Economical Impact of Roseires DAM Heightening on Agricultural Activities in Blue Nile State, Sudan
(A case study of Roseires and Geisan localities)

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Abstract— This research was conducted in Roseires and Geisan localities, Blue Nile state, Sudan 2014. The main objective of this research is to study the economical impact of Roseires dam heightening on agricultural activities in Blue Nile state at dam basin area through the investigation of the socio-economic characteristics of the farmers in the study area. The study depends mainly on primary data which was collected through a field survey from a multi-stage stratified random sample of 134 farmers at dam basin area in season 2014. The study also used secondary data collected from relevant sources. To achieve the research objectives general descriptive statistical analyses was used. The Statistical Packages for Social Sciences (SPSS) was used. Consequently the following results have been obtained. The study revealed there are two major sources of financing which are self-financing and other than self-financing. After the dam heightening 49 % of the respondents depended on cultivation as a living activity instead of 70 % before dam heightening, 33 % depended on fishing increasing from 17 %, 10 % depended on animal wealth instead of 5 % and 9 % depended on other talent's activities increasing from its ratio before dam heightening 8 %. Also 66 % of the respondents evaluated that the town's resettlement had positive social and ecological impacts. All farmers of dry land cultivation and the fishermen used local seeds varieties and old fishing methods. Present and ongoing discussion after the dam heightening 53 % of respondents have increased their total income, moreover 66 % agreed that extension services are not available. Further the study revealed farmer's absolute willingness to the introduction of the irrigated agriculture. For solving the negative impacts of Roseires dam heightening the research recommended that Ministry of irrigation, electricity and water resources should enable farmers to be participants and follow the access of the execution of the Rosieres dam heightening associated projects. Also Ministry of agriculture should support farmers with agricultural extension services so as to adopt new production technologies in order to increase crop productivity as well as profitability.

Key words: Roseires dam heightening, Geisan localities, Blue Nile State.

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I. Introduction

BLUE Nile state is bordered from the North and North West sides by Sinnar State, sharing international borders with Ethiopia from the east and southern Sudan from south and west sides. The area of Blue Nile state is about 38928 Km² which is resident by 900 thousands citizens in 2004 representing all ethnic diversification of the Sudan [1]. Blue Nile state is located in a semi-humid region, except for south eastern areas of Kurmuk which are located in the humid region.

The annual average rainfall in Blue Nile is around 700 mm but for the southern region it reaches 975. The region has a great scale of the solar energy, temperature is quite convenient within autumn and the highest temperature never goes over 35° or below 20°. The main economical activities in Blue Nile state are all aspects of agriculture, charcoal producing, trading and mining [1], [2] and [3].

Blue Nile State is considered as one of the most important states in agricultural production, particularly in mechanized and traditional rain-fed farming systems. The favorable environmental conditions made the area more suitable for agricultural production. It is also rich with animal wealth, horticultural crops and forests products.

The main grown crops are cereals specially sorghum, cotton, Oil crops like sesame, sunflower and groundnuts, in addition to gum Arabic, these crops are grown for local consumption and export.

The extended fertile land and the considerable rainfall and the favorable conditions for investment encouraged companies and individual farmers to establish investment schemes in Blue Nile state [1].

But major part of working population depend on farming for living, natural production problems of human and political nature means that food requirements are difficult to be secured[4].

Blue Nile state is predominantly an agricultural. And eighty percent of the state's population depends on agriculture in all its different aspects (cultivation, fishery, animal wealth, forestry, ground water, rainfall levels). In order to keep up with such requirements it is essential to increase its crops production not only for attaining self

sufficiency but also so as to export the surplus. By achieving such goals inhabitants can live up to the challenge of considering this state as one of the major important food producing states.

In recent years in Sudan the contribution of agriculture to the economic and social development has declined, but with intelligent planning, efficient management and the use of modern technologies, agriculture will play the pivotal role in the future's development and prosperity in the state and in the Sudan even if other sources of wealth have been discovered [5].

Besides the rain the important source of water is the Nile which is 6670 kilometers long with annual flow of 125 milliard m³, according to the 1959 Nile agreement with Egypt the annual share of the Sudan is about 18.5 milliard m³ of water as measured at Aswan [6].

Annual share of Egypt from the water is about 57.4 milliard m³ of water [7].

