plans for irrigation schemes downstream of Khartoum in Nile and Northern states are likely to give rise to significant environmental concerns in the next fifteen to twenty years. In Northern state, for instance, ambitious estimates by official planning place the potentially irrigable area at 800,000 to 2 million hectares. This represents a

two and a half to six fold increase of the presently cultivated area. The planned expansion is almost entirely in the upper terraces of the Nile, and a substantial proportion (around 300,000 hectares) is to be irrigated by the Merowe dam reservoir once it is completed. The long term sustainability of these reclamation projects is questionable, and they should proceed with care based on prior environmental impact assessment studies

3.**Water pollution from sugar factories and spread of water –borne diseases**

The main environmental problem associated with the country's five major sugar estates is the release of effluent from the sugar factories. Permanent irrigation has also resulted ion spread of water borne – diseases such as malaria and bilharzias which are widely spread among the local in habitants.

4. Canal siltation, soil salinization and yield reduction

Most of the major schemes have been seriously affected by heavy siltation in canals, a process that is accentuated by upstream watershed degradation. For example, the average sediment load entering the main canal in Gezira increased more than fivefold between 1933 and 1989, from 700 ppm to 3,800 ppm. It is estimated that 15 percent of the Gezira scheme is now out of production due to siltation . Sedimentation of canals

also leads to water stagnation and the emergence of weeds that provide an ideal habitat for the proliferation of water- and vector-borne diseases, in particular schistosomiasis and malaria. Chronic incidence of these diseases has been exceptionally high in the irrigation schemes.
Due to the nature of the heavy clay cracking soils, the two major problems of soil salinization and water logging typically associated with irrigated agriculture are not prevalent in Sudan's schemes. Nevertheless, there is reportedly significant salinization at local levels in the drier north-western reaches of the Gezira near Khartoum, as well as in the Guneid sugar scheme. Monoculture farming and poor implementation of crop rotation has also led to deterioration in soil fertility and a significant decline in yields.

D)Traditional irrigation sector threats
Traditional irrigation is concentrated on the floodplains of the main Nile downstream of Khartoum, but is also practised over substantial areas along the White and Blue Nile and the Atbara river, as well as on the Gash and Tokar deltas.
Traditional irrigation is not considered to have significant environmental impacts: in contrast, it is a relatively sustainable sector that is actually under threat from external factors including environmental problems. three environmental threats, which in combination are anticipated to significantly reduce this sector's output:
1. Sand dune encroachment;
2. Riverbank erosion, including downstream erosion from the new Merowe dam; and
3.Mesquite invasion.
All of these factors lead to the loss of arable land, which in turn increases poverty levels and threatens the food security of local communities. Riverbank erosion and sand dune encroachment have both had major socio-economic consequences resulting in the abandonment of entire villages [1].

Plate (4) Encroaching sand dunes, seen here in Arji in Northern state, threaten to smother the narrow strip of arable land along the Nile's floodplain, which sustains thousands of communities
E) Threats to Sustainable livestock husbandry:
The area of rangeland in Sudan is estimated at about 100 million hectares. Livestock is estimated to be over 120 millions composed of cattle, sheep and goats and camels which are kept under both nomadic and sedentary traditional pastoral system. Livestock accounts for about 47 % of agricultural GDP and 22 % of the total GDP in year 2000. It is an important sector that provides a source of livelihood for huge segment of the population. It is also an important foreign exchange earner. Livestock production comprises pastoralism, sedentary and semi-sedentary and commercial fattening and dairy[4].
These causes can be presented as follows[4]:

