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Effects of Water Scarcity on Rural Household Economy

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Abstract:

This study examined the effects of water scarcity on rural household economy in El Fashir Rural Council / North Darfur State- western Sudan. Both quantitative and qualitative methods were used as to get a deeper understanding of the impact of water scarcity on the rural house economy in the study area. 174 households out of 2017 were selected from 45 villages which were distributed in eight village councils forming the study area. Statistical methods were used to manipulate the data of the study. The obtained results revealed that water scarcity negatively affected the rural household economy in the study area in many features. These include the followings: much family efforts and time were directed to fetch for water consequently, reducing time on farming activities and off-farm income- generating activities especially in summer season. Also scarcity of water negatively affects the household budget allocation in the sense that considerable portion of family income was devoted to meet human and animal water needs or in medical treatments from water related diseases due to consumption of unfit water. But the biggest impact of water scarcity is its adverse effect on the rural household food security due to the reduction of the stable and cash crops productivity or increasing food prices as a fall in the rural household income due to the declining of the annual rainfalls. Finally, water scarcity has resulted in increasing school dropout rates, especially girls, in order to help their families in fetching water for both human and animal consumption which, in the long-run, affect the household economy by jeopardizing the rural household's human capital.

Keywords: **Rural Household Economy, Water Scarcity, Household Food Security El Fashir, Rural Council, Darfur.**
Paper type: Research paper

1. Introduction:

It is increasingly recognized that water scarcity has a negative impact on rural households in different ways, for example, significant distortion of household resource allocation, health, and sanitation, food security, family income, human capital. With regard to rural Darfur in western Sudan, water shortage is a common phenomenon, especially in the summer season. According to Ali (2011), the per capita water in Darfur states does not exceed five liters per day, which is equivalent to only 25% of the minimum standers recommended by the World Health Organization (WHO) and UNICEF. Furthermore, the United Nations Children's Fund (UNICEF) report (2006) showed that only 48.2% of households in North Darfur state have access to clean drinking water, and 32.2% have sanitation. Additionally, the lack or scarcity of water forced many people to store water in their homes. Such a practice can contribute to increasing the risk of indoor water pollution and creating a fertile environment for the reproduction of mosquitoes that transmit diseases such as dengue fever and malaria.

The existing literature has revealed limited studies regarding the effect of water scarcity on the rural household economy in rural Darfur. This research paper aims to analyze the impact of water scarcity on the rural household economy in North Darfur state - western Sudan.

The rest of the paper is structured as follows: the second section reviews the literature. Section three presents methodology, specifically describing methods of data collection, the sampling of respondents, sample size, and methods of data analysis. In the fourth section results, analysis and interpretation are presented. Lastly, section five summarizes the results and offers some recommendations.

2. Literature Review:

Water scarcity defined by FAO (2008) as the point at which the aggregate impact of all users impinges on the supply, or quality, of water under prevailing institutional arrangements to the extent that the demands from all sectors, including the environment, cannot be fully satisfied and that the problem is most prevalent in rural areas, where water stress affects the most vulnerable people. Water scarcity has two dimensions; physical and economic. The physical one occurs when there is not enough water to meet demand; its symptoms include severe environmental degradation, declining groundwater, and unequal water distribution. Economic water scarcity occurs when there is a lack of investment and proper control to meet the demand of people who do not have the financial means to use existing water sources; the symptoms in this case normally include poor infrastructure (FAO, 2007). The UNDP (2006) report studies water scarcity from two points of view where: first, as a crisis arising from the absence of services that provide safe water, and, second as a crisis produced by scarce water resources. According to UNDP (2006), water shortage can also mean scarcity in availability due to physical shortage, or scarcity in access due to the failure of institutions to ensure a regular supply, or a lack of acceptable infrastructure. Water scarcity is also defined 'from the viewpoint of individual water users who lack secure access to safe and affordable water to consistently satisfy their need for food production, drinking, washing, or livelihoods' (Inkani, 2015).

Water scarcity has many negative implications on the rural household economy including time, income, health and sanitation, food security, etc. According to Hadush, (2018) water scarcity has negative implications for agricultural production and food security by diminishing households' food supply and incomes, and hence their capacity to acquire food and nutrition. Additionally, water scarcity has negative effects on a household's hygiene and health status. According to WHO, UNICEF and the Cooperative Council for Water and Sanitation Supply (2000) each week, an estimated 42,000 people die from diseases related to poor quality of drinking water and lack of sanitation. Beyond this, water scarcity also increases food prices, which again disproportionally affects the most vulnerable members of the society.