Ground water is another source of irrigation water and it is not well explored yet at the present time, it has a limited use but expected to be an important source of water for irrigation in the foreseeable future since the general explorations have indicated the presence of ground water bearing formations in many parts of the country [5]. Roseires dam was initially designed and constructed in 1966 to a top water level of 483 meters with allowance for it to be raised by 10 meters to the level of 493 meters at a future date. In the year 2005, the previous economical studies for the project were reviewed and updated confirming its economic viability. The studies of social and environmental impacts were reported in two volumes, the main report and appendices in February 1994 by Gaafar Karrar, and partners who was the consultant in social and environmental impacts of the projects.

Ecologically the area of the study lies within the low rainfall woodland savannah zone. In general the vegetation types are associated with soil types and watering regime, types according to the geomorphologic divisions [8].

The area has been subject to socio-cultural diffusion from West Africa, northern Sudan and central Sudan. The social and cultural systems brought by the immigrants to the area have resulted in a new social and cultural practices and new habits [9].

The Roseires dam heightening project result in the raising of the dam to maximum full supply level (F.S.L) of embankment level (E.L) with the main objectives of storing a greater proportion of the annual flood of the Blue Nile so as to provide an assured supply for the extension of downstream irrigated reaches.

For power benefits the worst case power scenario has been assumed with no upstream benefits while dam heightening increases the hydropower generation [10].

There are some simultaneous projects in the study area which was accompanying the Roseires dam heightening which are social affairs projects, Agricultural schemes, and the immigrants resettled towns project (Dam implementing unit, translated from Arabic [11].

The main objective of this research is to study the economical impact of Roseires dam heightening on agricultural activities.

The specific objectives of this study were:

1. Identify socioeconomic characteristics of farmers at the study area.
2. Evaluate the revenue, benefits and income of the farmers at the study area (dam basin area).
3. Investigate whether Roseires Dam heightening achieved social, economical values and benefits at the study area.

II. Methodology

Both secondary and primary data were used in the study**.** The primary data was collected from two localities (Roseiris, and Geisan localities) through a structured questionnaire. Secondary data was provided by the Ministry of irrigation and water resources, Ministry of Agriculture, animal production and forest in The Blue Nile State, the Internet and some books. For sampling technique the study used a multi-stage stratified random sampling technique. The study stratifies two localities out of six, twelve towns out of the state's towns and the size of the questionnaire decided on the size of the village's population and then selects the sample out of that village's population randomly. The sample size determined by the following equation: n=N/1+N(e)2 .Therefore the sample is equal to 398 farmers approx. farmer's size in each village was selected based on their relative to the total number of farmers in the study area. Due to security situation the study selected 134 farmers as a sample size out of the homogeneous population of the study area instead of 398 farmers which was determined by the equation. The study used a fish bowl draw to select the farmers randomly out of the community after we stratified the sample size for the community. The data have been analyzed using descriptive statistics such as averages and percentages. This has been done through Statistical Package for Social Sciences (SPSS) program and simple computer calculations.

III. Results And Discussion

The results include the analysis of socioeconomic characteristics of surveyed farmers, in addition to the results of the correlation analysis and discussion.

Table I
Farmers Willingness To Give Their Names And Address

Address	Freq.	%	Valid %	Cumulative %
willing to give their names	27	20.1	20.1	20.1
not willing to give their names	107	79.9	79.9	100.0
Total	134	100.0	100.0	

The result indicated that the majority of farmers were not able to participate in the designed questionnaire if they have been conditioned to give their address, may be always they think of being focused on for taxes and fees, fearing to be questioned and tied to some government authorities, or athe

majority of farmers were not able to participate in the designed questionnaire if they havny other justified reasons.

TABLE II
FARMERS' GENDER

Gender	Freq.	%	Valid %	Cumulative %
Male	108	80.6	80.6	80.6
Female	026	19.4	19.4	100.0
Total	134	100.0	100.0	

The result indicated that the responsibility of living is on the males, who are playing a leading role in the dominating paternal family system.

TABLE III
FARMERS EDUCATION LEVEL

Education level	Freq.	%	Valid %	Cumulative %
Illiterate	051	38.1	38.1	38.1
Khalwa	030	22.4	22.4	60.4
primary schools	020	14.9	14.9	75.4
high schools	030	22.4	22.4	97.8
University	003	02.2	02.2	100.0
Total	134	100.0	100.0	

The importance of education is to broaden people's mind and correct their ways of thinking, behavior and attitudes.

