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Desertification in Africa - A Critique and an Alternative Approach

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ABSTRACT: This article critically reviews the international debate on desertification, its status and rate as well as causes and consequences. The article rejects the commonly used concept of a degrading environment, but tries to explain the environmental problems as symptoms of a wider economic and political crisis. An alternative approach applying systems analysis of the entire socio-economic-system to the study of desertification and land degradation is discussed, with examples from the Western Sudan.

Introduction

Desertification has been described in many catchy ways. Below are some examples from the scientific and popular press as well as reports from development organisations.

> "Desertification... is probably the greatest single environmental threat to the future well-being of the Earth" (Högel 1979)
> "The best recent example of desert encroachment occurred with the Sahelian drought between 1968 and 1974, when climatically and ecologically it was as if the Sahara had extended its limit southwards by 5 degrees of latitude" (Tyson 1980)
> "Currently, 35 per cent of the world's land surface is at risk... each year, 21 million hectares is reduced to near or complete uselessness" (UNEP 1984)
> "The Sahara Desert continues to creep southward, claiming an area the size of New York State every decade" (Smith 1986)
> "It has been estimated that 650,000 square kilometres of the Sudan had been desertified over the last 50 years and that the front-line has been advancing at a rate of 90–100 kilometres annually during the last 19 years" (Suliman 1988)
> "Vice-President Bush was being urged to give aid to the Sudan because desertification was advancing at 9 km per annum" (Warren & Agnew 1988)
> "We now must stop the advance of the desert... in Mali the Sahara has been drawn 350 kilometres south by desertification over the past 20 years" The President of the World Bank (Forse 1989).
> "Recently, desertification has become one of the most serious environmental and socio-economic problems of the world. ...The global assessment carried out by UNEP in 1990–1991 shows that desertification continues to spread and intensify" (Dregne et. al. 1991)
> "... it (desertification) results in deserts, which are not just less productive lands, they are non-productive lands unsuitable for human life... about 1.5 billion hectares of formerly productive land were irreversibly converted into desert, an area equivalent to all presently cultivated land of the world." (UNEP 1991)

The statements above show that the desertification debate is still intensive, and the arguments used are still very much the same as in the 1970s. The last quote, by UNEP, is remarkable in saying that deserts are non-productive lands unsuitable for human life. Recognising that pastoral societies occupy and have long occupied desert areas in a sustainable way renders the statement disdainful. Furthermore, 1.5 billion hectares irreversibly transformed into desert is a staggering number. In comparison, the United States of America is 0.92 billion hectares. Where are all those hectares where the productivity has been reduced to zero?

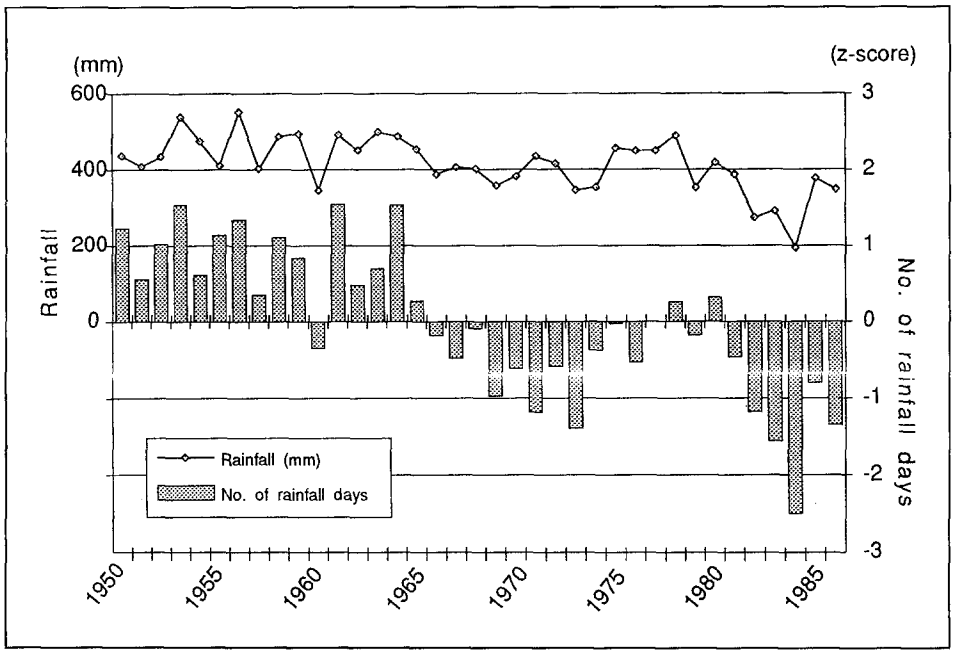

Fig 1
Rainfall and number of rainfall days at five stations (Bara, El Obeid, Ed Dueim, Jebelein, Kosti) throughout central Sudan. Source: Sudan Meteorological Department

