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May Gadalla,[1] Nesma Amer,[2] Sara Ragab[3] and Dalia Hany[4]

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Abstract

Years of internal conflict, political instability, and inflation had already battered Sudan's economy before the recent civil war erupted in April 2023. Against this backdrop, this paper investigates income, including wage levels and inequality, in the country in 2022. We examine how households diversify their income sources as a way to build resilience, and we also explore the extent of this diversification and the contribution of each income source to overall household income. The analysis covers income and wage distributions, income diversification, and inequality in Sudan by exploring characteristics such as the household head's sex, sector of employment, education level, and location. Additionally, the paper identifies the main sources of income for households in different regions and by households' characteristics, and assesses how these sources contribute to income inequality. Finally, we analyze wages in both the public and private sectors, and examine the gender wage gap between and within these sectors.

Keywords: Wages, Wage inequality, Income inequality, Gini index, Sudan, Income diversification
JEL Classifications: D31, E24, J31, O15

ملخص

كانت سنوات من الصراع الداخلي وعدم الاستقرار السياسي والتضخم قد ضربت بالفعل الاقتصاد السوداني قبل اندلاع الحرب الأهلية الأخيرة في أبريل 2023. وعلى هذه الخلفية، نبحث في هذه الورقة في الدخل، بما في ذلك مستويات الأجور وعدم المساواة، في البلاد في عام 2022. نقوم بدراسة كيفية قيام الأسر بتنويع مصادر دخلها كوسيلة لبناء القدرة على الصمود، ونستكشف أيضًا مدى هذا التنويع ومساهمة كل مصدر دخل في إجمالي دخل الأسرة. ويغطي التحليل توزيعات الدخل والأجور، وتنويع الدخل، وعدم المساواة في السودان من خلال استكشاف خصائص مثل نوع رب الأسرة، وقطاع العمل، ومستوى التعليم، والموقع. بالإضافة إلى ذلك، تحدد الورقة المصادر الرئيسية للدخل للأسر في مناطق مختلفة وبحسب خصائص الأسر، وتقيم كيف تساهم هذه المصادر في عدم المساواة في الدخل. وأخيرا، نقوم بتحليل الأجور في كل من القطاعين العام والخاص، ودراسة الفجوة في الأجور بين الجنسين بين هذه القطاعات وداخلها.

1. Introduction

Sudan was struggling with anemic economic growth, low incomes, and high rates of poverty even before the recent conflict in 2023 began (African Development Bank Group, 2018). However, Sudan's last household budget survey was in 2014-15, precluding an understanding of how income and poverty had evolved up to the onset of the conflict (Central Bureau of Statistics, 2015). This paper aims to fill that gap, examining the state of wages and income, along with inequality, income diversification, and the contribution of different income sources in Sudan as of 2022.

Although the importance of income, wages, and inequality is self-evident, the role of income diversification also warrants attention. Researchers measure income diversification by looking at the variety of income sources a household has. Diversification positively impacts people's socioeconomic well-being at the household level (Abdulai and CroleRees, 2001). This is particularly important in developing countries, where diversification is a powerful tool to reduce income risks and improve household well-being (Senevirthna and Dharmadasa, 2021). Households in Sub-Saharan Africa often engage in income diversification, spreading their resources across various income-generating activities to ensure survival, reduce risk, or finance agricultural needs (Abdulai and CroleRees, 2001; Alobo Loison, 2015). This strategy, whether intentional or a forced response to crises, has been linked to improvements in household income, wealth, consumption, and nutrition (Barrett et al., 2001).

In this paper, we use data from the 2022 Sudan Labor Market Panel Survey (SLMPS), as it is the most recent and comprehensive nationally representative data available for Sudan, offering a detailed profile of the country just before the onset of the 2023 conflict (OAMDI, 2023; Krafft et al., 2023). We examine the diversification of income sources within the country as of 2022. Additionally, we identify the main sources of income for households in different regions and by households' characteristics, as well as the contribution of these sources to income and inequality. Finally, we analyze wages in both the public and private sectors, and examine the gender wage gap within and between the sectors.

The results highlight that income diversification and income level vary notably by the gender of the household head and the region in which they reside. Areas such as Darfur and Kordofan, which were prone to conflict prior to the April 2023 civil war, experience low incomes and the least income diversification. There is a gender gap in both household income and individual wages, with female-headed households, particularly in rural areas, experiencing lower incomes and lower income diversification. Beyond the income gap between female- and male-headed households, women in wage employment earn less across all sectors.

The paper is organized as follows. Before analyzing the distribution of income and wages and the diversity of income sources in Sudan, the following section provides a brief overview of the

economic context of Sudan since the 1990s (1973-2022). Section 3 provides comprehensive information on household income sources as documented in the data, followed by an assessment of income diversification in Sudan. It also analyzes the prevalence of the different sources of income across households and identifies the main sources of income. Additionally, it extends the analysis to the distribution of income in different regions and the main characteristics of household heads, including gender, education, age, and employment status. Then, it provides a breakdown of inequality by source of income. Section 4 focuses on individual wages, which are categorized by sector (public, regular private, and irregular[5] private), taking into account important individual characteristics such as gender, education, and age, in addition to occupation and economic sector. Finally, section 5 includes a summary of the most important results and discusses the conclusions.

2. Sudan's economic background

2.1. Evolving Inequality in Sudan

During the 1990s, the Sudanese government adopted a series of structural adjustment programs that privatized public entities, which magnified unemployment and negatively affected the size of the middle class, thus impacting inequality in the country (Omer, Nour, and Maglad, 2020). The middle class was historically predominantly composed of public sector employees. Hence, this decline in employment, whether as a result of privatization or the closure of public entities, had a direct impact on the size and stability of the middle class. Furthermore, the rise in economic growth after the 1999 oil exploration was accompanied by serious negative effects resulting from the Dutch Disease phenomenon, which led to an overvalued exchange rate brought about by the oil windfall (Omer, Nour, and Maglad, 2020).

The Household Income, Expenditure, and Consumption Survey (HIECS) was last conducted in Sudan in 2009 and 2014. Between these two years, expenditure inequality remained moderately low, with national level inequality dropping from 35.4 percent in 2009 to 29.2 percent in 2014, as measured by the Gini index (World Bank, 2024). The modest drop in inequality at the national level might be attributed to the gains in rural areas and falling living standards in urban areas (World Bank, 2019). However, inequality displayed declining trends within rural areas but rising trends within urban areas. This trend was apparent in the seven-percentage-point increase in the Gini index in the capital state of Khartoum, from 33.1 percent in 2009 to 40.6 percent in 2014 (World Bank, 2019), compared to declining inequality in states with larger rural populations.

Between 2009 and 2014, Sudan witnessed a small reduction in its poverty rate, decreasing from 37.6 percent to 36.1 percent (African Development Bank Group, 2020). Additionally, the proportion of the extremely poor in the population decreased from 29.6 percent in 2009 to 25.1 percent in 2014. Poverty incidence was highest in Central Darfur at 67.2 percent, followed closely

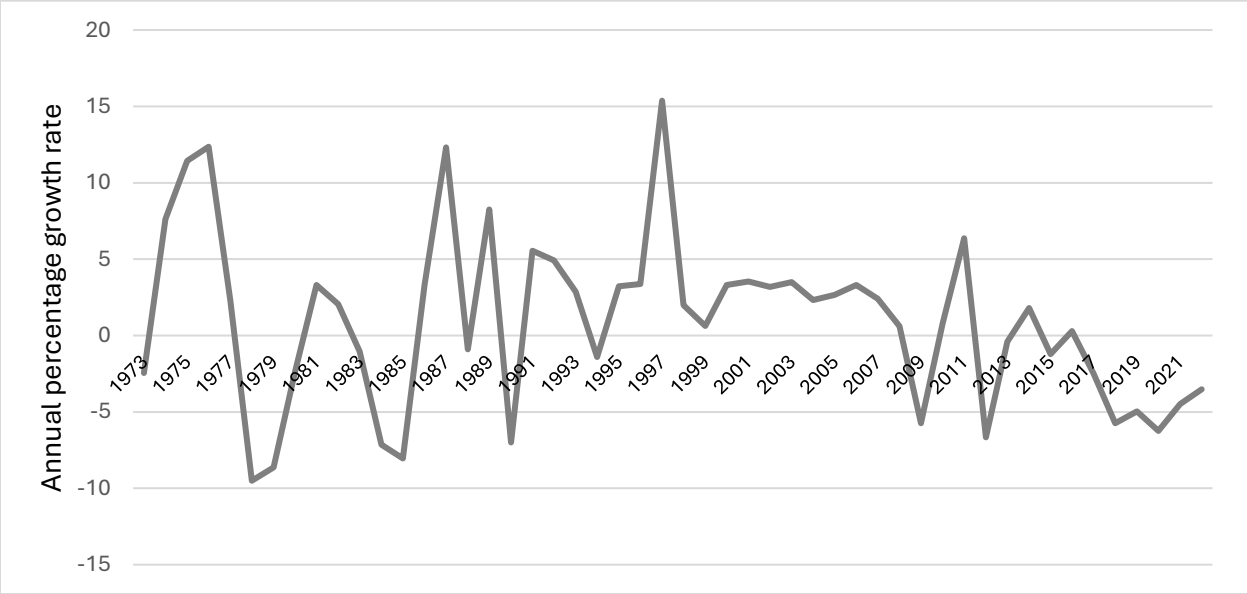
[5] Irregular workers are seasonal or casual workers, e.g., day laborers.

by South Kordofan at 67 percent, while in Khartoum and Northern State it was 29.9 and 12.2 percent, respectively (African Development Bank Group, 2020).

2.2. Riding the oil wave: Sudan's economic growth during its hydrocarbon boom

During the 1990s and all the way through 2008, Sudan's economy was growing. Figure 1 displays the annual real gross domestic product (GDP) per capita growth rate in Sudan starting from 1973 until 2022. In 1999, Sudan experienced an increase in oil production and exports, which marked the beginning of an era of economic growth for the country that lasted almost a decade from 1999 to 2011 (Etang Ndip and Lange, 2019). This growth was also reflected in the country's GDP per capita, which almost doubled within the same period (1999-2011), temporarily transforming Sudan from a lower-income country to a lower-middle-income country (Etang Ndip and Lange, 2019). The growth rate increased from an average of 2.8 percent in the 1980s to around 5.8 percent in the 1990s. The average annual GDP growth rate maintained its relatively high levels until 2011, as it was around 5.3 percent between 2000 and 2010 (World Bank, 2024).

Figure 1. Annual Real (2015 USD) GDP per capita growth (percentage), 1973-2022



Source: Authors' construction based on World Development Indicators (World Bank, 2024).

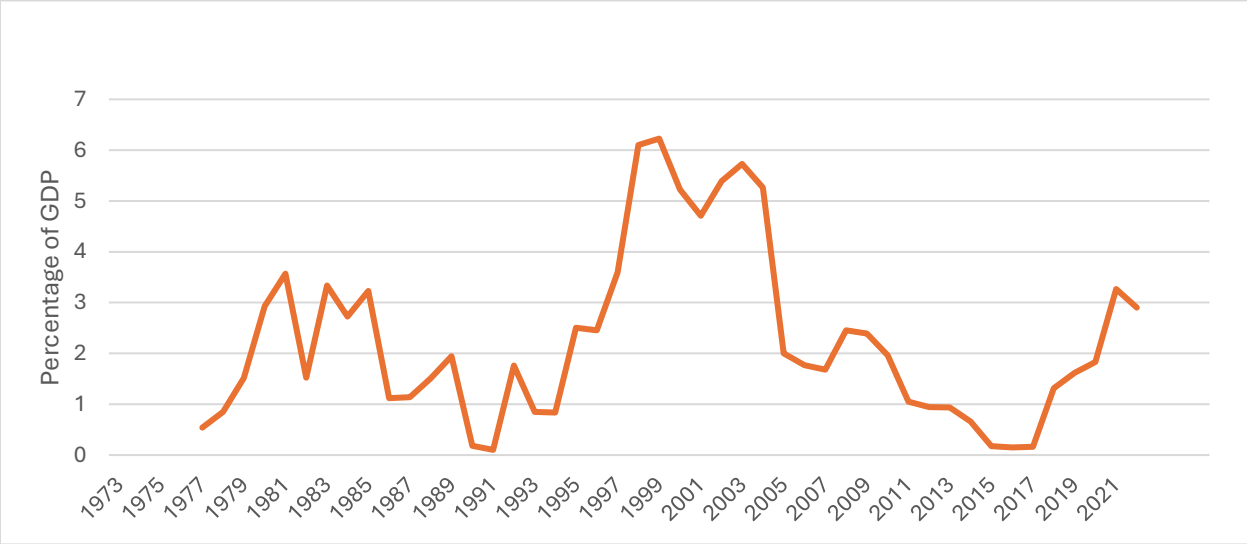
2.3. Global crisis, local impact: The great recession and its effects on Sudanese remittances

After the oil boom in the Arab Gulf countries in the 1970s, the increased labor demand due to the unprecedented growth in these countries led to a surge of Sudanese labor migration to the Gulf and the rising importance of remittances (UN-ESCWA, n.d.; El-Qorchi, Maimbo, and Wilson, 2005). Reported remittance figures in Sudan likely underestimate the actual inflows due to the fact

that most remittances are sent outside official banking and financial channels (UN-ESCWA, n.d.; El-Qorchi, Maimbo, and Wilson, 2005).

However, it is apparent that remittances from abroad are a major contributor to the Sudanese economy (Ahmed, 2010). Especially after 1990, remittances emerged as an important means to maintaining the livelihoods of some poor and middle-income families in the Arab countries (Behrendt, Haq, and Kamel, 2009). In the past, remittances were relatively resilient against economic shocks, but the 2008 global crisis had a much stronger effect, which might be attributed to the simultaneous downturn in most remittance-sending regions (Behrendt et al., 2009). This is reflected in Figure 2, which showcases remittances as a share of GDP in Sudan. There is a sharp decline in the share of remittances following the 2008 financial crisis. The share of remittances in GDP was between five and six percent prior to 2004, then plunged starting 2005, remaining low for several years before rising somewhat in 2017.

