

Food security in Sudan: the case of Kassala state

Samia Satti Osman Mohamed Nour

*Department of Economics, Faculty of Economic and Social Studies,
University of Khartoum, Khartoum, Sudan, and*

Eltayeb Mohamedain Abdalla

Department of Economics, University of Kassala, Kassala, Sudan

Abstract

Purpose – Different from the previous studies in the Sudanese literature, this study aims to examine the incidence and of food security, the variation in households' food insecurity between localities and the adaptation and survival strategy in Kassala State as a case study of Eastern Sudan.

Design/methodology/approach – This paper uses the measurement of Household Food Insecurity Access Scale (HFIAS) and uses new primary data from a Food Security Household Survey in Kassala State (2019) and uses the descriptive analysis to discuss the measurement of HFIAS, the incidence of food security, the variation in households' food insecurity between localities and the adaptation and survival strategy in Kassala State.

Findings – The authors find that the majority of household (77%) are food-insecure of various degrees, with 32.9% being severely food-insecure, while some households are food-secure (23%). The authors find support for their hypothesis that there will be variation in households' food insecurity between localities that most probably relate to variation in the distribution of monthly income between localities. In particular, the authors find that most households in rural areas are severely food-insecure.

Originality/value – This paper provides a significant contribution to the Sudanese and international literature because it discusses the incidence of food insecurity in Sudan. Different from the two other accompanying papers that focused on the determinants of food security in Kassala State using the measurement of HFIAS and determinants of production of food and consumption of food in Kassala State, this paper focuses on the incidence of food security in Kassala State using the measurement of HFIAS.

Keywords Food security, Regional discrepancy, Poverty, Inequality, Sudan, Kassala

Paper type Research paper

1. Introduction

Since September 2015, the global community adopted the 17 Sustainable Development Goals (SDGs) to be achieved by 2030. Sudan is committed to achieve SDGs by (2030), including Goal 2 – Zero Hunger – committed to end hunger, achieve food security, improve nutrition and promote sustainable agriculture. As in most other developing countries, in Sudan, the achievement of SDG2 implies that achieving food security relies heavily on sustainable food production systems, resilient agricultural practices, boosting agricultural productivity and increasing investments in agriculture, both public and private, from domestic and foreign sources.

Given the high poverty and undernourishment rates in Eastern Sudan (cf. [Abdalla et al., 2016](#)), and given the high stunting prevalence among children in Kassala State (48.8%), it is relevant to investigate the issues of food security and agricultural development in Kassala State as a case study of Eastern Sudan. Previous studies in the Sudanese literature examine some issues related to food security in Kassala State. For instance, [Abdalla et al. \(2016\)](#) investigate the effect of rural non-farm activities on households' food security in Kassala State. They find that the majority (about 61%) of population engages in one form of non-farm activities, and that non-farm income has a positive and significant impact on food security in the state. Recent statistics show that Kassala's food production meets only a small fraction of the state's total nutritional needs ([World Food Programme \(WFP\), 2012](#)). The income from the



non-farm activities allows people to improve food security by purchasing food from the market; this implies essential contributions through purchases from the market, the remaining shortfall is met, where possible, through contributions from the federal government, World Food Program (WFP) and international non-governmental organizations (NGOs). According to the comprehensive food security assessment conducted by UN WFP in December 2011 and January 2012 (WFP, 2012), the major factors related to food insecurity include: poverty, lack of education, unsustainable livelihood activities (unskilled labor, collection of wood/grass) and, to a certain extent, isolation and cultural practices (see Abdalla *et al.*, 2012). For the case of Kassala, it appears that we need to look for explanations beyond poverty, as it is not one of the poorest states in Sudan, but still suffers from high prevalence of stunting. Underlying explanations may be the choice of food, access to clean water, sanitation facilities, etc., or the prevalence of disease and access to health services.

Grounded on the above, this paper aims to discuss the incidence of food insecurity in Kassala State in Eastern Sudan. We use the measurement of Household Food Insecurity Access Scale (HFIAS); and we use new primary data from a food security [Household Survey in Kassala State \(2019\)](#); and we use the descriptive analysis to discuss the measurement of HFIAS, the incidence of food security, the variation in households' food insecurity between localities and the adaptation and survival strategy in Kassala State. This paper differs from our paper that focused on the determinants of food security; we use the measurement of HFIAS to examine the incidence of food security. This paper also differs from our paper that focused on agricultural development, production of food, consumption of food and food security in Sudan; we use new primary data from a food security [Household Survey in Kassala State \(2019\)](#), and we use the ordinary least squares (OLS) estimation to estimate the determinants of production of food and consumption of food and to discuss the importance of agricultural development, the determinants of supply of food (production of food) and demand for food (consumption of food) and food security food in Kassala State.

Different from the previous studies in the Sudanese literature, the proposed study aims to examine the incidence and determinants of food security in Kassala State as a case study of Eastern Sudan. We fill the gap in the Sudanese literature because we provide a more recent and comprehensive economic analysis of the four pillars of food security (availability, stability, access and utilization of food) using the Food and Agriculture Organization (FAO) conceptual framework, as explained above. We investigate the factors that impede (and those contribute towards) food security in Kassala State. Our analysis is useful from policy perspective because we provide useful policy recommendations to enhance food security through agricultural development in Kassala State.

The significance and relevance of focusing our analysis on the case of Kassala State is demonstrated from the fact that despite the abundance of natural resources (cultivable land and water), food security and agricultural development remain important problems in Kassala State. For instance, on the supply side, recent statistics show that Kassala's food production meets only a small fraction of the state's total nutritional needs (WFP, 2012). Moreover, on the demand side, the technical report of the integrated food security classification (IPC, 2013) explained the food security condition in the state and showed evidences on the incidence of food insecurity in the low-income areas of Kassala State. Food consumption was extremely inadequate in these low-income areas. Price increases strongly lowered access to markets, which was already hindered by poor infrastructure and bad roads and long distance to settlements. According to the comprehensive food security assessment conducted by UN WFP in December 2011 and January 2012 (WFP, 2012), many factors related to food insecurity, including poverty, lack of education and unsustainable livelihood activities (unskilled labor, collection of wood/grass), etc.

Based on the above, the central theme discussed in this research is the incidence of food security in Kassala State. In particular, the main objectives are to provide an economic analysis of food security, to examine the discrepancy in food security in Kassala and finally, to provide useful policy recommendations to enhance food security through agricultural development in Kassala. Regarding structure, this paper is organized as follows: [Section 1](#) shows the introduction and shows research problem, significance, relevance and objectives of the research. [Section 2](#) shows food security in Sudan and Kassala. [Section 3](#) presents the conceptual framework and literature review on the definition of the concepts of food security. [Section 4](#) explains the methodology (method of data collection and data analysis). [Section 5](#) discusses the main results concerning the incidence of food security and the adaptation and survival strategy in Kassala State. Finally, [Section 6](#) provides the conclusions and policy recommendations.

