



## The economic Impact of Sand dunes Fixation Project in Attura Al Khadra area White Nile State, Sudan

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### Abstract

This study investigated the economic impacts of the sand dunes fixation project which was carried out in the year 1984 at "Attura Alkhadra" area northern Ed-Dueim locality. The project planned to fix the sand dunes by planting *Leptadenia pyrotechnica* (Marikh) and *Panicumturgidum* (Tumam) on sand dunes (FNC Forest National Corporation, 1995). The study revealed that during the 1990s the sand dunes impact had started to be economically less harmful in "Attura Alkhadra"; that may mean that house desertification was less in the 1990s as compared to 1980s. This could indicate that the project of sand dunes fixation which was carried out in 1984 might have succeeded in fixing the sand dunes and eventually reducing houses damage losses and desertification and that might have contributed to the stability of families and stopped house desertification and losses. The study revealed that the sand dunes fixation project at "Attura Alkhadra" has succeeded to stabilize the creeping sand dunes encroachment and improved its soil to the extent that maintained crop cultivation and gained economic sustainability for the local communities.

### 1. Introduction

Sand dunes can lead to increase costs and losses to agricultural producers due to, annual and perennial crop losses, low crop quality, income loss for farmers. Generally, and therefore crop yields reduction was observed, low productivity of cropland might be due to (wind erosion, long-term loss of organic matter, etc.) and insect infestation. Other problems like, plant disease, increased irrigation costs and or supplemental water resource development such as (wells, dams, pipelines). Due to productivity reduction of rangeland, reduced milk production, forced reduction of foundation stock, and closure/limitation of public lands to grazing. Accordance of some problems such as unavailability of water for livestock, cost (unavailability of feed for livestock, Increased feed transportation costs and high livestock mortality rates. Loss from timber production due to wild land fires, tree disease, Insect infestation, impaired productivity of forest land and direct loss of trees, especially young ones. Increased energy demand and reduced supply because of drought-related power curtailments. (Gasmelseed. M. Noor, 2009). Water Suppliers revenue shortfalls and/or windfall profits, cost of water transport or transfer and cost of new or supplemental water resource development can be affected. Decline in food production/ disrupted food supply by increase in food prices Increased importation of food (higher costs). (Sharp, Robert P. and Saunders, R. S. 1978).

### 2. Study Area

This study has been carried out in Attura Al Khadra area, western White Nile state, which consists of many villages like Attura Al Khadra, Al Ishaire, Al Bunonaab and Goz Al Khanjar. This area is located about 56 km northern Ed-Dueim town the provincial capital of Ed-Dueim locality. The area is about 7 km from the western bank of the White Nile. It lies about 180 km southern Omdurman. Figure (1). (Abdel Salam, 2004). Two villages were selected for the socioeconomic investigation; named as Attura Alkhadra village and Alishare village. The former was the site where the sand dunes fixation project was done and the later represent an area where sand dunes were not subjected to any stabilization program.



Attura Alkhadra village is estimated to be about 800 families; while Al Ishaire village consists of about 700 families. Source: N.F.C. Ed-Dueim.

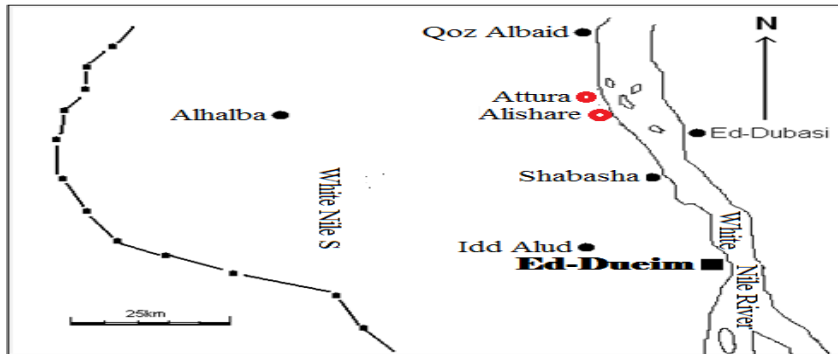


Figure (1) map of the study area

### 3. Data collection

The data was collected by personal interviews; the interview started by a general talk and a brief explanation about the nature and objectives of the study to gain the trust and confidence of the respondents to ensure the most possible reliable data.

