

Identification of Factors that Affect Crop Productivity in the Traditional Rain-fed Sector of Sudan

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Abstract: This study investigates the factors affecting crop productivity in the Blue Nile State, Sudan. From four localities, 200 representative samples were randomly selected. The data were collected by the use of pre-tested interview schedule. Descriptive statistics was used to describe the socioeconomic characteristics of respondents. Pearson correlation coefficients and regression was also adopted to indicate positive or negative association of some variables. The results revealed that the main limiting factors of crop productivity are the use of unimproved varieties, untreated seeds, delayed sowing date, inadequate measures of weeds and pests control, and limited financial capability to conduct the agricultural operations correctly. Pearson correlation coefficients indicated that the current area of sorghum has a positive association with the previous year of sorghum price; yield and area cultivated. The study recommended some interventions to improve crop productivity and production in the studied area.

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Key words: Crop productivity; traditional rain-fed sector; Blue Nile State; Sudan

1. Introduction

Rain-fed agriculture produces much of the food consumed globally, precisely by poor communities in developing countries. This sector accounts for more than 95% of farmed land in sub-Saharan Africa; 90% in Latin America; 75% in the Near East and North Africa; 65% in East Asia; and 60% in South Asia. Various factors can cause agricultural productivity to increase or decrease in this sector. Such factors include: a-Weather, b-capacity of a given farm, c-pests, d-available and e-market supply and demand (<http://www.agrivi.com/factors-that-affect-agricultural-productivity/> 2016).

Sudan is a very large agricultural and pastoral country in Africa with total area is estimated to 2,505,813 sq. km and contrasting sharp differences in all its characteristics (Ali, 2012). From north to south, the desert semi-desert with ephemeral grasses and xerophytes scattered shrubs to short grass savannah, through long grass savannah to tropical forest with evergreen trees and tall and very thick canopy of grasses. The country total population of well over 33 million, out of which 51% live in rural areas. Agriculture is the dominant sector in the Sudanese economy. It contributes about 31.6% to the Gross Domestic Product (GDP), and about 9% of non-petroleum exports, and provides the raw materials for agro-industries and employment for over 50.23% of the labor force (Ministry of Information 2011). According to the WFP (2015), household food

security in Sudan is strongly linked to the performance of the agricultural sector of the economy. Directly, the agricultural sector provides food production for domestic consumption at household level and wage labor opportunities on farms. However, as indicated by the WFP, (2015) the sector account for 27 percent of the active labor force. Indirectly, the level of agricultural production influences the price of food, which helps determine household economic access, as most households rely on markets as their main food source. As indicated by Mahgoub (2014) the country agricultural sector comprises five sub-sectors: modern (mechanized) irrigated schemes, traditional irrigated, mechanized rain-fed, traditional rain-fed and livestock husbandry/pastoralism. Each of these sub-sectors produces food and cash crops for both local consumption and export. The traditional rain fed sub-sector is responsible for the production of most of the sorghum, millet and groundnut. According to by Suleiman et al (2008) constraints limiting production in traditional rain-fed sub-sector are: a- Low productivity resulting from use of traditional technology; b- Lack of rural saving and credit institutions; c- Marketing bottlenecks; d- Lack of research and extension services; e- Poor infrastructure; f- Inadequate safe water; g- Weed and pest infestation; h- Over-cultivation and shifting exhausted far m plots, passing-by animals, and i- Seasonal and sharp variations of rainfall and complete failure in some years (uncertainty).