1. **Continuous increase in animals' number:**
there has been an increase in the livestock population over the past few years due to a number of factors which include: inherited culture that the number of animals is a source of political power and social prestige, improvement in veterinary services, low take off of animal or poor sale resulted from poor transportation, absence of proper marketing channels and the nomadic life of the majority of the herders, vast improvement in animal health care, which had drastically reduced outbreaks of epidemics and small rate of take-off for export or national consumption, high local taxes have also contribute to this increase.
In addition, an explosive growth in livestock numbers – from 28.6 million in 1961 to 134.6 million in 2004 – has resulted in widespread degradation of the rangelands. Inadequate rural land tenure, finally, is an underlying cause of many environmental problems and a major obstacle to sustainable land use, as farmers have little incentive to invest in and protect natural resources.
2. **Land degradation** through over-use or misuse, population growth or displacement disadvantageous changes I land tenure, cause lasting damages to the people, the animals and environment.
3. Insecurity of land ownership, the government of the Sudan owns all lands in Sudan but it does not exercise any effective control over its use. At the same time the government has not fully the customary use of land by different groups of people. The communal use of land particularly in rural Sudan is a very strong institution.
4. Expansion of mechanized agriculture at the expense of traditional grazing sites or range lands
The horizontal expansion of agriculture into areas that were previously either rangeland or forest has been a well recognized trend for the last four decades. The northwards expansion of rain-fed agriculture into
marginal areas historically only used for grazing has been particularly damaging. Three examples from the recent UNEP-ICRAF study of land use changes illustrate a major reduction in rangeland areas due to expanding agriculture:
• In Ed Damazin, Blue Nile state, agricultural land (mainly mechanized), increased from 42 to 77 percent between 1972 and 1999, while rangeland effectively disappeared, dropping from 8.3 to 0.1 percent;
• In the El Obeid region of Northern Kordofan, rain-fed agricultural land increased by 57.6 percent between 1973 and 1999, while rangeland decreased by 33.8 percent and wooded pasture by 27 percent; and
• In the Um Chelluta region of Southern Darfur, rain-fed agricultural land increased by 138 percent between 1973 and 2000, while rangeland and closed woodland decreased by 56 and 32 percent, respectively.
In addition to the loss of grazing land, agricultural expansion has also blocked livestock migratory routes between many of the widely separated dry and wet season pastures, and between the herds and daily watering points. A further complication is that sedentary farmers are increasingly raising their own

livestock, and are hence less willing to give grazing rights to nomads in transit.

In many parts of Sudan particularly Eastern, Central and western arts, the expansion of mechanized agriculture is the main cause, as vast lacks of natural pasture grazing has been converted to agricultural ecosystems without replacement of their lost grazing biomass. The traditional corridors of animal grazing movement which were synchronized with pasture productivity have been disrupted as a result . This in turn led to overcrowding and overgrazing and resulted in conflicts between herders and cultivators, blockage of the road to water points and eating of animals on the grown crops.

The impact of the expansion of mechanized rain fed agriculture on herding

The net result – disappearing livelihoods for dry lands and pastoral socities .The clear trend that emerges when these various elements are pieced together is that of a significant long-term increase in livestock density on rangelands that are reducing in total area, accessibility and quality. In environmental terms, the observed net result is overgrazing and land degradation. In social terms, the reported consequence for pastoralist societies is an effectively permanent loss of livelihoods and entrenched poverty[4].

Pastoralist societies in Sudan have always been relatively vulnerable to losing their livelihoods due to erratic rainfall, but the above-noted combination of factors has propelled many pastoralists into a negative spiral of poverty, displacement, and in the worst cases, conflict. Their coping strategies or the impact) include:

1. Abandoning pastoralism as a livelihood in favour of sedentary agriculture, or displacement to cities;
2. Increasing or varying the extent of annual herd movements where possible, with a general trend towards a permanently more southerly migration;
3. Maximizing herd sizes as an insurance measure (assisted by the provision of water points and veterinary services);
4. Changing herd composition, replacing camels by small animals, mainly sheep, in response to the curtailment of long-distance migration;
5. Competing directly with other grazers for preferred areas of higher productivity
6. Moving and grazing livestock on cropland without consent (may result in a conflict); and
7. Displaced populations settle on the outskirts of existing towns, as seen here in El Fasher, Northern Darfur, where the new settlement is distinguished by white plastic sheeting.

These new arrivals add to the environmental burden on the surrounding desert environment. One can conclude that the environmental degradation is the main cause of conflicts in Sudan e.g. between cultivators and herders and in between herders.

Other factors that affect the livestock production in Sudan include:

1**. Deforestation and decrease of perennial grasses** due to overgrazing and spread of annual and evasive species.

Deforestation occurs due to many factors the most important nes are: expansion of mechanized farming on natural forests and traditional rangelands. Moreover nomads are used to destroy annually millions of Acacia trees for cocking and warming purposes[4].