2. Food security in Sudan

Although Sudan is endowed with vast and diverse agricultural resource base that provides various means of sustaining livelihood and despite the importance of the agricultural sector for Sudan economy and the potential opportunities for achieving food security in Sudan as explained above, unfortunately, Sudan suffers from a serious food insecurity problem and failure to achieve food and nutrition security for the whole population. According to the US Agency for International Development ([USAID](#)) ([2019](#)), chronic food insecurity in Sudan threatens lives, livelihoods and stability. Due to prolonged conflict, environmental deterioration and other disasters such as drought and floods, many of Sudan's people are at risk of food insecurity. According to the [WFP](#) ([2019](#)), approximately 5.5 million people were food-insecure in early 2018 – up from 3.8 million in 2017.

According to [Famine Early Warning Systems Network](#) ([2018](#)) “Sudan Food Security Outlook,” food security would deteriorate across the country with more households facing stressed (Integrated Food Security Phase Classification (IPC) Phase 2) and crisis (IPC Phase 3) outcomes. Although parts of North Darfur, parts of West Kordofan, North Kordofan and South Kordofan, southern Blue Nile, northern Kassala and much of Red Sea states would remain areas of greatest concern, food security would also deteriorate in other areas.

According to [IPC](#) ([2018](#)), people in (IPC Phase 3+) are considered as people facing severe acute food insecurity and in need of urgent action. IPC explains the intensity, severity and geographical distribution of people facing severe acute food insecurity and in need of urgent action in the periods (October to December 2018) and (January to March 2019) ([Figure 1](#)). For instance, in the period October–December 2018, 5.67 million people (representing 12.8% of the analyzed population) are estimated to be in crisis and emergency (IPC Phases 3 and 4). Almost one million people (representing 2.2% of the population analyzed) are in IPC Phase 4 (emergency) and more than 4.5 million people (representing 10.6% of the population analyzed) are in IPC Phase 3 (crisis). In the projected period, (January–March 2019), 5.76 million people (representing 13% of the analyzed population) are estimated to be in crisis and emergency (IPC Phases 3 and 4). More than one million people (representing 2.4% of the population analyzed) are in IPC Phase 4 (emergency), and more than 4.67 million people (representing 10.5% of the population analyzed) are in IPC Phase 3 (crisis). Regarding the geographical distribution, 171 localities were classified in all states in Sudan. Further, 33 localities are estimated to be in IPC Phase 3 (crisis) in Blue Nile, White Nile, Southern Kordofan, Kassala, Gedaref, Red Sea and Darfur states. Darfur accounts for about 45% of the population in IPC Phases 3 and 4; however, there has been no area classified in IPC Phase 4 (emergency).

The WFP most recent comprehensive food security assessment showed that about 2% of the households in Kassala State are suffering from acute food insecurity, and 4.5% are

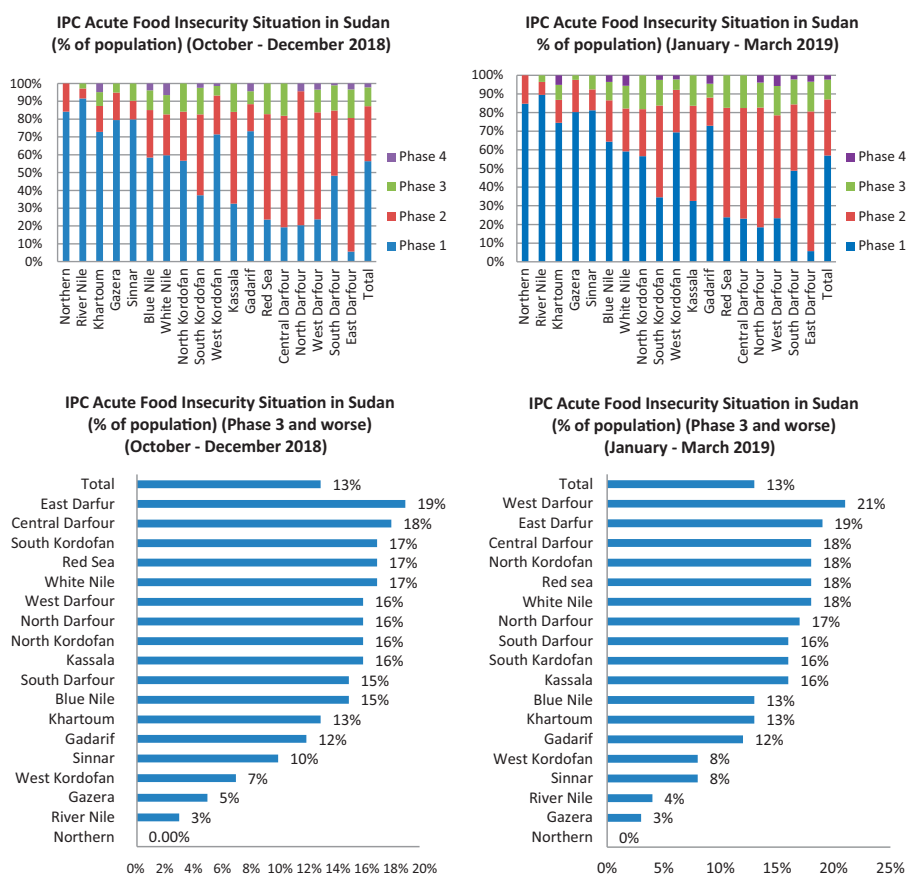


Figure 1.
IPC acute food
insecurity situation in
Sudan (2018–2019))
(% of population)

Source(s): Adapted from IPC (2018), p. 4

vulnerable to acute food insecurity (WFP, 2012). Regarding the chronic food insecurity, the report reveals that 22% of the households in Kassala State are suffering from chronic food insecurity, while 26% are chronically moderately food-insecure. The main factors related to food insecurity include: poverty, lack of education, unsustainable livelihood activities (unskilled labor, collection of wood/grass) and, to a certain extent, isolation and cultural practices (WFP, 2012).

Furthermore, the problem of malnutrition in Kassala is attributed to many factors that include inadequate intake of nutrients, diseases, inadequate access to portable water and preventive health services, poor child care, poor hygiene and sanitation practices and household food insecurity.

