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The Role of Contract Farming in Improving Agricultural Production and Household Food Security in North Kordofan State, Sudan

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Abstract

This study aimed to assess the role of contract farming in improving agricultural production and household food security in North Kordofan State, Sudan. The study was conducted in shiaken and Elrahad localities, primary data was collected through structured questionnaire distributed to 138 households selected through cluster random sampling. Descriptive statistics and Household Economy Approach (HEA) were employed to analyze the data and assess household food security. The results revealed that 80.4% of respondents relied on local seeds, while only 19.6% used improved seeds. Furthermore, 55.8% did not apply seed treatment, and 88.4% depended on manual harvesting. Regarding contractual arrangements, 74.6% of respondents reported having no written contracts, while 75.4% expressed dissatisfaction with existing contracts, indicating weaknesses in contractual relationships. Despite these challenges, household food consumption increased from 30.61 kg before contract farming to 51.57 kg afterward, representing an increase of approximately 68.5%. The results showed that food security threshold for household before contract farming was 2,455 kilocalories per person per day,so the person was marginally food insecure and for the households after contract farming was 3,486 kilocalories per person per day so the person was food secured, an increase of approximately 42.0%. In addition, consumption of meat increased from 1.12 kg to 3.87 kg, representing an increase of approximately 245.5%, while milk consumption increased from 1.16 kg to 2.30 kg, an increase of approximately 98.3%. Total household food expenditure increased from SDG 57,900 to SDG 67,300, representing an increase of approximately 16.2%. These findings suggest improvements in household food consumption and dietary quality following participation in contract farming. The study concludes that contract farming has the potential to contribute to household food security; however, improving contractual transparency, expanding access to improved seeds and agricultural inputs, strengthening extension services, and promoting modern farming technologies are essential to maximize its benefits. Further statistical analysis is required to establish the significance of the observed changes and determine the extent to which they can be attributed to contract farming.

Keywords:

Contract Farming, Household Economy Approach, Food Security, North Kordofan State.

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INTRODUCTION

Agriculture plays a vital role in Sudan's economy and rural development, providing a major source of income, employment, food, and livelihood for a large proportion of the population. It also contributes to poverty reduction, food availability, and the overall welfare of rural households. Despite its importance, the agricultural sector faces numerous challenges, including high production costs, limited access to improved agricultural inputs, inadequate financing, marketing difficulties, price fluctuations, and insufficient access to agricultural extension services and modern technologies. These constraints can reduce agricultural productivity, weaken farmers' competitiveness, and limit their capacity to improve household income and achieve sustainable food security. Contract Farming has emerged as a potential institutional arrangement for strengthening the relationship between farmers and buyers and improving the integration of smallholder farmers into agricultural markets. Through contractual arrangements, farmers may gain better access to agricultural inputs, technical assistance, production finance, and reliable marketing channels. Such arrangements can also contribute to reducing marketing uncertainties, improving production planning, and enhancing farmers' bargaining power. By improving market access and income opportunities, Contract Farming may contribute to better household food consumption, dietary diversity, and nutritional well-being. However, the effectiveness of this arrangement depends on the quality of contractual relationships, the reliability of contracting parties, the availability of production inputs, and the fairness of pricing and marketing conditions.

The importance of Contract Farming is particularly evident in North Kordofan State, where agriculture constitutes an important livelihood activity for rural communities. Farmers in the state face several production and marketing constraints, including limited use of improved seeds, inadequate application of seed treatment, continued dependence on traditional planting and harvesting methods, and limited access to agricultural machinery and modern production technologies. These challenges may affect production efficiency, increase farmers' vulnerability to agricultural risks, and restrict their ability to generate sufficient income. Furthermore, weaknesses in agricultural marketing systems and limited access to reliable markets may expose farmers to price instability and reduce the economic benefits derived from agricultural production. Household food security is an essential indicator of rural welfare and sustainable development. It involves not only the availability of sufficient food but also households' physical and economic access to safe, nutritious, and diverse food throughout the year. Household food consumption, dietary diversity, and daily per capita caloric intake are important indicators for assessing the quantity and quality of food available to household members. Improvements in agricultural productivity, household income, and access to markets may enhance food security by increasing households' ability to obtain adequate quantities and varieties of food. Therefore, examining the relationship between Contract Farming and household food security is important for understanding its potential contribution to improving the living conditions of agricultural households. Despite its potential benefits, Contract Farming does not