Deforestation in Sudan is estimated to be occurring at a rate of over 0.84 percent per annum at the national level, and 1.87 percent per annum in UNEP case study areas. It is driven principally by energy needs and agricultural clearance. Between 1990 and 2005, the country lost 11.6 percent of its forest cover, or approximately 8,835,000 hectares. At the regional level, two-thirds of the forests in north, central and eastern Sudan disappeared between 1972 and 2001. In Darfur, a third of the forest cover was lost between 1973 and 2006. Southern Sudan is estimated to have lost 40 percent of its forests since independence and deforestation is ongoing, particularly around major towns. Extrapolation of deforestation rates indicate that forest cover could reduce by over 10 percent per decade. In areas under extreme pressure, UNEP estimates that total loss could occur within the next 10 years.

These negative trends demonstrate that this valuable resource upon which the rural population and a large part of the urban population depend completely for energy is seriously threatened. The growing use of fuel wood for brick-making in all parts of Sudan is an additional cause for concern. In Darfur, for instance, brick-making provides a livelihood for many IDP camp residents, but also contributes to severe localized deforestation. If it were properly managed, however, the forestry sector could epresent a significant opportunity for economic development and sustainable north-south trade.

2. Fire and fire line maintenance:

Annually fire destroys 47 % of the total rangelands of the country. In the past and prior the dissolution of native administration in 1970 regular maintenance of fire lines were used to be done under the supervision of these institutions. This had resulted in annual fires destroying the rangelands.

These institutions were not only responsible for fire line maintenance but also regulating the use of the available forage and water resources among various nomadic tribes and local herders as well as solving the conflicts

Therefore the uses of range lands are sustainable and secured

3. Micro- and macroclimatic changes (practically continuous Sahel drought since 1967 and 1980; diminishing and erratic rainfall and accelerating desertification doubling of livestock within 20 years; and deforestation on massive scales

4. Oil E**xploration and its impact on herders and their herds**

* Most of oil exploration areas in Sudan had confined to the majority of rangelands in South and West Kordofan. They present about more than 80% of the area of these two states.
* Traditional animal migratory routes had been blocked by the construction of new roads
* Rangelands had polluted by petroleum wastes that are hazardous to herds
* Cattle in Eastern Sudan were prohibited from gazing nearer to Bashayer oil exporting ports
* Periodic maintenance of animal migratory routes is difficult because of the continuation in exporting oil * local inhabitants of Abu Jabara fields complained from the contamination of their drinking water sources from the wastewater resulted from oil exploration[5].

The Socio-economic Impacts of above mentioned threats:

1. Nomadism in its way to disappear in Eastern and Central Sudan (Butana area)
2. Small ruminant animals are now dominant at the expense of cattle
3. Drought resulted in loss of herds and inability of nomads to restock their herds to the pre-drought levels.
4. Some nomads work nowadays as causal agricultural labour while others migrated to the outskirts of the neighbouring urban centers. This has resulted in socio-cultural transformation of

displaced people who work in marginal jobs and living in slums receiving no social services or the basic needs for sustainable living conditions [6]

ii) Sustainable Indigenous Farming practices

(Green food production):

Traditional farmers all over the world think about their societies and seek to understand their environment and manipulate what they perceive.

They develop semi-coherent schemes by which they possess accumulated experiences resulting from every day activities.

A paradoxical situation exists when scientists and technicians insist on enforcing their "scientific knowledge, on farmers on the belief that they know better than farmers. Usually the farmers refuse to accept the recommendations and when pressed hard they tend to abandon their fields or other wise develop strategies to counteract these decision [7].

The use of modern farming inputs(e.g. introduction of high yielding varieties, fertilizers or pesticides, irrigation, and mechanization has caused several environmental problems such as los of genetic resources, increased pest hazards, pesticide and fertilizer pollution, water and soil pollution, and Stalinization. However, attention has been directed to traditional resource management strategies to build-on, and promotes local technology in order to increase agricultural production without causing harmful nvironmental and socioeconomic impacts [8].