Analysis of the Desertification Debate

Desertification has been a buzzword in the development debate since the UN Conference on Desertification in 1977. The vaguely and ambiguously defined process of desertification was made the scapegoat of the food crisis in Africa as well as of other economic and social problems. In the different attempts to define this extremely complex process, causes and effects were often mixed up. Perhaps one of the gravest mixed-up factors is poverty. A number of articles claim poverty to be the effect of desertification. I would like to stress firmly that poverty is the ultimate cause of land degradation. The rural poor people are forced by shortage of money, caused by biased pricing strategies and malfunctioning markets (Olsson 1993; Bates 1981), and consequently by lack of food and other necessities, to exploit the natural environment.

Because of the lack of proper definitions, the whole concept of desertification became much misused. The main body responsible for the co-ordination of research into and counteracting desertification, the Desertification Control Programme within UNEP[1)], defined desertification in the following way:

> "... the diminution or destruction of the biological potential of the land, and can lead ultimately to desert-like conditions..." (Mabbutt & Berkowicz 1980)

The main ambiguity in this definition is "desert-like". Most of the drylands (arid, semi-arid and sub-humid areas) can give a "desert-like" impression on any western traveller during the dry season (the season for many expert missions on this theme) or during periods of drought. One of the most influential and misleading studies was written by Lamprey (1975). He compared the position of the desert boundary in western Sudan at two different times, the first being the desert boundary marked on a vegetation map in 1958 (Harrison & Jackson 1958). The second was the result from his own light aircraft reconnaissance carried out in 1975. Lamprey found that the desert edge had advanced 90–100 km southwards in 17 years. In this report there were two fundamental mistakes.

The first one was not to distinguish between the temporary effects of a severe drought (the Sahelian drought 1968–74) and a secular trend independent of rainfall variations. Lamprey did the survey in 1975, just after the drought, while 1958 was during an exceptionally wet period, Fig 1.

The second mistake was that both definitions and methods varied between the two studies. Harrison & Jackson used the 75 mm isohyet (Harrison & Jackson 1958), drawn from a very scarce and inaccurate network of rainfall stations, while Lamprey used field and aerial observations of vegetation conditions.

Another ambiguity in the desertification debate has been the question whether the process is reversible or irreversible. There are examples of both. Some of the salinized lands of Babylon are still unproductive, while the lands of the "dust bowl" disaster in USA have been successfully restored and recovered as productive rangeland in just a few years (Rapp 1987). In the Sahel, there are few if any, examples of widespread and irreversible land degradation leading to what can be called a desert, that cannot be explained by climatic factors.

A major source of misleading information is the estimates carried out by UNEP in 1977 and 1984 (reviewed