automatically guarantee improved agricultural performance or household food security. The absence of written contracts, dissatisfaction with contractual arrangements, limited access to agricultural inputs, and weak bargaining power may restrict the benefits farmers receive from participation. Understanding these challenges is essential for evaluating the effectiveness of Contract Farming and identifying measures that can strengthen its contribution to rural development and food security. Against this background, this study assesses the role of Contract Farming in improving agricultural production and household food security in North Kordofan State, Sudan. It examines farmers' socioeconomic characteristics and agricultural production practices, evaluates contractual relationships and marketing arrangements, and investigates changes in household food consumption, dietary diversity, and average daily per capita caloric intake before and after participation in Contract Farming. The findings indicate that total food consumption increased from 30.61 kg before participation to 51.57 kg after participation, while average daily per capita caloric intake increased from 2,455 kcal to 3,486 kcal. These changes suggest an improvement in food consumption among participating households, although further statistical analysis is necessary to determine the significance of the differences and the extent to which they can be attributed to Contract Farming.

Literature Review:

Concept and Nature of Contract Farming

Contract farming is an agricultural production and marketing arrangement in which farmers and buyers agree in advance on the production and supply of agricultural products under specified conditions. These agreements may cover production quantities, product quality, delivery schedules, prices, and the provision of agricultural inputs and technical services. Contract farming has become increasingly important in developing countries as a mechanism for linking smallholder farmers to markets and improving the coordination of agricultural value chains (Otsuka et al., 2016). According to Prowse (2012), contract farming can provide farmers with access to inputs, credit, extension services, and more reliable marketing opportunities. However, its effectiveness depends on the institutional environment, the nature of contractual relationships, and the capacity of both farmers and contracting firms to fulfill their obligations. Contract farming may therefore be viewed not only as a marketing arrangement but also as a mechanism for organizing agricultural production and facilitating farmers' participation in commercial markets.

Contract Farming and Agricultural Production

Contract farming can contribute to improving agricultural production by facilitating access to improved seeds, fertilizers, production technologies, technical advice, and other essential inputs. These services may encourage farmers to adopt improved production practices, increase productivity, and improve the quality of agricultural output. Otsuka et al. (2016) reviewed evidence from developed and developing countries and concluded that contract farming can improve production efficiency and

farmers' income, particularly when it introduces new crops and improved production methods. Nevertheless, the benefits of contract farming are not uniform across agricultural settings. Farmers' ability to benefit depends on the quality of the services provided, the suitability of recommended technologies, and the reliability of the contracting arrangement. Prowse (2012) also emphasized the importance of understanding the conditions under which smallholder farmers are included in or excluded from contractual schemes. In areas such as North Kordofan State, where farmers may face constraints in accessing improved seeds, agricultural machinery, and extension services, contract farming could offer an opportunity to strengthen production practices. However, its contribution should be assessed in relation to the actual inputs and services received by participating farmers.

Contract Farming, Marketing, and Household Income

Access to markets and the ability to obtain remunerative prices are important determinants of smallholder farmers' economic welfare. Contract farming may reduce some marketing uncertainties by establishing purchasing arrangements before production or harvest. It may also facilitate coordination between producers and buyers, improve access to market information, and reduce the difficulties associated with selling agricultural products. These benefits are particularly relevant to smallholder farmers who have limited bargaining power and face high transaction costs when accessing formal markets (Prowse, 2012). Empirical evidence also suggests that participation in contract farming can be associated with improved household income. Bellemare (2012), using data from several regions, firms, and crops in Madagascar, found that a higher likelihood of participation in contract farming was associated with higher household income. However, the author highlighted the methodological challenge of distinguishing the actual effects of participation from differences between farmers who choose to participate and those who do not. This finding indicates that contract farming may improve farmers' economic welfare, although the magnitude of its benefits depends on the contractual conditions and the characteristics of participating households. The income effects of contract farming are important because household income influences the ability to purchase food, agricultural inputs, healthcare, and other essential goods and services. Nevertheless, higher income does not automatically guarantee improved household welfare if farmers face high production costs, delayed payments, unfair pricing arrangements, or limited control over their agricultural decisions.