Indigenous pest control and plant protection in the past were achieved by non-chemical methods: careful field sanitation, proper crop rotation that reduce the carry-over of pests from one season to another. Coping strategies to avoid or reduce the limitations imposed by the natural environment and socioeconomic conditions according to Abdel Rahman, 1994)[9]:

Several methods have been developed to adapt to the high variability in the amount and distribution of rainfall, and minimize the negative effects of pests on crop yields. Some of the methods used by the farmers are briefly mentioned below:

1. Land clearing

2. Early sowing: in order to make use of any rainfall and to repeat sowing in case of the first seeding fails.

3.Intercropping: farmer plants crop between the rows of different crop previously planted or planted simultaneously e.g. intercropping of karkade (Hibiscus) and water million with millet or sorghum.

4. Wide spacing and low crop density per unit of land in order to reduce pest infestation but sowing large amounts of seeds per hole so that crop germinates as a bush. By increasing the density of plants per hole wind is less likely to below them away.

5. Frequent weeding of crops during the growing season: regular and intensive weeding is quite important for the control of wed pests especially Striga hermanhica (buda).

6. Seed dressing and improved seeds: contribute to higher seed germination and crop establishment and through their use of seed borne diseases and protection against insect pests.

Some literature indicate that the productivity of land could possibly be increased by the use of seed dressing, improved seeds by 36 % compared to those who had not use these measures.

7. Cultivation- fallow rotation: the hashab tree (Acacia senegal) is a leguminous tree native to most areas of the savannah of the Sudan, and it is valued as restorer of soil fertility during fallow period as well as producer of gum Arabic, an important export cash incomes for farmers in the Acacia senegal Belt. Generally, land holdings may either be under cultivation or under fallow, hashab. In average, a field is put under cultivation for five/six years before it is left fallow. The field is left to go fallow when signs of fertility loss become apparent through low yields and appearance of Striga hermanthica (buda) . Hashab tress is allowed to grow in the fallow fields. After a period of about 15 years hashab trees degenerate and eventually the field is cleared and put under cultivation.

8.Other techniques to combat pests: Several other techniques are used by farmers for combating birds and locusts. These include, first, children carry noise makers through the field to scare birds and locusts away from farms. Secondly, farmers erect "scare quelea birds" figures in their fields. Thirdly, farmers get together and destroy any bird nests they find in trees near their cultivated areas. Fourthly, farmers rotate their crops in the field from one year to the next. For instance, if they plant sesame in the field the following years grow sorghum. This strategy helps lessen the danger of a major pest build- up year after year in the same field.

9. Indigenous methods of drought forecasting) are considered important because they represent the first step towards adopting a rotational coping strategy. Coping strategy adopted by the traditional farmers of the White Nile of the Sudan has the following aims, based on how they perceive droughty: a) to adapt to the failure of rainfall, b) to find a substitute for low yields, c) to find possibilities for expanding the grazing areas and/or to find areas with rich fodder for animals, d) to maximize land use returns and e) to compensate for high prices of food crops. Farmers who grow vegetables s are used to use organic fertilizers rather than chemical ones. Some other farmers either use pesticides or cultivate new crops that resist drought[9].

Another important element in the farmers' coping mechanism is investment and credit types use to finance activities. Informal credit or sheil system is regarded by a large number of farmers as an exploitation of the rich against the poor farmers. Small farms have attempted to adopt new creative methods of production. These methods include the adoption of labour intensive programme using family labour, use of animal traction, practicing shifting cultivation as a safe guard against low yields in times of drought. Migration is considered another prominent element in the coping mechanism. Usually migration starts in December and ends in May to prepare for the agricultural season.

The last alternative for farmers, when all other choices are not attainable, is to move towards towns in the camps of displaced people. Another management which is used by the local people to adapt to the environmental stress is the sale of animals.

10. Development of cooperative organizations: one of the main advantages of these organizations is that it has been accepted by the banks for extending credit to small farmers.

Conclusions:

1.Drought is one of the important aspects of environmental stress in Sudan. People are forced to use certain mechanism to combat environmental stresses with the reference to cultural practices, crop calendar, credit and land tenure systems and pest control, animals are either get rid of by sale or transfer to another persons or taken to another environmentally richer areas

3. Sometimes people migrate to either areas to compensate for their loss in income and food production caused by drought

3. Adopting some creative methods of grain storage and use of indigenous technology for maximization of benefits

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