المستخلص

أجري بحث ميداني ظريفى صغيرة وجد الطين الواقعتين جنوب مدينة القضارف لدراسة الصراع حول الموارد الطبيعية شرق السودان شبه الجاف مناخياً وذلك في شهر نوفمبر عام 2009. ويجادل البحث بأن أنماط الصراع على المستوى الدقيق - الدقيق والمستوى الدقيق - الحكير ترتبط ارتباطاً وثيقاً بالتناقض على الموارد الطبيعية، الضغوط التنمية، عدم المساواة البيني، والتغيرات المناخية والديمغرافية وهي محفزة لبعضها البعض، وتظهر نتائج العمل الميداني أن الصراع على الموارد الطبيعية قد تسبب ترحيل بعض القبائل (18%), زيادة الصرفيات (18%), الهجرة والتعصب القبلي (20%), تلف المحاصيل (20%), الاعتداء على الأراضي (10%), سرقة الحيوانات (6%) وفقدان الأرواح (6%). ويعتبر الصراع على الموارد الطبيعية ظريفى صغيرة وقد الطين مثالاً للصراعات غير العنيفة التي تعتبر مؤجلاً للاستجابة المستدامة من الموارد الطبيعية عند مستوى المجتمع في السودان. وتشابه عوامل الصراع في منطقة الدراسة تلك الموجودة في نطاق الساحل الإفريقي حيث تثبت صعوبة تحقيق معالجة الصراعات على المستوى الكبير، ولكن بمراعاة الأحداث الجارية والمتجددة عند المستوى الدقيق، والتي تتراوح بالسعي والجحافياً، استوفى قاعدة بيانات تعمل على تحليل الصراعات وحسن إدارتها بغرض تطور استغلال الموارد المختلفة. ولتحقيق ذلك تختبر الورقة "نموذج مثل البقاء البيئي" الذي يعمل على الموارد بين النشاطات البشرية والقدرة البيئية واستغلال الموارد في منطقة الدراسة.
ABSTRACT

Natural resources based conflicts are examined in the semi arid eastern Sudan by studying the two villages of Sinaibra and Id el Tien, south of Gedaref Town, during November 2009. The paper argues that, micro-micro and micro-macro types of conflicts are inextricably linked with natural resources competition; developmental pressures; structural injustices, climatic and demographic changes and acting as a catalyst to one others. Results depict that, conflicts caused deportation of some tribes (18%); increasing penalties (18%); tribal fidelity and hatred (20%); crop damage (20%); land grabs (10%); animal robbery (9%) and loss of life (5%). The situation in Sinaibra and Id el Tien villages will be a showcase for the problem of non-violent conflicts and disputes as a constraint to sustainable natural resource utilization at the community level in Sudan. Factors for conflicts in the study area are similar to those in the Sahelian zone where curbing conflicts at macro levels mostly proved difficult. Acknowledging current and renewing events at micro levels which are closely related to society and geography will provide data base for mitigating and managing conflicts so as to promote resource utilization. To achieve that, the paper proposes "triangle of environmental surveillance model " which works to equilibrate between human activities, the environment capacity and resource utilization for the study area.

Key words: Sudan; farmers; herders; mechanized rainfed farming; conflict; environmental fragility; natural resources; modeling.

INTRODUCTION

Natural resource-based conflicts are defining characteristics of arid and drought-prone areas in Africa. The causes of these conflicts
are many, such as demographic change; natural resources competition; developmental pressures and structural injustices. The combination of demographic change and the limits to sustainable harvesting of renewable natural resources (forests, water bodies, grazing areas, wildlife and agricultural land) are often cited as the underlying cause of conflict over natural resources, both among community groups, and between community groups and outside public and private organizations (Warner, 2000). The short-term adverse impact of conflicts can range from a temporary reduction in the efficiency of resource management regimes, to the complete collapse of initiatives or abandonment of government or donor-sponsored projects. In extreme cases conflicts over natural resource management can escalate into physical violence.

The modern history of Africa is characterised with foreign invasions by regional and international powers seeking to gain control of the Continent's strategic location and rich natural resources. Prior to those invasions, African societies used to live on subsistence economy of traditional agriculture and grazing at times when population was small and no competition for resources is triggering on. During the colonial period, from late 19th century through the mid of the 20th century, African economies are incorporated into the world market economy through production of cash crops and mining of precious minerals for export. Many of the traditional African communities saw that a form of violation of their rights on resources of land and pastures. Colonial socio-economic policies had caused regional disparities of development in many places as they targeted easy access areas and left the illiterate majority as either pastoralists seeking for
pastures or traditional agriculturalists producing for self subsistence. Tribalism among Africans enhanced tendency towards tribal ownership of resources other than by a Nation.

