

Assessment of the households food security and poverty situation in the traditional rainfed agriculture in Sudan: the case of North Kordofan

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The aim of this paper was to assess food security and poverty situation among rainfed agricultural households' in North Kordofan State. Structured questionnaire using stratified sampling technique was used to gather households' poverty and food security data from four localities in North Kordofan State, a total of 205 households were interviewed. Household Economy Approach and Costs of the Basic Needs were used to evaluate the food security situation while Foster-Greer-Thorbecke poverty measures and Gini coefficient were used to assess poverty situation. The results revealed that farming and animal production constitute 88% of the households' income, households' spending exceed the earned income by 37%. Moreover, the share of food spending amounted to 71% of the total households' total expenditure implying that households' in North Kordofan State has poor access to food and securing a minimum level of food becomes the top priority for the low income households. Only 39% of respondents were found to be food secure, 24% were marginally food insecure, 10% were moderately food insecure and 27% were severely food insecure. The poverty incidence, average poverty gap and square poverty gap were 68.8, 37.3 and 20.3%, respectively. The Gini coefficient was 48.7% when the 1 US\$ per day index was applied. The richest quintile share of the received income is almost more than 17 folds of the poorest, indicating a perfect income inequality among the households in rainfed agriculture in North Kordofan State. To improve household food security and poverty in North Kordofan state, the study recommends the improving productivity of main crops and enhancing institutional environment, promotion of agricultural research sectors, and investment in agriculture to raise agricultural productivity, enhance production (increased food availability) through improved production practices and provision of credit and extension service.

Key words: Food security, poverty, inequality, North Kordofan State, CBN, rainfed.

INTRODUCTION

Today, almost half of the world's population (three billions peoples) lives in poverty, earning less than two US dollars per day and about 1.2 billion live in extreme poverty, trying to survive on less than one US dollar per day. Of those 1.2 billions, over three quarters (900 millions) live in rural areas deriving their income mainly from agriculture and other related activities. These

staggering numbers have sent a strong message to the international community to place poverty reduction at the forefront of development efforts (IFAD, 2003).

According to world Bank estimate the Sudan's poverty headcount ration at \$1.25 a day (PPP) is amounted to 19.8% of the total population in 2009 (World Bank, 2014). Poverty in the Sudan is deeply entrenched and

is largely rural. Poverty predominantly affects rainfed agricultural farmers. Moreover, small-scale farmers and herders in the traditional rainfed farming and livestock sectors are poorer than those in the irrigated agricultural sector (IFAD, 2010).

During the last three decades extreme poverty declined from 85% in 1990's to 60% at present due to the sustained economic growth in Sudan, however, important regional disparities exist (IFAD, 2010).

In Sudan, the income held by the poorest quintile is amounted to 6.8%; followed by 11.7 for the second; 16.4% for the third; 22.7% for the fourth and 42.4% for the fifth richest quintile. Income share held by the richest quintile is almost more than six folds of the poorest quintile with a GINI coefficient of about 35.3, indicating a prefect inequality in the income distribution in Sudan (World Bank, 2014).

Rainfed agriculture covers by far the largest area in Sudan. The area actually cultivated and total yield may, however, vary considerably from year to year depending on variability of rainfall. The rainfed farming system is characterized by a small farm size, labor-intensive cultivation techniques employing hand tools, low input levels, and poor yields (Kundell, 2008).

The traditional agriculture in Sudan occupies 60% of the total cultivated land and employs 65% of the agricultural population. Nevertheless, it is characterized by its low crop productivity, which is mainly driven by low technical efficiency, while drought and civil conflicts threaten most of its areas countrywide. Therefore, it has contributed only an average of 16% to the total agricultural GDP during the last decade (Khalid et al., 2011).

The state of North Kordofan lies in the dry zone in central Sudan between longitudes 27° and 32.20° East and latitudes 12.12° and 16.4° North (Adam et al., 2013). The region is semi-arid and is characterized by recurrent episodes of drought and increasing desertification. The state is bordered by six states: the northern state from the north, Khartoum State and White Nile from the east, South Kordofan from the south, South Darfur from the south-west and North Darfur from the west (NSDDRC et al., 2010). North Kordofan is one of the four largest states in the country with an area of 244, 700 square kilometers, equivalent to 139 square miles and 58.8 million acres of land. The state is composed of 13 localities, these are: Shikan, Barra, Jabrat El Sheikh, Soderi, GhibEaish, EL Nuhud, Umrwaba, Abo Zabd, Wad Banda, El khwei, Elrahad, West Bara, and Um dum, each of which encompasses several administrative units (NSDDRC et al., 2010), (Figure 1).