The result indicated that the percentage of illiteracy is the highest where high schools and khalwa education standards came in second rank then primary schools and the university education level at the bottom rank.

TABLE IV
FARMERS AGE RANGES

Age ranges	Freq.	%	Valid %	Cumulative %
18 - 27 years	27	20.1	20.1	20.1
28 - 37 years	48	35.8	35.8	56.0
38 - 47 years	20	14.9	14.9	70.9
48 - 57 years	23	17.2	17.2	88.1
58 - 67 years	16	11.9	11.9	100.0
Total	134	100.0	100.0	

Age affects on people's power, thinking, capabilities, efficiencies, and then their output as labor force.

The results of the surveyed farmers showed that 71 % of the respondents being in the active age range limit of 18 to 47 years, this indicates that farmers within that age limit are capable to increase their productivity and production due to acknowledgement and power which can secure the economical activities success, satisfying farmers' ambitions, while 29 % of the farmers represents the experience of adults in the community which transmit knowledge between the generations

TABLE V
FARMERS MARITAL STATUS

Marital status	Freq.	%	Valid %	Cumulative %
Single	17	12.7	12.7	12.7
Married	81	60.4	60.4	73.1
Divorced	15	11.2	11.2	84.3
Widow	021	15.7	15.7	100.0
Total	134	100.0	100.0	

The results indicated the population growth possibility. And the influence of war on the community is distinct (widows and divorced percent is high) which can be an indication or a reason for future shortage of human source or power in the area of the study.

TABLE VI
FARMERS FAMILY SIZE

family size	Freq.	%	Valid %	Cumulative %
1 - 2 members	26	19.4	19.4	19.4
3 - 5 members	57	42.5	42.5	61.9
6 - 8 members	24	17.9	17.9	79.9
9 - 11 members	9	6.7	6.7	86.6
12 - 14 members	018	13.4	13.4	100.0
Total	134	100.0	100.0	

The results indicated the fertility of the people in the area of the study that 81 % of the population in the range of medium and large family size which can give a good opportunity for the development of the producing forces to be depend on in the future at the study area.

TABLE VII
FARMERS' ECONOMICAL ACTIVITY BEFORE HEIGHTENING

activity before dam heightening	Freq.	%	Valid %	Cumulative %
Cultivation	94	70.1	70.1	70.1
Fishing	23	17.2	17.2	87.3
Animal raising	06	4.5	4.5	91.8
Other	11	08.2	08.2	100.0
Total	134	100.0	100.0	

The results indicated that before dam heightening the majority were depending on cultivation (70 %) which is characterized by risks and constrains, where only 17 % depend on fishing nevertheless the high fishing potentiality of the Roseires dam lake, 8 % were depending on other talents, and 5 % were depending on animal raising.

This result (situation) demonstrated poor utilization of available resources in the study area.

TABLE VIII
FARMERS ECONOMICAL ACTIVITY AFTER DAM HEIGHTENING

activity after dam heightening	Freq.	%	Valid %	Cumulative %
Cultivation	65	48.5	48.5	48.5
Fishing	44	32.8	32.8	81.3
Animal raising	13	09.7	09.7	91.0
Other	012	009.0	009.0	100.0
Total	134	100.0	100.0	

The results indicated that the dam heightening coincidence (loss of land due to water inundation) decreased the cultivation area percent and created opportunities for fishing, animal wealth, and other talents which represent an improvement in resources utilization.

TABLE IX
FARMERS' INCOME CHANGE ESTIMATION AFTER DAM HEIGHTENING

income change estimation	Freq.	%	Valid %	Cumulative %
Increase from cultivation	9	6.7	6.7	6.7
Increase from Fishing	39	29.1	29.1	35.8
Increase from animal raising	11	8.2	8.2	44.0
Increase from Others	12	9.0	9.0	53.0
Decrease in cultivation	56	41.8	41.8	94.8
Decrease in Fishing	5	3.7	3.7	98.5
Decrease in animal raising	002	01.5	01.5	100.0
Total	134	100.0	100.0	

The results indicated that the majority of the respondents (53 %) had an increase in their total income after the dam heightening which matches the hypothesis of this study.