Post-Independence African did not succeed to overcome such burdens left by colonial powers and therefore is challenged with very violent resource-based conflicts. Many of the conflicts concentrated in poor and divided countries that possess only one or two major sources of wealth and in the regions with a precious pool of natural resource such as Sierra Leone whose natural resources have been a source of conflict from 1991 to 2000 due to the resources got from the illegal sales of diamonds (Nnane, 2007). Oil discoveries and exploitation have similarly led to many conflicts in Nigeria, Angola, Chad and Sudan, for example (le Billon, 2010). Severe scarcities of water and arable land could provoke conflict over the distribution of shared water resources in Africa (Shatima and Tar, 2008). The West African sub-region has witnessed resource conflicts involving sedentary farmers and mobile pastoralists. There is a history of pastoral communities fighting for scarce resources in southern parts of Ethiopia, Northern Kenya, parts of Somalia and the Sudan (Mekonnen, 2006). Such conflicts take place although "Pastoralists have interacted with sedentary farmers for millennia, with established practices of trade and symbiotic production such as grazing of livestock on farmers’ fields before planting seasons. However, both population growth and increasing commodity production have led to the expansion of agriculture on formerly shared grazing lands, and have increased tension and conflicts between these groups in many parts of the world" (Fratkin, 1997).
Of particular concern are conflicts in Sub-Saharan Africa, including Sudan, which is more vulnerable to water stress than any other regions. In this region, about 64 percent of Africans rely on limited and highly variable water resources where 25 percent of them suffer from water stress. They also rely on croplands inhabit the driest regions where some 40 percent of the irrigated land is unsustainable and 96 percent of agriculture is rain-fed. Soil nutrient depletion is a more pressing problem than drought and nearly 13 percent of the population in Africa experiences drought-related stress once each generation (Tatlock, 2006).

Drought is one of the causes of conflict. Many areas affected by drought are arid and semi-arid. When drought occurs in such areas, the land yields no crops and water is insufficient for human consumption as well. People compete for the meager available resources. Pastoral communities increase their movements during drought where different pastoral groups move to the same place and want to use the same scarce resources, which cause conflicts between the two communities. At the same time a period of severe drought led to large-scale environmental degradation, population displacement and urbanization.

In addition to drought, there are economic globalization; unsustainable consumption; population growth and economic warfare in poor and developing countries (Klare, 2001). The growing internationalization of finance and trade is having an effect on the demand for and consumption of basic resources. Globalization increases the demand for resources thought the spread and acceleration of industrialization. Although the global stocks of most
vital materials are sufficient for current requirements, the consumption of many of them is rapidly growing especially for water. The world’s human population is expected to grow by about three billion people between now and 2050. Obviously, many of the countries with the highest levels of population growth are located in areas where the availability of some vital resources is in doubt, especially true for water and arable land.

Resource-based conflict constitutes one of the most serious challenges facing many regions in Sudan. Traditionally, resource-based conflict has been represented by the old competition between farmers and pastoralists over water and land resources. The conflict in Darfur was over water and grazing rights (Schanche, 2007) where the areas of the Fur, Birgid, Berti and Daju tribes then became targets for waves of displaced groups from Northern Darfur, especially the Zaghawa and various camel pastoralists whose traditional grazing lands had suffered (Ayoub, 2006). Conflicts over resources take place at community local levels, but they are often escalated by population and climatic factors and by the state policies. Population increased from 26 million to 30 million by the year 2008 (Ministry of Health, 2008). The hyper-arid region of Sudan is characterized by high year-to-year variability in rainfall leading to extreme seasonality/irregular distribution of rainfall over the year and there are marked tendencies for some months to become wetter, and indicating changing intra-annual rainfall variability and thus monthly rainfall erosivity (Elagib, 2010). Rainfall depletion has been most severe in semi-arid central Sudan where between 1921-50 and 1956-85 annual rainfall has declined by 15 per cent, the length of the wet season has contracted by
three weeks, and rainfall zones have migrated southwards by between 50 km and 100 km (Hulme, 1990). Rainfall decline had been in the magnitude of 30-40 per cent (Ayoub, 1999).

Understanding conflicts in Sudan requires attention to the state and the institutional framework within which conflicts take place (Assal, 2006). These conflicts have many causes where at the root of each conflict are questions over the control and distribution of resources where the most important resource is land (Ayoub, 2006). Due to the prolonged nature of conflicts over resources in Sudan, conflicts take on political side which is threatening the entity of the country. In eastern Sudan, the new level of native administration created for the Rashaida tribe, gave them administrative power without land ownership. In the Blue Nile state, the new traditional administration status created for Fellata tribe, originally from West Africa, fought the indigenous Funj and Hamag tribes. The main political movement of the Nuba Mountains stated one of its main objectives is the "implementation of a land reform policy for the benefit of the indigenous farmers of the Nuba Mountains and the eradication of the feudalistic land policies and relations of production from all forms of exploitation" (Ayoub, 2006). The scarcity of land is also a result of the population movements, both from mechanized farming and from the war involving southern tribal militias, and is a prominent feature of the Beja insurgency in eastern Sudan. These conflicts could be situated within the current government policy of governance and development which imposed sovereignty of the center over the periphery. This led to the distorted idea among the peripherals that power and wealth are unequally distributed although
resources are adequate, but was unsustainable, due to inappropriate policies of development.

However, there are some of the knowledge gaps regarding resource-based conflicts in the literature about Sudan. This work might contribute to bridging some of these knowledge gaps. This might be done by achieving the main objective of this study which is to examine types and factors of natural resources based conflict in eastern Sudan by taking the example of the two villages of Sinaibra and Id el Tien, south of Gedaref Town. In addition, there is a necessity to curb such conflicts which threaten the social fabric of the Sudanese community and its political entity. Therefore, the author proposes the "triangle of environmental surveillance model" that could be useful to equilibrate between human activities, the environment capacity and resource utilization. This might help to achieve resource sustainability and better understanding and explaining resource-based conflicts in the study area. This is particularly that the model is dynamic one which could be developed and updated according to occurring conflicts. The time dimension to fit in the model considers early intervention when resource-based conflicts take place so as to equilibrate between man benefits, environment capacity and resource utilization. The space dimension firstly considers conflicts occurring at the micro level of a place that could be a field or a village. There should be linkages between the three components of the model to work effectively. This requires cooperation of grass root society, local governance and national government. The implementation of the model could hierarchical, starting with man then the environment and lastly how properly
organize resource utilization according the foregoing two components, man and the environment.