Contract Farming and Household Food Security

Household food security is closely related to agricultural income, food availability, market access, and the purchasing power of household members. Contract farming may contribute to food security through several pathways, including increased agricultural income, improved access to markets, reduced marketing risks, and better access to production inputs and technical services. These improvements may increase households' ability to obtain sufficient food and maintain more stable consumption

throughout the year. Recent empirical research has examined the relationship between contract farming and household food security more directly. Debela et al. (2022) investigated the effects of contract farming on diets and nutrition in Ghana's palm oil sector. Their findings indicated that contracting could improve smallholder nutrition, although the effects varied according to the type of contract. This suggests that the specific services and obligations included in contractual arrangements may influence whether increased commercial agricultural activity translates into improved household nutrition. Similarly, a study by Ndip et al. (2026) on rice-producing households in Senegal examined the relationship between contract farming and dietary diversity. The findings indicated a positive association between participation in contract farming and household dietary diversity, with household income identified as an important pathway linking contractual participation to diet quality. These findings highlight the potential contribution of contract farming to nutrition-sensitive agricultural development, while also demonstrating the importance of examining food consumption outcomes rather than relying exclusively on income or production indicators. The relationship between contract farming and food security is particularly relevant to agricultural households in North Kordofan State. Assessing changes in household food consumption and daily per capita caloric intake can help determine whether participation is associated with improvements in the quantity of food consumed. Dietary diversity provides an additional indicator of the variety of foods available to households. Examining these indicators together offers a broader understanding of household food security than agricultural production or income measures alone.

Contract Farming and Dietary Diversity

Dietary diversity refers to the variety of food groups consumed by individuals or households over a specified period. It is an important indicator of diet quality because the consumption of different food groups can reflect access to a wider range of nutrients. Although agricultural commercialization may increase household income, its nutritional consequences depend on how additional income is allocated and whether households can access diverse and nutritious foods.

Ndip et al. (2026) examined whether contract farming involving staple crops could improve diet quality among rice-producing households in Senegal. Their findings showed a positive relationship between contract farming and household dietary diversity, suggesting that income generated through contractual participation may help households access a wider variety of foods. The study is relevant because it demonstrates that the relationship between agricultural commercialization and nutrition is not limited to high-value or specialized crops. However, dietary outcomes may vary according to household characteristics, local food availability, market conditions, and the structure of contractual arrangements. Contract farming may also influence household food consumption indirectly through changes in income, labor allocation, and the crops cultivated for sale. Therefore, assessing dietary diversity alongside total food consumption and caloric intake is important for evaluating the contribution of contract farming to household food security.

Challenges and Limitations of Contract Farming

Despite its potential benefits, contract farming may expose farmers to several institutional and economic challenges. These include unclear contractual terms, unequal bargaining power, delayed payments, price disagreements, limited transparency, and difficulties in enforcing agreements. The absence of written contracts may make it more difficult for farmers to understand their rights and obligations or resolve disputes with buyers.