3. Methodology:

First: Study Area:

El Fasher Rural council occupies the central part of North Darfur State and surrounds El Fasher town. It covers an area of about 565 km2 and lies between latitudes 13°49' - 14°25' N and longitude 24°56' – 25°39' E (Fig. 1). The economic activities, to a greater extent, are manifested in agricultural production and animal husbandry. Conventional crops produced are represented by some cereals mainly millet which is considered as the main subsistence crop followed by maize in addition to vegetables and chewing tobacco, sesame, and watermelon as cash crops.

The area witnessed a prolonged decline in rainfall quantity, distribution, and intensity since the sixties and the seventies of the last century (Fadoul, 2004). To cope with this situation, inhabitants in the study area have adopted several strategies to sustain their livelihood e.g. intercropping techniques, different timing for sowing and traditional crop rotational techniques to farm particular crops each year, a combination of crops in the same field, or several crops in one hole, shift from farming millet on sandy lands to cultivation of maize in clay plains by construction an earth embankment or dyke made of clay across the direction of floods to intercept the runoff to harvest water for moistening the clay soil which will later be farmed in October (Arabi, 2005).

Second/ Methods of Data Collection:

Different methods were used to collect the related data. These include a questionnaire at a household level, interviews with some key informants in water-related sectors, and the registered data from different water-related departments.

Third/ Sampling Procedure and Sample Size:

The study area was divided into four segments: North, South, West, and East which consist of eight village councils. 174 households out of 2017 were selected from 45 villages constituting the eight mentioned village councils.

Fourth/ Methods of Data Analysis:

Statistical methods, mainly frequencies, and chi-square tests were applied to manipulate the data of the study.

4. Results and discussion:

Table (1): Distribution of Respondents by Head of Household

Level of Education	Frequencies%	Cumulative%
Non - Formal Education	60	60
Primary level	6	66
Secondary level	22	88
University level	12	100

Source: Own Calculations

The table above indicates the majority (% 60) of respondents with non-formal education, only % 6 of them reached a primary level, % 22 of them reached the secondary level and only % 12 of them reached university level. This means more than two-third ((% 66) of the respondents have a very low level of education. The respondent's level of education affects his awareness regarding water issues. Those that are highly educated are more cautious about water characteristics, hygiene, and safe water for human consumption.

Table (2): Distribution of Respondents by Head of Household Occupation

Head of Household occupation	Frequencies %	Cumulative %
Farmer	40.5	40.5
Gov. Employee	25.6	66.1
Herd Owner	9.3	75.4
Casual Worker	24.6	100

Source: Own Calculations

The table above revealed that 40.5 % of head of household are farmers, 25.6% are government employees, 9.3% are herd owners, and 24.6 are casual workers. This indicates that inhabitants in the study area have diversified their economic activities as a strategy to sustain their livelihood (this is mainly due to water shortage which affected their normal economic activity – farming and livestock rising).

Table (3): Distribution of Respondents by Water Source

Water Source	Frequencies%	Cumulative %
Surface well	15%	15%
Hand pumps	17%	32 %
Water station	26.4%	58.4 %
Local dam\ hafeer	11%	69.4 %
Piped-water	8.6%	78%
Stream	22 %	100%

Source: Own Calculations

The table above indicates that the community in the area studied relies on different sources of water, 15% of whom receive water from surface wells, 17% from hand pumps, 26.4% from water stations, 11% from Local dams\ excavations, 8.6% from piped-water, and 22%. 8% from Streams. This means that 52% of the community members receive their water from sources of low productivity (hand pumps and water stations) because these sources are either stop functioning or

disabled or obsoleted as there has been no renovation or periodic maintenance or lack of operating facilities (spare parts, fuel.... etc.). Furthermore, 36.8% of the community receives their water needs from unsafe sources (surface wells, local dams\ hafeers, and streams).