The state is traditionally an agro-pastoral community, where rainfed agricultural crops production and animal keeping are and will be the major livelihoods source. In North Kordofan, farming is the main economic activity, followed by animal husbandry and trade (WFP, 2010).

The state is semi-arid and prone to both drought and desertification and lack of water is one of the key issues in the state and has been for decades. Consequently, North Kordofan is exposed to both chronic and sporadic food shortages state (WFP, 2010).

According to the Sudan Social Development Organization (SUDO), poverty is a key challenge in the state, particularly in rural areas. Additionally, North Kordofan struggles with very poor health indicators and rates for maternal and infant mortality are high.

The North Kordofan State characterized by complex interlinks among environment, poverty and conflict over natural resources that are becoming increasingly scarce. This situation illustrates the connection between drought, resource degradation and armed conflict on the one hand and vulnerability to food insecurity on the other (WFP, 2010). Thus, the main aim of this paper was to assess the food security and poverty status among households in traditional rainfed sector in North Kordofan State. To achieve this objective, there is a need to estimate the poverty measures (prevalence, gap and severity); measure income inequality and assess the households' food security situation in traditionally rainfed agriculture in North Kordofan State.

MATERIALS AND METHODS

Data collection

The present paper depends on both primary and secondary data. Structured questionnaire using stratified sampling technique was used to collect households' poverty and food security primary data. The collected data include households' socio-economic characteristics; households' food and income sources and expenditures, where, detailed data on households' quantities and costs of the consumed food and non-food items were collected. Moreover, questions to evaluate households' food security status and the adopted coping strategies in case of food shortage were asked to the respondents.

Out of the 13 localities that constitute the North Kordofan state, four localities were randomly selected, namely: Sheikan; Umrwaba; Elnuhoud; and Elkhawi. A total of 205 households were randomly selected from the selected four localities. Secondary data were collected from the relevant databases at the international, national and state levels.

Analytical techniques

Different analytical tools were used to analyze the collected data, such as household economy approach (HEA), costs of the basic needs (CBN) approach, Foster-Greer-Thorbecke (FGT) poverty measures and

Gini coefficient. These methods and their uses were discussed in the following subsequent sections (James et al., 2010).

Household economy approach (HEA)

HEA was developed between 1992 and 2000 by Save the Children in collaboration with the Food and Agricultural Organization (FAO) Global Information and Early Warning System (GIEWS) with aim of finding a method that indicates the effect of the factors influencing the future food supply (Seaman et al., 2000). The HEA provides a direct estimate of the food gap by establishing a household "food balance". The established food balance will match all the income and food sources converted either to kilocalories or cash against household requirements of food intake as well as the other important needs in either kilocalories or cash equivalents (Seaman et al., 2000).

Cost of the basic needs approach

The household food security was modeled in framework of the Cost of the Basic Needs (CBN) to quantify households' food gaps in North Korodfan. The CBN is one of the relevant approaches to construct food poverty line and then after estimating poverty line (Ravallion, 1998; Haughton and Khandker, 2009). The CBN approach can be used if the prices of the food bundle that is consumed by the respondents are available. Nonetheless, the approach considers both food and non-food items costs for constructing poverty line. Food cost represents the cost of obtaining the adult equivalent recommended calories per person per day as specified by the international standards measures for people in the developing countries. The cost of the non-food items of housing, clothing, services, etc are then added (Adam et al., 2013). Based on the CBN approach, first household food consumption data were converted into adult equivalent in Kcal/person/day using the food composition table. These data were compared against a certain reference (2100kcal/person/day) to estimate the food access shortage and to categorize the degree of Households' severity of food insecurity in North Kordofan State

Poverty measures

Foster-Greer-Thorbecke (FGT) is a generalized measure of poverty. It combines information on the extent of poverty (as measured by the head count ratio), the intensity of poverty (as measured by the total poverty gap) and inequality among the poor (as measured by the Gini and the coefficient of variation

ratios) (James et al., 2010).

The formula for the FGT is given by Equation 1:

$$P_{\alpha} = \frac{1}{N} \sum_{i=1}^H \left(\frac{z - y_i}{z} \right)^{\alpha} \quad 1$$

Where N is the total number of population under consideration, H is the number of poor (those with incomes at or below z), y_i is the individual income of the i-th poor, Z represents the poverty line, and α is a parameter characterizing the degree of poverty aversion i.e. the parameter α determines the precise measure of poverty. When α equal zero the head count ratio (H) is generated, when α equal one the poverty gap ratio (PG) is generated (often considered as representing the depth of poverty) and when α equal two the poverty severity (PS) is generated.