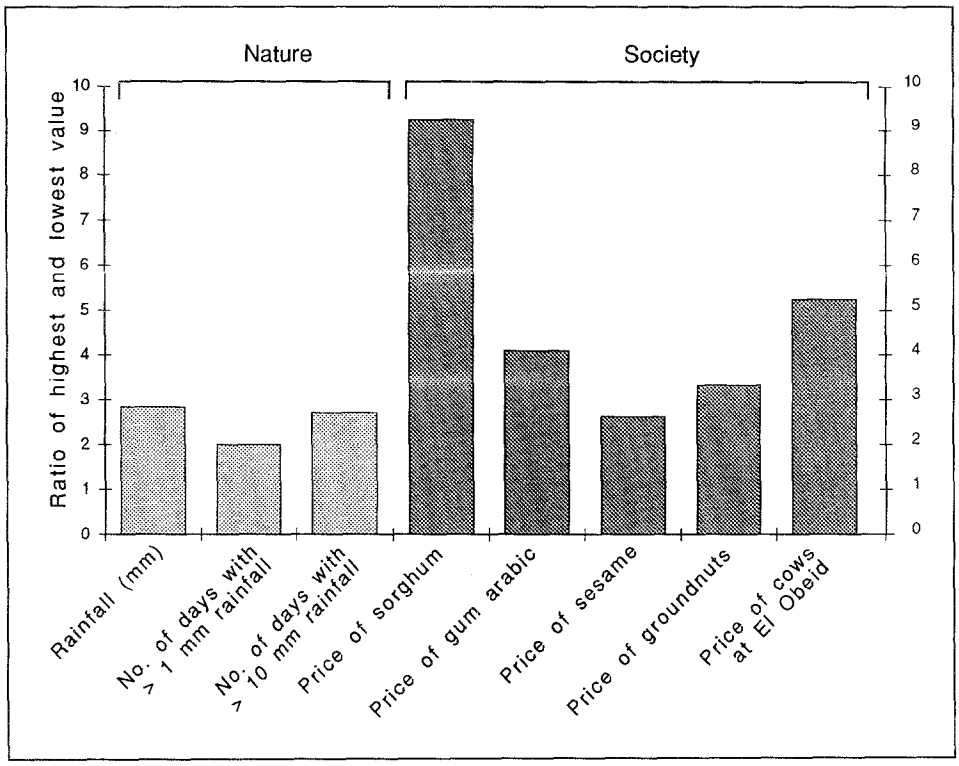

Fig 2
Diagram showing the variability of certain natural and societal phenomena. The variability was calculated as the ratio of the highest and lowest value in time series. The climatic series were yearly values from 1950 to 1990 for four stations in central Sudan, while the price series were monthly values 1984–1990, compensated for inflation.

by Mabbut 1985). However, no systematic world survey of the status and trend of desertification was carried out for the 1977 estimate, presented at the UN Conference on Desertification. The second estimate, carried out in 1984, was based on two sources; questionnaires to 91 affected countries and 10 donor countries, and regional assessments conducted by the UN Regional Commissions, though only 20 of the questionnaires were used (Mainguet 1991). In an evaluation of the two estimates, Mabbutt (1985) points out the weaknesses and poor reliability of the data. However, he then goes into a detailed analysis of the estimates. These extremely rough figures have then been quoted and manipulated by other authors. The estimates, aimed at popularising the severeness of land degradation, contributed to the false picture of an advancing desert.

The estimates resulted in different quantitative statements on status and rate of desertification, often expressed as number of hectares being *desertified or lost to the desert* annually. The same kind of reasoning, that it is possible to define a rate at which desertification is advancing, is still very much alive. Dregne et. al (1991) states that *"there are no reliable global data on the present rate of desertification"* (p. 13). Nevertheless, after some numerical examples of desertification rates in different countries, his conclusion is *"... an average rate of current desertification progress of 3.5%"* (p. 14) throughout the drylands of the world.

This view of desertification also gave birth to a number of more or less futile attempts to stop the *"march of the desert"*, like green belts and sand fixation, where the goal is *"... to protect agricultural lands against desert encroachment..."* (Skoupy 1991). Many such projects are still very active today throughout Africa.

The debate on desertification will probably take another turn with the recent publication of the World Atlas of Desertification (UNEP 1992). It seems to be a better attempt to address the desertification complex at a global scale than the previous ones (1977 and 1984).

But unfortunately, the World Atlas on Desertification does not clarify the global situation of land degradation and desertification. The atlas is not based on primary research into the regions most affected, but again, like in 1977 and in 1984, based on estimates and guesses. The most important source of information for the Atlas is the Global Assessment of Soil Degradation (GLASOD), (Oldeman 1991). This is a compilation of existing information and of the knowledge of over 250 different experts. The GLASOD is presented in a series of 3 maps in the scale of 1:15 million. A serious methodological problem arises when comparing the opinions from the over 250 experts. Is it at all possible to compile a global map where the input emanates from so many individuals - each one with potentially different perceptions of the problem, its definitions and probably also different political goals? The resulting maps are sometimes preposterous. The map shows for example large tracts of the Sudan as stable terrain with no human induced soil deterioration, while Southern Sweden (one of the most high yielding