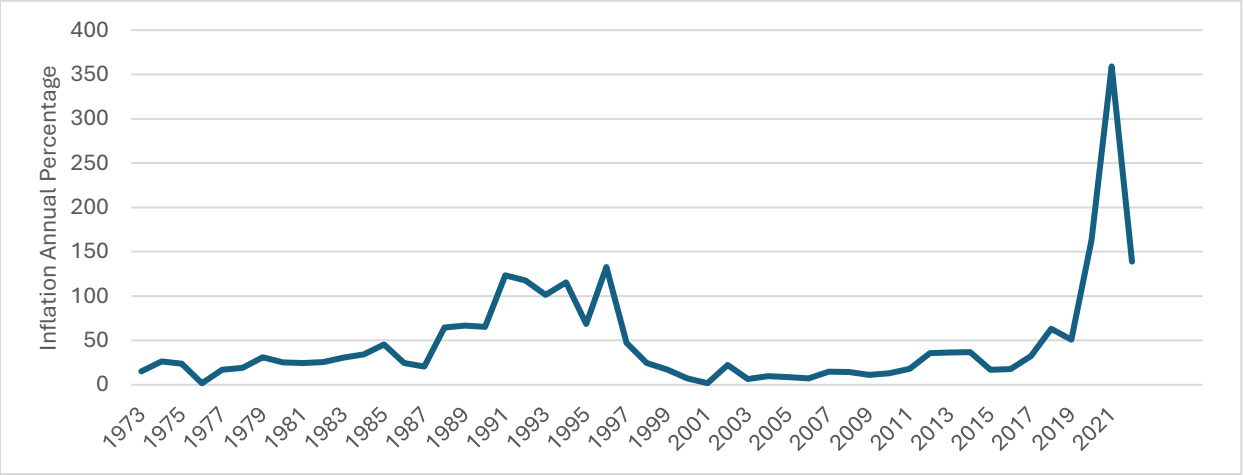
Figure 2. Remittances as a percentage of GDP in Sudan (1977-2021)



Source: Authors' construction based on World Development Indicators (World Bank, 2024).

Following the secession of South Sudan in 2011, economic shocks spiraled due to the loss of oil revenues, which accounted for more than half of the Sudanese government's revenue and the majority of its exports (Etang Ndip and Lange, 2019). The secession resulted in a deterioration in economic growth and a spike in inflation reaching double digits (United Nations, 2019). This deterioration is reflected in Figure 3, which shows a gradual increase in the inflation rate following 2011, from 12.3 percent in 2010 to 35.6 percent in 2013. Inflation continued rising to reach more than 350 percent in 2021. The 2021 spike in inflation followed the unseating of President Omar Bashir and his National Congress Party government, which caused short-term disruptions to businesses and economic activity (World Food Programme, 2020).

Figure 3. Inflation, consumer prices (annual percentage) in Sudan (1973-2022)



Source: Authors' construction based on World Development Indicators (World Bank, 2024).

3. Income

Given the changing nature of the Sudanese economy and the various external shocks to which it is exposed, it is crucial to gain a deeper understanding of the population's income levels, main income sources, and the distribution of these incomes. The nationally-representative SLMPS 2022 collected data at both the household and individual levels through a survey covering 4,878 households and 25,442 individuals. The household questionnaire captured detailed information on various income sources at the household level, while the individual questionnaire captured wage income. In this section, we provide details regarding the description and construction of each of these income sources, including labor and capital income, as well as transfers from both domestic and international sources.

Labor income consists of wage income, which was collected at the individual level, and self-employment or employer income, which was collected at the level of household enterprises, whether in agriculture (farming, animal husbandry, or other agricultural activities such as fishing) or non-agricultural sectors. Capital income (e.g., from rent or interest) and transfer income (including remittances, pensions, and social assistance) were collected at the household level. The comprehensive information on the receipt and amount of all of these different sources of income not only allows us to identify the main sources of income of Sudanese households, but also enables us to study income inequality by income source. Table 1 describes the income sources available in the data.

Table 1. Income sources used for the analyses

Income Source			Availability
Labor Income	Wages and salaries received from regular and irregular work from primary and secondary jobs.	Net total wages and salaries from primary job.	For regular workers, the net amount received in the past three months in each of the following categories (basic salary and wage; incentives and bonuses; overtime; shared profits; and others). For irregular workers, the average daily or hourly wage in your main job and time spent working over the past three months.
		Net total wages and salaries from secondary job.	Total wages from secondary job in the last three months.
	Total income from self-employment/employer, defined as profits/losses from household enterprise activities, including farm and non-farm businesses.	From agriculture.	Revenues from selling any of the following in last 12 months: • Livestock • Crops • Other agricultural products
		From non-agriculture.	The average net earnings of the enterprise per month during the past 12 months that usually go to the family.[6]
Capital Income	Cash payments from property and capital (both financial and non-financial assets), including interest and dividends, rental income and royalties, and other capital income.	From financial assets (interest and profits).	Annual income from interest or profit on financial investments.
		From non-financial assets (rents).	Annual income from rent (buildings, land…etc.). Income from rent of agricultural equipment.
Transfers	Sum of total pensions (including public and private pensions) and non-pension public social insurance benefits, universal or assistance schemes (including in-kind social assistance transfers), as well as cash and non-cash private transfers.	Remittances: Cash and in-kind transfers from temporarily absent household members.	The monthly received cash and in-kind transfers from individuals from abroad or elsewhere in the country.
		Domestic cash transfers and value of in-kind goods and services.	Cash and in-kind transfers received monthly from different programs, such as: Normal pension; Zakat bureau, Direct support program for the poor, World Food Program (food, ration card, or cash); UNHCR, other assistance for displaced people; essential commodity support, and any other support related to COVID-19; cash for unemployed people; Any other support from government, nonprofit, or charity organizations.

Monetary indicators are subject to missing data, either for a specific item or for an individual or household entirely (non-response), with particular challenges at the tails of the distribution (Brunori et al., 2022). For the monetary income analysis, this paper utilizes only data for which all sources are non-missing. Missing data on capital income and transfers do not surpass one percent. However, 15 percent of the households lack wage information for at least one wage earner. Additionally, around 11 percent of households lack detailed income data from agricultural enterprises and five percent are missing information on non-agricultural enterprises' income. These missing data could be due to illiteracy or innumeracy, making respondents unable to report monetary values, as well as other sources of respondents' refusal or lack of knowledge. Consequently, only around 70 percent of the surveyed households have complete data on all income sources, while the remaining 30 percent are missing data on one or more income source.

[6] Enterprise earnings that usually go to the family were missing for 25 households, therefore they were replaced by the average net earnings of the enterprise.

The sampling weights are therefore adjusted for analyses that involve monetary income amounts to account for non-random non-response leading to the missing income.[7]

Wages and salaries[8] were aggregated for all individuals in the household into three categories based on the sector and regularity: (1) Wages from the government or public enterprises ("public sector"), (2) Regular, or (3) Irregular wages from a private employer ("private sector"). Income from non-agricultural household enterprises is based on detailed questions on non-agricultural activities producing goods or services for sale (see Table 1). Detailed information on agricultural activities and sales is also collected. Households report the quantity harvested and the net income from the sale of each crop. In addition, the total value of income that households earned from selling livestock and other agricultural products is reported for each item, which is subsequently added to the agricultural income. Households also report ownership of lands and certain agricultural equipment, such as tractors or pumps, and report payments for renting this equipment, which is accounted for as income from assets. Additionally, earnings from profits or interest on financial investments are included under assets income. Therefore, households' capital income encompasses earnings from both financial and non-financial assets. The detailed questions on the sources of household income in this study enable an in-depth analysis of the following eight sources of income:

1. Public wages
2. Regular private wages
3. Irregular private wages
4. Enterprise earnings
5. Agricultural income
6. Assets (financial and non-financial)
7. Remittances
8. Transfers

For consistency, the monthly total income is computed for each household and divided by household size to obtain the monthly per capita income. To understand the income structure in Sudan and the dependence on different income sources, we compare the receipt of different sources and amounts. The analysis shows the number of income sources per household, the percentage of households receiving each income source, and the main income source, analyzed by the region and household head's characteristics, such as gender, age, educational level, and employment status.

[7] A probit model using the main household characteristics is implemented to estimate the probability of missing income, and the estimated probability was used to adjust the weights (see Appendix B for details).
[8] Only 5.5 percent of the waged workers report having a second job; the sector classification is based on the primary job.

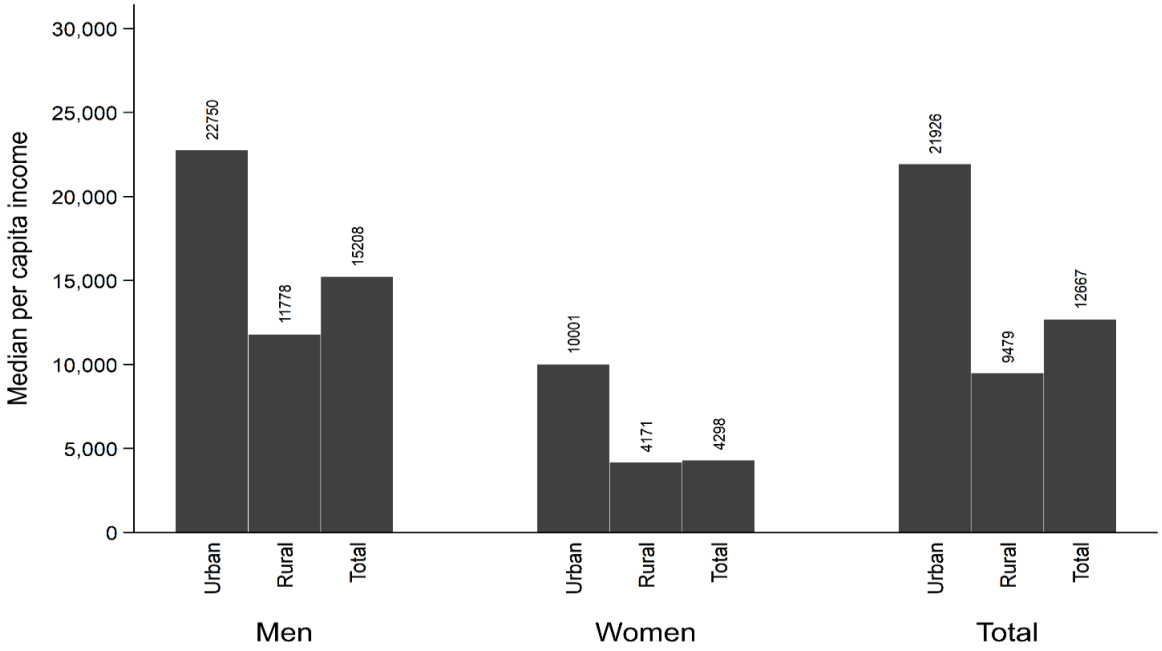
3.1. Income Distribution[9]

In 2021, Sudan experienced an upsurge in the inflation rate, reaching more than 350 percent (Figure 3). Despite the decline in the inflation rate in 2022, it remained very high at around 150 percent. Using the income levels reported in the SLMPS 2022 as a proxy to measure poverty in Sudan highlights challenging economic conditions. Applying the World Bank's most recent definition of the extreme poverty line equivalent to 2.15 international dollars (I$) and accounting for purchasing power parity (PPP) and considering the PPP exchange rate for the Sudanese pound[10] (International Monetary Fund, n.d.), an analysis of per capita income using SLMPS 2022 data reveals that approximately two-fifths (40 percent) of Sudan's population are below the extreme poverty line. This extreme poverty incidence was more pronounced in rural areas, reaching 45 percent, while urban areas experienced a comparatively lower rate of 24 percent. Specific rural regions like Darfur (56 percent) and Kordofan (71 percent) faced even higher poverty challenges.

The SLMPS 2022 data estimates that in 2022,[11] the median monthly income per capita for those receiving any source of income in Sudan was around 12,700 Sudanese pound (SDG), approximately equivalent to I$ 121 PPP. This median implies that around half of the Sudanese population was subsisting on less than I$ 4 PPP per day. Figure 4 indicates that female-headed households had lower income compared to male-headed households, with a median monthly per capita income around one third of the male-headed households' median (SDG ~4,300 vs. SDG ~15,200). Moreover, the median per capita income in rural areas is approximately half of the median income observed in urban areas.

[9] The top one percent from the income distribution was excluded from analysis to prevent the undue influence of outliers.
[10] PPP exchange rate in 2022 for Sudan was evaluated at around SDG 105 per PPP$
[11] The SLMPS was fielded in the second half of the year.

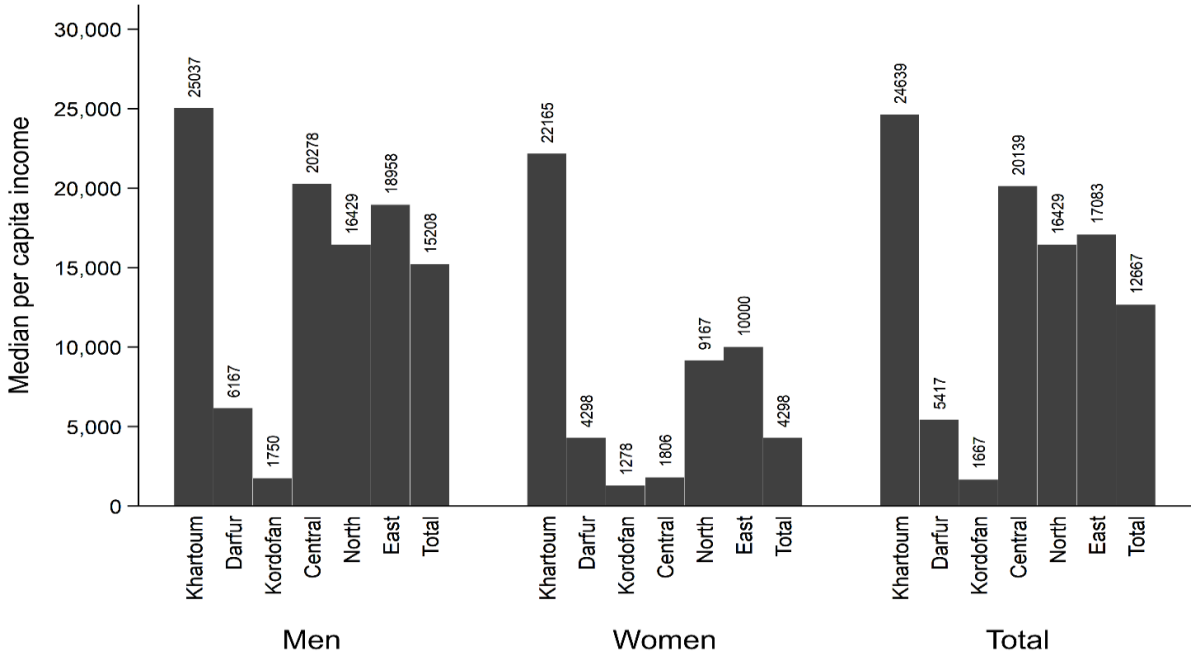
Figure 4. Median per capita monthly income in SDG by sex and location of household head, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

Figure 5 indicates that urban-dominated regions such as Khartoum had the highest median income (SDG 25,347 per capita per month). In contrast, rural regions like Darfur (SDG 5,417 ~= I$ 52 PPP) and Kordofan (SDG 1,667 =~ I$ 16 PPP) exhibited the lowest median monthly income per capita. Although female-headed households consistently had lower median per capita income than male-headed counterparts, regardless of the place of residence, the gap widened in certain regions, namely the Central, North, and East (Figure 5).