According to Bello and Fadul (2015) the country faces numerous problems including *inter alia* social conflict, civil war, on-going rural urban migration and the consequences of the July 2011 secession of South Sudan. The new born country share in the oil sector estimated to about three-fourths of the former Sudan's total oil production. The oil sector had driven much of Sudan's GDP growth since it began exporting oil in 1999, the matter that hardly affected the country national budget. Blue Nile State is located in the south-east of Sudan. The State borders Sinnar State from the North, Ethiopia from the East and South, White Nile state from the West and Upper Nile State from the South West. It extends from latitudes 12° 40' to 9° 20', and from longitudes 35° 10' to 33° 30'. It has an area of 38,500km² and sparsely populated with an estimated total population of 1017510 (Blue Nile State Food Security Technical Secretariat, 2014). The dominate livelihood in the state is agro-pastoralism, with the northern part of the state relying more on livestock and the southern more on agriculture (WFP, 2010). According Daoud (2009) the farming system in the State is mainly mechanized, semi-mechanized and traditional rain-fed agriculture. The main crops grown are sorghum, sesame, sunflower, maize and cotton while chickpeas, maize, vegetables are grown under smallholder irrigation. Cultivation of grains and oil seeds is carried out in a large-scale using mechanized or semi- mechanized technology (company and individuals) or in small scale using traditional methods where farmers grow traditional varieties and operated with package of simple traditional technology from land preparation to harvest. She also commented that the rain-fed sub-sector with its vast land resources represents the main source for the production of grains and oil seeds for local consumption, while foreign exchange earnings obtained from cultivation of food and cash crops (Daoud (2009).

Regarding ethnic composition, the major ethnic groups of the Blue Nile Sate include *inter alia* the Funj, Hawsa, Falatta, Hamaj, and Barta. Therefore the State is often called the "small Sudan" since it hosts many Sudanese tribes living together with indigenous groups (Daoud 2009). It is evident that the insecurity of Blue Nile State has seriously affected the regular rehabilitation and maintenance of the existing water supplies initiated over time by the respective government departments. In this context Almagboul (2015) indicated that the Blue Nile State has been heavily affected by civil war since 1987. This ongoing civil resulted in deterioration of infrastructure and social services, lack of government resources, and consequent instability and insecurity and forced about 115,000 and 165,000 people to flee their homes in the rural areas to live in and around the neighboring towns

of Damazin and Rosaries, 550 kilometers south of the capital city of Khartoum. Another 50,000 people sought refuge in Ethiopia. Therefore, the civil war has resulted in drastic changes in quality of life, modes of livelihood in the State.

2. Objectives of the Study

The study was conducted to investigate factors affecting crop production and productivity in the Blue Nile state. The specific objectives are to:

- i) Determine production aspects of crops grown in the state.
- ii) Identify constraints that face crop production in the different farming systems and livelihoods.
- iii) Investigate factors affecting the production and productivity of crops in Blue Nile State.
- iv) Propose policy measures for improving the food and cash/export in the State.

3. Methodology

The study area

This study was conducted June- November, 2014 to determine factors affecting crop productivity in four localities of the Blue Nile State, Sudan. These localities are; Roseires, Ed-Damazine, At-Tadamon and Gessan localities were purposively selected (map 1).

Sample and data collection

About 200 farmers from these localities were randomly selected and interviewed. A pretested questionnaire was meant to collect primary qualitative and quantitative data. It was designed to provide different sets of information including socioeconomic characteristics of selected household respondents, crop production and farm management with emphasis on factors affecting crop productivity. Secondary data was also collected from the relevant sources. Descriptive statistics such as frequency count and percentages were used to analyze the data gathered on the socioeconomic characteristics of the respondents. Pearson correlation coefficient was also adopted to indicate positive or negative association of different variables.