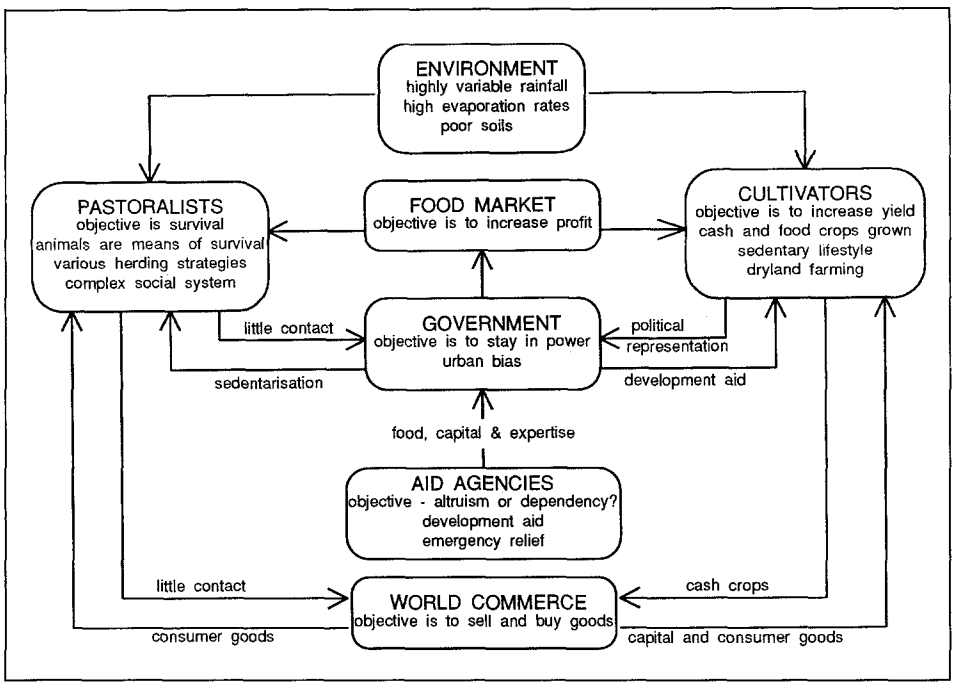

Fig 3
A possible conceptual model of a typical Sahel production system. Modified from Agnew (1984)

agricultural regions of the World) is in the worst category for physical and chemical soil deterioration. It is obvious that GLASOD confuses information from different sources, where different definitions and methods have been applied. Since the World Atlas of Desertification is not based on profound primary research, but a mere compilation of personal views and opinions, it conserves the traditional concepts of desertification instead of throwing new light on a very controversial issue. The conclusions of the Atlas are as sweeping as in the previous assessments (1977 and 1984), and there are virtually no attempts to give a more profound discussion on the real causes and consequences of dryland problems. Political, social and economic conditions are not even mentioned.

This new assessment of the global status of desertification was described by Dregne et. al. (1991). The status and rate of desertification as well as the economic loss due to desertification and the costs of rehabilitation of desertified lands are presented in numbers, tables and diagrams, with no references whatsoever. Since the data is presented uncritically without any methodological discussion at all, it must be dismissed as nothing but guesses, speculations or perhaps political propaganda.

The grave exaggerations concerning the area subject to desertification as well as the rate of progression of desertification had a number of negative effects on the dryland communities. I would like to stress that many exaggerations were made with a good purpose - to increase the flow of international aid to the drought and famine stricken communities. I argue that the exaggerations made more harm than good, since the net flow of development aid to the African drylands probably decreased during the 1980s (Nelson 1988). A change in this policy took place in 1989, to a large extent after the completion of a report by Ridley Nelson of the World Bank (Nelson 1988). The report concluded that the problem of desertification had been gravely exaggerated and the evidence of desertification was extremely scanty. Another important conclusion was that *"the availability of profitable technologies to combat the problem has been overestimated"* (Nelson 1988, p. 1). The report recommended that the World Bank increase its support to dryland communities, and emphasised the need for profound research in order to reach a deeper understanding of causes and effects of desertification. Another report that expressed similar ideas was written by Warren & Agnew (1989).Criticism of the popular view of desertification was reviewed in a short paper by Forse (1989) which had a significant impact on the international debate.

Some of the research results, reviewed by Nelson (1988), Forse (1989) and Warren & Agnew (1989), opposing the conventional desertification paradigm were carried out in the Western Sudan by scientists from Sweden and the University of Khartoum. The research was recently reviewed by Hellden (1991), and the main conclusions from the studies, covering roughly the last 30 years, were:

- creation of long lasting desert-like conditions could not be found;
- degraded areas surrounding settlements did not expand;
- the northern cultivation limit did not change significantly;
- no changes in vegetation cover took place that could not be explained by climatic variations;

Tab 1
Possible subsystems of a dryland socio-economicsystem, and some factors of importance for the resilience of the whole system sketched in Fig 3.

Main Component	Sub-system	Resilience positive	Resilience negative
Environment	Vegetation	☐ drought resistant, drought evading and fire resistant speeles;	
	Soil	☐ sandy soils → high rainfall acceptance;	☐ sandy soils → low nutrient status;
		☐ fine soils → high nutrient status;	☐ fine soils → sealing of soil surface;
	Climate		☐ erratic rainfall
			☐ high evaporation;
Pastoralists		☐ spatially mobile;	☐ mobility restricted;
		☐ various herding strategies;	☐ conflicts with cultivators;
		☐ social network;	☐ conflicts with the state;
		☐ emergency relief;	
		☐ provision of fodder;	
Cultivators		☐ drought resistant and drought evading crops	☐ spatially immobile;
		☐ emergency relief;	☐ lack of credits;
		☐ mixed cash & food crops;	
		☐ mixed cultivation & livestock breeding;	
		☐ labour migration;	
		☐ fallow periods;	
		☐ storage of grain	
Domestic food market		☐ balancing spatial differences;	☐ prices soar in case of crop failure;
			☐ prices slump in case of crop surplus
Government		☐ pricing policies;	☐ urban bias;
Aid agencies		☐ supply of emergence relief;	☐ creating dependencies;
		☐ improve food security;	
World market		☐ source of cash;	☐ favour cash crops at cost of food crops;

- crop yield variations could mainly be explained by climatic variations, rather than a secular trend

These results do not mean that there are no environmental symptoms or problems in that area, but it is a clear indication that many of the arguments used in the desertification debate are flawed.