Gini Coefficient is the most commonly used measure of the degree of inequality. The coefficient varies between 0, which reflects complete equality and 1 or 100%, which indicates complete inequality (Haughton and Khandker, 2009). Graphically, the Gini coefficient can be easily represented by the area between the Lorenz curve and the line of equality. To measure income inequality and compare it among households more accurately, Lorenz curve and Gini index were used.

RESULTS AND DISCUSSION

Household economy approach

Table 1, presents the household's annual income and expenditure balance sheet in cash equivalents term (SDG) in North Kordofan State. The results revealed that the households' average annual income was amounted to 7326.88 SD, out of which, 88% were attained from agricultural and animal production and the remaining 12% were from non-farming activities. On other hand, households' average annual expenditure were estimate to be 10050.86 SDG implying an annual households' income deficit of 2724 SDG, representing a 37% of the current annual households' income in the state. In addition to that, food share represents more than 70% of the households' expenditure implying that households' in North Kordofan State has poor access to food and securing a minimum level of food becomes the top priority for the low income households.

Costs of the basic need approach

The standards of living of households in the study area were measured based on the expenditure of the households. The household expenditure was converted

Table 1. Household income and expenditure balance sheet in cash equivalent term (SDG).

Items	Average Cash Value (SDG/Year)	% Share
Farm income (SDG)	4282.371	58.4
Animal income (SDG)	2198.171	30.0
Off-farm income (SDG)	846.3415	11.6
Total income	7326.883	100
Consumed goods cost (SDG)	7131.278	71.0
Non-consumed goods cost (SDG)	2919.585	29.0
Total expenditure	10050.863	100

Table 2. Households' Food consumption (kcal/person/day) and food cost in SDG.

Food items	Quantity (K.cal/person/day)		Cost (SDG)	
	Mean	% share	(SDG)	% share
Millet	281.85	14	0.233	5
Sorghum	431.21	21	0.284	6
Rice	120.92	6	0.167	3
Wheat	324.44	16	0.768	15
Meat	95.34	5	1.452	29
Milk	30.12	1	0.077	2
Chicken	44.2	2	0.330	7
Oil	275.5	13	0.481	10
Onion	129.9	6	0.147	3
Okra	12.9	1	0.259	5
Cowbe		0	0.105	2
Sugar	323.5	16	0.356	7
Tea		0	0.132	3
Coffee		0	0.146	3
Salt		0	0.015	0
Other		0	0.046	1
Total	2070.1	100	4.99	100

Table 3. The Level of Food Calorie Consumption (person/day).

Calorie consumption (person/day)	%	Food Security Status
Above 2,100 kcal	39.0	Food secure
(1,800 - 2100) kcal	24.3	Marginally food insecure
(1,500 - 1,800) kcal	09.8	Moderately food insecure
Less than 1,500 kcal	26.9	Severely food insecure

Source: Samar (2014).

into per capita expenditure by dividing it by the number of the members of the household. This was further converted into adult equivalents based on the nutritional requirement, using the nutrition-based adult equivalent scales provided by FOS (2004).

The mean calories intake in north Kordofan state is 2070.1kcal/person/day (Table 1). This result is close to the recommended kcal/person/day (2100kcal/person/day) (Devereux, 2006). The result indicates that, on average, the households of North Kordofan state are food insecure (consumes less than 2100 kcal/person/day) which is due to the variability of food consumption among households in study area.

Cereals (Sorghum, millet, wheat and rice) constitutes about 58% of the total Households' consumed energy

and represents only 29% of the total cost of the households consumed kilocalories per person per day. On the other hand, meat contributed only 5% of the households' consumed kilocalories (kcal/person/day), however, it amount to 29% of households' total kilocalories cost (Table 2).

Furthermore, the obtained calorie consumption estimates have been utilized to categorize the degree of severity of food insecurity among households in North Kordofan State through adopting Devereux's references (Devereux, 2006). The results revealed that 39% of North Kordofan Households' were found to be food secure, 24.3% were marginally food insecure, 9.8% were moderately food insecure and 26.9% were severely food insecure (Table 3).