TABLE X
FARMERS LAND OWNERSHIP BEFORE DAM HEIGHTENING

land ownership before dam heightening	Freq.	%	Valid %	Cumulative %
Lease ownership	108	80.6	80.6	80.6
rent ownership	026	19.4	19.4	100.0
Total	134	100.0	100.0	

The results indicated that land ownership was either lease or rent and no free ownership registration in the study area.

TABLE XI
FARMERS LAND OWNERSHIP AFTER DAM HEIGHTENING

land ownership after dam heightening	Freq.	%	Valid %	Cumulative %
Lease ownership	53	39.6	39.6	39.6
Rent ownership	81	60.4	60.4	100.0
Total	134	100.0	100.0	

The results indicated that the majority of farmers in the study area lost their land due to water inundation and resettlement in new areas so the rent ownership increased on the account of lease.

TABLE XII
FARMERS CULTIVATED CROPS AFTER DAM HEIGHTENING

cultivated crops after dam heightening		Freq.	%	Valid %	Cumulative %
	Vegetables	27	20.1	41.5	41.5
	Fruits	12	9.0	18.5	60.0
	Cereals	24	17.9	36.9	96.9
	Forests	2	1.5	3.1	100.0
	Total	65	48.5	100.0	
Other	0	69	51.5		
Total		134	100.0		

The result indicated that after dam heightening the majority (42 %) depended on vegetables production. Because the dry land cultivation is faced by so many constrains and risks the decrease in the area of dry land cultivation secured the farmer's benefits in his new economical activity that definitely has less constrains, risks and guaranteed the farmers success.

TABLE XIII
FARMERS CROPS CULTIVATION SYSTEM AFTER DAM HEIGHTENING

cultivation system after dam heightening		Freq.	%	Valid %	Cumulative %
	Vegetables Twice a season	27	20.1	41.5	41.5
	Cereals Once a season	24	17.9	36.9	78.5
	Fruits Once a season	12	9.0	18.5	96.9
	forests once a season	2	1.5	3.1	100.0
	Total	65	48.5	100.0	
Other	0	69	51.5		
Total		134	100.0		

The result indicated that after dam heightening not only the majority of farmers at the study area works in vegetables producing but also they grow it twice in the year which can give a chance to maximize the income, satisfy citizen's needs and improve life standard which matches the hypothesis of this study.

TABLE XIV
FARMERS' TYPE AND SOURCE OF THE CULTIVATED SEEDS

Type, source of the cultivated seeds		Freq.	%	Valid %	Cumula. %
	Local seeds for cereals	24	17.9	36.9	36.9
	certified seeds for fruits, forest trees and vegetables	41	30.6	63.1	100.0
	Total	65	48.5	100.0	
Other	0	69	51.5		
Total		134	100.0		

The results of the surveyed respondents indicated that the cereal producers depend on the local produced seeds, may be

due to the lack of extension services, tolerance of the local varieties under local conditions, shortage in the certified seeds supply or high costs of the certified seeds.

TABLE XV
FARMERS SOURCES OF FUND

sources of fund	Freq.	%	Valid %	Cumulative %
Banks	20	14.9	14.9	14.9
Self (personal)	108	80.6	80.6	95.5
Other	006	04.5	04.5	100.0
Total	134	100.0	100.0	

The result indicated that the majority (81 %) depends on self funding may be due to obstacles of funding policies, lack of banks' funds.

TABLE XVI
FARMERS OPINIONS ABOUT THE EXTENSION SERVICE AVAILABILITY

extension service	Freq.	%	Valid %	Cumulative %
Not available	88	65.7	65.7	65.7
Available to some extend	46	34.3	34.3	100.0
Total	134	100.0	100.0	

The result indicated that farmer's majority (66 %) agreed, the extension services is not available may be that was a part of the reasons that why the farmers depend on local seeds in the production of cereals.

Fishing organizations at the dam lake

According to farmers investigated about the authorized fishing organizations at the lake, the result showed that all fishermen in the area of the study were fishing under the umbrella of their families, similarly lack of administrative, structural and marketing services.

TABLE XVII
FARMERS' BELIEVES ABOUT THE TOWN'S RESETTLEMENT SOCIAL AND ECOLOGICAL IMPACTS

resettlement social and ecological impacts	Freq.	%	Valid %	Cumulative %
Positive affect	89	66.4	66.4	66.4
negative affect	45	33.6	33.6	100.0
Total	134	100.0	100.0	

The result indicated that the majority (66 %) agreed that they gained positive changes from the resettlement, while 34% are resisting the coincidence changes.