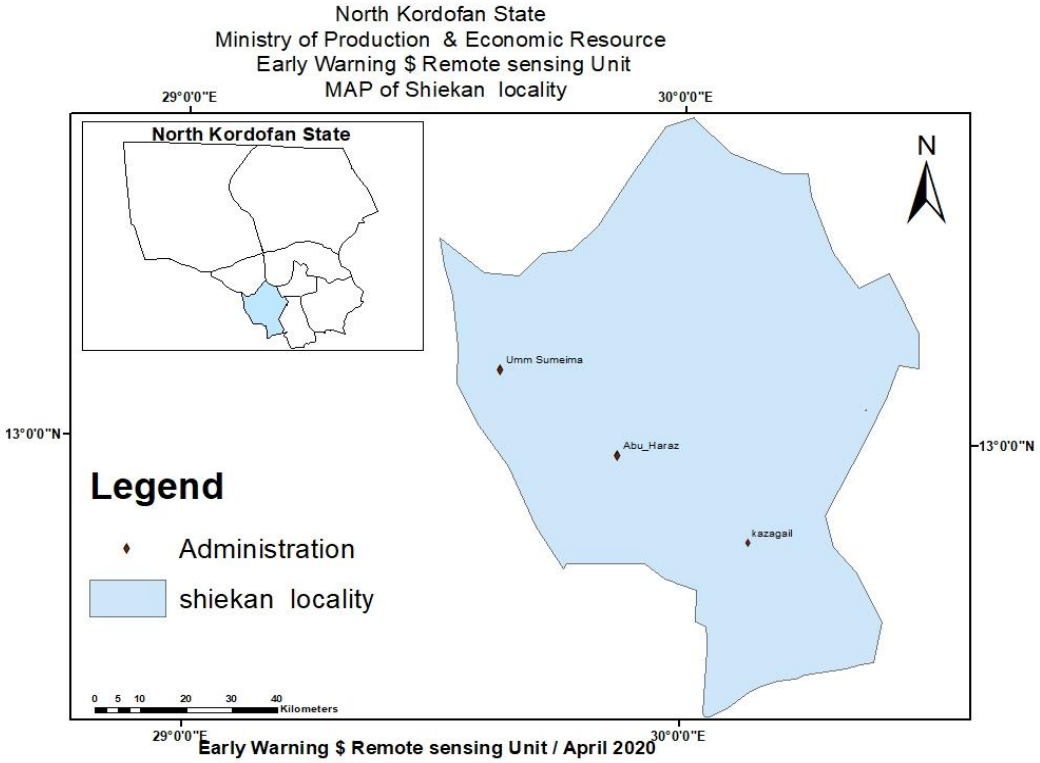
Prowse (2012) reviewed contract farming experiences in developing countries and highlighted the importance of contractual design, institutional support, and the management of risks in determining the success or failure of these arrangements. Similarly, Otsuka et al. (2016) noted that although contract farming can improve farmers' income and production efficiency, its contribution to poverty reduction can be strengthened through appropriate policies and institutional arrangements. Bellemare (2012) also demonstrated the importance of accounting for differences between participating and non-participating farmers when evaluating the effects of contract farming. This issue is particularly important because farmers who participate may differ in their resources, education, market access, and production capacity before entering a contractual arrangement.

STUDY AREA AND RESEARCH METHODOLOGY

STUDY AREA

North Kordofan State is located in the west-central part of Sudan and represents an important agricultural region within the country's Gum Arabic Belt. The state is characterized by arid and semi-arid climatic conditions, with seasonal and irregular rainfall that generally increases from the northern to the southern areas. Annual rainfall varies considerably across the state, influencing crop selection, agricultural productivity, and farmers' livelihoods. The region contains different soil types, including sandy Goz soils, Gardud soils, clay soils, and alluvial soils, which support the cultivation of millet, sorghum, sesame, groundnuts, and watermelon, as well as Gum Arabic production from *Acacia senegal*. Agriculture and livestock production constitute important sources of income and food for rural households, although farmers face several challenges, including limited water availability, inadequate access to improved seeds and agricultural machinery, weak extension services, limited financing, and difficulties in accessing reliable markets. According to Sudan's 2008 Population and Housing Census, the state had approximately 2.92 million inhabitants. This study was conducted in three selected areas: Kazagail, Abu Haraz, and Um Simaima, which had a combined total of 22,825 households. A sample of 138 households was selected, comprising 40 households from Kazagail, 62 from Abu Haraz, and 36 from Um Simaima. Land tenure arrangements, access to natural resources, and agricultural marketing conditions are important factors influencing farmers' production decisions and investment opportunities. In this context, contract farming may provide opportunities to improve access to agricultural inputs, strengthen relationships between farmers and buyers, facilitate market access, and enhance household income and food

security. Therefore, North Kordofan State provides a relevant setting for examining the role of contract farming in agricultural production and household food security (Sudan Central Bureau of Statistics, 2008; Ahmed et al., 2024; Hamad et al., 2021).