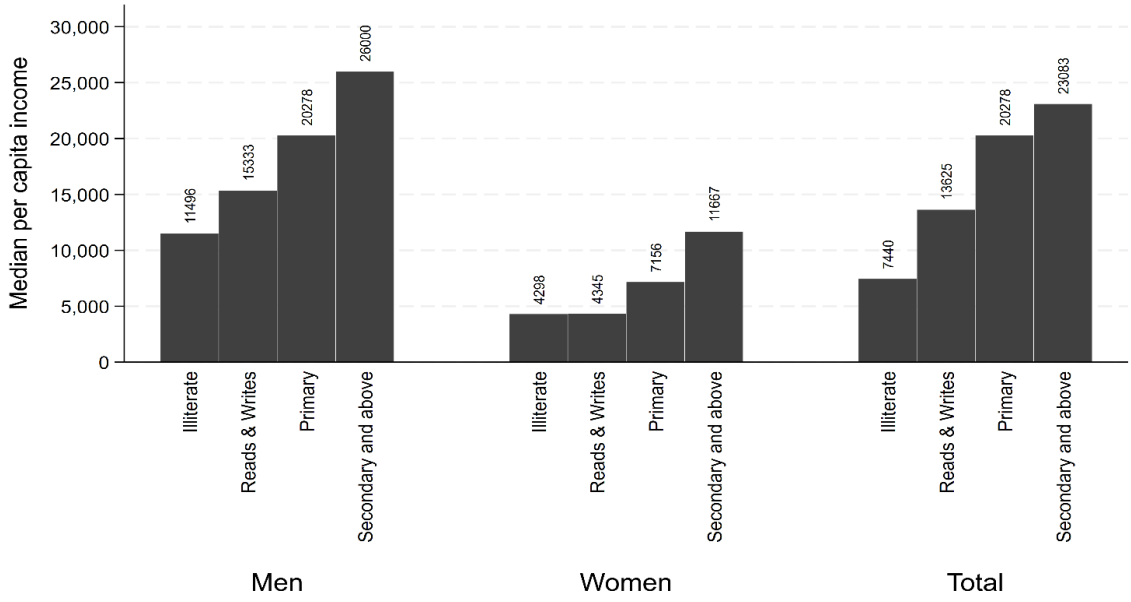
Figure 5. Median per capita monthly income in SDG by sex and region of household head, Sudan 2022



Source: Authors' calculation using SLMPS 2022.

When looking at the median per capita income by the educational attainment of the household head (Figure 6), there is a notable relationship with the head's level of education, particularly among those with higher educational attainment. The median income among households with highly educated heads is nearly four times the median income if the head is illiterate (approximately SDG 23,000 compared to SDG 7,500 among illiterate heads). Having reading and writing skills approximately doubles the median income compared to those who are illiterate. Nevertheless, the median monthly income among female-headed households with secondary or above educational level is almost the same as the median income among illiterate male-headed households (SDG ~11,660 among female-headed households with secondary and above compared to SDG ~11,500 among male-headed households with illiterate heads).

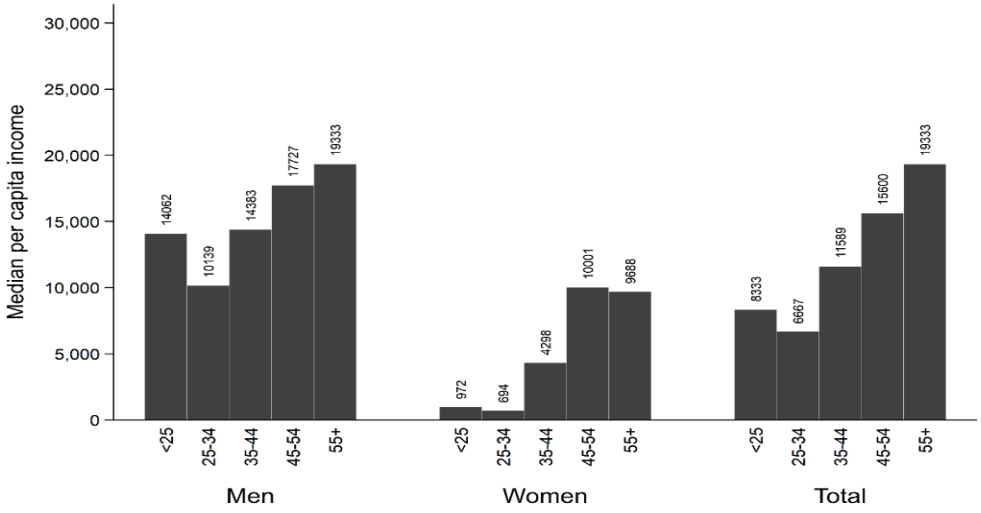
Figure 6. Median per capita monthly income in SDG by sex and educational attainment of household head, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

The age of the household head is also associated with income (Figure 7). Heads aged 35 and older have increasing incomes among both female- and male-headed households. Although the median income gap between both genders persists throughout all age groups, the gap widens among younger age groups.

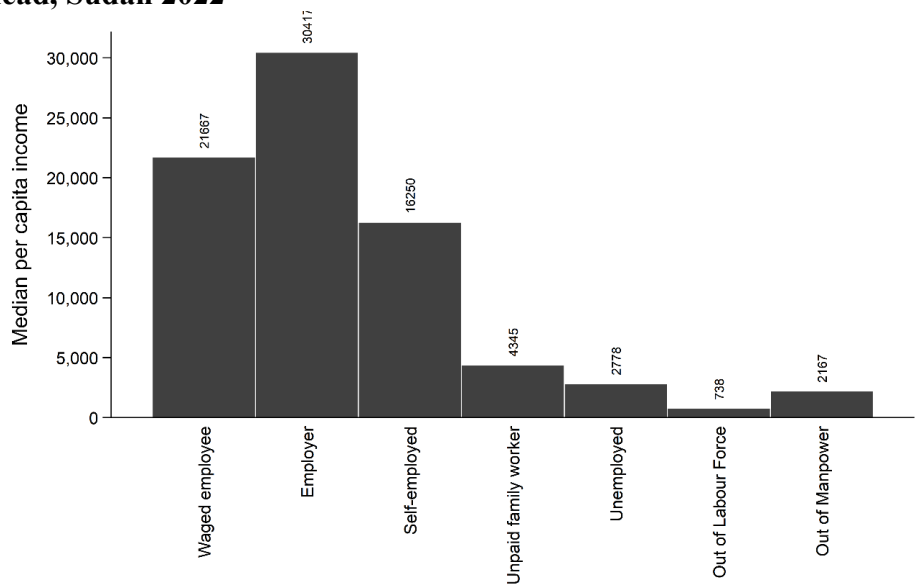
Figure 7. Median per capita monthly income in SDG by sex and age group of household head, Sudan 2022



Source: Authors' calculation using SLMPS 2022.

The level of income is associated with the labor market status of the household head (Figure 8). Per capita income is higher when the head is employed, particularly when the head is an employer. In contrast, the lowest income levels are in households with non-employed heads.

Figure 8. Median per capita monthly income in SDG by labor market status of household head, Sudan 2022

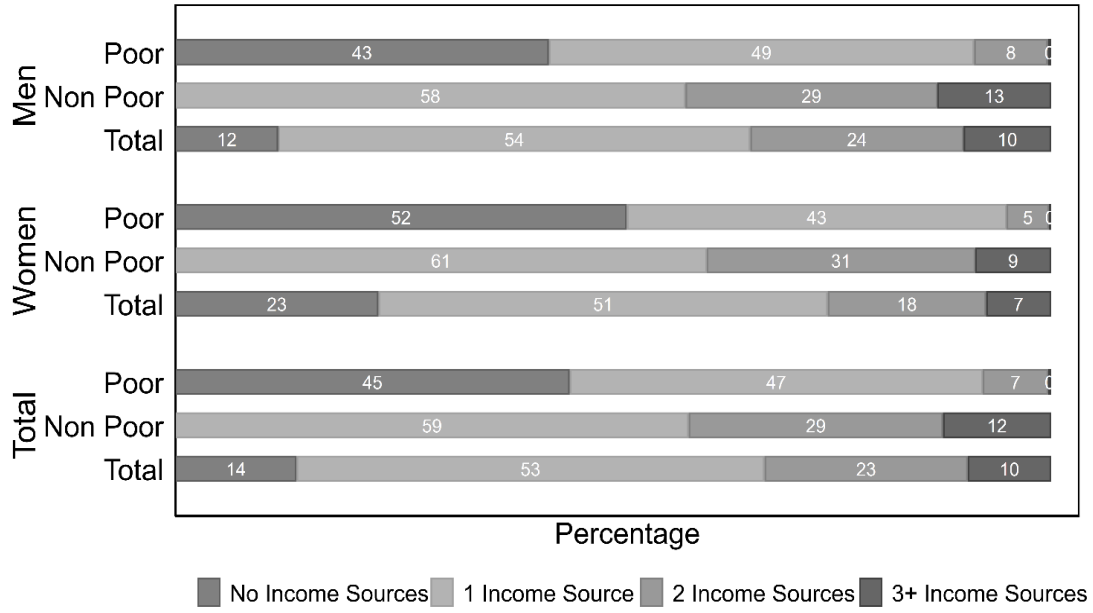


Source: Authors' calculation using SLMPS 2022.

3.2. Income diversification

While diversifying income sources can shield households from poverty, data from SLMPS 2022 reveal that income diversification is limited in Sudan. Approximately 14 percent of Sudanese households do not report any of the listed income sources. Slightly over half of Sudanese households rely solely on one income source (53 percent), while only a third (33 percent) receive income from two or more sources (Figure 9). Income diversification is also positively associated with higher income. To differentiate between poor and non-poor households, the World Bank poverty line of I$ 2.15 PPP per capita per day is applied and compared to the per capita daily income. As illustrated in Figure 9, 44 percent of the non-poor households have two or more income sources, compared to only seven percent of the poor households. Poor female-headed households are the most disadvantaged, where half of them report no income source and the remainder have only one source of income. The distribution of the number of income sources does not vary considerably by head's sex among non-poor households.

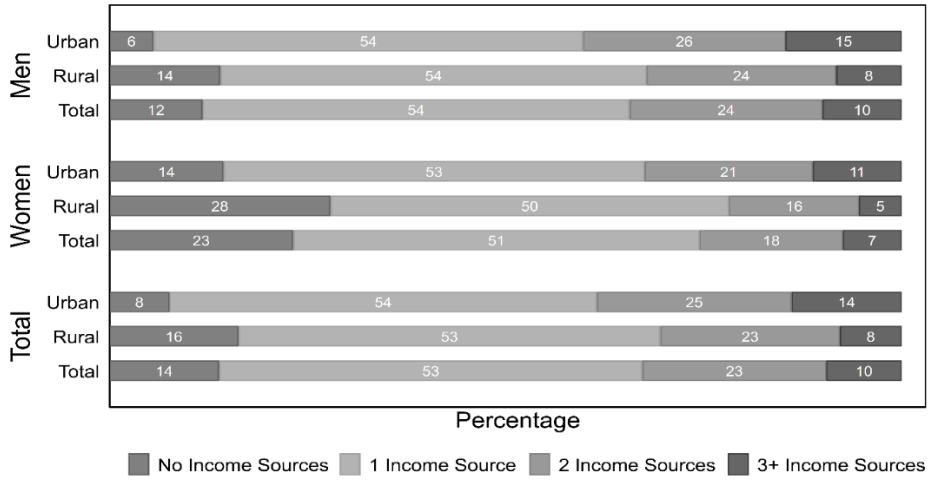
Figure 9. Number of income sources in household (percentage of households) by sex and poverty status of household head, Sudan 2022



Source: Authors' calculation using SLMPS 2022.

Households in urban areas have slightly more income diversification than rural ones (Figure 10). Female-headed households, especially those in rural areas, are the category experiencing the highest degree of no income sources. The percentage of all female-headed households with no income source is almost double (23 percent) that of all male-headed households (12 percent). The percentage rises in rural areas and reaches more than one quarter of female-headed households there (28 percent). Male-headed households residing in urban areas are more likely to have two or more income sources (40 percent) than female-headed households in general (25 percent) and their counterparts in rural areas (22 percent).

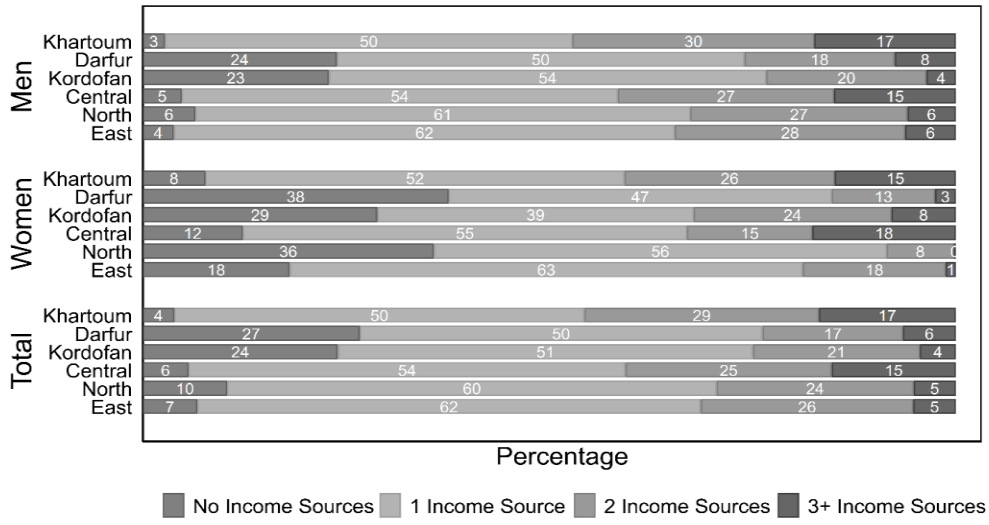
Figure 10. Number of income sources in household by sex and location of household head (percentage of households), Sudan 2022



Source: Authors' calculation using SLMPS 2022.

Figure 11 shows that high percentages of households with no reported income are in conflict-ridden regions such as Darfur (27 percent) and Kordofan (24 percent). Additionally, the incidence of multiple income sources increases in urban regions such as Khartoum (46 percent) and Central (41 percent).