Food cost represents the cost of obtaining the adult equivalent recommended calories per person per day as specified by the international standards measures for people in the developing countries. The average expenditure on food was SDG 4.9/person/day (an average person spends 4.9 SDG to consume 2070.1 kcal/day). The average amount spent on non-food items is SDG 1.55/person/day. The non-food items include health, education, cloths, house rent, communication costs, transportation, electricity costs and social contributions and gifts. Spending on health is the highest among all non-food items. This result agrees with the findings of Adam et al. (2013). The result, as well, indicates the very high share of the health care costs in the households' budget.

Estimation of the poverty line and poverty status

The first step in the analysis of poverty is the determination of the poverty line. The poverty line used in this study was calculated from the international measures of the mean per capita income. The application of dollar per day in the computation of poverty measure was achieved by adopting the World Bank (2002), of Purchasing Power Parity (PPP). In addition, the poverty line of US\$1, US\$1.25 and US\$2 /day were applied. One US\$ was equivalent to SDG 2.8 (exchange rate) during the data collection time. As seen from Table 4, about 68.8% of households' in north Kordofan state live below the poverty line, 9.2% were moderate and 22% were non poor, if US\$ 1 index is applied. This percentage increases to 82.9% for poor respondents, and decreases to 2.4 and 14.6% for moderate and non poor, respectively, when US\$ 1.25 index poverty line is applied. The percentage of respondents who live below poverty line increases to 90.2% and non-poor decreases to 9.8%, when US\$ 2 index of poverty line is applied (Table 4).

Table 4. Poverty status in North Kordofan state.

North Kordofan state	Poverty lines		
	\$ 1	\$ 1.25	\$ 2
Poor	68.8	82.9	90.2
Moderate	9.2	2.4	0.0
Non-poor	22	14.6	9.8
Total	100	100	100

Source: (Field survey, 2013).

FGT measures results

Many attempts have been made to measure poverty but there exist different views about the concept of poverty which made it difficult to find a universally-accepted method of poverty measurement (Khan, 2009). However, due to this relativity and multidimensional

nature of poverty, this study adopted the basic Foster-Greer-Thorbecke (FGT), an indices which is one of the most commonly used as a measure of poverty (Foster et al., 2010). This measure has three components: (a) the incidence of poverty which shows the share of the population that are below the poverty line (absolute poverty), (b) the depth of poverty which shows how far the households are from the poverty line (depth of poverty), and (c) the severity of poverty which relates to the distance separating the poorest households from the poverty line and combines information on both poverty and inequality among the poor. The results of poverty indicators in study area are summarized in Table 5. The incidence of poverty, average poverty gap and square poverty gap were 68.8, 37.3 and 20.3%, respectively, if US\$ 1 a day index is applied.

These ratios were 83.4, 46.2 and 25.6%, respectively, when US\$ 1.25 a day index is applied. The ratios changed to 90.2, 61.2 and 41.6%, respectively when poverty line US\$ 2 day index is applied. These figures of poverty incidence, gap and severity are greater than those estimated by the Sudan Institutional Capacity Program (2011), based on standard levels of food poverty line US\$ 1 a day index. These high poverty indices may be explained by farmers' low productivity due to the traditional farming and practices, economic limitations like poor infrastructural services, shortage of productive assets, insufficient rainfall, and high prices of factors of production, increasing costs of living, inadequate development strategies, climatic volatility and erosion of natural resources. Although sustained economic growth was behind the decline of extreme poverty from 85% in the 1990 to an estimated 60% at present, important regional disparities still exist. The Sudan remains a low-income, food-deficit country. It ranks 147th (out of 177 countries) on the United Nations Development Programme (HDI, 2007, 2008).

Gini coefficient of inequality

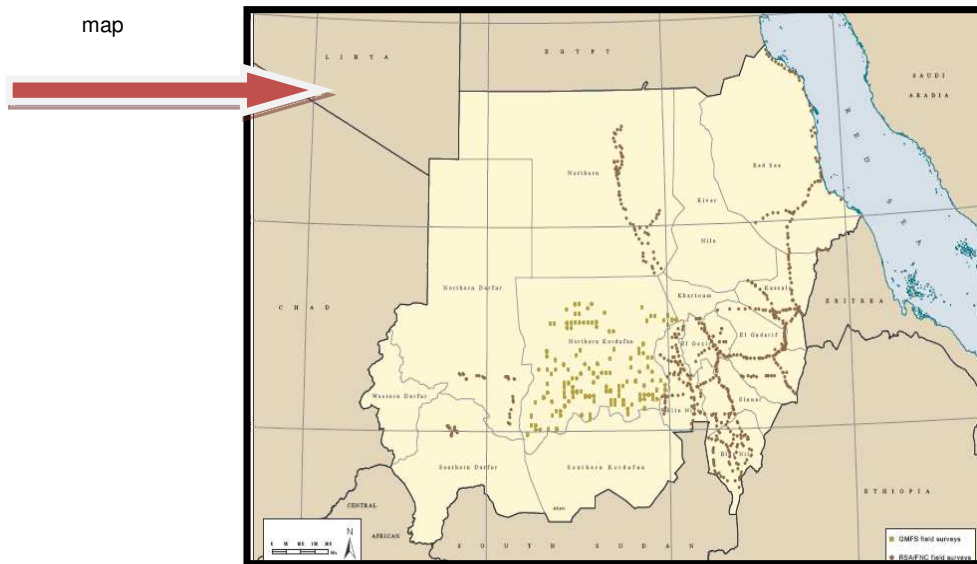
The estimated Gini coefficient of 48.7% is extremely high, indicating a much skewed distribution of income. Lorenz curve plots the cumulative percentages of total income received against the cumulative percentages of population starting with the poorest individual or household (Figure 2).