The above findings indicate that the community in the study area suffers from water scarcity because the sources referred to do not provide the commodity with its actual needs for various purposes. This situation has been exacerbated by the decrease in annual rainfall rates and distributions since the 1960s, which contributed to the reduction in the production and productivity of the stable and cash crops consequently, affected the rural households' food security, increasing food prices and reducing their income levels.

Table (4): Distribution of Respondents by Distance to the Water Sources

Distance to the Water Sources	Frequencies%	Cumulative%
< 500m	23.7	23.7
500m	22.7	46.4
1 km	30.6	77
1.5 km	5.8	82.8
>3 km	17.2	100

Source: Own Calculations

The table above indicates that 23.7% of households travel 500 meters and more to reach the water source, 22.7% travel 500 meters, 30.6% travel 1000 meters, 5.8% travel 1500 meters, while 17.2% travel 3000 meters and more. What usually happens in developing countries is that it is women who take on the task of bringing water, where women have to travel an average of six kilometers on foot every day and carry the equivalent of a bag of travel bags or 20 kg (World Summit on Sustainable Development, Johannesburg, 2002).

Table (5): Distribution of Respondents by Frequency of Attaining Water Point per Day.

Freq. of Attaining Water Points	Frequencies%	Cumulative%
Once	41.3	41.3
Twice	70.0	28.7
Several Times	100	30.0

Source: Own Calculations

In many developing regions, women and young girls spend several hours daily in the collection of natural resources. The table above indicates that 41.3% once go to the water source, 28. 7% go twice, and 30% go several times. The results in tables (4-4) and (4-5) indicate that families in the study area waste considerable time to bring water. This result is consistent with the study of Dr. Hamed Omar Ali, a water expert and water consultant for the United Nations Program, UNDP on the environment and water resources in Darfur, in which he noted that there are a huge number of people in Darfur who spend about (140) days a year to bring water, and this phenomenon has a negative economic, environmental and security implications. Further, he said: water shortages cause family income to be drained, with rural households spending 40% of their income on access to clean drinking water, although the World Bank studies indicate that such spending should not exceed 4% of the income of rural households.

Table (6): Distribution of Respondents by Problem Facing Them in Getting Water.

The Problem	Frequencies%	Cumulative %
Water shortage	31.6%	31.6%
Long distance to water sources	27.6%	59.2%
Low water quality	26.4%	85.6%
High water tariff	5,8%	91.4%
Other	8.6%	100%

Source: Own Calculations

The table above indicates that the community in the study area has a number of problems in accessing water, including water shortages: 13.6% of the respondents suffer from water shortages, 27% suffer from long distance to water sources, and 26.4% suffer from low water quality (there are three reasons for this: it may be from the source, and maybe from the means by which water is transported, or from the ways of storage water). The all above factors could contribute to an increasing in diarrheal diseases. The table also shows that 5.8% of the community suffers from high water tariffs, indicating weak investments in water sector, which is one of the reasons for the scarcity of water in the study area.

Table (7): Distribution of Respondents by Type of latrines

Type of latrine	Frequencies%	Cumulative%
Traditional latrines	38	38
Improved Pits	20	58
Open Air	42	100

Source: Own Calculations

The table above indicates that 38% of the community uses traditional toilets, only 20% use improved toilets, and 42% defecate on open air. This means that 80% of the community members in the area in question are deprived of the necessary sanitation services, another manifestation of water scarcity.

Chi Square Test:

Table (8): The Relationship between Water Scarcity and Some Variables

Variable	Chi Square	Degrees of Freedom	Prop. Value
Continuity of Children at Schools	19.185	4	0.000
Type of Water Used	50.046	5	0.000
Quantity of Water Consumed by Household	24.064	4	0.000
Frequency of Attaining Water Point per Day	5.103	2	0.000
Distance to the Water Sources	42.609	4	0.000

Source: Own Calculations

The table above indicates that there is a statistically significant relationship (probability value of the Chi- square = 0.000) between the independent variable (water scarcity) and the dependent variables: the first variable is the continuity of children at schools – water scarcity leads to a high dropout rate for pupils, especially girls, from their schools in order to help their families to get water, whether for human or animal consumption .The second variable is the quality of the water used - water scarcity forced some rural households to use of contaminated water as such increasing and the amount of water consumed by families - i.e. water scarcity leads to decrease the rate of water related diseases. The third variable is the amount of water consumed by the individual – water scarcity leads to falls of the water quantities consumed by individual below the recommended rates of the World Health Organization (WHO). The fourth variable is the number of times an individual goes to the water source, and the fifth is the distance crossed by an individual to obtain water and these at the expense of other productive activities. I.e., water scarcity has a negative effect on the rural household's productive activities in the sense that the family members devote most of their time in search of water for both human and animal consumption.