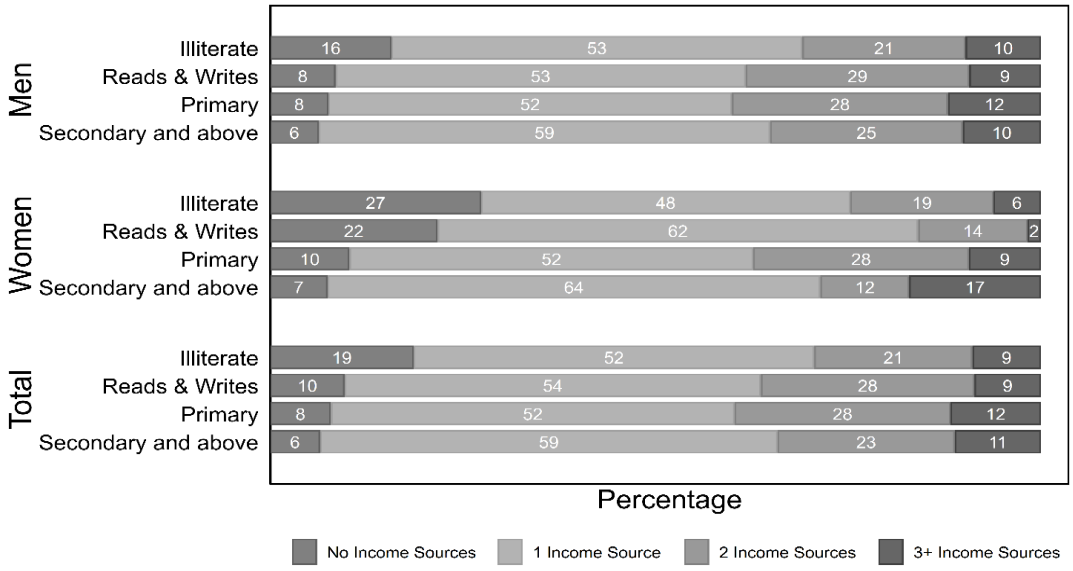
Figure 11. Number of income sources in household (percentage of households) by sex and region of household head, Sudan 2022



Source: Authors' calculation using SLMPS 2022.

Moreover, both the absence of an income source and income diversification vary with the educational level of the household head. Households with illiterate heads are more prone to having no income source (19 percent, as illustrated in Figure 12) and less likely to have multiple income sources (29 percent) compared to households with higher educated heads (six percent have no source and 34 percent have multiple sources).

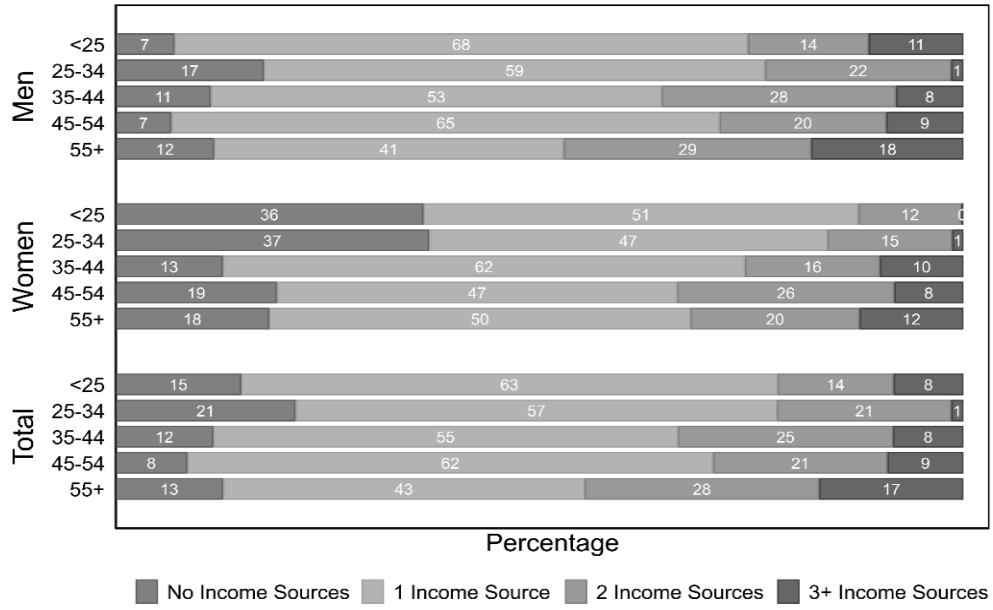
Figure 12. Number of income sources in households (percentage of households) by sex and educational level of household head, Sudan 2022



Source: Authors' calculation using SLMPS 2022.

Figure 13 illustrates that income diversification increases with the age of the household head for both female- and male-headed households. Nearly half (47 percent) of male-headed households aged 55 years and above have two or more sources of income compared to slightly less than one-third among male-headed households in the 45-54 age group and around 36 percent among those aged 35-44. Young female-headed households appear to be the most economically vulnerable group; 37 percent of those aged 25-34 and 36 percent of those under 25 report no income, respectively. Income diversification among female-headed households improves with age. Among those aged 55 years, levels of income diversification are almost comparable to those of male-headed households in the same age group. These results confirm the heightened vulnerability of young female-headed households both in terms of income level and diversification.

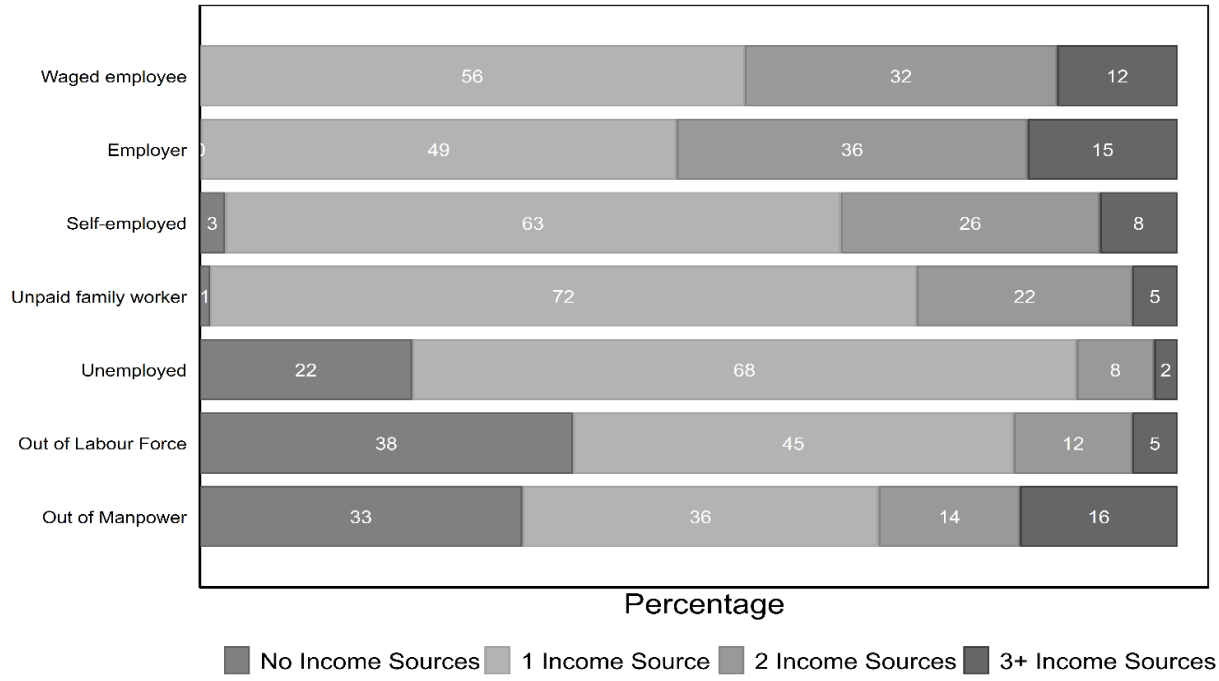
Figure 13. Number of income sources in household (percentage of households) by sex and age of household head, Sudan 2022



Source: Authors' calculation using SLMPS 2022.

As expected, income diversification increases among employed household heads (Figure 14). However, its pattern varies by employment status. The diversification is lower among self-employed and unpaid family workers; the majority of them rely only on one single income source (63 percent self-employed and 72 percent unpaid family workers). In contrast, the proportion of households with no income source is higher among those headed by individuals who are unemployed (22 percent), out of the labor force (38 percent), or out of the manpower basis (33 percent).

Figure 14. Number of Income Sources in Household (Percentage of Households) by Labor Market Status of Household Head, Sudan 2022[12]



Source: Authors' calculation using SLMPS 2022.

For a more comprehensive understanding of household income, it is important to know the prevalence of each income source. In the next section, we investigate the prevalence of each source by key characteristics, while the contribution of each source is analyzed subsequently.

3.3. Prevalence of different income sources

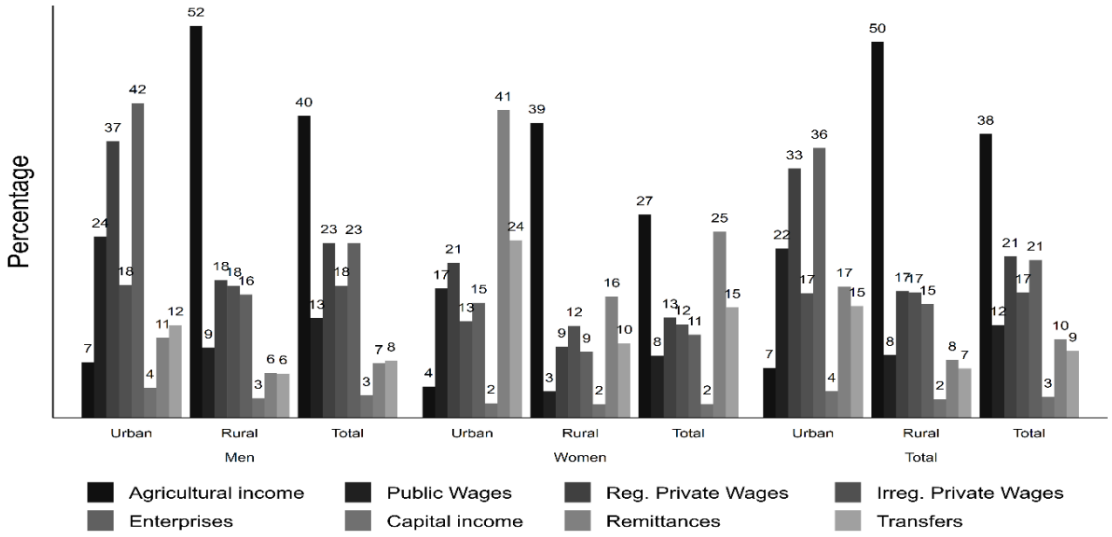
Our analysis reveals that labor income constitutes the most common source of income in Sudan, as around half of the households receive wage income (Figure 15). Agricultural income is the second most prevalent source, received by two-fifths of the Sudanese households, rising to 50 percent in rural areas.

Wages from the regular private sector are the most common wage type (21 percent of households). Regular private wages are especially prevalent in urban areas, where 33 percent of households have at least one member engaged in regular private wage work compared to only 17 percent in rural areas. The percentage of households receiving wages from irregular private sector wage work is the same in both urban and rural areas (17 percent). Around one-fifth of the households earn non-agricultural enterprise income (21 percent), with a higher rate in urban areas (36 percent).

[12] Number of observations doesn't allow for further classification by sex of household heads.

The proportion of households receiving capital income is low, particularly in rural areas (two percent), compared to urban areas (four percent). The receipt of remittances or transfers is more prevalent in urban areas, at 17 percent for remittances, compared to eight percent in rural areas. The prevalence of remittances and transfers increases among female-headed households, particularly in urban areas, reaching 41 percent for remittances and 24 percent for transfers.

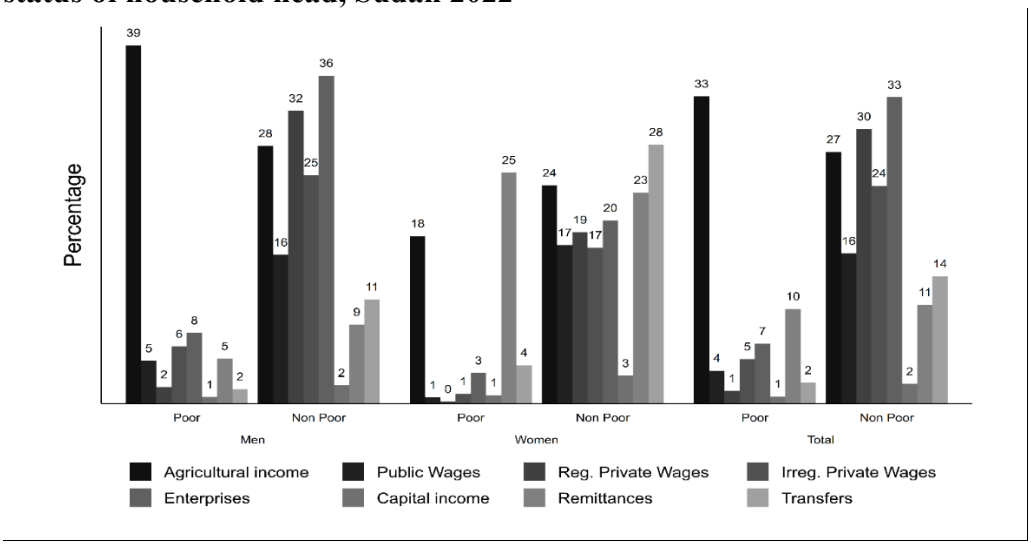
Figure 15. Percentage of households receiving different income sources by sex and location of household head, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

Furthermore, Figure 16 shows that the prevalence of all income sources is higher among non-poor households than poor households, except for agricultural income. The receipt of remittances and transfer payments rises among poor (23 percent) and non-poor female-headed households (25 percent). On the other hand, while non-poor male-headed households are more likely to have labor income, poor male-headed households are more likely to have agricultural income.