DATA AND METHODS

Gedarief state is located at 34-360 E, bordered by states of Kassala, Sinar, Gezira and Khartoum from the north, south, west and northwest sides respectively and by the Ethiopian borders from the east (Fig. 1). Gedarief state is part of the Butana region which is a plain surface intermitted by dispersed hills covered with alluvium. Topography of Gedarief state includes three major units. Firstly, are the highlands and isolated mountains in the southeast part, secondly, plain area dominating the state characterized by clayey soil (45-80% clay particles) either flat or slow sloped, and thirdly, Wadis (valleys) area including depositional areas around seasonal rivers like Atbara and Rahad. The two case study villages of Sinaibra and Id el Tien belong to Gedarief locality and located south of Gedarief town by 40 km. The two villages are the homeland for the Arab tribes of Bawarda, Fadnia, Lhwien, Muslamia, Muashra, Bani Aamir, Taaysha, Aarkien, Gaalien, Rikabia and migrants from Darfur and west Africa similar to many parts of eastern Sudan. In addition to official Government administrative system in Gedarief area, population are also under power of traditional administrations holding names of the major tribes living in the area and dates back to hundreds of years.
The fieldwork survey was conducted during 2 - 4 November 2009. A questionnaire was designed including data on some socioeconomic and demographic aspects of the two villages' populations, land tenure, relations between population groups, and aspects of conflicts between the farmers themselves, between farmers and herders and between farmers, herds and scheme landlords. In addition, perspectives of the respondents for resolving natural resources based conflicts were
included. Moreover, observations techniques were applied in addition to direct interviewing with some elder people and the heads of the tribes representing farmers and herders, Local government officials, representatives of operating banks and companies on agricultural crops and animals in Gedaref Bourse, as well as collection of relevant office data.

The two villages extend longitudinally from north to south in accordance with Gedaref – Galabat highway which reaches Sudan-Ethiopian border. Morphology of the two villages is distinguished by irregular narrow roads, houses are mere huts built by straw and mud and lacking numbering. Therefore, it was difficult to apply random sampling techniques for the choice of the respondents whom were therefore chosen according to their accessibility during time of the survey. The sample size was 50 households representing 20% of total households in the two villages according to Sudan Census (1993). Respondents were mainly the heads of the households who were either males or females and mainly farmers or herders or combine farming and keeping animals. Data was manually tabulated and treated statistically to get frequencies and percentages. In addition, relevant office data collected during the fieldwork was used and indicated where appropriate in the results section.

Conceptual modeling of the research results was based on Tacconi' (2000) categorization of types of conflicts into micro-micro (among community groups) and micro-macro (between community groups and outsiders), and on some types peculiar to the study area. This was supported by the definition of a model which expresses some facts intending for the explanation of some prominent characteristics
(Yeates et al., 1971) and as a constructive view or composition of some information (Coler et al., 1968).

RESULTS
ECONOMY

The economy of the study area is agriculturally based where farmers and herders constitute 68%, agric – based traders 2%, government employees 10% of the households surveyed; while those informally engaged into agricultural works and locally called "free workers" constitute 20% of the population surveyed. This last segment is reflection of the nature of this economy which thoroughly depends on subsidiary agricultural wage labor force. Farmers are mainly producing Dura (sorghum vulgare) and sesame for marketing and some food crops for their own and usually join between agriculture and animal keeping. Land tenure system among the two villages population included individual ownership "Hiaza" (68%), inherited land " family share" (12%) and land renting (20%) from landlords. Land renting is usually highly charged (34%) and subject to changing of area allocated annually for cultivation by landowners (16%). This is partially due to the influence of common ownership of land by inheritance (8%), fluctuation of rainfall (8%) and delaying / non-paying of rent charges (8%) and although 76% of the respondents concerned with this question did not reply to that issue in the questionnaire, direct interviewing revealed common consensus with these explanations.

This agricultural economy of the study area is historically associated with introduction of mechanized crop production schemes (MCPS) in Sudan. Because the Gedairief area is a wide flat grassy
plain deep fertile soil, it was chosen for the mechanized crop production schemes as it had a long tradition of Dura production. It was just estimated after the Second World War that of the 100000 tons of Dura marketed annually in the Sudan; 30000 tons came from the Gedarief area (Jefferson, 1949). Of course, the current total market for dura in Sudan is dynamic, but still Gedarief area’s share of the market occupy the first rank. In the Five – Year Post War Development Program of 1946 – 1951, mechanization of Dura production in Gedarief was a major achievement. Many parts of this grassy area were normally uncultivated because of the shortage of drinking water during the dry season, and it was anticipated that mechanization of production would solve this difficult problem by reducing the labor force required in Dura production. The 1970 Investment Act and 1990 Investment Act enabled the expansion of the mechanized farming and by the year 2005 the total area under mechanized farming had increased fifteenfold (Ayoub, 2006).