RESEARCH METHODOLOGY

This study relied on both primary and secondary data sources. Primary data were collected through a field survey using a cluster random sampling technique, where structured household questionnaires were administered. Secondary data were obtained from relevant previous studies, research reports, and published literature. The total sample size of the study was 138 randomly selected households from the study area. For data analysis, descriptive statistics were used to summarize and organize the data by describing relationships between variables in a clear and systematic manner. These statistics included measures of frequency, central tendency, dispersion, and variable classification (nominal, ordinal, interval, and ratio). Descriptive analysis was applied as an initial step to simplify the data and support interpretation, particularly for decision-making purposes in relation to population characteristics (Kaur *et al*., 2018). In addition, the Food Energy Intake (FEI) approach was used to assess household food security status. This method involves two main procedures: the first is a simple approach based on selecting a sub-sample of households whose income or expenditure is close to the recommended calorie level and calculating their average intake to estimate food insecurity levels; the second is a regression-based approach that relates household food expenditure (cost of food basket) to its calorie equivalent, thereby allowing estimation of food consumption adequacy. Although the FEI method incorporates non-food basic needs implicitly, it has some limitations (Ravallion, 1995).

According to Stephen (2006), food security levels can be classified based on daily per capita calorie intake, where households consuming 2400 calories and above are considered food secure, 2100–2399 marginally insecure, 1800–2099 moderately food insecure, 1500–1799 severely food insecure, and less than 1500 very severely food insecure.

RESULTS AND DISCUSSION

Educational Level:

Table shows the distribution of respondents according to their educational level, the results indicate that primary education constituted the largest category, with 69 respondents (50.0%). Illiterate respondents accounted for 21 individuals (15.2%), while 17 respondents (12.3%) had attained secondary education. Intermediate education represented 16 respondents (11.6%), and 9 respondents (6.5%) had received education through Khalwa (traditional religious schools). University graduates accounted for only 5 respondents (3.6%), while one respondent (0.7%) belonged to another educational category, these findings suggest that the majority of respondents possessed basic educational qualifications, with relatively few having attained higher education.

Table (1): Distribution of respondents by educational level

Educational Level	Frequency	Vialled Percent
Illiterate	21	15.2
Khalwa	9	6.5
Primary School	69	50.0
Intermediate School	16	11.6
Secondary School	17	12.3
University	5	3.6
Other	1	0.7
Total	**138**	**100.0**

Source: Field Survey, 2025.

Main Occupation:

The table shows that the majority of the respondents were engaged in self-employment (65.2%), followed by farming (24.6%), trading (6.5%), and government employment (3.6%). These findings indicate that most of the respondents were involved in self-employed and productive economic activities.

Table (2): Distribution of Respondents by main occupation

main Occupation	Frequency	Vialled Percent
Self-employed	90	65.2
Trader	9	6.5
Government Employee	5	6.3
Farmer	34	24.6
Total	**138**	**100.0**

Source: Field Survey, 2025.

Written Contract:

Table 3 shows that the majority of the respondents did not have a written contract, accounting for 74.6%, while 25.4% reported having a written contract. These findings indicate that unwritten contractual arrangements are more common among the respondents, reflecting limited reliance on written contracts in regulating contractual relationships.

Table (3): Distribution of Respondents by Written Contract

Items	Frequency	Vialled Percent
yes	35	25.4
No	103	74.6
Total	**138**	**100.0**

Source: Field Survey, 2025

Contract satisfactory:

The results presented in table (4) indicated that 75.4% of the respondents reported that they were not satisfied with the contract, while only 25.6% expressed satisfaction with it. These findings suggest that a large proportion of the respondents believe that the current contracts didn't meet their expectations or provide the desired benefits. This may reflect shortcomings in the contract terms and conditions or in the mechanisms used for their implementation.

Table (4): Distribution of Respondents by contract satisfactory

Items	Frequency	Vialled Percent
yes	34	25.6
No	104	75.4
Total	**138**	**100.0**

Source: Field Survey, 2025

Adoption of Crop Rotation:

The results in table (5) showed that 98.6% of the respondents adopted crop rotation, while only 1.4% didn't practice crop rotation. This indicated a high level of adoption among farmers, reflecting their awareness of the importance of crop rotation in maintaining soil fertility and improving agricultural productivity.

Table (5): Adoption of Crop Rotation

Items	Frequency	Vialled Percent
yes	136	98.6
No	2	1.4
Total	**138**	**100.0**

Source: Field Survey, 2025

Continuous Cultivation of the Same Crop:

The results in table (6) indicated that 82.6**%** of the respondents practice continuous cultivation of the same crop, while 17.4**%** do not follow this practice. This finding shows that a large proportion of farmers cultivated the same crop repeatedly, which may be associated with market preferences, availability of production inputs, and farmers' experience with specific crops.