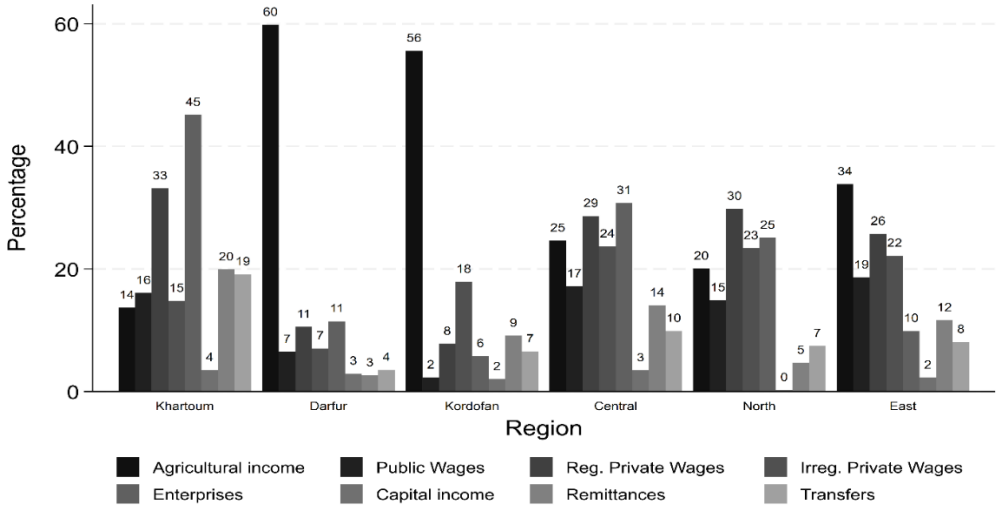
Figure 16. Percentage of households receiving different income sources by sex and poverty status of household head, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

Furthermore, when examining income sources by region, unsurprisingly, the percentage of households receiving income from agriculture is higher in predominantly rural regions like Darfur (60 percent) and Kordofan (56 percent) (Figure 17). In contrast, non-agricultural enterprise income is most prevalent in urban regions, such as Khartoum, where 45 percent of households receive such income. Khartoum also has the highest incidence of remittances (20 percent) and transfers (19 percent).

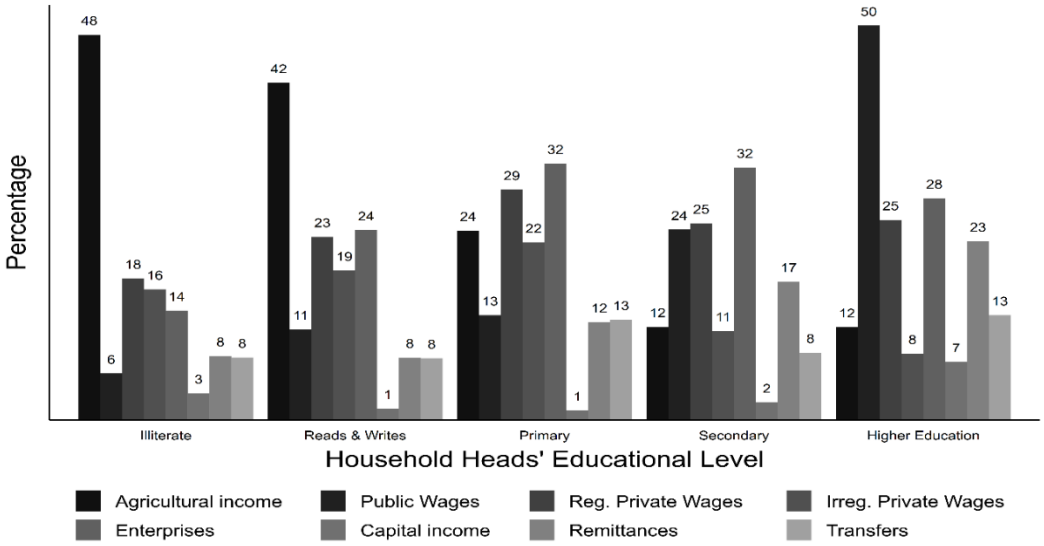
Figure 17. Percentage of households receiving different income sources by region, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

Figure 18 indicates that households with less educated heads tend to have agricultural income. Conversely, those with more educated heads are more likely to have wage income, particularly from the public and regular private sector. On the other hand, irregular wage income is more common among households with less educated heads. Additionally, households headed by more highly educated individuals are more likely to receive capital income compared to those headed by less educated heads. The prevalence of both remittances and transfers also increases with educational attainment, reaching their highest among households with highly educated heads (23 percent for remittances and 13 percent for transfers) and their lowest among households headed by illiterate individuals or those with only basic education (around eight percent for both transfers and remittances).

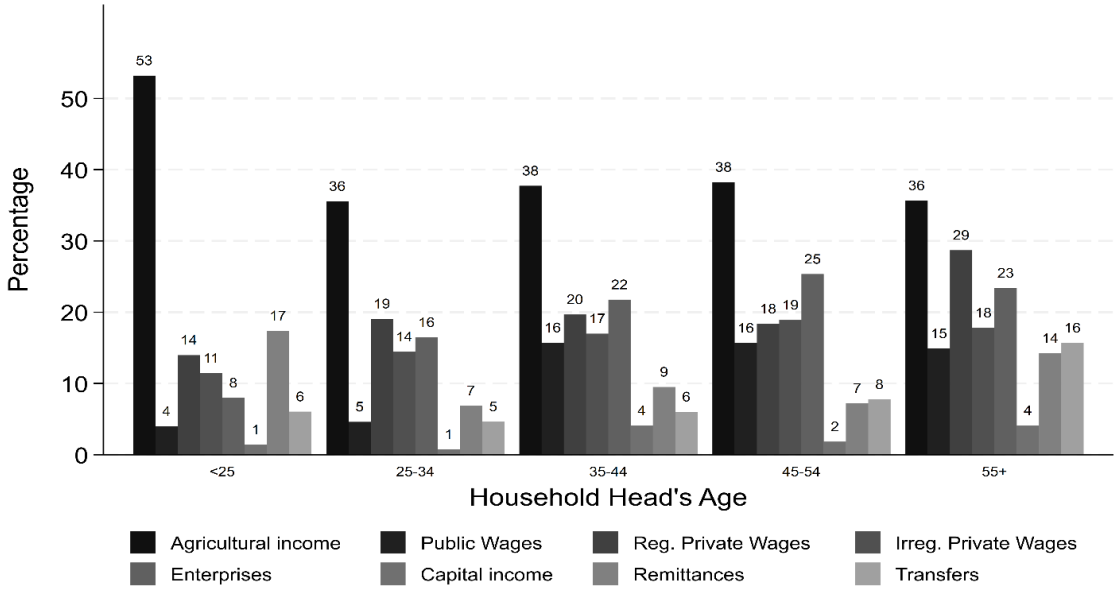
Figure 18. Percentage of households receiving different income sources by educational level of household head, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

For older household heads, the likelihood of receiving remittances and transfers is higher, reaching 30 percent together for households with heads aged 55 years and above. Similarly, the prevalence of labor income, whether from wages or enterprises, rises with age, from 54 percent among heads aged 25-34 years to 75 percent in the 35-44 age category, up to 85 percent for those aged 55 and older (Figure 19).

Figure 19. Percentage of households receiving different income sources by age of household head, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

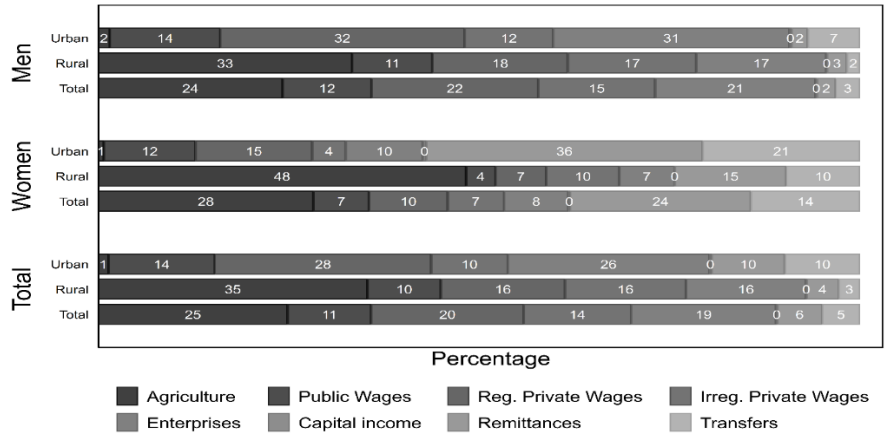
3.4. Main sources of income

Analyzing the contributions of different income sources to household income and examining the dependence of households on these sources based on their characteristics is crucial. Therefore, in this paper, the income with the largest contribution to total income is referred to as the main source of income. Main sources of income differ mainly based on gender, education of the household head, region, and whether the household head is out of the labor force or not.[13]

Figure 21 aligns with the income sources prevalence results. The regular private sector is the main source of wage income in Sudan at 20 percent, which increases in urban areas to around 28 percent. While more than half the households in urban areas rely mainly on wages (52 percent), both agricultural income (35 percent) and wages (33 percent) constitute the two main income sources in rural areas. Although 38 percent of the households receive agricultural income, it is considered a main source for only 25 percent of them.

[13] Households with no income source are excluded from this section.

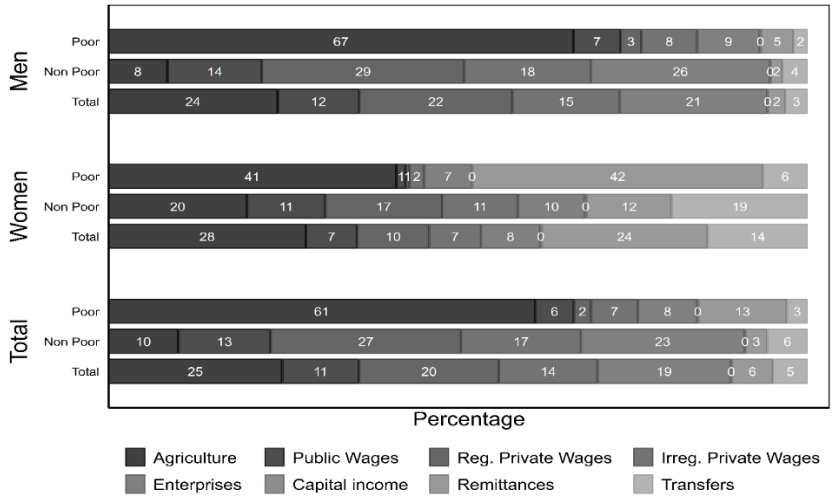
Figure 20. Household's main income source by sex and location of household head (percentage of households), Sudan 2022



Source: Authors' calculations using SLMPS 2022.

Approximately two-fifths of households led by females depend primarily on remittances and transfers, in particular the poor (48 percent) and those living in urban areas (47 percent) (Figure 20, Figure 21). In contrast, households led by males have a greater reliance on wages (49 percent), which increases to around two-thirds among non-poor male-headed households, and among those who reside in urban areas. Among poor male-headed households, however, two-thirds rely on agricultural income (67 percent), compared to only one-third of the households led by men in rural areas.

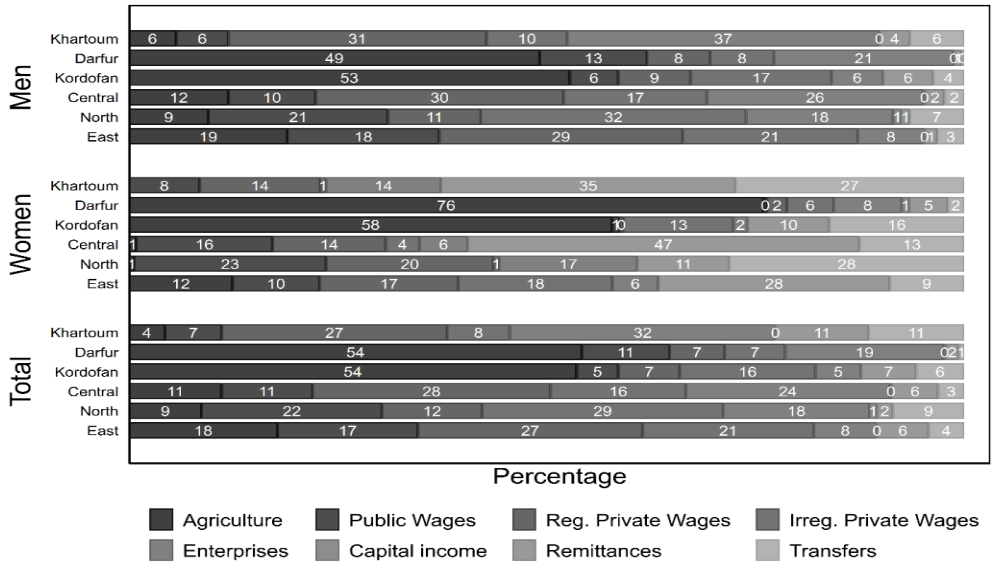
Figure 21. Household's main income source by sex and poverty status of household head (percentage of households), Sudan 2022



Source: Authors' calculations using SLMPS 2022

The nature of each region is reflected in its primary source of income (Figure 22). Regions with a predominantly rural profile, like Darfur and Kordofan, rely more on agriculture as their main income source. Conversely, in more urbanized regions, such as Khartoum, nearly one-third of residents depend on wages from the private sector, particularly from the regular private sector (27 percent) as their main income source, while another third rely on income from household enterprises (32 percent). In Sudan, only one out of every 10 households has public sector wages as their main income source, with percentages higher in the North (23 percent) and East regions (18 percent).

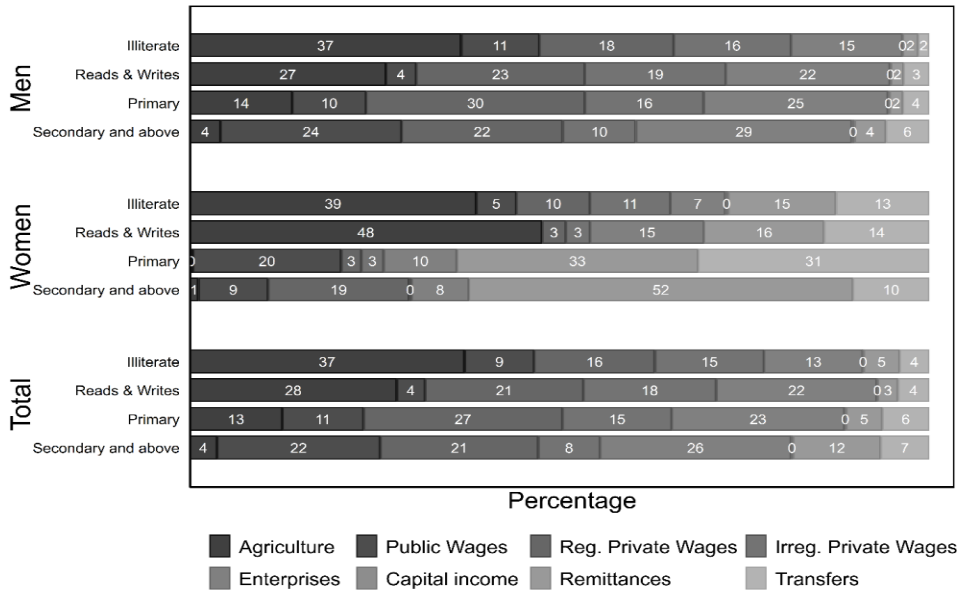
Figure 22. Household's main income source by sex and region of household head (percentage of households), Sudan 2022



Source: Authors' calculations using SLMPS 2022.