Herders and grazers are the other segment of the economy of the study area. Some of these herders and grazers, similar to farmers, combine seasonal farming with livestock-raising and are known as agro-pastoralists. Pastoralism was a traditional way of life in the study area which was very famous all over the Sudan by its Pastoral Poets like el Hardalou Poet.

Pastoralism and semi-Pastoralism in the study area are forms of natural resource use and management that comprise movements ranging from year-round camel breeding and long-distance migration, to seasonal movements over shorter distances. Generally, there is a
decrease in nomads in Gedaref area from 3.7 % in 1983 to 1.3% in 1993 (MFEP, 1995) and is expected to be more decreased thereafter.

In Gedaref area the total number of animals was 1,630,000 heads in the year 2001 (Veterinary Authority- Gedaref, 2009) and is predicted to increase continuously. The average size of animal ownership per household in the two villages studied is 3 for goats, 5 for sheep and 2 for cows. Landlords also used to keep animals in their schemes depending on farm remnants and fodder for feeding after the rainy season period while depending also on nearby pastures during the rainy season. People of the two villages do not keep camels which are linked with mobile Arab tribes. Although the holding of animals per household seems small, they are the major source of milk and cash income by sales to provide some family needs for sugar, cloth and medicine.

**TYPES OF CONFLICTS**

Many types of resource based conflicts could be distinguished in the study area. Conflicts are occurring among farmers (40%), among grazers or herdsmen (55%) and between farmers and grazers and herdsmen (67%) who are directly involved into utilization of land, pasture and water resources. Farmers are utilizing land and water for agricultural production while herdsmen and grazers are utilizing pastures and water for animal keeping. Farmers work hard to secure high production and productivity of crops to sustain their livelihood either working independently or for landlords. This makes them very keen to utilize all resources of land, water, capital and wage labor force. This leads to disputes among farmers over land resource ownership, land
boundaries, latent family and relationship in cases of land inheritance and even more they can be generated by jealousy released to growing wealth disparities among farmers and among relatives living together in the neighborhood due to income differences. However, although many farmers compete for better agricultural production, they usually face high charges and cost of feeding wage laborers in situations of vulnerability to crop failure or low agricultural production. This will, of course, aggravate conflict situation.

Local herders and grazers, including farmers, and mobile herders who come during the dry season looking for pasture in the neighborhood or move for shorter distances restricted by animal passages. Many incoming tribes into the study area have migrated from far north such as Shukria, Rufaa, Lhwien tribes as being pushed by recurring drought onsets, or from southwest such as Kenana and Fellatah tribes as being driven by military conflict in Blue Nile area by Sudan People's Liberation Army "SPLA", or from Red sea including Bani Amir and Hudandawa tribes were also driven by rebellious militia of East Liberation Front "ELF". Good pastures and grazing areas are targeted by all and therefore become overburdened by huge number of animals versus low pasture holding capacity. Herders are confronting among themselves over pastures, water sources and sometimes on boundaries entitled as a grazing area for a particular tribe. They work to increase number of animals in order to compensate for high taxes, charged veterinary services and low animal sales profits.

Historically, there has always been tension along pastoral corridors over land and grazing rights between nomads and farmers,
even though the population was small, as reported by 45.5% of the population surveyed. But recently, some parts of these areas have been caught in a complex tangle of severe droughts and dwindling resources. Disputes flare up between farmers and migrating camel and livestock herders, in search of water and pasture for their animals during the dry season which extends from December up to July. They would sometimes graze on farmers' lands and use their water points. However, intrusion into farms is recorded by 87% of the population and land grabbing by 13% among the surveyed population of the study area. Farmers keep working to protect farms against animal intrusions when crops are at pre harvest and still keeping on restricting using farms remnants by herders. Sometimes disputes occur over lost crops and access to water and pastoralists' routes are sometimes settled by tribal leaders.

Herders have no boundaries for looking for pastures. They mostly consider agricultural lands their open homeland and further motivated by culture of "Badiat el Sudan" Nomads land of Sudan, where land is common share and resource is endless giving. Therefore many disputes occur between sedentary farmers as resource owners of agricultural lands and these herders who intended to use these resources. The introduction of mechanized farming in vast grassy areas had affected the mobility system of herders. They usually move southwards with the retreat of rainfall and northwards with the advance of the rainy season. Herders have inherited the nomads' norms that the land is theirs. They look at the investors into mechanized agriculture as intruders who occupied their lands. The investors see they have the right to exploit land authorized to them.
The conflict here is that of latent type on who have the right first to make use of the land where historical right of herders or the government sovereignty have the right first. In addition, many incoming herders who managed to stay permanently in the study area firstly join between agricultural works and animal keeping in order transferring into the sedentary economy. Later, they either become pure agriculturalists or semi-pastoralists by proceeding into the agricultural economy as they possess animals they can sell and buy land from farmers who have been run out of money or failed to pay bank debts or plan to migrate outside the area.