According to IPC Acute Food Insecurity Analysis in Sudan (2018) in the period October–December 2018, Kassala State, together with North Kordofan, North Darfour and West Darfour States, reported that 16% of their analyzed population are estimated to be in crisis and emergency (IPC Phases 3 and 4) (people facing severe acute food insecurity), they are ranked third after the Red Sea, South Kordofan and White Nile and Central Darfour States.

3. Conceptual framework and literature review

This section begins with the conceptual framework and the definition of the concepts of food security, discusses the most common measures used in the international literature and then reviews the literature on the relationship between agricultural development and food security.

The concept food security has evolved over the past decades and has been widely used in the international literature (cf. Clay, 2002; Heidhues *et al.*, 2004). The term first originated in the mid-1970s, when the [World Food Conference \(1974\)](#) defined food security in terms of food supply – assuring the availability and price stability of basic foodstuffs at the international and national level: “Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices.” In 1983, FAO analysis focused on food access, leading to a definition based on the balance between the demand and supply side of the food security equation: “Ensuring that all people at all times have both physical and economic access to the basic food that they need” (FAO, 1983). The widely accepted definition of [The World Food Summit \(1996\)](#) indicates that “Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” ([World Food Summit, 1996](#)). This widely accepted definition reinforces the different dimensions of food security and includes food access, availability, food use and stability. *Food availability*: the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid). *Food access*: access by individuals to adequate resources (income) for acquiring appropriate foods for a nutritious diet. *Utilization*: utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security. *Stability*: to be food-secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity). The concept of stability refers to both the availability and access dimensions of food security.

Several studies in the international literature use several indicators to measure various aspects of food security.

[Barrett \(2010\)](#) discusses measuring food insecurity and argues that because indicators inform action, much current research focuses on improving food insecurity measurement. Measurement matters for at least three major reasons. First, each measure captures and neglects different phenomena intrinsic to the concept of food security, thereby subtly influencing prioritization among food security interventions. Historically, reliance on national food availability estimates has focused attention on food aid shipments and agricultural production strategies to increase food supplies in the short and long term, respectively. Second, observational data necessarily report on the past. But policymakers are most interested in the likely future effects of prospective interventions. Third, national-level measures inherently lend themselves only to addressing national-scale food availability shortfalls, not intranational access and utilization concerns. Insofar, as food insecurity measures diagnostically inform actions, they must be readily associated with targetable characteristics of vulnerable households and individuals and remediable causal factors that lead to food insecurity. The research frontier, therefore, revolves around the development of cross-nationally comparable, longitudinal monitoring and analysis at the household and individual level [\[1\]](#).

Several studies in the international literature use several measures, including HFIAS, to measure food insecurity. According to [Bertelli and Macours \(2014\)](#), validation studies of the Household Food Security Survey Measure (HFSSM) in different developing countries led to

the development of the HFIAS in 2006 by the USAID Food and Nutrition Technical Assistance project. According to [Tiwari et al. \(2013\)](#), the HFIAS is a measure developed by USAID Food and Nutritional Technical Assistance (FANTA) to assess food access problems faced by households during a recall period of 30 days. It aims to capture the changes in food consumption patterns and reflect the severity of food insecurity faced by households due to lack of or limited resources to access food. It is composed of nine questions, and these questions relate to three different domains of the access component food insecurity: anxiety and uncertainty about household food access, insufficient quality and insufficient food intake ([Swindindale and Bilinsky, 2006](#)) [2].

According to [Bertelli and Macours \(2014\)](#), less common indicators of food security are the ones assessing coping strategies implemented by households when facing insufficiency of food. While this methodology tries to capture the food insecurity experience more directly, it still looks at its consequences, in terms of behaviors adopted by households and individuals ([Coates et al., 2006](#)). [Maxwell \(1995\)](#) proposes six different indicators of short-term food-based coping strategies [3]. The use of coping strategies in assessing food security is adopted also by [Bonanno and Li \(2011\)](#), which define “Low food-secure households” as those having “enough food to avoid substantial disruption in their eating patterns or reduced food intake by using a variety of coping strategies,” while “Very low food-insecure households” face disruption of normal eating patterns of one or more members [4].

The literature on food security covers other developing countries like India (see, e.g. [Reddy, 2016](#); [Reddy et al., 2016](#)). For instance, [Reddy \(2016\)](#) examines the progress of India's food security from 1990 to 2016, using four components, i.e. food availability, access, stability and utilization with the use of FAO food security indicators. India's progress is compared with eight countries (country groups) with similar per capita gross domestic product (GDP). The selected countries are Samoa, Vietnam, Uzbekistan, Nigeria and Congo, and country groups are Southern Africa, lower middle-income economies and South Asia (excluding India). The study shows that even though India's performance is better for some food availability (dietary energy supply and value of food production) and stability (domestic food price indices) indicators, its record in some other (protein availability and prevalence of undernourishment indicators) is dismal. In case of food access and utilization indicators, its performance is miserable. India needs to improve its production of protein-rich foods and increase investments in irrigation to stabilize food supply. The study provides policy options for increased food security and achieves the SDGs by 2030. The study recommends that India needs to strengthen food entitlements for its vulnerable population through employment guarantee programs and midday meals programs. [Reddy et al., \(2016\)](#) measure performance of India in food and nutrition security relative to other Asian countries like Bangladesh, China, Africa and also developed countries from 1991 to 2016. The study is based on FAO food security indicators under four dimensions, namely, food availability, access, stability and utilization. These indicators are further categorized into determinants and outcome indicators of food security. A comprehensive 15 indicators are examined in depth. The study found that food availability in terms of dietary calories and protein per capita was less in India compared to even Africa and Bangladesh. However, food access indicators like road density is better, food prices remain low and stable, which improved food access and stability. However, in utilization indicators, access to water and sanitation remained low, anemia among pregnant women and undernourishment was relatively higher when even compared to least developed countries like Africa and Bangladesh. The depth of food deficit (an indicator of severity of food deficit) was higher in India, except Africa. The results highlight the severity of food deficit and anemia among women, undernourishment and provide benchmark to monitor sustainable development goals in zero hunger goal.

[Bonanno and Li \(2011\)](#) argue that food insecurity and its resulting social, psychological and physical consequences have been extensively studied. There is substantial evidence

suggesting that areas with large low-income populations tend to have limited access to full-service grocery stores, and that food environments with limited access can make it difficult for people to obtain adequate amounts of nutritious and affordable food.