During the 1970s and early 1980s, much of the research was devoted to monitoring the process of desertification. Due to the lack of proper definitions and the lack of knowledge of the many interrelated factors, the research became focused on indicators of desertification. The many indicators (Reining 1978; Dregne 1983) proposed were seldom related to any conceptual model of the socio-ecosystem under study. Attempts to build deterministic models based on these indicators (Hellden 1981) failed. A major problem of this "indicator approach" is that virtually all indicators are, to varying extent, dependent on each other. In practical primary research, however, it may be necessary to use indicators in order to obtain tangible information since there is often a conflict between what is feasible for the individual researcher and what is relevant in a wider context.

Twenty years of scientific research and development endeavours have not been able to significantly improve environmental security of dryland communities in Africa. A main reason has probably been that the desertification problem has mainly been considered an environmental issue, dealt with primarily by natural scientists using natural science based methodologies and data. If we see dryland degradation as a symptom of a socio-economic-political disease rather than an environmental one, we may be more successful. As a theoretical frame for this integrated analysis, I would like to put forward a systems analysis approach where the social and economic spheres are included, together with the environment.

It is often claimed that desertification acts primarily in areas of harsh environment with erratic rainfall. However, if we analyse the variability of various important phenomena, natural as well as societal, it seems that prices of food and livestock are much more variable than the climatic features, making survival tricky for the rural poor, Fig 2.

The Resilient Arid Ecosystem - A Systems Analysis Approach

The discussion on reversibility or not of desertification leads to the concepts of resilience and stability of the socio-

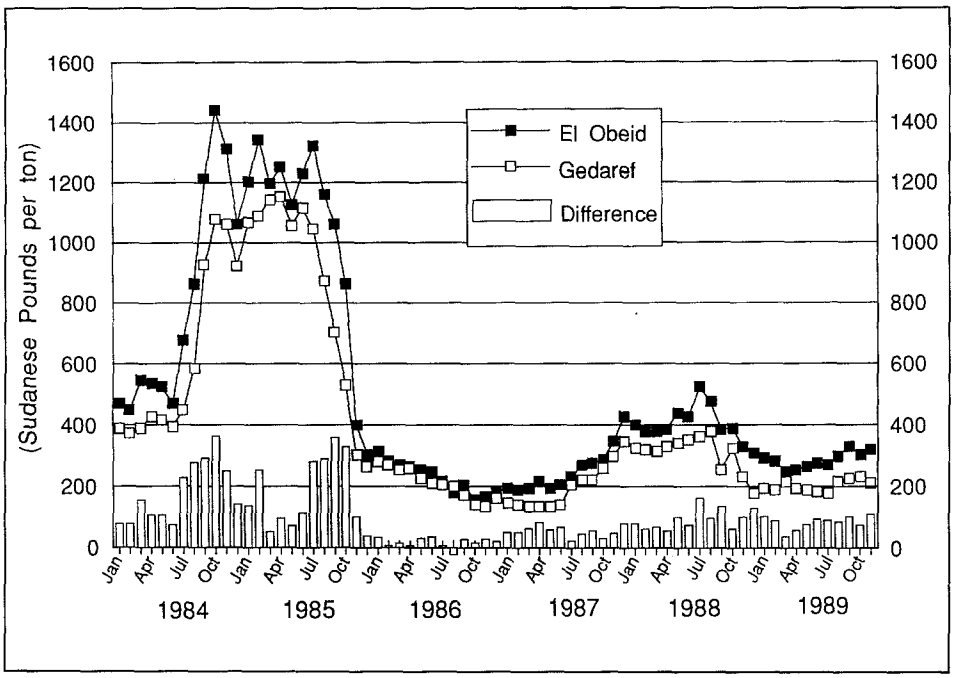

Fig 4
Prices of sorghum at the El Obeid and Gedaref markets and the difference between the two, 1984-89. Prices are expressed as Sudanese Pounds per ton and are compensated for inflation. Sources: Dept. of Agricultural Economics, Khartoum (prices) and IMF, Washington DC. (inflation). From Olsson (1993).

economicsystem. Stability of a system can be defined as its ability to remain the same while external conditions change (Noy-Meir & Walker 1986). If a stable system collapses, it will not be able to regain its original status again, even if conditions causing the collapse return to normal. Resilience of an ecosystem was defined by Holling in the following way: *"Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes..."* (Holling 1973). A resilient ecosystem will change when subject to stress (eg drought, intensive grazing, tree clearing, etc.) but will return to its original state when conditions so allow. Contrary to humid tropical ecosystems, arid and semi-arid ecosystems are highly resilient. When dealing with land degradation issues, the system under scrutiny is not only the ecosystem, but the integrated socio-economicsystem. For such a system, it is possible to identify certain properties that contribute to the resilience of the whole system.