Local subsidiary workers who live in the vicinities of the agricultural mechanized schemes also confront with farmers and herders, as indicated by 34% of the population surveyed. They are either newly settled traditional farmers or herders who look for an opportunity into the agro-animal system, or might be those who are mainly nonprofessional farmers or herders but look for any work to get living. They usually stay with their relatives whom they have spent longer periods in the study area or they were imported from different parts of Sudan by landlords during production seasons. They conflict with traditional farmers and scheme owners on farm remnants, drinking water, sharing into job opportunities. They are not formally engaged into the agricultural operations but they are under request when these land owners need them as wage laborers. They struggle for survival by dependency on the available resources with the resident population because of scarcity of cultivable land, obstruction of animal herding routes or in the search for fresh water and grazing land.
In addition, 45% of the population surveyed indicated to conflicts occurring between farmers, herders, grazers against middlemen, companies and market dealers who are not directly involved into agricultural production and animal keeping. Middlemen do their job in farms or places of animal gatherings when they present themselves as market dealers or mediators working with big merchants. They control pricing according to sales prices, taxes and local authority commerce regulations. The establishment of Gedarief Bourse in 2005, introduced companies and banks as new market dealers. They work according to hard currency pricing and world market demand. Calculations of costs of agricultural operations and marketing revenue might be in many situations in a deficit to the farmers. The presence of many dealers generates competition among them which is expected to be for the benefit of local producers, but the situation is opposite to that since these dealers control money flow in the market which enforce these local producers to sell at low prices in order avoid crop loss or damage which might create disputes over unfair distribution of profits between the two sides.

Conflicts also occur between traditional farmers and owners of the scheme "landlords" as indicated to by 25% of the population surveyed. Landlords own big mechanized schemes while traditional farmers own small farms or rent lands from landlords. There are many differences exist between them at farm size, capital invested, use of machines, wage labors, income and facilities for marketing agricultural production and animals. In cases when small traditional farmers work for his own benefit, they will be faced with that, bank will not finance them as they have no guarantee to pay to return the indebted money in
case of crop, or in situations of low production and/or vermin attacks. Because landlords produce hugely and have facilities for storage they control pricing and have priority for marketing where small producers might be subject to crop damage when storage facilities are not available or

are very expensive to meet. For those farmers who work into big landlords schemes under supervision of resident clients, they get into agreements biased for a landlord. They mostly consider themselves producing for others who own the land. These clients, in order to keep on with their jobs and to express their care for landlords, are very tough which makes farmers feel that as if they are working under slavery or feudal system. Farmers confront on with these clients and complain to their landlords who mostly do not response. Many farmers have abandoned agricultural works to other jobs in the marginal economy of towns of Sudan. In such situations, disputes over unfair distribution of profits and jealousy related to growing wealth disparities between land owners and these farmers are generated.

Conflict between the state, as major supporter of the scheme owners, and the small farmers and herders is the most serious of all as indicated by (70%) of the population surveyed. This is because the state is the authority which introduced mechanized rainfed farming and has often been the authorized body to license for land ownership and has opposed the spontaneous resettlement of many indigenous people when stricken by drought. Mechanized farming as natural resource projects are being captured by élites from outside the study area and/or those who happened to own resources of a higher quality in the study area such as big tribal leaders. The structure and location
of the large-scale mechanized farms is a source of recurrent and continuous confrontation. It is interesting to note that during the period of rapid expansion of mechanized farming from 1970 to 1985; more than 20 major regional tribal conferences were organized to solve land disputes between the various groups. Here, many disputes can be distinguished over project management between community groups and outside project-sponsors; or those caused by political influence; or arising from differences between the aspirations of community groups and expectations of commercial companies over the unfair distribution of work and profits all of which are imposed by the introduction of mechanized agriculture in the study area.

the short-term adverse impact of conflicts in the study area have led to deportation of some tribes (18%); increasing penalties (18%); tribal fidelity and hatred (20%); crop damage (20%); land grab (10); animals robbery (9%) and loss of life (5%). People resolve such conflicts through courts (53%); signing agreements between conflicting sides (20%); or use of good reputation mediators "Judiah" such as heads of the tribes or respected persons in the community (12%); or paying kind compensations and money penalty (15%). On the other side, official authorities apply laws.

Because the economy of study area is based on agro-animal related activities and the occurring types of resource based conflicts are inextricably linked together, conceptual modeling of such conflicts can be presented (Fig.2). The two major types of micro-micro and micro-macro conflicts can be identified. Micro-micro conflicts including those occurring among farmers, herders, and people live in the vicinities of the schemes, landlords and the state that are directly
involved into utilization of land and water resources. However, middlemen, companies and market dealers who are not directly involved into agricultural production and animal resources are also identified within micro-micro type of conflicts (Fig.2).