May be that is because people awareness about the heightening projects was not enough and their participation was week, so they feel they are not a part of those tremendous efforts of heightening.

TABLE XVIII
FARMERS OPINION ABOUT LAND TENURE AUTHORITY AND EFFICIENCY.

land tenure authority and efficiency	Freq.	%	Valid %	Cumulative %
Local leaders and good efficiency	3	2.2	2.2	2.2
Local leaders and middle efficiency	60	44.8	44.8	47.0
Local leaders and low (inconvenience) efficiency	61	45.5	45.5	92.5
Other authorized with inconvenience efficiency	10	07.5	07.5	100.0
Total	134	100.0	100.0	

The result indicated that 98 % of the respondents were not pleased with the land distribution and its efficiency.

TABLE XIX
FARMERS' OPINION ABOUT THE AVAILABILITY OF STRUGGLE (COMPETITION) ON RESOURCES

struggle (competition) on resources	Freq.	%	Valid %	Cumulative %
yes available	131	97.8	97.8	97.8
to some extend available	003	02.2	02.2	100.0
Total	134	100.0	100.0	

The result indicated that 98 % agreed to the presence of struggle on resources, only 2 % are satisfied which matches the percent of the satisfied respondents by the land distribution and its efficiency (in table 4.21.).

TABLE XX
FARMERS SATISFACTION ON DAM HEIGHTENING ASSOCIATED PROJECT'S EXECUTION

Satisfaction	Freq.	%	Valid %	Cumu. %
Middle	22	16.4	16.4	16.4
Acceptable	13	9.7	9.7	26.1
less than acceptable	93	69.4	69.4	95.5
Good	06	04.5	04.5	100.0
Total	134	100.0	100.0	

The result found that the majority of the respondents (69 %), evaluated the execution of Roseires dam heightening associated project's execution (R.D.H.A.P.E) as less than acceptable, 16 % as middle standard, 10 % as acceptable and 5 % as good execution's standard.

The result indicated that the majority of the respondents (86 %) were not pleased by the standard of the dam heightening associated projects execution.

According to farmers investigated about the introduction of irrigated agriculture, whether it will increase state's farmer's income, the result found that all respondents agreed on that. The result indicated farmer's absolute willingness to introduce irrigated agriculture which matches the study hypothesis.

IV. Conclusions

This research was conducted in Roseires and Geisan localities, Blue Nile state, Sudan 2014. The main objective of this research is to study the economical impact of Roseires dam heightening on agricultural activities in Blue Nile state. The main constraints facing farmers at dam basin area in Blue Nile State can be summarized as follows: Poor skills, organizational capacities, poor awareness among the farmers, limited access to extension services, low awareness about present competition on resources, poor production administrative and structure, poor technical skills and lack of technical support e.g. extension services might be the reason for the used traditional methods of fishing, local seeds used in production, and poor market information and services, lack of finance and support services, there is an apparent shortage of finance and funding, even if it is sometimes available the disbursement of loans is late, in addition to rising production cost, lack of awareness, transparency and public participation in Dam heightening stages inhibited full awareness and satisfaction, unfavorable natural conditions in production e.g. lack of streams around the lake after heightening to enable fishing at a long period of the water rise, pests, and new shores crocodiles etc. Ministry of agriculture requested to support farmers with agricultural extension services to adopt new production technologies.Ministry of agriculture requested to demand and make the funds available for farmers in a right amount, at the right time.Ministry of agriculture requested to establish marketing within the state to analyze fish and all agricultural products value chain with the view of identifying the factors involved in the chain and establishes win-win relationship between them .The Government requested to work for the Introduction of irrigated agriculture to Blue Nile state in order to maximize the production, and the profits to the farmers. inistry of agriculture requested to organize the land ownership and to work on the production maximization in the basin land in the study area. Ministry of agriculture requested to categorized farmers into production and marketing associations according to the activity so as to take collective decisions regarding purchase of inputs, process and sell of the produce with the view of minimizing cost of production and maximizing gross margins to land, labor and cash capital. Ministry of irrigation, electricity and water resources requested to enable farmers to be participants and follow the access of the execution of the Rosieres dam heightening simultaneous projects in order to get all benefits and to achieve the projects main goals for the community.

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