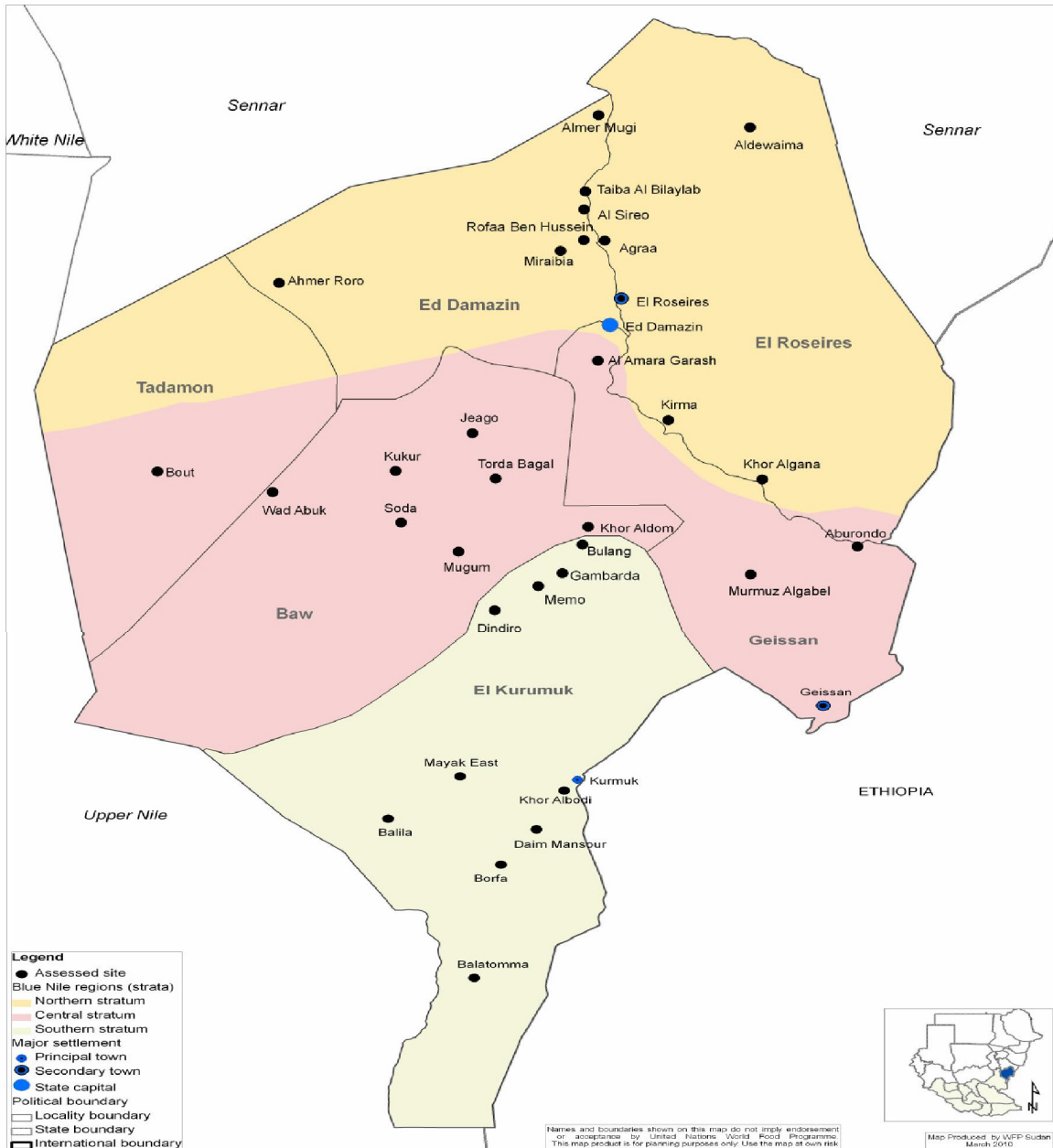
4. Research findings and discussion

4.1 Socioeconomic characteristics of farmers

Table 1 shows that 87% of respondents were males, 96% were married, illiteracy level was 40% about 15.5% have higher education, and the rest had some level of education ranging from elementary to high school. According to Daoud, (2009) the illiteracy rate was 74% at the State level. High illiteracy level is a negative factor as educated people are expected to be more receptive to extension messages and modern technologies than others. Agriculture represents the main occupation for about 80.5% of respondents. This

finding is consistent with the WFP (2010) which indicated that agricultural activities are undertaken by a large majority (79 percent) of the Blue Nile population. Data in the table also reflected that 81% of the respondents have farms size less than 100 feddan while those who have more than 1000 feddan represent 4% only. According to Daoud, (2009) the average household farm size in the setae is estimated

to be less than 5 feddans. The table also indicates that 91.5% of respondents were agro-pastoralism. These results also in line with Almagboul (2015), Daoud (2009) and WFP(2010) who reported that the dominate livelihood in the state is agro-pastoralism, with the northern part of the state relying more on livestock and the southern more on agriculture.