**Figure 2**

**Modeling types of conflict in the study area**

- **Types of conflicts**
  - Micro-Micro (among community groups)
    - Between groups and those not directly involved in resource utilization
  - Micro-Macro (between community groups and outsiders)
    - Between traditional farmers and owners of the schemes
    - Between Local people and those who live in the vicinity of the schemes
    - Between the State and the small farmers and pastoralists
  - Intra micro - micro
  - Inter micro - micro
    - Disputes over:
      1. land resource ownership
      2. land boundaries between individuals or groups
      3. latent family and relationship
      4. unfair distribution of work and profits
      5. resources captured by elites and those who own high quality resources
    - 1. between land owners and resource users
    - 2. between indigenous people and more recent settlers
    - 3. those generated by jealousy released to growing wealth disparities
    - 4. lack of cooperation between different community groups
    - 5. over renewal arrangements for leased land
    - 6. internal land ownership ignited by the speculation activities of commercial companies.
Micro-micro types of conflicts are further subdivided into intra and inter disputes. Intra disputes are those over land resource ownership, land boundaries between farmers and herders or their groups, latent family and relationship, unfair distribution of work and profits between farmers and landlords, resources captured by elites and those who own high quality resources who might be politicians, tribal leaders or businessmen. Inter types of conflicts include those between land owners and resource users, between indigenous people and more recent settlers, those generated by jealousy released to growing wealth disparities, lack of cooperation between different community groups, over renewal arrangements for leased land, internal land ownership ignited by the speculation activities of commercial companies. Types of micro-macro conflicts including the three sub groups outlined by figure (2) which are strongly linked with the micro-micro types of conflicts and their sub divisions which are fitting with our previous discussion.

FACTORS OF CONFLICT

Factors considered responsible for natural resources based conflicts in the study area include physical and human ones. Lack of water and pastures are the two major factors for direct conflict among farmers, grazers and herders (54%) and among local grazers and incoming herders (42%). The majority of the area's population indicated that conflicts are increasing during rainy season (41%) including moths of June up to September, while only 4.5% indicated to after the rainy season period including October up to May. Lack of water and pastures are reflections of the type of the natural
environment of the study area where geologic and climatic characteristics/or change are determining factors.

Most of the Gedarief area is underlain by Basement Complex of Tertiary Basalts both of which provide little water except in the
detrital material around the occasional hills and small supplies to be
found along joints in the rock. Basement complex rocks prohibit well
digging and they are of low porosity and permeability which allow
little or no water to penetrate downwards except along temporary
water streams where the upper part of these rocks is weathered for few
meters and is therefore porous. The underground supplies are not only
small, but those at depth are extremely hard whilst the shallower ones
are saline. Most of these water sources are temporal and linking with
the rainy season where rainfall range is 300-900m/year. Gedarief area
has two distinctive climatic belts. The first one is semi arid climate
found in the north and northwest and characterized by summer
seasonal rains during July - October. The second one is a wet climate
found in the eastern and southern parts with average rainfall of 500-
900 mm/ year and maximum mean temperature of 47 °C. Rainfall in
some major stations during 1994 recorded 777mm in Gedarief, 669.5
mm in Wd el Houri and 616 mm in Gedambalia while it was 600 mm
in Hawata (Meteorology Office-Gedarief, 1994). This closely related
to rain variability in the Sahelian zone of Sudan.

Demographic aspects of the study area's population are also
important into resource based conflicts. The average family size is 8.9
with sex structure distributed as 49% males and 51% females.
Economic reflections indicated that 75% of the populations are
permanently staying in the study area while 25% of them have
migrated to nearby Gedaref town (58%), Greater Khartoum (38%) and outside Sudan (4%). Reasons for migration included looking for work (60%), to collect money for marriage (28%) and education (12%). Incoming migration to Gedaref state numbered 746,714 in 1983 and reached 1,148,462 in 1993 with annual growth rate of 3.7% which exceeds 2.8% for whole Sudan. This is due to migrations seeking agricultural work, seasonal migration, natural increase and refugees inflowing from Ethiopia and Eritrea. Rural population was almost stable between 1983 (73.6%) and 1983 (73.7). The urban population increased from 22.7% in 1983 to 25% in 1993 that either the nomads became urban or rural became urban and the replace by nomads (MFEP, 1983-1993).

Major factors considered responsible for natural resources based conflicts in the study area can be conceptually modeled (Fig.3) into four principal factors. The economy structure consists of mechanized and subsistence farming and traditional animal keeping are subject to climatic change and demographic factors; higher land demand and overpressure on the available infrastructure. The combination of demographic change and the limits to sustainable harvesting of renewable natural resources of forests, water bodies, grazing areas and agricultural land are often underlying cause of conflict over these natural resources, both among community groups, and between community groups and outside public and private resource utilizes in the study area. Mechanized agriculture has led to natural resources competition; developmental pressures; structural injustices, privatization of the economy and bound with world market economies which are enhanced by governmental intervention. However, there are
mutual interactions between types and factors of resource based conflicts in the study area.

**Figure 3**

**Factors of natural resource based conflict in the study area**

- Introduction of mechanized rainfed agriculture, privatization of the economy, collapse of farming - grazing old relation, government intervention, world market economy.
- Migration, population increase, excess land demand, resource and infrastructure overpressure.
- Climate change, rainfall fluctuations, pasture loss, soil depletion, migration of nomad tribes, closure of animal passages.

Demographic change

Development pressures and structural injustices

Natural resources competition
DISCUSSION

The general findings of this study depict many types of conflicts taking place at various levels. There are conflicts among community groups and between community groups and outsiders who engaged into resource utilization in the study area. These conflicts were initiated between directly and not directly involved into resource utilization at the community base – level and furthermore, between community groups and outsiders (Figure 2). They were thoroughly affected by environmental factors, socioeconomic, demographic, development pressures and structural injustice caused by mechanized agriculture (Fig.3).

People of the study area used to live on self subsistence economy, similar to African societies, prior to the introduction of extensive mechanized rainfed agriculture. The politicization of land ownership dates back to Sudan's division by colonial administrators in 1923 into tribal homelands. The strong relationship between a tribe and its homeland has allowed the major tribes to use and monopolize the natural resources within their homeland and to deny minor tribes any claim to rights or ownership which would allow them to exercise political or administrative power.