Mota *et al.* (2019) use the HFIAS and find that the majority (71.6%) of rural households in the study area in southern Ethiopia were food-insecure. The Household Food Insecurity Access Scale (HFIAS) indicates that HH cannot cover the required daily food from the production generated from their agriculture as well as other activities.

Mustapha *et al.* (2016) discuss food insecurity in Northern Ghana and examine the relative occurrence of food insecurity using the classification of food insecurity as mild/very low, moderate/low and severe and using ordered probit model and analyzing data from 4,288 households in Northern Ghana. The study shows that for each of these categories, households' rural dwelling, age, land size and access to credit significantly increase food insecurity, while maize crop output and marital status decrease food insecurity. The study shows that food insecurity is a rural and productivity problem and not a poverty issue (or inadequate credit).

Ramakrishna and Demeke (2002) assess the food insecurity situation in the North Wello zone of Ethiopia using household data. They constructed a food balance sheet and an aggregate household food security index and studied food insecurity causation using a logit model. They studied also survival mechanisms of the people. They find that the study area is highly food-insecure, and survival mechanisms are traditional. Along with food availability and enticement, attitudinal variables also influence food insecurity.

Otaha (2013) discusses food insecurity in Nigeria and argues that in Nigeria, there is high level of food insecurity for the past four decades as a result of neglect in food production when oil has become the major export product and the because of the adoption of neoliberal economic policies such as devaluation of naira, trade liberalization and withdrawal of government from economic activities, ethnic and religious conflicts; disasters, such as flooding and drought have also contributed to food insecurity in Nigeria. Unfortunately, most of the food need in Nigeria is produced by peasant farmers who lack capital, skills, energy and other viable ingredients to produce on large quantity that will meet the requirement of the growing population. Thus food insecurity in Nigeria is a recurrent and double-digit problem. The paper however proffers workable solution to these problems.

Owoo (2020) argues that close to 14 million people in Nigeria, including children, are malnourished. Owoo (2020) hypothesizes that demographic considerations play an important role in food insecurity within Nigerian households. Using data from three waves of the World Bank's Living Standard Measurement Survey for Nigeria, Owoo (2020) illustrates spatial patterns of food security in the country. Using fixed-effects regressions, Owoo (2020) also shows that, at the household level, larger households have worse food security outcomes and are more likely to report being food-insecure. Children from large households also suffer worse malnutrition outcomes. This relationship is significant in urban Nigeria as well, with implications for sustainable urban planning and family planning to address unmet need for contraceptives.

Liwenga (2003) discusses food insecurity and coping strategies in semi-arid areas in Central Tanzania, an area with a long history of food shortages. The study specifically examines the potential for dryland resources to sustain livelihoods. The study looks at the historical perspective of the problem to explore factors influencing the food situation in the area. It specifically investigates the role of local knowledge as a factor for adapting to dryland conditions by exploiting seasonality and local diversity. A detailed account is made of the coping strategies among three identified wealth groups in the area. Apart from their wealth levels, households in these wealth categories differ in how they mobilize and deal with labor in various seasons. Households in the well-off group have greater ability in mobilizing and using external labor as well as accumulating and managing food surplus. The households in

the intermediate group are flexible in utilizing their own labor by performing various farm and non-farm activities according to their seasonalities. The households in the poor category sell their own labor and perform various farm and non-farm activities regardless of the season. It is clear from the study that different wealth groups differ in their ability to develop immediate coping into more proactive livelihood strategies. The study winds up by assessing the potentials of the prominent land resource utilization strategies in terms of economic, social and environmental perspectives.

4. Methodology (method of data collection and data analysis)

Based on the conceptual framework and the literature review on agricultural development and food security presented above in the previous section, this section discusses the methodology for measurement of food security in Sudan, with particular reference to Kassala State.

Regarding the research method, this research uses primary data, qualitative and quantitative data and the descriptive method to measure food security and to provide an empirical investigation of the relationship between agricultural development and food security in Kassala State. The secondary data were obtained from relevant national and international sources. The primary data were obtained through a survey questionnaire that was distributed among 500 households to represent different areas in Kassala State during April 10–20, 2019. The research covers both rural and urban areas in Kassala State in Eastern Sudan. The sample included in the study was 500 households in total, covering both rural and urban areas in Kassala. Regarding the sample, the survey covered five areas or localities out of 11 localities in Kassala State. In particular, the survey included New Halfa locality, Rural Aroma, Kassala locality, Rural Kassala locality and Waldel Helew or Khasm Algirba locality. The rationale for selection of these five localities in Kassala is that they reflect the diversity of agricultural activities defined by the type of irrigation (including gravity irrigated area, flood irrigated land, Basin irrigated areas and rain fed areas). Another criterion for selection is the contribution of these five localities in food production and employment of population in Kassala State.

The questionnaire “Food security in Kassala State: Household Questionnaire (2019)” examines food security in Kassala State; it is composed of seven sections. [Section 1](#) provides the background information about household family, [Section 2](#) explains family size and characteristics of household members. [Section 3](#) shows the housing status, quality and environment, infrastructure and services. [Section 4](#) discusses the agricultural production, household income and expenditure. [Section 5](#) examines the adaptation and survival strategy. [Section 6](#) discusses the measurement of food security (HFIAS) in Kassala State. Finally, [Section 7](#) provides the conclusions and recommendations.

We use both the descriptive and comparative methods of analysis using the qualitative observations and quantitative data related to characteristics of households and food security that obtained from household survey in Kassala in 2019. We use FAO definition and conceptual framework that are often used in the international literature that defined the multidimensional nature of food security that includes food access, availability, food use and stability. The qualitative observations provide explanations of the severity of food insecurity and the factors that cause the regional discrepancy in food security in Kassala State.

The descriptive analysis was utilized to explore adaptation and survival strategies to deal with food insecurity and to discuss measurement of food security (HFIAS). We measure food insecurity using HFIAS that has been widely used as a more universal method for measuring food insecurity in several studies in the international literature (see, e.g. [Bertelli and Macours, 2014](#); [Tiwarei et al., 2013](#)). In our view, HFIAS is useful for our analysis because the HFIAS questionnaire allows classifying households according to a hunger scale with four levels

(food-secure, mild, moderately and severely food-insecure) and permits calculating the four categories and their prevalence in the sample. Furthermore, the HFIAS measure allows assessing food access problems faced by households during a recall period of 30 days, explaining the changes in food consumption patterns and reflecting the severity of food insecurity faced by households due to lack of or limited resources to access food. HFIAS is composed of nine questions; each question has four response options: never, rarely, sometimes and often, which are coded 0, 1, 2, and 3 in order of increasing frequency. Responses to these nine questions are summed to construct a food insecurity score, with a maximum score of 27 indicating most food-insecure households.