Income sources also differ by the educational attainment of the household head (Figure 23). The importance of income from non-agricultural household enterprises rises among heads of households with a moderate level of education. However, highly educated heads of households depend on wages from the public sector.

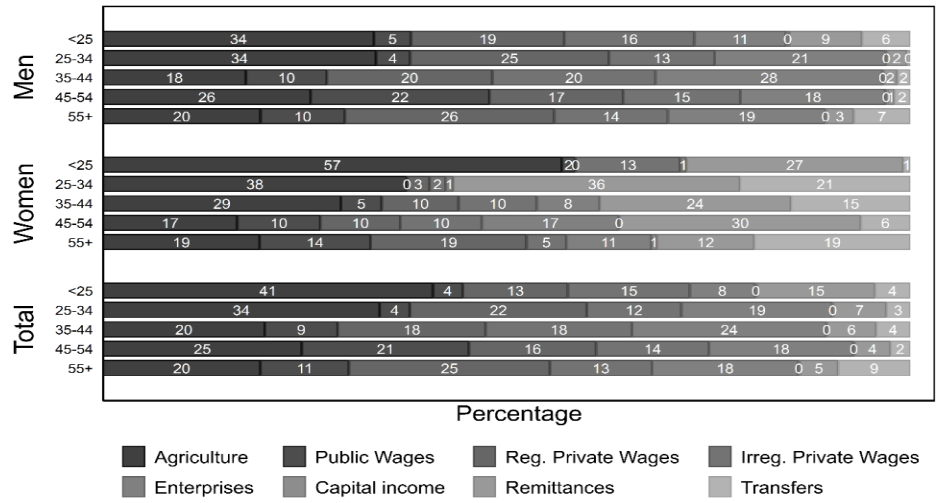
Figure 23. Household's main income source by sex and educational level of household head (percentage of households), Sudan 2022



Source: Authors' calculations using SLMPS 2022.

The age of the household head (Figure 24) further differentiates the main income source. Younger household heads, particularly women, are more dependent on agriculture. Around one-third (34 percent) of households with male heads younger than 25 rely mainly on agriculture compared to 57 percent of female-headed households in the same age group. Among household heads aged 25-34 years old, the percentages relying on agriculture are similar for male- and female-headed households (34-36 percent). Reliance on wages becomes more pronounced among middle-aged male-headed households, whereas dependence on remittances and transfers is more noticeable among middle-aged female-headed households. More than one-third of households headed by women aged 25 to 34 years rely primarily on remittances (36 percent), and one-fifth rely on transfers (21 percent). While dependency on remittances declines among households headed by women aged 55 years and above (12 percent), the proportion relying on transfers remains relatively the same (19 percent).

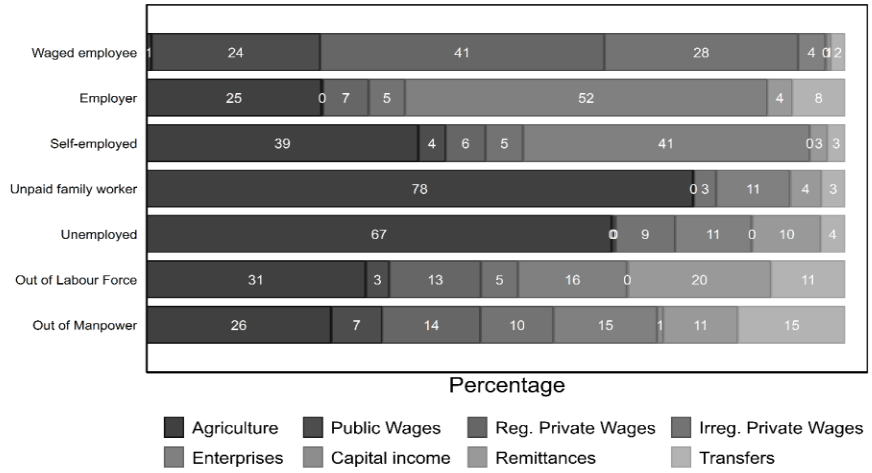
Figure 24. Household's main income source by sex and age of household head (percentage of households), Sudan 2022



Source: Authors' calculations using SLMPS 2022.

Households whose heads are out of the labor force often depend on remittances (20 percent) or transfers (11 percent), similar to those headed by individuals out of the manpower basis (11 percent remittances and 15 percent transfers). As expected, the household head's labor market status is highly associated with the main income source; a household with a waged head relies predominantly on wages (93 percent combined), while those headed by employers rely on enterprises' income (52 percent), and those headed by unpaid family workers rely on agriculture (78 percent) (Figure 25).

Figure 25. Household's main income source by labor market status of household head (percentage of households), Sudan 2022



Source: Authors' calculations using SLMPS 2022.

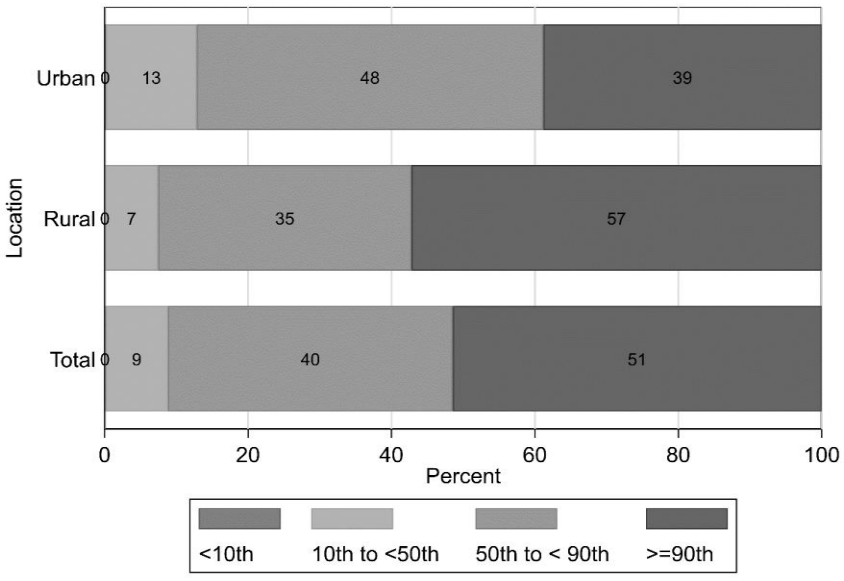
3.5. Income inequality

In 2022, Sudan not only witnessed high poverty levels but also faced substantial income inequality. The top 10 percent of the population earned an income that was more than 69 times greater than that of the lowest 10 percent (p90/p10, Table 2). Further examination of the inequality around the median shows that the disparities are more severe in the lower part of the income distribution ratio than the upper part, as reflected in a ratio of the bottom 10 percent's income to the median (p10/p50) of 0.07 compared with p90/p50 of four. This implies that the median is almost 14 times higher than the 10th percentile, while the 90th percentile earns four times the median.

Inequality is higher among female-headed households in rural areas, specifically in regions such as Darfur and Kordofan, and among households with illiterate heads or heads aged between 25 and 34 years. This pattern is broadly consistent across measures and across the main characteristics (Table 2).

Figure 26 shows that half of the population receives more than 90 percent of the total income, while the other half earns less than 10 percent. The income gap increases even more in rural areas, where the top 10 percent of the population receives around 57 percent of total income, while the lower middle 40 percent (from the 10th to 50th percentiles) receives only seven percent.

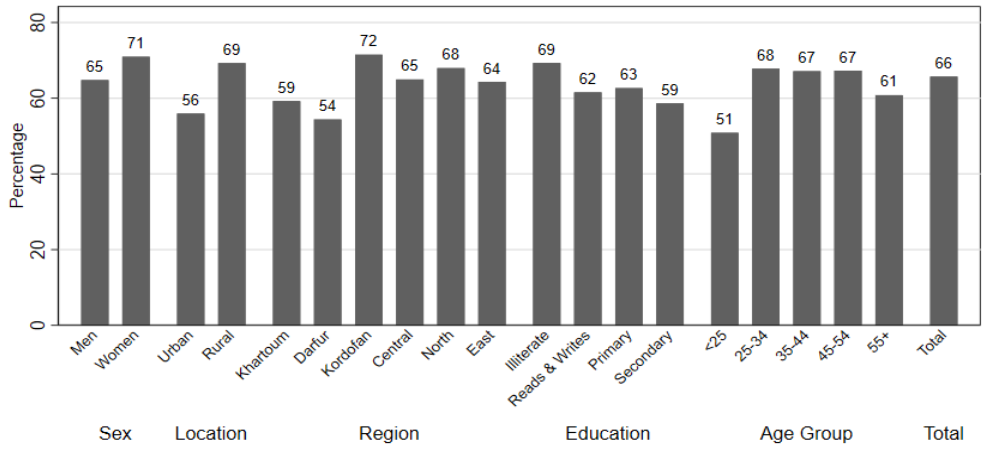
Figure 26. Share of total income by population segments, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

Using the Gini index to measure inequality[14] confirms high levels of income inequality in Sudan with a Gini of approximately 65 percent (Figure 27). There is a noticeable decrease in urban areas to 56 percent but a spike to 69 percent in rural regions. All alternative inequality metrics emphasize that female-headed households and rural areas in Sudan, particularly in Kordofan, face increased levels of inequality, exacerbating existing poverty problems (Figure 27, Table 2).

Figure 27. Gini coefficient for monthly per capita income by household and head characteristics, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

In recent years, several studies have attempted to determine the contribution of different income sources to income inequality in developing countries (Taylor et al., 2024; De Silva, 2013; Krafft and Davis, 2021). A key question when analyzing income decompositions by source is to determine the impact of changes in specific income sources on overall inequality (Shariff and Azam, 2009). This section focuses on inequality decomposition by income source. It is based on measuring the contribution of various income components, such as labor income, non-labor income, remittances, and transfers, to total income inequality (Shorrock, 1984). We adopt the income source decomposition approach (Lerman and Yitzhaki, 1985). This approach measures the contribution of each income source to the Gini coefficient, its share in total income, and its correlation with total income. It also quantifies the marginal effect of various income sources on overall inequality. The higher an income source's contribution to inequality relative to its contribution to income, the larger the impact on the inequality of marginal changes in the income source (Lerman, 1999; Urban I., 2024). If the income source has a negative marginal effect, this indicates that this income source has an equalizing effect, and vice versa.

Private sector wages, both regular and irregular, are identified as the predominant contributor among various sources of labor income in Sudan, together constituting approximately 41 percent

[14] Zero values are excluded from Gini coefficient calculations; therefore, they are excluded in the decomposition.

of the total income, 20 percent for regular, and 21 percent for irregular (Figure 28). Both forms of private sector wages, regular and irregular wages, exert a similar influence on income inequality, together contributing around 41 percent to the overall inequality (17 percent regular private sector wages and 24 percent irregular private sector wages). Regular private sector wages demonstrate a noteworthy ability to mitigate inequality, evidenced by the negative marginal effect (elasticity) of -0.021 (Table 3). Furthermore, irregular private sector wages contribute to aggravating inequality with a marginal effect of 0.032, which increases to 0.045 in rural areas.

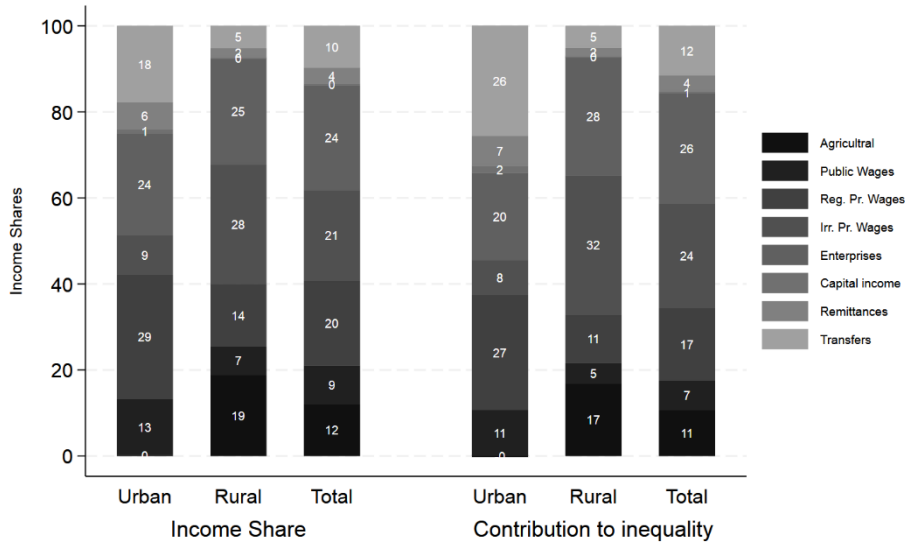
Public sector wages play a relatively minor role in household income, accounting for nine percent of the total, and contributing just seven percent to the total inequality. However, in urban areas, their importance is nearly double that of rural areas, comprising 13 percent of income compared to seven percent, and contributing 11 percent to inequality as opposed to five percent (Figure 28), In both urban and rural areas, public sector wages help reduce income inequality, with marginal effects of -0.023 in urban areas and -0.018 in rural areas (Table 3).

In contrast, income derived from enterprises emerges as the second-largest contributor to both total income (24 percent) and inequality (26 percent). Enterprise income's contribution to total inequality is similar in urban and rural areas (24-25 percent) (Figure 28). Agricultural income ranks third among income sources, contributing 12 percent to the overall income share in Sudan and rising to 19 percent in rural areas.[15] It has an equalizing and negative marginal effect in both urban and rural contexts (Table 3).

Regarding transfers, whether from abroad (remittances) or within the country from various programs, their shares in urban areas (24 percent) are nearly three times higher than their shares in rural areas (seven percent). Both remittances and internal transfers have a disequalizing impact on overall income in Sudan and urban areas, while exhibiting no appreciable effect in rural locations. Capital income in Sudan exhibits little share in overall income and does not substantially contribute to income inequality, with no discernible distinctions between urban and rural areas (Table 3 and Figure 28).

[15] Despite the common receipt of agricultural income, as mentioned in the earlier section, the interpretation of the low share is explained by the low agriculture per capita income in general. Specifically, the median monthly per capita income among recipients of agricultural income is SDG 2,452, compared to SDG 19,500 for regular private wage income.