Perhaps the most striking feature of the environmental problems in semi-arid Africa is drought and famine, and they have ever since the UN conference on Desertification (UNCOD) in 1977 been linked to desertification. In fact, the UNCOD came partly into being as a response to the Sahelian drought. Let us consider the food production system in a typical Sahel setting. In order to formulate a conceptual model of this system we need to determine the main components (sub-systems) of the system and to analyse the relationship between them, rather than the function of individual components. Agnew (1984) presented a conceptual model of a Sahel food production system, Fig 3. That model did not encompass the food market, simply because it does not produce any food. Nevertheless, as we will see, it has ultimate influence on the food availability.

When the system's main components have been identified, we try to define what characteristics of each component are important determinants for the resilience of the system. Doing this, we will come up with a list containing both factors having positive influence on the system's resilience as well as factors having negative influence. In Tab 1, such factors are listed for the conceptual model sketched in Fig 3.

At this stage, it is possible to compare and perhaps to interchange resilience factors. A loss of resilience in one component may be counterbalanced by increased resilience in another component, but when a situation occurs where people starve, it means that the system collapses, ie it is not resilient enough to cope with the stress it is put under.

A factor that is of special importance in dryland systems is spatial diversity, mainly caused by the erratic nature of rainfall. The high degree of resilience of the traditional nomadic socio-economicsystem, was based on the ability to move over large areas every season to make use of the large spatial variation which is a characteristic feature of all arid and semi-arid environments. With restricted spatial mobility, caused by conflict over land with sedentary people, the traditional pastoral system lost much of its resilience. Another factor that could increase the resilience of the pastoral society may be the provision of fodder in times of rainfall deficits, which in turn is dependent on the

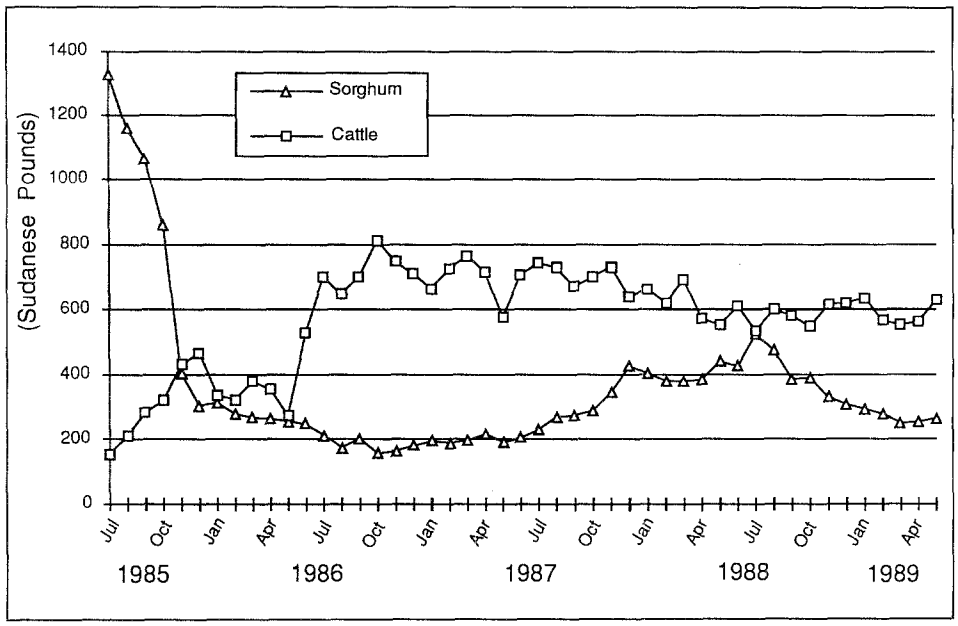

Fig 5
Prices of sorghum (LS/ton) and cattle (LS/head) at the El Obeid Market, 1984-89. The prices are compensated for inflation. Source: Dept. of Agricultural Economics, Sudan (prices), and IMF (inflation). From Olsson (1993).

possibilities of capital accumulation. In the case of sedentary farmers, seasonal migration of the male population to other regions has always been an important factor increasing the resilience of the sedentary farming socio-economicsystem.