Table (6): Continuous Cultivation of the Same Crop

Items	Frequency	Vialled Percent
yes	114	82.6
No	24	17.4
Total	**138**	**100.0**

Source: Field Survey, 2025

Total	**138**	**100.0**

Source: Field Survey, 2025

Type of Improved Seeds:

The results in table (7) indicated that 80.4% of respondents used local seeds, while only 19.6% used improved seeds. This showed that the majority of the farmers still depend on traditional local seed varieties, which may be due to farmers' familiarity with these varieties, lower cost, and easier availability compared with improved seeds.

Table (7): Type of Improved Seeds

Items	Frequency	Vialled Percent
Local Seeds	111	80.4
Improved Seeds	27	19.6
Total	**138**	**100.0**

Source: Field Survey, 2025

Sesame Variety Cultivated:

The results in table (8) showed that Red Sesame was the most cultivated variety among respondents, accounting for 37.0%, followed by White Sesame at 17.4% and Harahri Sesame at 16.7%. Jabrouk Sesame represented 10.1%, while Abu Sandouq Sesame accounted for 8.7%. The use of Local Sesame was 6.5%, whereas Abu Na'amah Sesame recorded the lowest percentage at 3.6%.

Table (8): Sesame Variety Cultivated

Items	Frequency	Vialled Percent
Local Sesame	9	6.5
Red Sesame	51	37.0
White Sesame	24	17.4
Harahri Sesame	23	16.7
Jabrouk Sesame	14	10.1
Abu Sandouq Sesame	12	8.7
Abu Na'amah Sesame	5	3.6
Total	**138**	**100.0**

Source: Field Survey, 2025

Groundnut Varieties Cultivated:

The results in table (9) indicated that Local Groundnut (Peanut) was the most cultivated variety among respondents, accounting for 71.7% of the total sample. This was followed by Gubeish Groundnut with 17.4%, while Sodari Groundnut represented 8.7%. Abu Amsa'dein Groundnut recorded the lowest percentage at 0.7%.

Table (9): Groundnut Varieties Cultivated

Items	Frequency	Vialled Percent
Local Groundnut (Peanut)	99	71.7
Gubeish Groundnut	24	17.4

Sudri Groundnut	12	8.7
Abu Amsa'dein Groundnut	1	.7
Total	**138**	**100.0**

Source: Field Survey, 2025

Use of Seed Treatment:

The results in table (10) indicated that 55.8% of respondents don't use seed treatment, while 42.0% of farmers use seed treatment before planting. This finding showed that more than half of the farmers don't apply seed treatment, which may be due to limited awareness, lack of access to treatment materials, or the additional cost associated with seed treatment. On the other hand, the adoption of seed treatment by 42.0% of farmers indicated a growing awareness of its importance in protecting seeds from pests and diseases and improving crop establishment and hence increases productivity.

Table (10): Use of Seed Treatment

Items	Frequency	Vialled Percent
yes	58	42.0
no	77	55.8
Total	**138**	**100.0**

Source: Field Survey, 2025

Methods of Planting:

The results in table (11) indicated that 93.5% of respondents use the method of ploughing and broadcasting for planting, while 3.6% use ploughing and mechanical planting. Only 2.2% of farmers practice traditional planting methods. The findings reveal that ploughing and broadcasting is the dominant planting method among farmers in the study area. This may be attributed to its simplicity, lower cost, and suitability to the prevailing farming conditions. The limited use of mechanical planting may be related to the high cost of machinery, limited availability of agricultural equipment, and farmers' dependence on traditional production systems.

Table (11): Methods of Planting

Items	Frequency	Vialled Percent
Traditional Planting	3	2.2
Ploughing and Broadcasting	129	93.5
Ploughing and Mechanical Planting	5	3.6
Total	**138**	**100.0**

Source: Field Survey, 2025

Harvesting Method:

The results in table (12) showed that 88.4% of respondents used manual harvesting, while 9.4% used a combination of manual and mechanical harvesting. Only 2.2% of farmers depend on mechanical harvesting. The findings indicated that manual harvesting is the dominant method among farmers in the study area. This may be attributed to the availability of family labor, lower harvesting costs, and limited access to agricultural machinery. The low adoption of mechanical harvesting may be related to the high cost of machinery, lack of availability, and the small size of farms.