The Colonial, post World War 11, Five-Year Development Program covering the period 1946 to 1951, considered mechanization of Dura production in Gedaref area a major success since it solved the problem of food shortage in African horn during war time. Therefore, the British were enthusiastic to expand mechanized agriculture in the Gedaref area irrespective of the negative impacts particularly that Gedaref area lies between the semi-arid zone and the rich savannah
southwards. The direct negative impacts were the violation of tribal rights on land resource; cut of huge areas used to produce crops and hold animal to the modern mercantile agriculture; formed a barrier against herders easy access to pastures and neglected rural societies of the study area who were left subject to rainfall fluctuations and impacts of droughts. This represents a kind of the effect internationalization of finance and trade is having on resource during that time when the British have invested huge money into mechanized agriculture to meet the demand for food in east Africa front against the Fascist and Reich, and later to mercantile traditional subsistence economy of the Gedareif area. The ultimate result, though positive results cannot be ignored, was the initiation of micro-micro and micro-macro types of conflicts among resource users there. From the early start, the division of land was unfair between landlords and local people in situation where problems of infrastructure were not solved and expansion into mechanized agriculture took place simultaneously with the import of machines and settlement of wage laborers who increased dramatically during the rainy season. This had caused pressure over resources, because the majority of the imported people was peasants or animal herders. In addition, the feelings of local people that they produce for landlords who gain much compared with farmers could be considered as latent factors for conflicts. This has been aggravated by climatic change, low soil fertility, deterioration and disappearance of natural vegetation, and loss of pastures.

The indirect role of Post Independence development policies in shaping conflict to natural resources was that, they have targeted development of the irrigated agriculture in the clayey plains of central
Sudan and neglected the traditional subsistence agriculture in western Sudan. The development program of 1957-1961, targeted the irrigated new extensions to the Gezira scheme which was established by the British in 1925 to produce cotton for export and further considered building new dams to bring more land under irrigated cultivation and the building of sugar factories and sugar plantations. There was a phenomenal increase in private pump schemes for cotton production along the Blue and White Niles. The Ten Year Plan of 1961/62 - 1970/71 also recommended the extension and crop intensification in the Gezira and development of new pump schemes on the Blue and White Niles which altogether increased the irrigated area by 1700000 feddans (MFEP, 1961). The share of the study area from this Plan is reflected in the number of the tractors which increased from 2040 to 8000 and combined harvesters in use from 120 to 700 (Lees et al., 1977). The Seven Year Plan, 1970/71-1976/77 emphasized on proposing new irrigated schemes in central Sudan. Flood irrigation was to be substituted by gravity irrigation in Northern Province. Rural development projects included settlement of nomads. Conflicts over land were further politicized by the 1970 Unregistered Lands Act which enabled the government to implement a development policy based on the expansion of the agricultural sector, especially mechanized farming. The legislation had given the government the right to use force o safeguard "its" land, and to encourage the accumulation of land by minority of rich local and foreign investors. This alienated agro-pastoralists from their traditional homelands, denied any formal legitimacy or juridical status to traditional property rights, and implied the cancellation of all rights - and income - relating...
to water, land and grazing by pastoralists. The six year plan, 1977/8 – 1982/3, and later replaced by the Three Year Investment program up to 1983, proposed the development of subsistence agricultural sector and conservation of Sudan's natural resources. The neglect of the traditional subsistence agriculture has driven the farmers involved in that sector to migrate to the more developed areas in central Sudan and to compete with population living there over available resources. The Gedaref area is not exceptional where in addition to migration, landlords of mechanized farms had brought seasonal and wage workers from western Sudan and West Africa.

These conflicts could be situated within the current government policy of governance which was launched with the National Economic Salvation Program, 1990 -1993. This program had implied more emphasis on agricultural development and export oriented policies through liberalization. It also tended to encourage agricultural credit through special fund and exclusion of all bank credit to agriculture and animal production from credit ceiling. The 1990 Investment Act have allocated vast tracts of land to private capital investments by which substantially cutting rural communities' rights to land and dislocating people from their homeland. This government policy is still continuing adopting privatization of public sector agricultural schemes, commercialization and lift of subsidy to agriculture which lastly brought foreign capital investment to this sector. The adverse effects are the sealing off nomadic routes, water points and pastures, fostering a culture of land-grabbing and creating large landless groups who are forced to work as precarious wage laborers or to migrate elsewhere. The establishment of Gedaref Bourse was to further
mercantile agricultural produce where the resident representative of Banks, Companies and wealthiest individuals are controlling their business from Khartoum.