4.1 The model

This paper employed the logit model to examine the most important factors affecting the household food security status. The model took the following form:

$$FS_i = \alpha + \beta X_i + \mu_i$$

where FS_i is the food security status of household i , α is the constant, β is the vector of parameters to be estimated, X_i is the vector of factors influencing food security status of household i , whereas μ_i is the error term, which is assumed to be normally distributed.

Food security status is the dependent variable taking a value of one if a household is food-secure, and zero otherwise. To measure the food security status of household, HFIAS data were used. Household that got 3 score or less was considered as food-secure and took the value of one, whereas households that got more than 3 score were identified as food-insecure, and took the value of zero. The explanatory variables include socioeconomic and demographic characteristics of households such as household head age, gender and education, family size, livestock ownership and the agricultural land owned by household. In addition, village characteristics include the physical infrastructure affecting household food security like the characteristics of road linking villages with the nearest market and available market services are also examined. The gender of household head is dummy variable taking a value of one for a male-headed household, and zero otherwise. According to some studies in the literature, lack of access to resources like land, inputs and other services limit the capacity of women to contribute to their families' food basket as compared to male. Therefore, male-headed households are expected to be more food-secure than female-headed ones. Thus, the rest of the explanatory variables are expected to affect the food security status of household as in the above reviewed literature.

5. Results and discussion

This section discusses the main results of the Food Security Household Survey conducted in Kassala State in April (2019); we discuss the incidence and measurement of food security (HFIAS); finally, we explain the adaptation and survival strategy in Kassala State.

5.1 Measurement of food security (household food insecurity access scale (HFIAS)) in Kassala State (2019) [5]

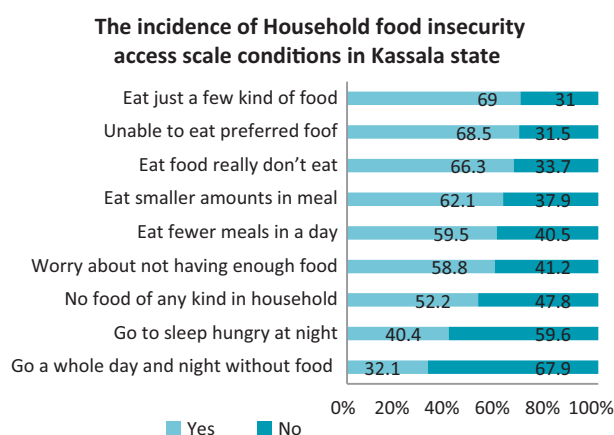
Our findings discuss the measurement of HFIAS in Kassala State and verify the incidence of food insecurity that appears from the fact that the majority of households eat just a few kind of food (69%), unable to eat preferred food (68.5%), eat food really do not eat (66.3%), eat smaller amounts in meal (62.1%), eat fewer meals in a day (59.5%), worry about not having enough food (58.8%), no food of any kind in household (52.2%), while some households go to sleep hungry at night (40.4%) and go a whole day and night without food (32.1%) (Table 1 and Figure 2).

Our results discuss the measurement of HFIAS by localities in Kassala State and indicate that few and less than a quarter of households are food-secure (23%). We find that the majority and more than three-quarters of household are food-insecure (77%), in particular, the majority of households are severe food-insecure (32.9%), while other households are either moderately food-insecure (29%), or mildly food-insecure (15.1%) (Table 2 and Figure 3) [6]. We observe serious discrepancies concerning households' food insecurity access scale by localities in Kassala State. For instance, HFIAS implies that food insecurity is a very serious problem in Rural Kassala locality (RK) because all households in RK suffer from either severe or moderately food insecurity (100%); different from RK, less than half of households suffer from either severe or moderately food insecurity in Rural Aroma locality (RA) (47.5%), and nearly half of the households suffer from either severe or moderately food insecurity in New Halfa locality (NH) (52.8%), in Kassala locality (KL) (53.3%) and in Wald Elhelew locality (WL) (55.7%) (Table 2 and Figure 3). The observed discrepancies in food insecurity by localities can be explained in relation to the observed discrepancies in the distribution of monthly income in localities. Therefore, the major policy implications from

Indicators	No		Yes	
	N	%	N	%
Worry about not having enough food	194	41.2	282	58.8
Unable to eat preferred food	144	31.5	327	68.5
Eat just a few kind of food	143	31	332	69
Eat food really do not eat	155	33.7	312	66.3
Eat smaller amounts in meal	177	37.9	291	62.1
Eat fewer meals in a day	188	40.5	278	59.5
No food of any kind in household	229	47.8	243	52.2
Go to sleep hungry at night	284	59.6	189	40.4
Go a whole day and night without food	326	67.9	153	32.1

Source(s): Authors' calculations based on [Food Security Household Survey in Kassala State \(2019\)](#)

Table 1.
The incidence of
HFIAS conditions in
Kassala State
(2019) (%)



Source(s): Authors' calculations based on Food Security Household Survey in Kassala State (2019)

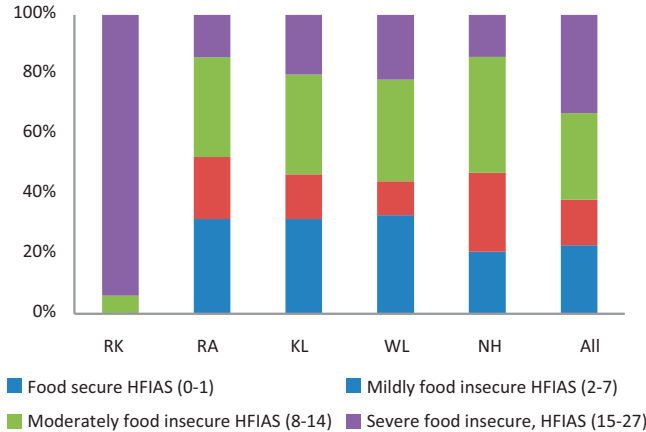
Figure 2.
The incidence of
HFIAS conditions in
Kassala State
(2019) (%)

Table 2.
HFIAS by localities in
Kassala State (2019)

Locality	RK %	RA %	KL %	WL %	NH %	All %
Food-secure HFIAS (0–1)	0	31.7	31.7	33	20.8	23
Mildly food-insecure HFIAS (2–7)	0	20.8	15	11.3	26.4	15.1
Moderately food-insecure HFIAS (8–14)	6	33.3	33.3	34	38.7	29
Severe food-insecure, HFIAS (15–27)	94	14.2	20	21.7	14.1	14.1
Total	100	100	100	100	100	100
Severe and moderately food-insecure, HFIAS (8–27)	100	47.5	53.3	55.7	52.8	61.9
Severe, moderately and mildly food-insecure, HFIAS (2–27)	100	68.3	68.3	67	79.2	77