Figure 28. Household income source shares and contributions to inequality (percentages) by location, Sudan 2022



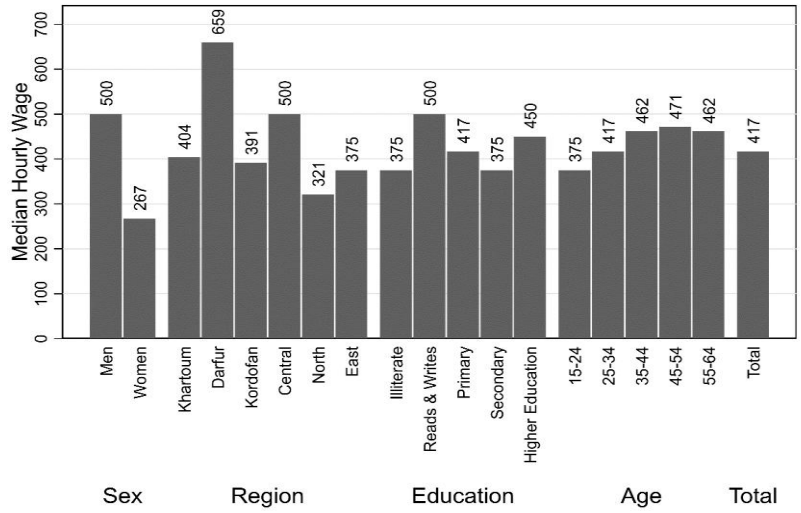
Source: Authors' calculations using SLMPS 2022.

4. Wage distribution and wage inequality

Among all wage workers,[16] the median hourly wage in Sudan is SDG 417 (Figure 29).[17] More than half the employed men are wage workers, specifically 57 percent, compared to 44 percent among employed women. The distribution by sector[18] shows a noteworthy distinction, as 48 percent of the female wage workers work in the public sector, compared to only one-fifth of the male wage workers (19 percent) (Krafft et al., 2023). For male wage workers, the median hourly wage is SDG 500, while it drops for female wage workers to around half, reaching SDG 267. In both the public and private sectors, whether regular or irregular, women earn substantially lower wages than their male counterparts (Figure 31).

[16] Around 15 percent of waged workers are missing their wages, therefore the individual weights were adjusted (see Appendix B for details).
[17] The highest 99th wage percentile was excluded from the analysis.
[18] The classification and analyses are based on the primary job, since only 5.5 percent of wage workers had a secondary job.

Figure 29. Median hourly wages (in 2022 SDG) by main characteristics, Sudan 2022

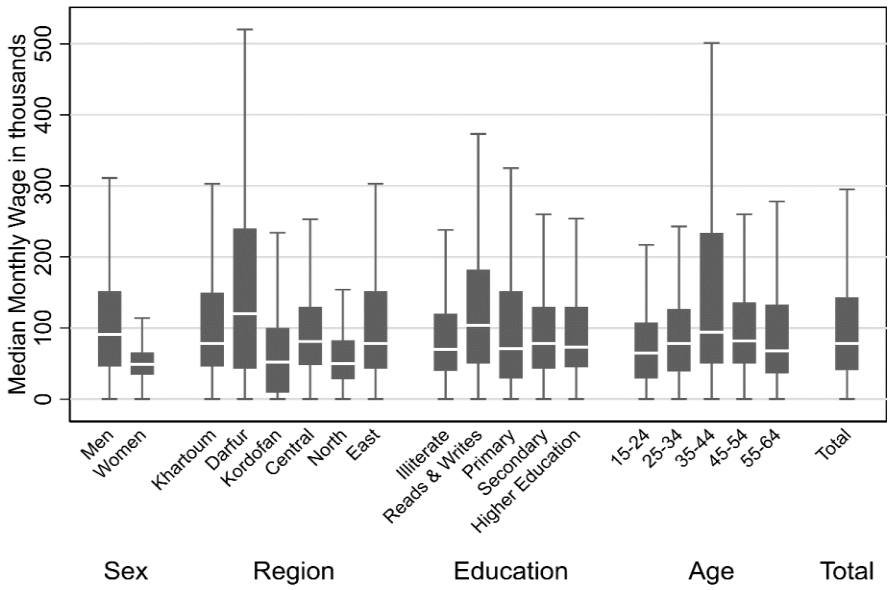


Source: Authors' calculations using SLMPS 2022.

Although Darfur is considered a low-income region with a high proportion of households falling below the international PPP based on reported incomes (56 percent), it has the highest median wage at around SDG 659. This is likely because only a select group of individuals are wage workers. An examination of wage disparities according to individual characteristics shows that educational attainment is not associated with higher wages; on the contrary, workers with basic literacy skills earn the highest wages of around SDG 500 per hour. Median hourly wages slightly increase among wage workers aged 35 years and above.

The distribution of the monthly wages yields the same conclusions. The box plots (Figure 31) confirm the presence of a large gender wage gap in monthly wages; while the overall median monthly wage is about SDG 78,000, female wage workers earn around half as much as their male counterparts (around SDG 49,000 for women compared to SDG 91,000 for men). Additionally, three-quarters of female wage workers earn less than the bottom quarter of male wage workers. Furthermore, the groups that earn higher hourly wages still earn higher monthly wages across the entire monthly wage distribution, such as those residing in Darfur, wage workers with only literacy skills, and those in the 35-44 age group. The paper therefore focuses on the hourly wages when examined by key characteristics in detail.

Figure 30. Distribution of monthly wages (in 2022 SDG) by main characteristics, Sudan 2022

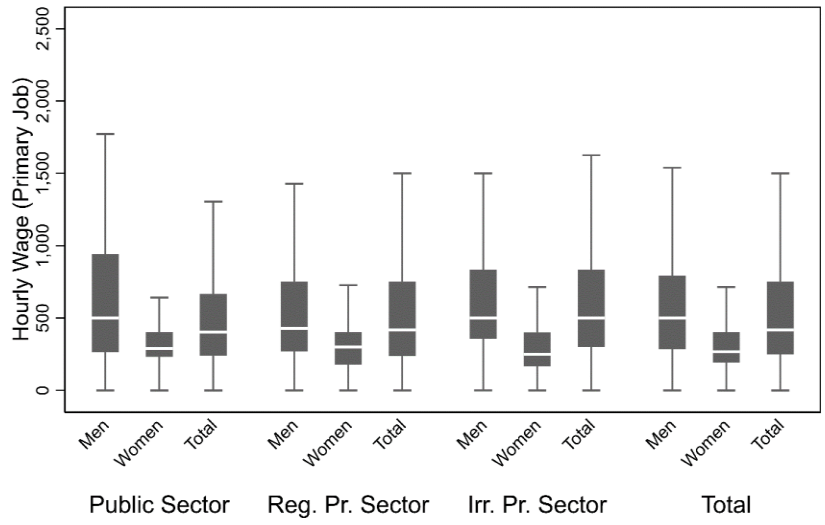


Source: Authors' calculations using SLMPS 2022.

Note: Observations beyond 1.5 times the interquartile range are excluded from the boxplot.

When breaking down the data by sector, Figure 31 illustrates that the public sector offers the lowest wages, with a median hourly wage of around SDG 404. This is slightly less than regular private sector wages of SDG 417 and nearly SDG 100 less than the irregular private sector. Sectoral differences change when gender is considered. Figure 31 indicates that male wage workers have the same median hourly wage in the public and irregular private sector (SDG 500), and a lower median hourly wage in the regular private sector at nearly SDG 430. The gender wage gap persists across all sectors, and is particularly pronounced in the irregular private sector, where women earn half of the men's median wage (SDG 250 for women versus SDG 500 for men), which are the lowest wages overall, compared with women earning SDG 288 in the public sector and SDG 300 in the regular private sector.

Figure 31. Distribution of median hourly wages (in 2022 SDG) by sex and sector, Sudan 2022

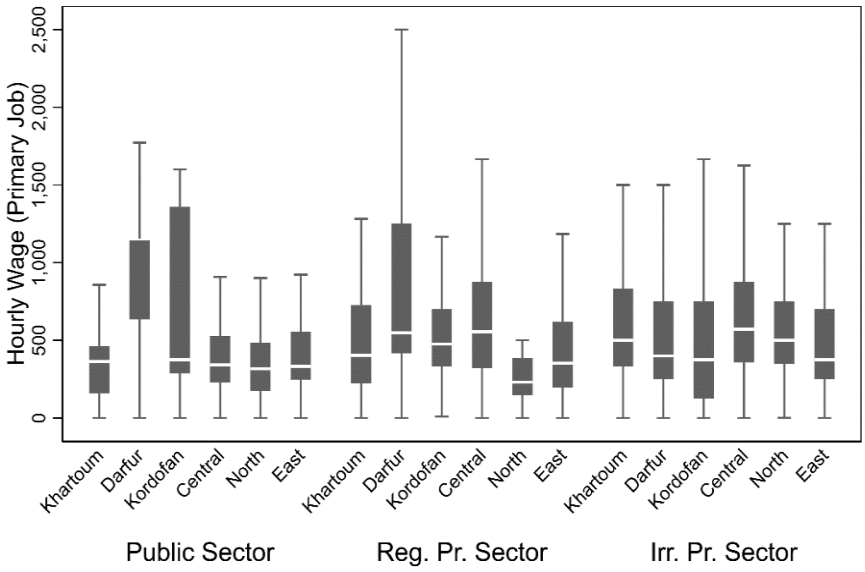


Source: Authors' calculations using SLMPS 2022.

Note: Observations beyond 1.5 times the interquartile range are excluded from the boxplot.

A closer look into the median hourly wages by sector and region (Figure 32) reveals that the North and East regions have the lowest wages in the regular sector, with medians of SDG 317 (North) and SDG 333 (East) in the public sector, and approximately SDG 231 (North) and SDG 353 (East) in the regular private sector. On the other hand, Kordofan experiences the largest wage variability, irrespective of the sector. Similar to the East region, it has a low irregular private wage (SDG 375). The highest median public sector wage is observed in Darfur, reaching SDG 1,154. In the regular private sector, the highest medians are recorded in Darfur (SDG 549) and the Central regions (SDG 555).

Figure 32. Distribution of median hourly wages (in 2022 SDG) by region and sector, Sudan 2022



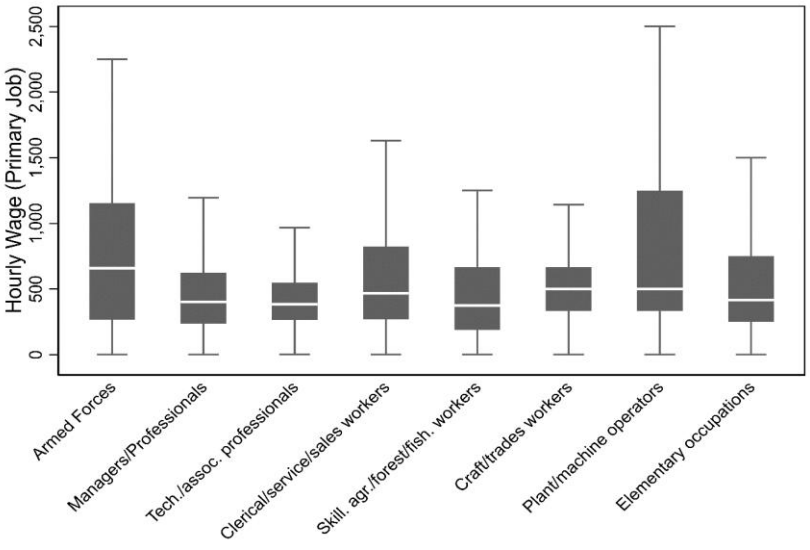
Source: Authors' calculations using SLMPS 2022.
Note: Observations beyond 1.5 times the interquartile range are excluded from the boxplot.

Analyzing hourly median wages by occupation (Figure 32) highlights that high-skilled occupations, such as managers, professionals, and technicians, experience lower hourly wages than low-skilled occupations, such as plant and machine operators. The median hourly wages for managers/professionals and technicians are SDG 403 and 385, respectively, compared to SDG 417 and 500 for elementary occupations and plant and machine operators, respectively. A similar pattern is observed when comparing the monthly wages, where the median monthly wage is SDG 55,000 for managers/professionals and SDG 60,000 for technicians, compared with SDG 78,000 for elementary occupations and SDG 132,000 for plant and machine operators. This pattern may reflect the political instability since the beginning of the new millennium in Sudan, which has likely contributed to the out-migration of highly educated professionals and managers who were concentrated at the upper end of the wage distribution (see Abuagla and Badr, 2016). Sudan's long history of political and economic instability has contributed to ongoing high levels of emigration, with an estimated four to five million Sudanese migrants abroad, leading to a sustained outflow of skilled workers that has weakened domestic human capital capacity (IOM, 2021).

Wage workers in agricultural occupations have the lowest median hourly wage at SDG 375. In contrast, individuals in the armed forces have the highest earnings, with a median of SDG 659.

This finding may elucidate the high wages in Darfur, considering that 55 percent of the armed forces are located there, with approximately half of them possessing only basic and writing skills.

Figure 33. Distribution of median hourly wages (in 2022 SDG) by occupation, Sudan 2022

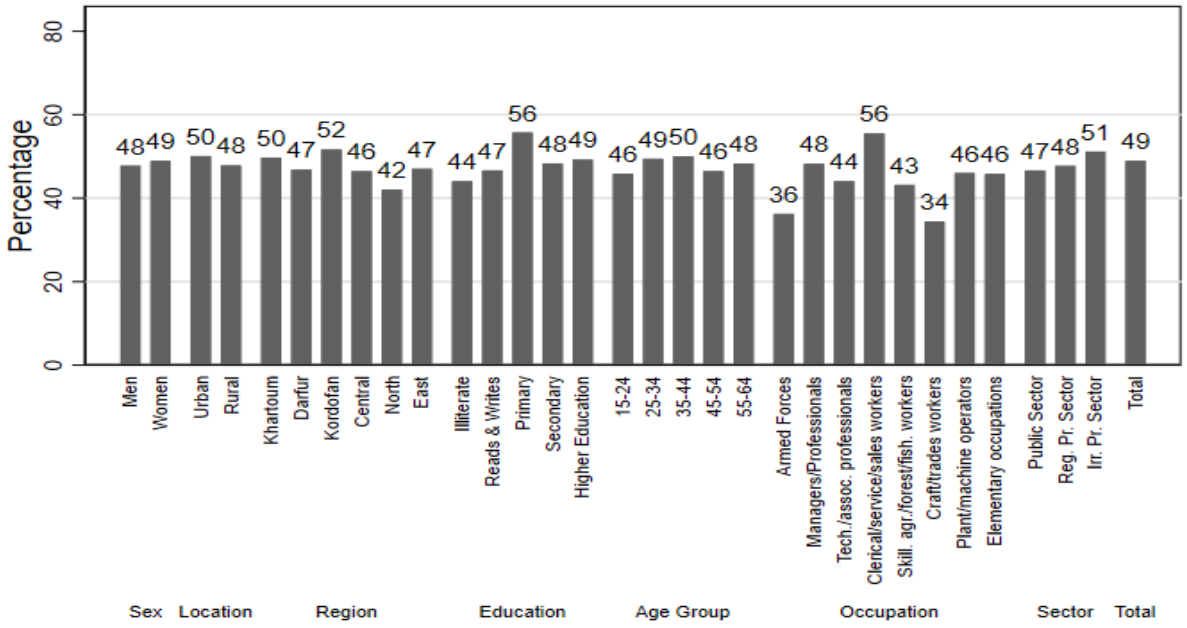


Source: Authors' calculations using SLMPS 2022.