Map 1. The Blue Nile State Localities

Table 2 indicates that 68% of the land is privately owned, 24% rent in land while very few (3.5%) practice sharecropping. These finding is contradicted with Almagboul (2015) in her study on

the effect of civil war on livelihood of three villages in the Blue Nile State. She indicated that about 40 % of the households own agricultural land while 59.4 % rented the land they use. The table also reveals that

farmers' experience (53%) is the most determinant factor of crop selection in in the studied area, where

74% of respondents either illiterate or have primary education (table1).

Table 1. Frequency distribution and percentages of respondents according to existing socio-economic situation (N=200)

Characteristics	F	%	Characteristics	F	%
<u>Gender</u>			<u>Marital Status</u>		
Male	174	87	Single	6	3
Female	26	13	Married	192	96
			widow	2	1
<u>Education</u>			<u>Main Occupation</u>		
Illiterate	80	40	Farmer	161	80.5
Primary	68	34	Livestock producer	16	8
Secondary school	21	10.5	Other	23	11.5
University or less	31	15.5			
<u>Secondary Occupation</u>			<u>Farm Size</u>		
Agro-pastoralist	183	91.5	< 50 feddan	134	67
Trade/business	8	4	51-100	28	14
Seasonal laborer	9	4.5	101-250	12	6
			251-500	9	4.5
			501-1000	9	4.5
			1001- 4000	8	4

4.2 The productivity of the main crops

In this season (2014), for example, sorghum productivity in the study area ranges from 0.5 to 7 sacks with an average of 2.7sack/feddan (table 3. In contrast with WFP (2010) the situation was worse. It was stated that sorghum production per household (for the seasons 2008/2009 and 2009/ 2010) dropped from 7.4 to 3.7 bags (90 kg). Sesame yield also range from zero up to 16 with an average of 1.96 sack/feddan, millet yield range from 1 to 10 with an average of 2 sacks /feddan while sunflower yield range from 1 to 2.7 with an average of 1.8 sacks /feddan. The same thing of a wide range of variability in the productivity of sorghum has been observed over the two seasons (2012/2013 and 2013/2014), as indicated by the standard deviation (table 3), due to factors affecting crop selection and productivity (table 2). The provision of short-term agricultural credit through the Agricultural Bank of Sudan (ABS) is a regular operational procedure in the rain-fed sectors, particularly in the commercial mechanized subsector. Loan uptake for cereal production is generally by entrepreneurs with strong business connections with the ABS and other banks; farmers in the traditional subsector are rarely able to raise the necessary collateral (Aburaida, 2014, Mahgoub, 2014, and Ahmed et al, 2012). Table 4 shows that only 18% of the respondents received credit from formal sources and only 1.8% of them commented that they prefer not to deal with formal credit.

The table also indicates that the majority of respondents not receiving credit attributed that *inter alia* to high interest rate (44.5%) and/or unavailability

of collaterals (34.7%). In this regard Ahmed et al (2012) commented that agricultural finance in Sudan is considered a limiting factor of food crop production. It faced various obstacles regarded the provision of short and long-term agricultural credit mainly the low devoted percentage for agricultural sectors injected through the agricultural finance institutions and it continues to show steady but slow progress, though there is wide variation amongst the various branches with regard to performance and efficiency. They also indicated that, these policies reflected in large number of farmers particularly in the irrigated and mechanized rain-fed sectors continue complaining of agricultural finance mechanism (Ahmed et al, 2012). It is worth noting that the financial capability of farmers is one of the most important factors that affect the performance of the farmer to conduct the cultural operations of sorghum and to manage their farm perfectly.

Data in table 4 also indicate that 80% of respondents never being subjected to extension services while only 20% of the farmers receive farming training or participate in demonstration plots. Contact with extension workers will increase farmers' awareness and directly reflected on crop production. Such participation assist the farmers to get acquainted with knowledge and practices related to the adoption of new variety and improve their experience, knowledge, attitudes, skill on ways of doing cultural practices and optimum use of inputs. Table 4 also indicates that only 16 % of respondents were actively involved in farmer' associations.