Table (12): Harvesting Method

Items	Frequency	Vialled Percent
Mechanical Harvesting	3	2.2
Manual Harvesting	122	88.4
Manual and Mechanical Harvesting	13	9.4
Total	**138**	**100.0**

Source: Field Survey, 2025

Appropriate Time for Marketing:

The results in table (13) indicated that 70.3% of respondents consider December as the most appropriate time for marketing their crops, followed by 17.4% who prefer January. Meanwhile, 5.1% of farmer's market their crops in February and the same percentage (5.1%) in April. The lowest percentage was recorded for March, with only 2.2% of respondents. The findings show that most farmers prefer marketing their crops during December, which may be due to the availability of harvested products, farmers' need for immediate cash after harvest, and favorable market conditions during this period. The variation in marketing times may reflect differences in crop storage capacity, price expectations, and farmers' financial needs.

Table (13): Appropriate Time for Marketing

Items	Frequency	Vialled Percent
December	97	70.3
January	24	17.4
February	7	5.1
March	3	2.2
April	7	5.1
Total	**138**	**100.0**

Source: Field Survey, 2025

Household Food Security Situations:

Food security, as defined by Bichel (2000), refers to condition in which all individuals, at all times, have physical and economic access to sufficient, safe, and nutritious food necessary for an active and healthy life. This concept includes two main components: the availability of nutritionally adequate and safe foods, and the ability of households to acquire these foods through socially acceptable means without resorting to emergency measures or coping strategies. The empirical results of household food consumption before and after Contract Farming presented in (Table 15) demonstrates a significant improvement in both the quantity and diversity of food intake among the study population. In terms of stable food, cereal consumption increased substantially, with wheat increasing from 3.19 kg to 5.60 kg, sorghum from 3.39 kg to 4.90 kg, and millet from 2.50 kg to 5.65 kg. This trend indicates enhanced availability and access to basic staple foods for households, thereby addressing the quantitative dimension of food security. In addition, improvements were observed in the consumption of animal-source foods. Meat intake showed marked improvement, and increased significantly from 1.12 kg to 3.87 kg. Similarly, milk consumption doubled from 1.16 kg to 2.30 kg, contributing to improved dietary quality and nutritional adequacy. Although vegetables and fruits continued to be consumed in relatively smaller quantities, also increased, indicating partial progress toward a more balanced diet. The observed increase in food consumption occurred alongside a rise in food expenditures from 57,900 SDG to 67,300 SDG, indicating that households were able to access and purchases these foods without relying on emergency or socially unacceptable coping strategies, aligning with Bichsel's definition and framework of food security.

Table (14): Quantities consumed/kg, cost/ SDG

Food Item	Quantities consumed/ kg After Contract Farming	Price/ SDG after finance	Quantities consumed/ kg Before Contract Farming	Price/ SDG before finance
Wheat	5.60	3,500	3.19	3,000
Sorghum	4.90	3.300	3.39	3,000
Millet	5.65	3,000	2.50	2,700
Rice	2.54	3,000	1.37	2,800
Meat	3.87	14,000	1.12	11,000
Okra	2.48	15,000	1.12	10,000
Tea	1.17	2,500	0.66	2,000
Milk	2.30	2,000	1.16	2,300
Sugar	5.14	3,400	3.23	3,500

Coffee	1.12	2,500	0.97	2,400
Macaroni	1.49	3,500	1.07	3,100
Oil	2.56	2,400	2.11	2,500
Onion	3.90	2,000	2.96	2,300
Lentils	5.90	3,500	3.77	3,000
Vegetable	1.96	2,000	1.18	1,800
Fruits	0.99	3,000	0.81	2,500
Total	**51.57**	**67,300**	**30.61**	**57,900**

Source: Field survey, 2024

Daily Caloric intake per person per day:

Table (16) illustrated the change in household consumption before Contract Farming in terms of quantities, caloric intake. The total weekly food consumption quantity amounted to 30.61 kg per household, providing a total of 120,302 kilocalories per week. On a daily household basis, consumption reached 17,186 kilocalories per day, at the individual level, each person received 2,204 kilocalories per day,so the person is marginally food insecure. Similarly, the findings in Table (17) present household food consumption after Contract Farming in terms of quantities, caloric intake. The total weekly food quantity increased to 51.57 kg per household, corresponding to ,828 kilocalories per week. On a daily household basis, consumption reached 24,404 kilocalories per day, at the individual level, each person consumed 3,410 kilocalories per day which indicated the person in the area became food secure.