Note: Observations beyond 1.5 times the interquartile range are excluded from the boxplot.

When exploring wage inequality, Figure 34 shows that the Gini index for hourly wages is around 49 percent. The Gini index is slightly elevated in the lower range of hourly wages, especially in Kordofan, within the irregular sector, and among women. A more noticeable distinction is observed between female workers in the irregular private sectors, with the Gini index reaching 55 percent (Table 4). Table 5 reveals that wages at the 90th percentile are more than eight times the wages at the bottom 10th percentile, and three times the median wage. Wage inequality is thus much lower than overall income inequality.

Figure 34. Gini coefficient for hourly wages by individual characteristics, Sudan 2022



Source: Authors' calculations using SLMPS 2022.

When comparing different measures of wage inequality in Sudan with global figures and those of other lower-middle-income and low-income countries (Table 5), Sudan experiences almost the same level of inequality as lower-middle-income countries. The Palma ratio[19] is estimated in Sudan to be around 2.92, indicating that the top 10 percent earn nearly three times the income of the bottom 40 percent. This figure is, however, slightly lower than the average for lower-middle-income countries, which stands at 3.16. The same conclusion holds for other measures, such as the p90/p50 with ~3 in Sudan and lower middle countries, and p50/p10 around 2.78 in Sudan compared to 2.69 (Table 5).

5. Conclusions

The Arab region exhibits pronounced inequality, characterized by substantial disparities in income distribution and access to economic opportunities across countries and subnational regions. Moreover, protracted conflicts in several countries, including Sudan, have deeply rooted the region in a vicious cycle that undermines development gains (ESCWA, 2022). Gender-based inequality is notable, and ongoing conflicts further perpetuate these disparities. Sudan exemplifies these patterns, having endured extensive political and economic turmoil since the 1990s. Following a

[19] The Palma ratio is a measurement of inequality calculated by dividing the total hourly wages shares of the top 10 percent of the wage distribution by the share of total hourly wages of the bottom 40 percent of the wage distribution.

decade-long civil war, the division into Sudan and South Sudan in 2011 led to continued instability. Comprehensive national household survey data were scarce from 2014 until the SLMPS 2022 survey, the first nationally representative study in nearly a decade. This paper uses SLMPS data to reveal income magnitude and diversification by gender, region, education, and poverty in Sudan. The analyses reveal low incomes, inequality, and limited income diversification, particularly in rural and politically unstable regions like Darfur and Kordofan.

Despite the prominence of the agricultural activity, especially in rural areas, where nearly two-fifths of Sudanese households derive income from agriculture, its contribution to total households' income remains around 12 percent, reflecting low agricultural income. Household enterprises are crucial, with around one-fifth of households primarily depending on them as a main source of income, with a contribution of about 24 percent.

Additionally, labor income constitutes approximately 86 percent of households' total income in Sudan, where wages are a dominant contributor to both income and income inequality, but this contribution varies by sector and region. Public sector wages have a lower prevalence and share compared to private sector wages, whether regular or irregular. The contribution of irregular wages to both income and inequality is more apparent in rural areas than in urban areas, possibly reflecting irregular agricultural labor. The contribution and prevalence of wages from the public sector increases in urban regions.

The share of financial assets in the average household's portfolio is expected to increase with national development (Honohan, 2006). As expected, in Sudan, which is a low-income, less developed country, capital income—both financial and non-financial—is notably low in terms of prevalence, share (0.02 percent), and contribution to inequality.[20]

The findings reveal that a gender gap in both household income and individual wages exists, especially in rural areas. Female-headed households experience a greater chance of having no income sources and lower income diversification. Furthermore, women in wage employment earn less than their male counterparts across all sectors, including public, regular private, and irregular private sectors.

Sudan also suffers from high levels of income and wage inequality, where the Gini coefficient for income is approximately 66 percent. This discrepancy is more prominent within rural areas such as Kordofan, with a Gini coefficient of 72 percent, followed by North, which has a Gini coefficient of 68 percent. While this reflects a notable level of inequality, it still lies below the global income inequality average of 67 percent in 2020 (World Inequality Report, 2020). For individual wages, the Gini coefficient is 49 percent. Wage inequality is more pronounced in the irregular private

[20] For more information on ownership of financial assets in Sudan, see Krafft and Moylan, 2024.

sector, with a Gini coefficient of 51 percent, and is particularly more severe among women in this sector, reaching 55 percent.

Sudan's current poverty and inequality are likely to have worsened since 2022, given the lack of essential infrastructure to maintain a minimum standard of living during conflict. The recent civil conflict in April 2023 might further worsen the situation, with more households expected to face reduced or lost incomes (Ahmed, Raouf, and Siddig, 2026).

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Appendix A

Table 2. Income (per capita) inequality measures by household and head characteristics, Sudan 2022

Characteristics of Household (Head)		Gini[21]	p10/p50	p90/p50	p90/p10	p75/p25[22]
Sex	Men	65	0.08	4	52	7
	Women	71	0.08	6	76	14
Location	Urban	56	0.07	4	49	6
	Rural	69	0.07	4	59	7
Region	Khartoum	59	0.03	4	119	6
	Darfur	54	0.03	4	159	5
	Kordofan	72	0.05	10	200	11
	Central	65	0.11	5	43	5
	North	68	0.13	3	25	4
	East	64	0.11	4	41	5
Education	Illiterate	69	0.05	4	81	7
	Reads and Writes	62	0.10	4	37	6
	Primary	63	0.08	5	60	8
	Secondary	59	0.04	3	80	6
Age Group	<25	51	0.09	3	29	3
	25-34	68	0.01	4	582	19
	35-44	67	0.05	5	93	8
	45-54	67	0.10	4	43	4
	55+	61	0.11	4	39	7
Total		66	0.07	4	64	8

Source: Authors' calculation using SLMPS 2022

[21] The Gini coefficient is calculated by comparing the cumulative share of income with the cumulative share of households.
[22] pnth/pqth is defined as the income/wage of the nth percentile household or individual divided by the income/wage of the qth percentile household or individual.

Table 3. Income (per capita) inequality decomposition by source, Sudan 2022

Location	Source of Income	Share	Relative contribution	Elasticity
Urban	Agricultural	0%	0%	-0.003***
	Public Wages	13%	11%	-0.023
	Regular Private Wages	29%	27%	-0.023
	Irregular Private Wages	9%	8%	-0.01
	Enterprises	24%	20%	-0.033**
	Capital Income	1%	2%	0.006
	Remittances	6%	7%	0.007
	Transfers	18%	26%	0.078***
Rural	Agricultural	19%	17%	-0.02
	Public Wages	7%	5%	-0.018**
	Regular Private Wages	14%	11%	-0.032***
	Irregular Private Wages	28%	32%	0.045*
	Enterprises	25%	28%	0.029
	Capital Income	0%	0%	-0.000*
	Remittances	2%	2%	-0.002*
	Transfers	5%	5%	-0.001
Total	Agricultural	12%	11%	-0.014
	Public Wages	9%	7%	-0.021**
	Regular Private Wages	20%	17%	-0.029***
	Irregular Private Wages	21%	24%	0.032*
	Enterprises	24%	26%	0.014
	Capital Income	0%	1%	0.001
	Remittances	4%	4%	0.000
	Transfers	10%	12%	0.018

Source: Authors' calculation using SLMPS 2022.

*Notes: P-values were generated using bootstrap: * p-value<0.1, ** p-value<0.05, *** p-value<0.01.*

Table 4. Hourly wage inequality measures by sector and sex, Sudan 2022

Gender and Sector Groups	Gini
Men in Public Sector	0.434
Men in Regular Private Sector	0.476
Men in Irregular Private Sector	0.495
Women in Public Sector	0.479
Women in Regular Private Sector	0.417
Women in Irregular Private Sector	0.554
Sector	
Public Sector	0.466
Regular Private Sector	0.478
Irregular Private Sector	0.512
Gender	
Male	0.478
Female	0.489
Total	0.489

Source: Authors' calculations using SLMPS 2022.

Table 5. Wage inequality measures in Sudan 2022, and by country income group (2021)

	Palma Ratio	p90/p10	p90/p50	p50/p10
Global*	4.82	16.82	4.96	3.39
Lower-Middle-Income Countries*	3.16	8.29	3.04	2.69
Low-Income Countries*	5.28	15.88	3.82	4.16
Sudan **	2.92	8.33	3	2.78

*Source: ** Authors' calculations using SLMPS 2022. * Generated from ILO 2024 Report (Table 7.2).*

Appendix B

Weights Adjustments

All of the above results are based on calculations by the authors using the STATA package version 19.0. In this paper, the highest percentile value for per capita income in Sudan was removed from all calculations and measurements in order to avoid the impact of outliers on the results.

With regard to the weights and due to the significant number of missing income data, whereby out of a total of 4,878 households, 1,483 households have missing income data, the authors predicted adjusted household weights as compensation or estimates for missing income data using a logit regression model and several variables relating to household characteristics as follows:

- Household structure: Number of children under 5, number of young people, number of men, number of women, and number of elderly men and women in households.
- Household location: Region, urban/rural areas, and home ownership status.
- Household wealth: Wealth quintile index.
- Characteristics of the household head: Age, gender, marital status, and current employment status.
- Sources of Income: Dummy variables indicating whether the household receives the source of income or not

The weights use the probability that the household has income reported (p_hh)

$$p\_hh=1-p\_hh\_2,$$

where p_hh_2 is the predicted probability of missing income, and then the adjusted household weight is calculated as follows:

$$hhweight=(1/p\_hh) * expan\_hh,$$

where expan_hh is the weight for the households in the original data file "SLMPS v2.2 all".

The individuals' weight is also multiplied by the adjusted households' weight discussed in the previous paragraph times household size. All of the income prevalence results are calculated using the expan_hh variable, which is the weight for the households.

With regard to the individuals' weight and due to the number of individuals missing wages data, whereby out of a total of 3,228 waged employees aged 15-64 years, 620 waged employees have no wages data, the authors adjusted individuals' weights for missing income data using a logit regression model and several variables relating to household characteristics as follows:

- Household location: Region, urban/rural areas, and home ownership status.
- Household wealth: Wealth quintile index.
- Characteristics of the individual: Age, gender, education, occupation and job sector.

We estimate the probability that the individual has income reported:

p_ind=1-p_ind_2,

where p_ind_2 is the predicted probability of missing income, and then the adjusted individual weight is calculated as follows:

ind_weight=(1/p_ind)* expan_indiv,

where expan_ indiv is the individual weight in the original data file "SLMPS v2.2 all."

Income Decomposition

Extending the results of Shorrocks (1982), Lerman and Yitzhaki (1985) show that the Gini coefficient for total income inequality, G, can be represented as:

$$G_y = \frac{2cov(y\,,F(y))}{\bar{y}} \quad (1)$$

In other words, it captures the distance of the observed income distribution from a perfect equality of having exactly the same income for each one, i.e., zero Gini index.

If the income *y* comes from *k* sources, i.e., $y = \sum_{k=1}^{K} y_k$

The Gini index can be rewritten as follows:

$$G_y = \sum_{k=1}^{K} \left[\frac{cov(y_k,F(y))}{cov(y_k,F(y_k))}\right]\left[2\,\frac{cov(y_k,F(y_k))}{\bar{y}_k}\right]\left[\frac{\bar{y}_k}{\bar{y}}\right] \quad (2)$$

$$G = \sum_{k=1}^{K} R_k \quad G_k \quad S_k \quad (3)$$

Where S_k represents the share of income source k in total income, G_k is the Gini index corresponding to the income source k and R_k is the Gini correlation of income from source *k* with the distribution of total income. $\bar{y}_k$ is the mean income for income source k and $\bar{y}$ is the mean income.

$R_k = Cov\{y_k,F(y)\}/Cov\{y_k,F(y_k)\}$, where $F(y)$and $F(y_k)$ are the cumulative distributions of total income and income source k, and

The product of R_k and G_k is the pseudo-Gini index C_k or concentration index:

$$C_k = R_k G_k = \frac{2cov(y_k, F(y))}{\bar{y}_k} \quad (4)$$

Hence, the Gini index can be considered a weighted average of the pseudo-Gini indices of income components, where the weights are the income shares.

When comparing equations (1) and (2), the difference between the Gini index and the "pseudo" Gini index (concentration index) is the reference ranking of individuals (Francese and Mulas-Granados, 2015). In the pseudo-Gini, each individual's weight corresponds to the ranking in the distribution of total income *F(y),* while in the Gini index, the ranking is that of the distribution of the *k*th income source $F(y_k)$. If the individuals' ranking in both total income *y* and income source y_k is the same, both indices, the Gini and the pseudo-Gini, will be the same.

The influence of any income component on the income inequality in equation (3) will depend on:

- The importance of the income source represented by S_k
- The inequality of the income source represented by G_k
- The correlation between the income source and the distribution of total income R_k

Based on this decomposition, if an income source has a large share of total income, it may also have a large impact on inequality. However, if income is equally distributed, it will not have an impact on the inequality. In addition, the techniques allow for quantifying the effect of marginal changes *e* in a particular income source *k* on the overall income inequality *G*, by taking the partial derivative of the Gini index with respect to the percentage change *e*.

$$\frac{\partial G}{\partial e} = S_k(G_k R_k - G) \quad (5)$$

$$\frac{\partial G / \partial e}{G} = \frac{S_k G_k R_k}{G} - S_k \quad (6)$$

Equation (6) represents the percentage change in inequality resulting from a small percentage change in income coming from source *k*.

The relative contribution of any income source *k* according to equation (6) is equal to $\frac{S_k G_k R_k}{G}$, i.e., it is determined by the inequality within the income source, its share, and the correlation coefficients R_k.

Equation (6) is simply the relative contribution of the income source to the total inequality G minus the share of income source k.[23] González and Gabriel (2016) argue that despite the Gini decomposition limitation of violation of the uniform property, the decomposition still has analytical value due to its interpretation of each of the sources' contributions.

[23] López Feldman (2006) provide a Stata user-written command to calculate the statistics of the Lerman and Yitzakhi approach.