These types of conflict in the study area are similar to those in sub-Saharan Africa in general, where population growth and increasing commodity production have led to the expansion of agriculture on formerly shared grazing lands, and have increased conflicts between these groups (Fratkin, 1997; Tatlock, 2006), and also similar to West African sub-region; southern Ethiopia, Northern Kenya and Somalia (Mekonnen, 2006). The factors of resource-based conflict in our example is also similar to many places in Sudan, where conflicts over resources are often escalated by high year-to-year variability in rainfall which leads to extreme seasonality and irregular distribution of rainfall over the year (Elagib, 2010), (Hulme, 1990), population increase and the state policies (Ayoub, 2006) and over water and grazing rights as in Darfur (Schanche, 2007). It also agrees with Suliman’s study (1994) that the ecological and social stress caused by large-scale mechanized agriculture in eastern Sudan can be held responsible for conflicts (Suliman, 1994). But, it differs than the conflict in southern Sudan which was basically ethnical (ebow.com, 2011), or that caused by cultural or ethnical beliefs as in Nigeria and South Africa (Irobi, 2005) or southern Ethiopia (Assefa, 2011). It also differs than those occurred in Sierra Leone (Nnane, 2007) and Angola and Chad (le Billon 2010) which were indicated in the introduction of this paper.
CONCLUSIONS AND RECOMMENDATIONS
The general conclusions of this study are:-

1) There are micro-micro and micro-macro types of conflicts.
2) Factors considered responsible for conflicts in the study area include natural resources competition; developmental pressures; structural injustices caused by mechanized agriculture and demographic change.
3) Globalization and world market economies impact on at subsistent farmers level.
4) These conflicts are similar to others occurring in the Sahelian zone and in Sudan.
5) These conflicts are threatening the relation between human, environment and resource utilization.

Conflicts in the study area are particularly vital for a conflict riddled country like Sudan where resource based conflicts have imperatively affected rural societies. Some scholars have proposed solutions for natural resources based conflicts. One example is that by Mekonnen (2006) who recommended the building of an early warning system that should be adopted at local, national, and regional levels for mitigating impacts of drought, famine and conflict. In this study, Triangle of Environmental Surveillance was proposed by the author (Fig. 4). It consists of a hierarchical structure of three interrelated axes including human, environment and resource utilization. Human inherited experience and traditional knowledge on agriculture and grazing and coping mechanisms, for example, could benefit here. Environmental holding capacity should be considered in order to keep on sustainability while resource utilization should match with these environmental capacity and make benefit from inherited experience and culture of the people of the study area.
Based on the results outlined in figures 2 and 3, the proposed triangle of environmental surveillance focuses on curbing natural resources based conflict by caring the human first. Provision of community based knowledge is essential. This knowledge should cover aspects of respecting others' rights in accordance to the type of resource utilized, strengthening and empowering traditional conflict resolving mechanism, contributes to building relationship among and across communities which diminishes the frequency and intensity of conflict, and encourages cooperative solutions to other problems. Building capacity of the institutions of the nomads including traditional administrative systems; culture of raising animals; and use of water points; mobility in search for pasture and knowledge sharing will make these communities more aware on misuse of resource utilizations and their impacts. Basic agricultural schools will teach farmers on how to use modern agricultural practices, appropriate use of water and soil, adaptation with climatic change and knowledge sharing among themselves and with others. Addressing specific needs of local populations, enhancing local knowledge and skills, building the capacity and preparation of traditional mechanisms for combating drought are essential. They include collecting/harvesting rainwater in man-made ponds, diversifying grazing lands, and planting trees that adapt to dry climates.

Rehabilitation of degraded rangelands, reserve of green belts, rainfall database, and permanent water points are major axes for the environment sustainability in our model. Rehabilitation of degraded rangeland will keep on recent use and increases its future holding capacity. Research on drought and desertification by identifying
causal natural and human factors is essential where the role of official authorities is remarkable either by monitoring or aware of people. Reserves of green belts will aware people to respect natural resources in order to respect others' rights on resources. Rainfall database will provide information for the agricultural season, expected pasture, locations for good agricultural production and vulnerable areas to crop failure and expected food shortage in order to avoid excess use by farmers or herders. Permanent water points have to be in accordance with rainfall database and population density taking into consideration the physical characteristics of the study area.

**Figure 4**

**Triangle of environmental surveillance for reduction of resource based conflict in eastern Sudan**
Resource Utilization included mobile extension team, community resource management bodies, secondary data for cattle routes and pastoralists movements, participatory demarcation with concrete posts for livestock routes and conflict prevention, mapping of long livestock routes. In addition, maps and secondary data for cattle routes and pastoralists movement should be introduced with local patrolling team comprising representatives of pastoralists, farmers, native administration and the old system of pastoralists. Protected animal resources could be through provision of veterinary drugs and vaccines and equipments and establishment of veterinary service pharmacies at wet grazing.

Introduction of small credit finance system, agricultural cooperative societies, opening of fire lines are also parts of natural resources management. Empowering farmers and pastoralists institutions to strengthen their capacity to understand tenure rights, knowledge sharing on natural resources management and conflict resolution and legal awareness about land tenure and conflict are also essential. In addition, trained local mediators in natural resources management and conflict resolution, establishment of networks including farmers and herdiers for building partnerships between pastoralists and farmers, and between pastoralists and local government are also vital.

Managing relationship between man, the environment and resource utilization have to be introduced into Sudanese planning in order to curb tribal conflicts and to keep the entity of the country. This is important as civil wars in southern, western and eastern Sudan are ignited by issues of marginalization, lack of development and
infrastructure and southern Sudan is now on the road for separation. However, understanding how communities access natural resources and tensions and rivalries entailed in this process is critical not only for discerning livelihood systems, but can also inform sustainable development policy in Sudan. Although the word 'conflict' is often thought of as the opposite of co-operation and peace, it can often be seen as a force for positive social change, its presence being a visible demonstration of society adapting to a new political, economic or physical environment.

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