5. Conclusion:

The study examined the effects of water scarcity on the rural household economy in El Fashir Rural council/ Northern Darfur State- western Sudan in which water scarcity negatively affected the household economy in many features. These include the following:

- **Much family efforts and time were directed to fetch for water consequently, reducing the time devoted to farming activities and off-farm income-generating activities, especially in the summer season.**
- **Water scarcity has negatively affected the household budget allocation in the sense that a considerable portion of family income was devoted to meet human and animal water needs or in medical treatments from water-related diseases due to consumption of unfit water.**
- **Reduction in the production and productivity of the rain-fed stable and cash crops due to the declining of annual rainfall which in turn negatively affected household food insecurity, increasing food prices as well as reducing income levels of the rural household.**
- **Increasing school dropout rates especially girls in order to help their families in fetching water for both human and animal consumption which in the long run affects the household economy by jeopardizing the rural household's human capital.**

Based on the study conclusions, recommendations were made for policymaking as below:

- **Encourage households in the study area to diversify their livelihoods to limit vulnerability to water scarcity.**
- **Efforts should be made to improve income levels by investing in activities that would improve the rural households' economy especially in those that directly impact household food security and income.**
- **More studies need to be done to explore the impact of water scarcity on; education dropout rates especially among girls, family breakdowns, household income, and the extent of participation of women in the water sector as well as on women's health.**

 Incentives should be given to the small–scale farmers by subsidizing mechanisms, introducing new high yield crop varieties, and improving the rural household access to clean and safe drinking water as well as water for irrigation purposes through establishing water harvesting projects.

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آثار ندرة المياه على اقتصاد الأسرة الريفية

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مستخلص البحث:

تناولت هذه الدراسة آثار ندرة المياه على اقتصاد الأسرة الريفية، بمجلس ريفي الفاشر في ولاية شمال دارفور غربي السودان. لقد تم استخدام كل من المنهج الكمي والكيفي للحصول على فهم عميق لتأثير ندرة المياه على اقتصاد الأسرة الريفية . تم اختيار عينة من 174 أسرة من جملة 2017 أسرة في 45 قرية موزعة على تسعة مجلس قرية تتكون منها منطقة الدراسة. تم استخدام الطرق الاحصائية لمعالجة بيانات الدراسة. النتائج التي تم التوصل إليها أوضحت أن ندرة المياه أثرت سلباً على اقتصاد الأسرة الريفية بمنطقة الدراسة في عدة أوجه شملت الآتي: إهدار جزء كبير من وقت وجهد الأسرة في البحث عن المياه وكان ذلك على حساب الأنشطة المزرعية وغير المزرعية المدرة للدخل خاصة في فصل الصيف . أيضا لندرة المياه تأثير على توظيف ميزانية الأسرة - إذ أن جزء مقدر من دخل الأسرة الريفية تستغل فى توفير المياه لمتطلبت الإنسان والحيوان أو المعلجة من الأمراض المنقولة بالمياه جراء إستهلاك مياه ملوثة. لكن الأثر الأكبر لندرة المياه هو تأثيرها السالب على الأمن الغذائي اللأسرة الريفية جراء تدني إنتاجية المحاصيل الغذائية والنقدية أو ارتفاع أسعار الغذاء أو انخفاض دخل الأسرة بسبب المعدلات السنوية المنخفضة لهطول الأمطار. وأخيراً أدت ندرة المياه إلى ارتفاع معدل تسرب التلاميذ من مدارسهم خاصة البنات من أجل مساعدة أسرهم فى جلب الماء سواء كان للاستهلاك البشري أو الحيواني الأمر الذي يؤثر سلبا على اقتصاد الأسرة الريفية على المدى الطويل فضلا بسبب تعريض رأسمالها البشري للخطر.

المصطلحات الرئيسة للبحث/ اقتصاد الأسرة الريفية، ندرة المياه، الأمن الغذائي الأسرى ، مجلس ريفي الفاشر ، دارفور
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