During periods of drought, like the Sahelian drought 1968-74 and the very severe 1984-85 drought of North East Africa, the socio-ecosystems collapsed in many cases - they were not resilient enough to cope with the extreme variations in rainfall, which triggered other processes, eg market speculations. Normally, the domestic food market can help alleviate local crop failures. But in the case of the 1984-85 famine in Western Sudan, it was shown by Olsson (1993) that the main cause of the tragedy was a failure of the food market to distribute food to the drought stricken regions, rather than a shortage of food in absolute terms on the national level. The situation is clearly demonstrated by Fig 4, where the average monthly price of sorghum is shown for El Obeid[2] and Gedaref[3]. As soon as the prospects of a severe drought became known in July 1984 (ie 3-4 months before harvest) the prices sky-rocketed without there being a net shortage of grain on the national level.

Prices remained extremely high throughout 1985 until the harvest in October - November. The rainfall in 1986 was adequate, resulting in a reasonable crop yield and causing the prices to fall to low levels.

Another contributing factor was the variation in the price relation between livestock and grain. Livestock is kept for different reasons: animals can provide milk and transportation and there is a kind of insurance for times of crop failure. In 1984/85 the terms of trade between livestock and grain changed drastically. The rise of grain prices corresponded to a slump of livestock prices (Fig 5). Cattle became almost worthless in the famine-stricken areas during the drought.

Banks and other financial institutions allegedly had contributed large sums of money as loans for speculations on food and livestock markets in 1984-85. I argue that this massive speculation by banks and merchants at all levels, was a significant contribution to the tragedy. According to Ibrahim (1988) one of the Islamic banks traded in sorghum during the famine, making a 100% profit, while the government omitted to protect the ones affected by it. If the extreme rise of food prices could have been avoided, people would probably have been able to survive the crisis by buying food from the local markets.

A second example where an environmental problem can directly be linked to other sectors of the society is overgrazing. Stocking rates in the Western Sudan are often extremely high, causing a shortage of fodder. This can to a large extent be ascribed to the lack of investment opportunities in the urban centres. The two most important investments for urban based people are livestock for short term investments, and land in urban areas (mainly in the Khartoum region) for long term investments[4]. Market turbulence in the case of a famine can substantially contribute to the redistribution of wealth and goods. In Fig 6, the price increases at Omdurman[5] over the price in El Obeid of cattle are shown from July 1985, in the midst of the severe famine, to May 1989. The large price fluctuations, in time as well as between the rural El Obeid and the capital, could be used for quick profits.

A third example is deforestation and the decrease of gum arabic production in Western Sudan. Gum arabic, produced by the Acacia Senegal tree predominantly on the sandy soils of Kordofan and Darfur provinces, has been an

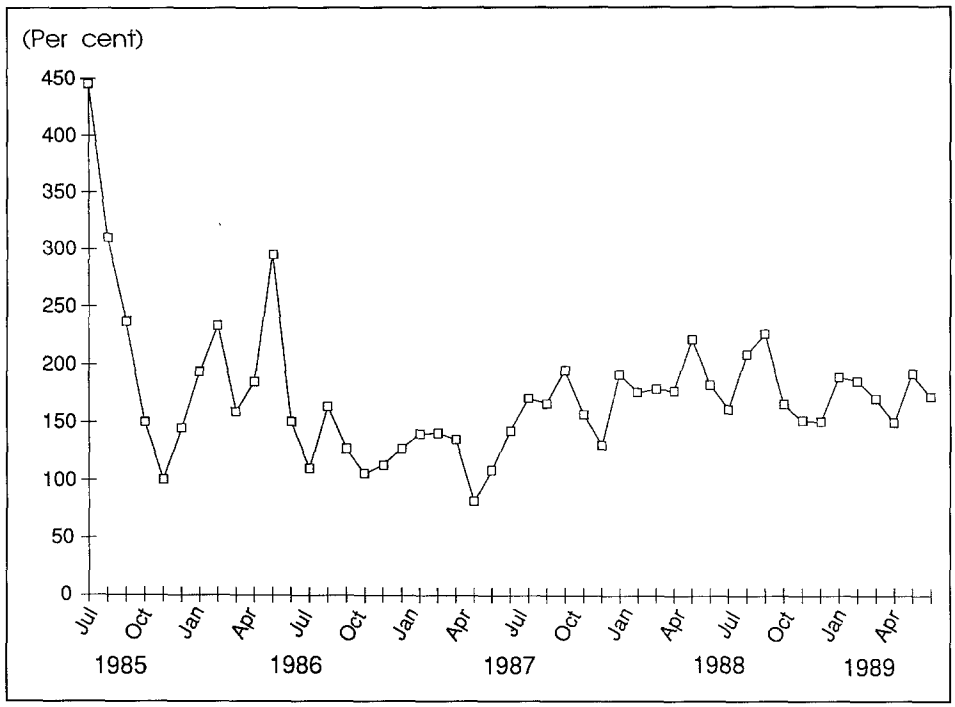

Fig 6
Price increases of cows (in %), at the Omdurman market over the price in El Obeid, July 1985 to November 1989. Source: Department of Agricultural Statistics, Khartoum.