Source(s): Authors’ calculations based on [Food Security Household Survey in Kassala State \(2019\)](#)

Household food insecurity access scale by localities in Kassala State (%)



Household food insecurity access scale in kassala State (%)

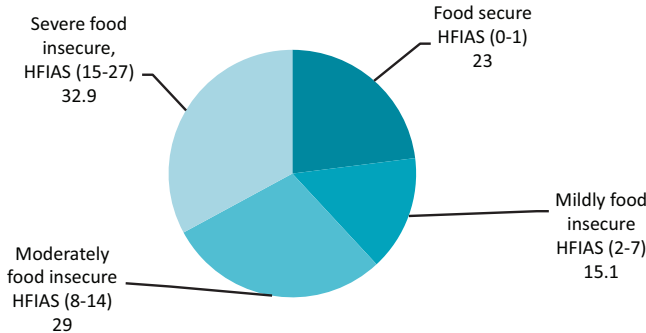


Figure 3.
HFIAS by localities in
Kassala State (2019)

Source(s): Authors’ calculations based on Food Security Household Survey in Kassala State (2019)

our results suggest the importance of improving households' income level to eliminate food insecurity in Kassala State.

5.1.1 The determinants of food security. Table 3 presents the value of logistic regression, where household food security status is a dependent variable and the core explanatory variables are dependency ratio, household characteristic (measured by sex of household head), agricultural land owned, livestock owned, non-farm income and village characteristics (measured by road characteristics and market services). Table 3 shows that the logistic regression was higher and significant at 1%, implying that there was no serious econometric problem in the model. When using dependency ratio as an indicator of family composition, the results revealed that the probability of household being food-secure is negatively affected by dependency ratio, and this result might be attributed to high percentage of non-adults in the family composition. The other factors that were significant and influence the probability of household food security include household characteristic (mainly, the sex of household head), ownership of livestock, farm size and non-farm income earned by household. Our results confirm that the property of the family, including the ownership of land and livestock and non-farm income projects, are positively affecting household food security status, and these results are plausible and consistent with the results in the international literature. Also, the results showed that the village characteristic (measured by road characteristics and market services) and infrastructure represented by the quality of roads linking the housing sites with the nearest markets positively influenced the probability of household food security. In addition, the organizational and administrative services provided by the government have a positive impact on the likelihood of household food security.

Explanatory variables	Coefficients	z-statistic	Prob
C	-5.194***	4.19-	0.000
Dependency ratio	-1.234***	-2.93	0.003
Sex of household head	0.696*	1.76	0.078
Agricultural land owned	0.216***	2.66	0.008
Livestock owned	0.074*	1.75	0.079
Non-farm income	0.329**	2.15	0.032
Road characteristics	0.286***	2.77	0.006
Market services	0.274***	2.59	0.010
Log likelihood	227.333		
LR(stat)	58.62	LR. Prob	(0.0000)
Number of observations		469	

Note(s): ***, ** and * indicate significant at the 1, 5 and 10% level, respectively

Table 3.
The results of logistic regression model (household food security status is dependent)

Explanatory variables	Coefficients	z-statistic	Prob
C	-2.765***	4.12-	0.000
Family size	-0.509*	-1.94	0.052
Sex of household head	0.773**	2.08	0.037
Agricultural product of household	0.127***	4.48	0.000
Road characteristics	0.299***	2.95	0.003
Market services	0.306***	2.93	0.003
Log likelihood	241.883		
LR(stat)	47.53	LR. Prob	(0.0000)
Number of observations		485	

Note(s): ***, ** and * indicate significant at the 1, 5 and 10% level, respectively

Table 4.
The results of logistic regression model (household food security status is dependent)

[Table 4](#) presents the value of logistic regression, where household food security status is a dependent variable and the core explanatory variables are family size, household characteristic (measured by sex of household head), agricultural product of household and village characteristics (measured by road characteristics and market services). [Table 2](#) shows that when using family size, household production factors, such as size of agricultural land owned and nonfarm income (capital), in addition to livestock, became insignificant. [Table 4](#) indicates that the agricultural product of household, village characteristics (measured by road characteristics and marketing services) and household characteristic (measured by sex of household (male-headed household)) are highly significant and positively affecting household food security status, and as expected, they were significantly and positively influencing the probability of household food security.

[Table 5](#) presents the value of logistic regression, where household food security status is a dependent variable and the core explanatory variables are family labor, agricultural land owned, livestock owned, nonfarm income and village characteristics (measured by road characteristics and market services). [Table 5](#) shows that when using family labor as an indicator of family composition, the results were similar to those found in [Table 1](#), except the effect of the sex of household head, which was insignificant. [Table 5](#) indicates that family labor, agricultural land owned, livestock owned, non-farm income and village characteristics (measured by road characteristics and marketing services) are highly significant and positively affecting household food security status and probability of household food security.

Our results presented in [Tables 3–5](#) show that all model estimates are good and have no econometric problems. Our results are useful from policy perspective, for instance, our model estimates in [Tables 3](#) and [4](#) include variables related to policy issues such as land tenure and reformulation, animal husbandry, non-farm activities, physical infrastructure and government procedures related to market regulation. Moreover, our result in [Table 3](#) regarding the impact of gender issue was significant and consistent with the results in the international literature and consistent with the prevailing situation in Sudan and other developing countries. For instance, our results are consistent with the results regarding the relationship between food security and households family size in Nigeria (cf. [Owoo, 2020](#)) and food security land size in Ghana (cf. [Mustapha *et al.*, 2016](#)).

5.2 *Adaptation and survival strategy*

We find that the majority and more than half of households (57.5 and 55%) worried of not having enough food in the past seven days and in the past month, respectively. We realize that the adaptation and survival strategy and the numerous actions adopted by households

Table 5.
The results of logistic
regression model
(household food
security status is
dependent)

Explanatory variables	Coefficients	z-statistic	Prob
C	−5.639***	4.62-	0.000
Family labor	0.388*	1.77	0.077
Agricultural land owned	0.232***	2.91	0.004
Livestock owned (TLU)	0.076*	1.68	0.092
Nonfarm income	0.345**	2.28	0.022
Road characteristics	0.298***	2.91	0.004
Market services	0.218**	2.12	0.034
Log likelihood	230.655-		
LR(stat)	48.55	LR. Prob	(0.0000)
Number of observations		467	
Note(s). ***, ** and * indicate significant at the 1, 5 and 10% level, respectively			

to face expected decrease of food are quite consistent in the past seven days and in the past month. Mainly, in the past seven days and in the past month, the adaptation and survival strategy and the various actions adopted by households to face expected decrease of food includes, for instance, reliance on less preferred and or less expensive food, limit portion size at meal times, reduce meals eaten in a day, restrict consumption by adults for small children to eat and borrow food or rely on help from friend or relatives (Table 6 and Figure 4).