These figures indicated that Contract Farming contributed to an increase in the energy intake per household and per individual compared to the pre-financing period. This reflects an improvement in households' purchasing power, enabling them to access a greater variety and quantity of food, including staple cereals, animal protein, legumes, vegetables, and fruits, thereby enhancing both the quantitative and qualitative aspects of household food security.

Table (16): Number of calories consumed/week/day before contract farming

Food Item	Quant/ Kg	Kilo Cal./kg.	Total k.cal consumed
Wheat	3.19	3,320	10590.8
Sorghum	3.39	3,350	11356.5
Millet	2.50	3,350	8375
Rice	1.37	3,350	4589.5
Meat	1.12	2,020	2262.4
Okra	1.12	350	392
Tea	0.66	1,080	712.8
Milk	1.16	660	765.6
Sugar	3.23	4,000	12920
Coffee	0.97	685	664.45
Macaroni	1.07	3,350	3584.5
Oil	2.11	8,840	18652.4
Onion	2.96	410	1213.6
Lentils	3.77	3,500	13195
Vegetable	1.18	860	1014.8
Fruits	0.81	2,800	2268
Total/H-H/W			92,557.35
Per/H-H/Day			**13,222**
Per/person/Day			**2,204**

Source: Field survey, 2024

Table (17): Number of calories consumed/week/day after contract farming

Food Item	Quant/ Kg	Kilo Cal./kg.	Total k.cal consumed
Wheat	4.60	3,320	15272
Sorghum	5,00	3,350	16750
Millet	4.65	3,350	15577.5
Rice	2.54	3,350	8509

Meat	3.87	2,020	7817.4
Okra	2.48	350	868
Tea	1.17	1,080	1263.6
Milk	2.30	660	1518
Sugar	5.14	4,000	20560
Coffee	1.12	685	767.2
Macaroni	1.49	3,350	4991.5
Oil	2.56	8,840	22630.4
Onion	3.90	410	1599
Lentils	5.90	3,500	20650
Vegetable	1.96	860	1685.6
Fruits	0.99	2,800	2772
Total/H-H/W	**51**		**143231.2**
Per/H-H/Day			**20,462**
Per/person/Day			**3,410**

Source: Field survey, 2024

CONCLUSION

This study assessed the role of contract farming in improving agricultural production and household food security in North Kordofan State, Sudan, based on data collected from 138 households in shiaken and Elrahad . The findings revealed that farmers continued to face several agricultural production and institutional challenges, including limited adoption of improved seeds (19.6%), inadequate seed treatment practices, and heavy dependence on manual harvesting (88.4%). Furthermore, 74.6% of respondents reported having no written contracts, while 75.4% expressed dissatisfaction with existing contractual arrangements, highlighting the need to strengthen contractual relationships and improve farmers' rights and benefits. Despite these challenges, household food consumption increased from 30.61 kg before contract farming to 51.57 kg afterward, representing an increase of approximately 68.5%. Similarly, average daily per capita caloric intake increased from 2,204 to 3,410 kilocalories, representing an improvement of approximately 55.00%. These findings indicated an improvement in household food consumption and suggest that participation in contract farming had contributed to enhanced food security and dietary quality. However, since the analysis primarily compares conditions before and after participation, further statistical investigation is needed to establish the significance of these changes and determine the

extent to which they can be attributed to contract farming. The study therefore emphasizes the importance of promoting transparent and fair contractual arrangements, improving access to improved agricultural inputs and financing, strengthening agricultural extension services, and encouraging the adoption of modern farming technologies. These measures could enhance agricultural productivity, improve farmers' livelihoods, and strengthen household food security in North Kordofan State.

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