important export product for thousands of years, and is still one of the biggest earners of foreign exchange in Sudan. However, in the early 1970s, the gum arabic production slumped, Fig 7, with substantial damage to the national economy of Sudan.

The sudden drop in production has often been blamed on drought, desertification and human mismanagement of the vegetation. However, the most important factor was probably the deteriorating price incentive (Larson & Bromley 1991). The farmers in western Sudan favoured millet production to gum production simply because it paid better. During the 1980s, the price of gum arabic paid to the pickers sharply increased, causing the production to rise again. But in the last years, inflation and price policies are again making gum production less profitable for the rural people.

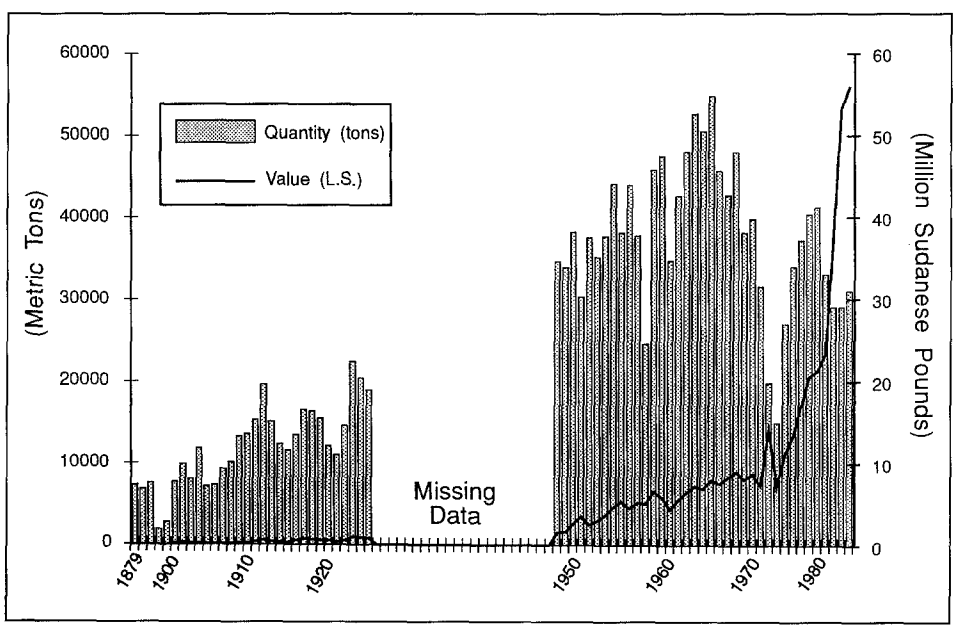

Fig 7
Export of gum arabic in quantity (tons) and economic revenue (LS). Source: Forests Department, Khartoum.

Concluding Remark

Poverty and inadequate food security are fatal problems in many African drylands. Desertification has during the last two decades been blamed as one of the most important roots to the problems. Due to inappropriate definitions, the concept of desertification has been misused and exaggerated. This has obscured some of the most crucial questions and prevented an efficient action. Research has often been fragmented, superficial and narrow. A systems analysis approach, where system is considered in its widest perspective, could assist us in addressing the crucial question: how can we increase the resilience of dryland socio-economicsystems in order to attain sustainable use of nature and food security. With this approach, land degradation is seen as a symptom of a socio-economic crisis, aggravated through unfavourable climatic conditions during three decades. The symptoms, which so often are called desertification, can not be successfully counteracted through technical solutions like tree planting or dune stabilising, but need to be tackled from a societal angle.

Footnotes:

[1] UNEP; United Nations Environment Programme, based in Nairobi

[2] El Obeid is the capital of the Northern Kordofan Province, one of the hardest hit provinces during the 1984-85 famine

[3] Gedaref is the centre of the commercial sorghum production in Eastern Sudan

[4] Viewpoints expressed by several merchants and urban based farmers in Khartoum and Gedaref, 1989

[5] Omdurman is the main livestock market for the capital Khartoum

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