### 4. Materials and Methods

A survey was conducted concerning the economic impacts of the project on the communities. Using a questionnaire targeting a community within the fixed sand dunes and another within the untreated sand dunes; was designed and data was collected.

#### Social survey

An accurate and specific questionnaire was made to study the economic impact of sand dunes fixation project in the area. The data of the questionnaire was collected from two communities. One is the community of Attura Al Khadra village where the sand dunes were fixed with the project in the year 1984, and the other community was at Al Ishaire village where sand dunes were not subjected to any kind of sand dunes fixation programs. The questionnaire was collected from representative samples of about 20% of the total family numbers of each community.

#### Results and Discussions

Human interactions with sand dunes impacts shown in Figure (2) represent some indication to land use, it is clear that the majority of people in the study area dependent on the land for livelihood support where agriculture, forests and animal husbandry. In dry lands area such land uses type's use of soil deterioration and land degradation and desertification.

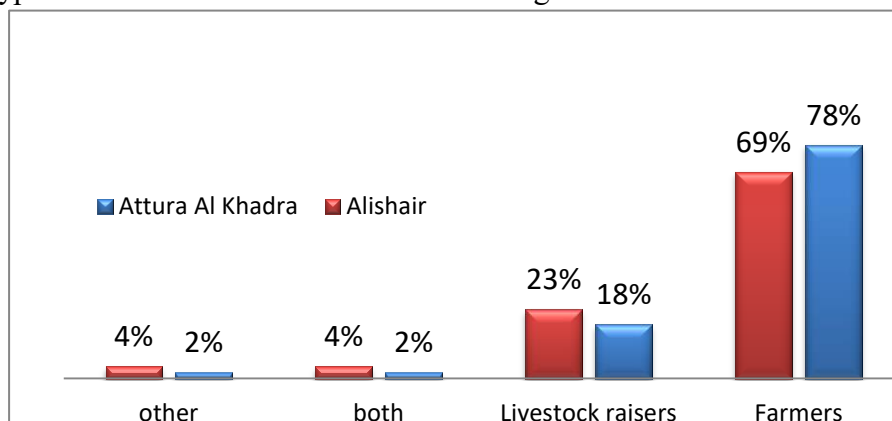
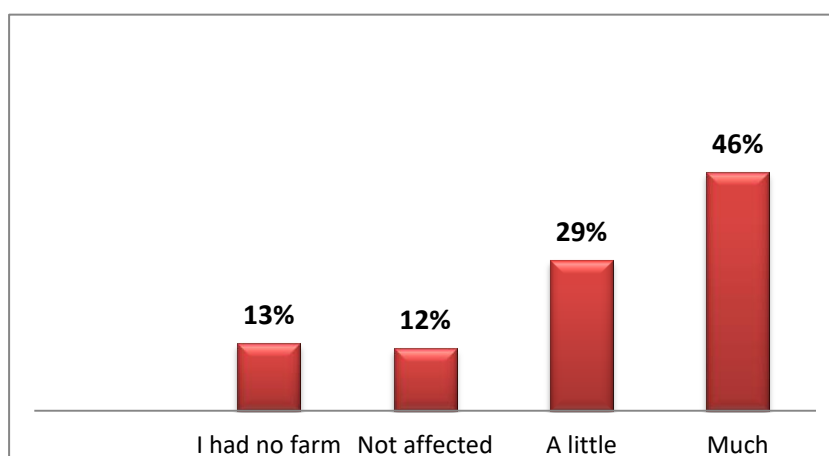