Table 2. Distribution of respondents according to land tenure and factors determines crops selection

Land tenure system			
Type/factor	F	%	Cumulative Percent
Missing	9	4.5	4.5
Privately owned	136	68.0	72.5
Share cropping	7	3.5	76.0
Rented/sublet from others	48	24.0	100.0
Factors determines the selection of crops			
Missing	11	5.5	5.5
Farmers' experience	106	53.0	58.5
Adaptability of the crop to this area	47	23.5	82.0
Market demand/crop price	20	10.0	92.0
Availability of inputs	4	2.0	94.0
Remunerative crop price	4	2.0	96.0
Easy to manage	3	1.5	97.5
Availability of labor	3	1.5	99.0
Encouraging agricultural policies	1	.5	99.5
Others	1	.5	100.0

4.3 Factors affecting the production of the crop over time

Pearson correlation coefficients indicated that the current area of sorghums has a positive association with the previous year of sorghum price, yield and area cultivated (Table 5). The same applied to other crops. This indicates that last year prices yield and area affected the decision of current area allocated to different crops and thus the production of different commodities. This is beside the quantity and contribution of the rainfall.

4.4 Quantification of factors affecting the productivity

The results in table 6 indicate highly significant, both individually as indicated by the t-statistics and collectively as indicated by the significant F-statistic. Similarly, the coefficient of determination, R², is high at 0.64 showing that 58% of the variation in the productivity of sorghum is explained by the mentioned variables (table 6). Results showed that, adoption of water harvesting techniques; improved variety, pest and disease control, farm size and the financial capability were among the important factor affecting the productivity of the crop. It is worth noting that none of the farmers adopt fertilizer application which is essential input in enhancing crop productivity and the financial capability affect conducting other important operations.

Table 3. Distribution of farmers according to crop productivity

Production/season	F	Min	Max	Mean	Std. Dev
Sorghum yield this season	195	.5	7.0	2.7	1.7
Sorghum yield last season	186	.5	7.0	2.9	1.8
Sesame yield this season	127	.0	16.0	1.97	1.9
Sesame yield last season	107	.00	8.0	2.3	1.5
Millet yield this season	23	1.0	10.0	2.8	2.1
Millet yield last season	24	.5	12.0	3.3	2.6
Sunflower yield this season	6	1.0	6.0	2.7	1.8
Sunflower yield last season	4	1.5	2.0	1.8	.3
Groundnut yield this season	10	2.0	10.0	5.7	2.5

- Sorghum and millet yield in a sack of 90 kg, Sunflower yield in a sack of 50 kg, Guar yield in a sack of 100 kg, and Sesame yield in Kantar of 100 kg.

Table 4. Respondents' classification according to agricultural services received

Characteristics	F	%	Characteristics	F	%
<u>Formal Credit</u>			<u>Reasons for not receiving formal credit</u>		
Receive credit	36	18	High interest rate	73	44.5
Do not receive credit	164	82	Not have down payment	31	18.9
			Not have collaterals	57	34.7
			Prefer not to deal with credit	3	1.8
<u>Extension services</u>			<u>Involvement in farmers' association</u>		
Received training	50	20	Member	32	16
Not receive training	150	80	Not member	168	84

Table 5. Pearson correlation coefficients for sorghums in the Blue Nile State

Variable	Lagged price	Lagged Yield	Lagged Area
Current Area	0.080	0.133	0.745

Table 6. Regression results of factors affecting the productivity of sorghum in the Blue Nile State

	Coefficients	Std. Error	Beta	t	Sig.
(Constant)	.332	.044		7.58	.000
Adoption of water harvesting techniques	.038	.055	.059	.696	.488
Adoption of improved variety	.031	.045	.059	.689	.492
Financial capability	.029	.048	.052	.602	.548
Pests disease control	.070	.059	.096	1.181	.239
Farm size	.034	.029	.097	1.171	.243

R2 = 0.64 Adjusted R2 = 0.58 F value = 5.7* Durbin Watson = 1.79

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5. Conclusion and Recommendations