6. Conclusions and policy recommendations

This paper provides significant contribution to the Sudanese and international literature because it discusses the incidence of food insecurity in Kassala State in Eastern Sudan.

Measurement of HFIAS in Kassala State verifies the incidence of food insecurity that appears from the fact that the majority of households eat just a few kind of food (69%), unable to eat preferred food (68.5%), eat food really do not eat (66.3%), eat smaller amounts in meal (62.1%), eat fewer meals in a day (59.5%), worry about not having enough food (58.8%), no food of any kind in household (52.2%), while some households go to sleep hungry at night (40.4%) and go a whole day and night without food (32.1%) respectively.

Our results discuss the measurement of HFIAS and indicate that few and less than a quarter of households are food-secure (23%) in Kassala State. We find that the majority and more than three-quarters of household are food-insecure (77%), in particular, the majority of households are severe food-insecure (32.9%), while other households are either moderately food-insecure (29%) or mildly food-insecure (15.1%), respectively. We observe serious discrepancies concerning households' food insecurity access scale by localities in Kassala State. For instance, HFIAS implies that food insecurity is a very serious problem in RK because all households in RK suffer from either severe or moderately food-insecure (100%), different from RK, less than half of households suffer from either severe or moderately food-insecure in RA (47.5%), and nearly half of households suffer from either severe or moderately food-insecure in NH (52.8%), in KL (53.3%) and in WL (55.7%). The observed discrepancies in food insecurity by localities can be explained in relation to the observed discrepancies in the

1. Actions adopted by households to face expected decrease of food in the past seven days

Actions	Zero days		1–2 days		3–4 days		5–7 days	
	N	%	N	%	N	%	N	%
Rely on less preferred and or less expensive food	89	25.6	95	27.3	98	28.2	66	18.9
Limit portion size at meal times	158	46.9	109	31.8	54	16	18	5.3
Reduce meals eaten in a day	154	45.7	114	33.8	51	15.2	18	5.3
Restrict consumption by adults for small children to eat	205	65.5	60	19.1	28	8.9	20	6.5
Borrow food or rely on help from friend or relatives	184	61.5	73	24.4	30	10.1	12	4

2. Actions adopted by households to face expected decrease of food in the past month

Actions	Zero days		1–7 days		8–15 days		More than 15 days	
	N	%	N	%	N	%	N	%
Rely on less preferred and or less expensive food	84	25.3	123	37	87	26.3	38	11.4
Limit portion size at meal times	129	39.6	116	35.6	65	19.9	16	4.9
Reduce meals eaten in a day	125	38	101	30.7	83	25.2	20	6.1
Restrict consumption by adults for small children to eat	172	54.4	86	27.3	43	13.6	15	4.7
Borrow food or rely on help from friend or relatives	143	47.1	97	32.1	56	18.5	7	2.3

Source(s): Authors' calculations based on [Food Security Household Survey in Kassala State \(2019\)](#)

Table 6.
Household adaptation
and survival strategy

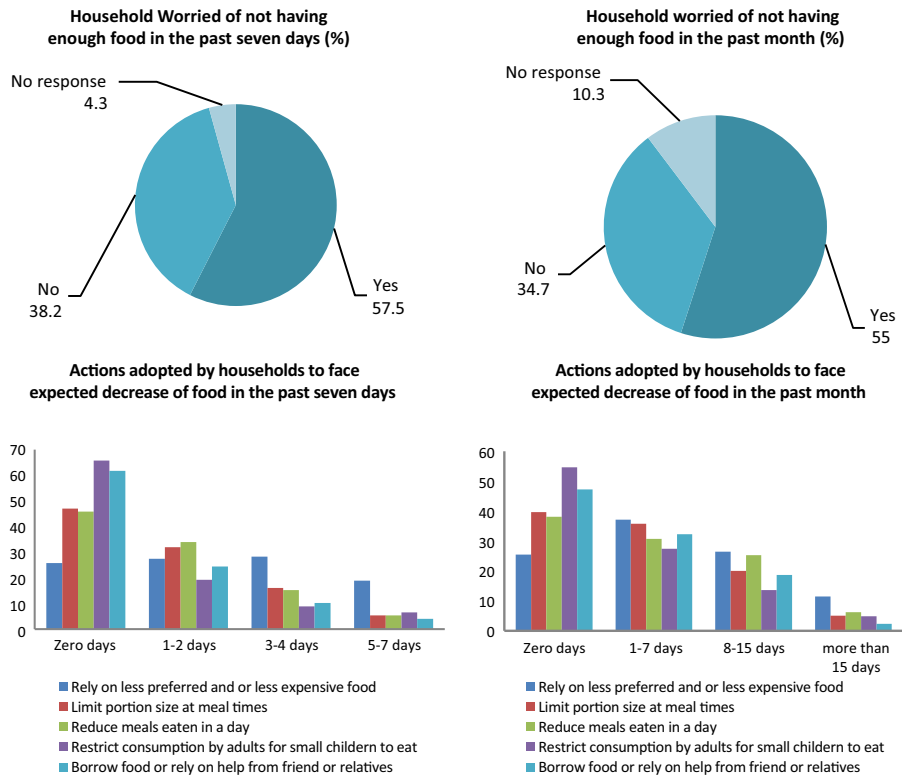


Figure 4.
Household adaptation
and survival strategy

Source(s): Authors' calculations based on Food Security Household Survey in Kassala State (2019)

distribution of monthly income in localities. Therefore, the major policy implications from our results suggest the importance of improving households' income level to eliminate food insecurity in Kassala State. Therefore, we recommend increasing households income to enhance food security in Kassala State.

We find that the majority and more than half of households worried of not having enough food in the past seven days and in the past month, respectively. We realize that the adaptation and survival strategy and the numerous actions adopted by households to face expected decrease of food are quite consistent in the past seven days and in the past month. Mainly, in the past seven days and in the past month, the adaptation and survival strategy and the various actions adopted by households to face expected decrease of food includes for instance, reliance on less preferred and or less expensive food, limit portion size at meal times, reduce meals eaten in a day, restrict consumption by adults for small children to eat and borrow food or rely on help from friend or relatives. Therefore, we recommend supporting the adaptation and survival strategy to enhance food security in Kassala State and in Sudan.