Figure (2) household jobs

The situation is clear that sand dunes and encroachment and affected these activities and created a problem that necessitated the planning and implementation of "Attura Alkhadra"



project. Its positive effect on sand dunes stabilization was obvious as compared with the situation of "Alishare" where there is no intervention has been adopted. Moving sand dunes have great impact on agricultural land. . Physical changes may be due to accumulation of sandy soil on the clay soil in the chemical composition of the soil and eventually deteriorated soil. The majority of families, in the study area dependent directly on agriculture as farmers and indirectly as agro-pastoralists . Family farm is considered as the main source of income for the families, therefore the effect of sand dunes was disastrous. Figure (3) shows that sand dunes variably affect farms. Some of the farm, (46%) were buried while about 29% of the farms were mildly affected by sand dunes. It can be deduced that 40% of those who own farms are affected by sand dunes; even though the effect could be very severe or mild, but this percentage is very high in a very small and poor community.



**Figure (3) Effect of sand dunes on farms**

After the implementation of the project; people have begun to cultivate crops on sand dunes, this could indicate that soil properties of sand dunes have started to be improved, and being suitable for the cultivation of some crops such as sorghum, millet, and vegetables. Asking communities whether they started to cultivate any crops on sand dunes, we found that 95.8% of the population of "Attura Alkhadra" answered yes, versus 10.4% of the population of "Alishare". The results are highly significant [(2 is  $p= 0.00 (> 0.05)$ ]. This might revealed that the properties of soil at "Attura Alkhadra" area has been improved; being suitable for the cultivation of some crops and some vegetables, and the dunes may have been fixed according to the intervention of the project. It is clear that the soil of sand dunes has not improved much in the "Alishare". It is so far not suitable for the cultivation of many crops otherwise the people would have used it Table (1) Chi-square test indicated highly significant difference between those who use sand dunes for cultivation in "Attura Alkhadra" compared to those in "Alishare", Table (1)

**Table (1) is there any crops cultivation on sand dunes later**

Area	Yes%	No%	A little%	Not Sure%
Sand dunes fixed by the project	46	1	1	0
	95.80%	2.10%	2.10%	
Sand dunes naturally fixed	5	19	23	1
	10.40%	39.60%	2.10%	
total	51	20	24	1
	53.10%	20.80%	25%	1.00%

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	70.327 <sup>a</sup>	3	.000
Likelihood Ratio	84.113	3	.000
Linear-by-Linear Association	57.677	1	.000
N of Valid Cases	96		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is .50.  $\chi^2$  is  $p = 0.00 (> 0.05)$  and the difference is highly significant

After the implementation of the project; table (1.2) showed that the sorghum crop, which does not succeed in sandy soil is grown by 31.2% in "Attura Alkhadra" and 29.2% in "Alishare". Pearl millet with its harsh nature is cultivated at "Attura Alkhadra" by 64.6% and 70.8% in "Alishare". Cultivation of sorghum on sand dunes at "Attura Alkhadra" may indicate that sand dunes soil has been improved by nutrients and became suitable for the cultivation of crops. In contrast millet is still dominating over "Alishare's" soil. Cultivation of water melon, sweet melon and other vegetables at Attura also indicate that Attura sand dunes' soil had been improved. This success improved the economic status of the community. Improving soil properties and qualifying it for the cultivation of more crops, is a great economic impact on local communities in "Attura Alkhadra" area. Providing more opportunities to grow crops on the sand dunes; increases the overall income of the families and improves their economic situation. This may be one of the economic successes of sand dunes fixation project.

**Table 2 .Type of crops cultivated on sand dunes**

#### AREA \* Type of crops cultivated on sand dunes Cross tabulation

			Type of crops cultivated on sand dunes				Total
			sorghum	millet	water melon + sweet melon	vegetables	
AREA	sand dunes fixed	Count	15	31	1	1	48
	by the project	, within AREA	31.3%	64.6%	2.1%	2.1%	100.0%
naturally fixed area	Count	14	34			48	
	vithin AREA		29.2%	70.8%			100.0%
Total	Count	29	65	1	1	96	
	vithin AREA		30.2%	67.7%	1.0%	1.0%	100.0%

small and poor communitites.