Changes in the level of production and productivity were among the most important factors that contribute to food insecurity and the standard of living of households in the rain-fed areas. Rain-fed agriculture produces much of the food consumed in the Blue Nile State in in general and the study area in particular. The study showed that there is a wide range of crop production attributed to that farmers' experience, adaptability of the crop to the area, market demand, availability of inputs, presence of enumerative prices, easy to be managed, availability of labor and encouraging agricultural policies are among the most important ones. It is also revealed that the main limiting factors of crop productivity are the use of unimproved varieties, untreated seeds, delayed sowing date, absence of adequate measures to control weeds and pests and weak financial capability to conduct the agricultural operations perfectly. The study recommended some interventions to improve

crop productivity and production in the Blue Nile State. These include:

1- The government, NGOs and UNs agencies concerned with agriculture (e.g. FAO and IFAD) should provide some rural agricultural finance facilities to enhance crop productivity in the study area in general particular and the state in general.

2- Provision of relevant agricultural extension packages to meet the farmers' need improved and treated seeds, adequate measures to control weeds and pests enhance the productivity of the cultivated crops.

3- The need for further research and studies to identify and propose relevant long term agricultural extension intervention strategies addressing the farmers' needs and awareness in the study area.

4- Early declaration of prices or insuring a minimum price level and improving market information with regard to supply and demand situation of the crop to enhance crop productivity and production in the area.

References

1. Aburaida, K (2014). Rural Finance as Mechanism for Poverty Alleviation in Sudan, with an Emphasis on "Salam Mode". European Scientific Journal December edition vol. 7, No.26 ISSN: 1857 - 7881: 157-166.

2. Ahmed1, E, Faki, H and Abubkr Hussein, A (2012). Role of Agricultural Finance in Producing Food Crops. *International Journal of Agriculture and Forestry* 2012, 2(2): 10-15.
3. Ali, S (2012). Agricultural Extension Systems in Sudan. Available at <http://www.scribd.com/doc/86784926/Agricultural-Extension-System-in-Sudan>.
4. Bello AS, Fadul E MA (2015). FAO Contribution to food and income security in Sudan: An Assessment. *World Rural Observ* 2015;7(4):71-76]. ISSN: 1944-6543:71-76.
5. Blue Nile State Food Security Technical Secretariat, (2014). Livestock Policy Brief No.1/February 2014 (Unpublished report):3.
6. Elmagboul N (2015). Effect of Civil War on Livelihood of Three Villages/ Blue Nile State, Sudan. *International Journal of Research in Humanities and Social Studies* Volume 2, Issue 5: 69-75.
7. Elmulatham, N, Awad, M, E & Elamin, A, E, M (2011). Can Sudan achieve food security during the next decade: Some forecasts of self-sufficiency in cereals? *Scientific Research and Essays* Vol. 6(3), pp. 529-532.
8. <http://www.agriwi.com/factors-that-affect-agricultural-productivity/> 2016.
9. Ibrahim, I., Al-feel, M., and Ahmed, A (2014). Identification of Factors That Influence Technical Efficiency of Cash Crops Production (Sesame and Groundnut) In North Kordofan State, Sudan: *International Journal of Scientific and Technology Research* Vol. 3. Issue (10): 89-94.
10. Mahgoub, F (2014). Current Status of Agriculture and Future Challenges in Sudan. Nordiska Afrikainsitutet, Uppsala:98.
11. Ministry of Information, Sudan (2011). Sudan Land of Opportunities (Facts & Figures): 6-10.
12. Suleiman I., Salih, A., Bello, A., Bannaga, A., and Abelmagid, H. (2008). Final Scoping Study-Sudan. Socio-Economic Development and Benefit Sharing Project (SDBS). Nile Basin Initiative, Entebbe, Uganda: 114.
13. WFP, (2015). Food Security Update. At: <file:///C:/Users/User/Desktop/Food%20security%20update%20v%202015.pdf>. (WFP, 2010). Emergency food security, blue Nile State-Sudan (Report): 58.

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