Our results regarding the widespread occurrence of food insecurity in Kassala State in Sudan are consistent with the earlier results in the international literature in developing countries. Mainly, the widespread occurrence of food insecurity in Ethiopia (cf. [Mota et al., 2019](#); [Ramakrishna and Demeke, 2002](#)), in Ghana (cf. [Mustapha et al., 2016](#)), in Nigeria (cf. [Otaha, 2013](#); [Owoo, 2020](#)) and India (cf. [Reddy, 2016](#); [Reddy et al., 2016](#)). In particular, our finding concerning the high incidence of food insecurity using the HFIAS in Kassala State in

Sudan is consistent with the findings concerning the high incidence of food insecurity using the HFIAS in Ethiopia (cf. [Mota et al., 2019](#)).

We use logistic regression to investigate the factors that determine food security. Our results show that the major determinant factors that affect the household food security include the family composition (measured by dependency ratio, family size and household labor), household characteristic (measured by sex of household head), farm size or the size of agricultural land owned, agricultural land owned, livestock owned, non-farm income and village characteristics (measured by road characteristics and market services) ([Tables 3–5](#)). Our findings are consistent with the findings in the international literature regarding the relationship between food security and dependency ratio in Ethiopia ([Sisha, 2020](#)), in Nigeria ([Omotesho et al., 2014](#)) and in Nepal ([Maharjan and Khatri-Chhetri, 2006](#)). Our results are consistent with the results in the international literature concerning the relationship between food security and family size in Nepal ([Maharjan and Khatri-Chhetri, 2006](#)) and in Nigeria ([Omotesho et al., 2014](#)). Our findings are consistent with the findings in the international literature regarding the relationship between food security and household labor in Nigeria ([Omotesho et al., 2014](#)). Our results are consistent with the results in the international literature concerning the relationship between food security and farm size in Nepal ([Maharjan and Khatri-Chhetri, 2006](#)) and in Nigeria ([Omotesho et al., 2014](#)). Moreover, our findings are consistent with the findings in the international literature that gender played a dominant role in food insecurity as female-headed households were food-insecure, while male-headed households were food-secure in Pakistan (cf. [Abdullah et al., 2017](#)) and in Nigeria ([Omotesho et al., 2014](#)). Our results are consistent with the results in the international literature concerning the importance of the adaptation and survival strategy ([Bertelli and Macours, 2014](#); [Coates et al., 2006](#); [Maxwell, 1995](#); and [Bonanno and Li, 2011](#)).

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Notes

1. See [Barrett \(2010\)](#), pp. 825–826.

2. See [Tiwari et al. \(2013\)](#), p. 11.
3. Eating foods that are less preferred, limiting portion size, borrowing food or money to buy food, buffering in favor of another member, skipping meals and skipping eating for whole days. The author then develops a relative frequency scale such that the higher the number, the less frequently the strategy is used.
4. See [Bertelli and Macours \(2014\)](#), p. 4.
5. We use the definition of HFIAS used in the international literature (e.g. [Tiwari et al., 2013](#)). HFIAS captures the changes in food consumption patterns and reflects the severity of food insecurity faced by households during a recall period of 30 days due to lack of or limited resources to access food. It is composed of nine questions; each question has four response options: never, rarely, sometimes and often, which are coded 0, 1, 2 and 3 in order of increasing frequency. Responses to these nine questions are summed to construct a food insecurity score, with a maximum score of 27 indicating most food-insecure households (see [Tiwari et al., 2013](#), p. 11).
6. We use the measurement of HFIAS defined in four groups: food-secure HFIAS (0–1), mildly food-insecure HFIAS (2–7), moderately food-insecure HFIAS (8–14) and severe food-insecure, HFIAS (15–27).

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About the authors

Prof Dr Samia Satti Osman Mohamed Nour was a Visiting Professor of Economic and Research Fellow at the Department of Economics (CSAE), University of Oxford, UK (January 2020–March 2020). Professor Nour is a Full Professor of Economics at the Department of Economics, Faculty of Economic

and Social Studies, University of Khartoum, Sudan. She is a member of the University Senate and the Faculty Board. Prof Nour is the first female professor in the Faculty of Economic and Social Studies, University of Khartoum, since its establishment in 1958; first female professor of Economics, in the Department of Economics, Faculty of Economic and Social Studies, University of Khartoum, since the establishment of the Department of Economics; and also the first new professor of Economics in the Department of Economics, University of Khartoum, since the mid of 1970s. Currently, she is an Affiliated Researcher at the United Nations University, Maastricht Economic and Social Research Institute on Innovation and Technology (UNU-MERIT), Maastricht, The Netherlands. She is an Affiliated Research Fellow of the African Studies Centre Leiden (ASC), Leiden University, Leiden, The Netherlands. At the Department of Economics, Khartoum University, she teaches Macroeconomics, Microeconomics, Development Economics, Development Planning, Labor Economics, Monetary Economics and International Economics. She is the author of several papers published in international refereed journals; she is the author of four books, including: *Economic Systems of Innovation in the Arab Region* (Palgrave Macmillan, USA, 2016), *Information and Communication Technology in Sudan: An Economic Analysis of Impact and Use in Universities* (Springer, Switzerland, 2015), *Technological Change and Skill Development in Arab Gulf Countries* (Springer, Switzerland, 2013) and *Technological Change and Skill Development in Sudan* (Springer, Germany, 2013). She is the co-author of the Arab States Chapter of the UNESCO Science Report in the World (2015). Prof Nour's main research interests are in the fields of Economics, Economics of Innovation and Technological Change, Macroeconomics, Microeconomics, International Economics, Labor Economics, Development Economics, Inclusive Growth and Sustainable Development, Endogenous Growth, Human Capital and Knowledge Economy. Samia Satti Osman Mohamed Nour is the corresponding author and can be contacted at: samiasatti@yahoo.com

Dr Eltayeb Mohamedain Abdalla is an Associate Professor, Department of Economics, Faculty of Economic and Administrative sciences, University of Kassala, Sudan, from August 2017 up to now; he obtained his PhD in Economics, from the faculty of Trade Studies, Sudan University of Technology and Sciences, 2008, Sudan; his teaching and research interest includes Microeconomics, Macroeconomics, Public Finance, International Economics, Monetary Theory and Development Economics.