Table 3 .Houses affected by sand dunes

	Frequency	Percent	Valid Percent	Percent
Valid much		42.1	42.1	
mild	24	25.3	25.3	67.4
not affected	24	25.3	25.3	92.6
I had no house	7	7.4	7.4	100.0
Total	95	100.0	100.0	

### 7.5 People deserted their house due to sand dunes

Sand dunes have compelled many families to leave their houses and move to other areas. According to this study about 12.6% of families had once deserted their houses because the houses were buried by the creeping sands and 6.3% had been forced to desert their buried houses twice during sand dunes formation. It is clear that sand dunes had affected severely some families causing both social and economic impact (Table. 4).

Table 1.4 houses deserted due to sand dunes

DESERTED YOU HOUSE					
	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid once	12	12.6	12.6	12.6	12.6
twice	6	6.3	6.3	6.3	18.9
i hadn't deserted my house	42	44.2	44.2	44.2	63.2
i had no house	35	36.8	36.8	36.8	100.0
Total	95	100.0	100.0	100.0	

### 7.6 The last time people deserted their houses

It is obvious that sand dunes were very sever during the 1980s of the last century; hence 20% of the people had deserted their houses due to sand dunes, while only 5% had deserted their houses during the 1990s. It seems that during the 1990s the sand dunes impact had started to be less harmful in "Attura Alkhadra"; That may mean that house desertification was less in the 1990s as compared to 1980s. This could indicate that the project of sand dunes fixation which was carried out in 1984 might have succeeded in fixing the sand dunes and eventually reducing houses damage and desertification and that might have contributed to the stability of families and stopped house desertification Figure (4)

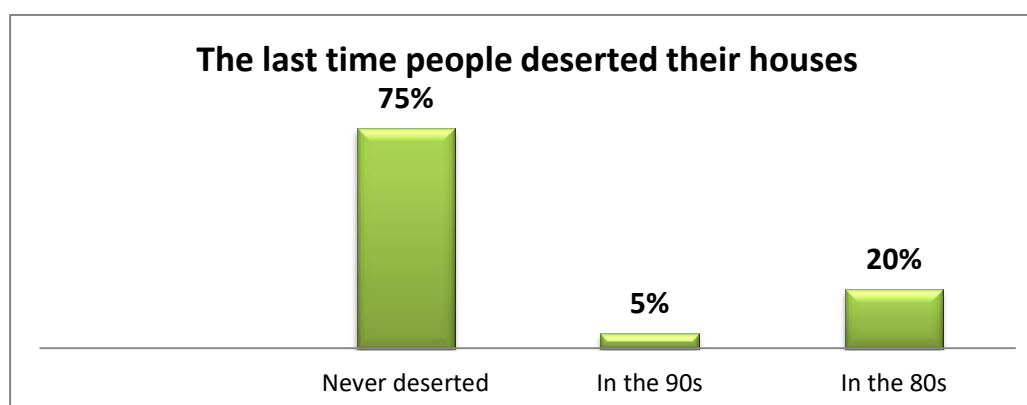




Figure (4) the last time people deserted their houses

### 7.7 Immigration of people due to sand dunes

Table (5) shows that 75% of the population of Attura believes that some people have immigrated from the region because of the sand dunes, while 52.4% of the population at "Alishare" see that real emigration occurred as a result of sand dunes movement. It is clear that the impact of sand dunes extension was very severe in the region, forcing the people to migrate. Although the results of the two areas were significant ( $p= 0.013 > 0.05$ ) it is indicative that the effect of sand dunes at "Attura Alkhadra" has been more serious than at "Alishare" and that may be the reason that the project concentrated at "Attura Alkhadra". However, the effect in both areas asw serious.