First, all the individuals or households were ranked according to their income level, from the poorest to the richest. Then all of these individuals or households were divided into 5 groups (20 percent each). The Lorenz curve shows the percentage of total income earned by cumulative percentage of the population. The study results show that the poorest 20% of the Households in North Kordofan State earned 3.2% of the total income while the richest 20% earned 51.7% of the total income. The second 20% poorest earned 6.74% while the following 20% richest earned 25.9% of the

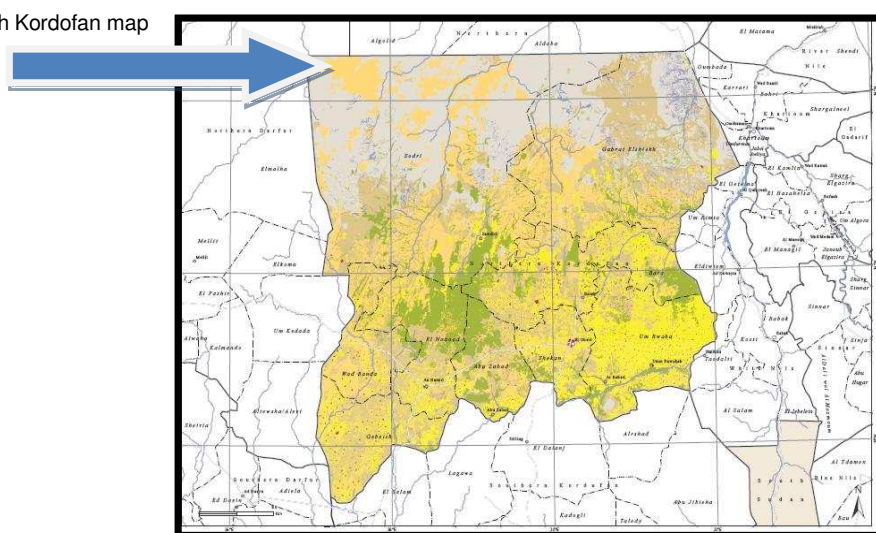
Table 5. FGT Measurement of poverty in North Kordofan state.

Poverty type	Standard living of poverty line		
	1 Dollar day	1.25 Dollar day	2 Dollar day
Head count ratio (P_0)	68.8	83.4	90.2
Poverty gap (P_1)	37.3	46.2	61.2
Poverty severity (P_2)	20.3	25.6	41.6

Source: Field survey (2013).



North Kordofan map



total income. The results also indicate that the 50% poorest of the population earned 15.1% of the total income while the 50% richest of the population earned 84.9% of the total income. These results indicate that the distribution of income among households in north Kordofan state is perfectly unequal.

Conclusions

The objective of this paper was to assess the food security and poverty status of farming households in

North Kordofan State. The household food security was modeled in the framework of Household Economy Approach and the Cost of the Basic Needs Approaches. The Foster-Greer-Thorbecke was used to measure poverty. This model combines information on the extent of poverty as measured by the head count ratio, the intensity of poverty as measured by the total poverty gap and inequality among the poor as measured by Gini ratio and the coefficient of variation. The results showed that food insecurity and poverty (incidence, gap and severity) were persistent in the households in the traditional farms because the majority of household were food insecure and live below the poverty line. Income inequality among the studied population was found high as well. To improve household food security and poverty in North Kordofan state, the study recommends the improving productivity of main crops and enhancing institutional environment, promotion of agricultural research sectors, and investment in agriculture to raise agricultural productivity, enhance production (increased food availability) through improved production practices and provision of credit and extension service.

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