Table (5) Emigration of people due to sand dunes

AREA \* people emigration due to sand dunes Crosstabulation

			people emigration due to sand dunes			Total
			yes	no	i don't know	
AREA	sand dunes fixed by the project	Count	36	11	1	48
		Expected Count	30.5	12.5	5.0	48.0
		% within AREA	75.0%	22.9%	2.1%	100.0%
	naturally fixed area	Count	25	14	9	48
		Expected Count	30.5	12.5	5.0	48.0
		% within AREA	52.1%	29.2%	18.8%	100.0%
Total		Count	61	25	10	96
		Expected Count	61.0	25.0	10.0	96.0
		% within AREA	63.5%	26.0%	10.4%	100.0%

### 7.7 The tribal migration to the areas

After the fixation of sand dunes, when the communities in "Attura Alkhadra" we asked if some tribes had arrived to their area, 83.3% of them answered yes, while 31.3% of the people of "Alishare" agreed. No doubt that the tribes in the rural areas move from place to another seeking for their requirements of agriculture, pasture and water resources. It seems that the area of sand dunes has been environmentally improved at "Attura Alkhadra" as compared to "Alishare". There may be other reasons that encouraged the tribes to arrive to the area of "Attura Alkhadra" but is also possible that the sand dunes fixation project might have helped to prove the dunes, prompting the tribes to come and settle in the region.

Chi-square test indicated that the results were significantly different between the answers of "Attura Alkhadra" and "Alishare" people ( $p= 0.00 > 0.05$ ) (Table 7.6).



Table (6) the arrival of new tribes to the areas

**AREA \* Is there any arrival of new tribes on sand dunes Crosstabulation**

			Is there any arrival of new tribes on sand dunes			Total
			yes	no	i don't know	
AREA	sand dunes fixed by the project	Count	40	7	1	48
		Expected Count	27.5	18.5	2.0	48.0
		% within AREA	83.3%	14.6%	2.1%	100.0%
	naturally fixed area	Count	15	30	3	48
		Expected Count	27.5	18.5	2.0	48.0
		% within AREA	31.3%	62.5%	6.3%	100.0%
Total	Count	55	37	4	96	
	Expected Count	55.0	37.0	4.0	96.0	
	% within AREA	57.3%	38.5%	4.2%	100.0%	

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.661 <sup>a</sup>	2	.000
Likelihood Ratio	28.237	2	.000
Linear-by-Linear Association	22.610	1	.000
N of Valid Cases	96		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 2.00.

"Alishare" area was environmentally not attractive to many of the incoming tribes, and this shows that the natural fixation of sand dunes was not with the same success as in the "Attura Alkhadra". There may be many reasons, but the fact that the environment in "Alishare" is very harsh and the sand dunes are still not fixed, and it may be one of these reasons.

**7.8 Effect of sand dunes on water table**

The water table is the level at which the groundwater pressure is equal to atmospheric pressure. It may be conveniently visualized as the 'surface' of the groundwater in given vicinity. It usually coincides approximately with the 'phreatic surface', but can be many feet above it. As water infiltrates through pore spaces in the soil, it first passes through the zone of aeration, where the soil is unsaturated. In the areas of sand dunes it may become deeper due to the accumulation of thick layers of sand.

Table (7) shows that before sand dunes formation, about 85.4% of the population in "Attura Alkhadra" area and 77.1 % in "Alishare" said that the depth of water table was about 18 – 27 meters.

On the other hand 7 % at "Attura Alkhadra" and 5 % at "Alishare" believed that the water table was at 28 – 35 meter deep. This shows that the water table at both areas was almost at the same depth and in the range of 17 – 35 meters (Table. 7)



Table (7) water table before sand dunes formation

**AREA \* water table before sand dunes formation Cross tabulation**

			Water table before sand dunes formation			Total
			18-27 m	28-36m	I don't know	
AREA	sand dunes fixed by the project	Count	41	7		48
		% within AREA	85.4%	14.6%		100.0%
	naturally fixed area	Count	37	5	6	48
		% within AREA	77.1%	10.4%	12.5%	100.0%
Total		Count	78	12	6	96
		% within AREA	81.3%	12.5%	6.3%	100.0%

Chi square test indicated no significant difference between the understandings of the people in the two areas with regards to the level of the water table . People know this because they used to dig boreholes for drinking water and know the depth they reach at the water level. After sand dunes fixation in "Attura Alkhadra", about 91.7% in Attura area and 33.3 % at "Alishare" said that the depth of water table was at 18 – 27 meters. On the other hand, 8.3 % at Attura and 20.8 % at "Alishare" believed that water table was at 28 - 35m deep (Table 7.8). At "Alishare" 27.1 % believe that the water table retreated to the depth of 37 - 54 meters (Table 7.8). This shows that the water table at "Alishare" areas had become deeper. Therefore it may be other reasons for that, but sand dunes might still not be completely fixed. The recorded water table level in "Alishare" illustrates the fact that the natural fixation of sand dune in this region is not parallel to its counterpart in "Attura Alkhadra", the sand dune fixation project area. It is worth pointing out here that intervention for sand dune fixation should be speeded up.

**Table (8) water table after sand dunes Fixation**

**AREA \* water table after sand dunes fixation Cross tabulation**

			water table after sand dunes fixation				Total
			18-27 m	28-36m	37-54m	I don't know	
AREA	sand dunes fixed by the project	Count	44	4			48
		% within AREA	91.7%	8.3%			100.0%
	naturally fixed area	Count	16	10	13	9	48
		% within AREA	33.3%	20.8%	27.1%	18.8%	100.0%
Total		Count	60	14	13	9	96
		% within AREA	62.5%	14.6%	13.5%	9.4%	100.0%





#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.638 <sup>a</sup>	3	.000
Likelihood Ratio	46.743	3	.000
Linear-by-Linear Association	24.564	1	.000
N of Valid Cases	96		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 4.50.

#### Recommendations

1. Necessity of man interference is a must to fix the moving sand dunes as natural fixation of sand dunes is a slow process.
2. Tumam (*Panicum turgidum*) and Marikh (*Leptadenia pyrotechnica*); must be used for sand dunes fixation as they have proved to be the most perfect plants regarding their ecological and economic benefits to both soil and communities.
3. More concern to the community participation should be taken while establishing any environmental project, as local communities represent an important component which insures its success, commitment and its sustainability.
4. Great emphasis must be made towards the evaluation of any environmental project to insure its success and its impacts.

#### References

- Albushra, A.O (2005)** M. Sc.in Bakhat Er-ruda University, Thesis: The Environmental and Socioeconomic Impact of Sand dune Fixation Project in Attura Al Khadra area White Nile State, Sudan.
- Sidahmed A.O. (2004)** ph. D. in Bakhat Er-ruda University, Thesis: The Main Ecological Components of The Management of Dryland Natural Forests. University of Sudan. Sudan.
- FNC (Forest National Corporation), (1995)**. Forest products consumption in The Sudan. Final report. Forest Development project FAO/ GCP/ SUD/ 047/ NET . Forest National Corporation. Ministry of Environment and Tourism. Khartoum.
- Gasmelseed. M. Noor, (2009)** PhD thesis: Traditional Utilization of Natural resources for Sustainable Livelihoods Support in Northern west area of white Nile State.
- Sharp, Robert P. and Saunders, R. S. 1978**.Eolian activity in westernmost Coachella Valley and at Garnet Hill. In Aeolian Features of Southern California: A Comparative Planetary Geology, R. Greeley, M. Womer, R. Papson and P. Spudis, eds., pp. 9-22. Washington, NASA.
- Shamsul Hage. (1994)**, Climate change ,and desertification at the republic of The Sudan