EFFECTS OF LOCAL CLIMATIC CONDITIONS ON HOUSEHOLD CONSUMPTION. A CASE OF SOUTH AFRICA

By

Calvin Mudzingiri,Gibson Mudiriza &

Getrude Jana

November 30, 2023

Outline

- Overview
- Some anecdotes on impact of climate
- A case of south Africa
- Data
- Methodology
- Impact of area-specific average precipitation and temperature on household consumption in South Africa
- Mitigatory measures on the impact of climate on household consumption and income
- References
- Comments and questions

© Copyright reserved Kopiereg voorbehou

UFS UV

An Overview

- What is Consumption? (use of goods, services, or resources)
- Consumer goods & services as well as private& public consumption
- $C = a + bY_d$
- $GDP\ or\ Y = C + I + G + X - M$
- Cobb Douglas function $Y = AK^{\alpha}L^{\beta}$
- A-can represent (technology, human capital, climate etc)
- Consumption is a function of income
- Climate can directly or indirectly affect consumption
- Favourable climatic conditions increase consumption
- Adverse climatic condition reduce consumption
- https://www.youtube.com/watch?v=G4H1N_yXBiA
- https://www.youtube.com/watch?v=EuwMB1Dal-4

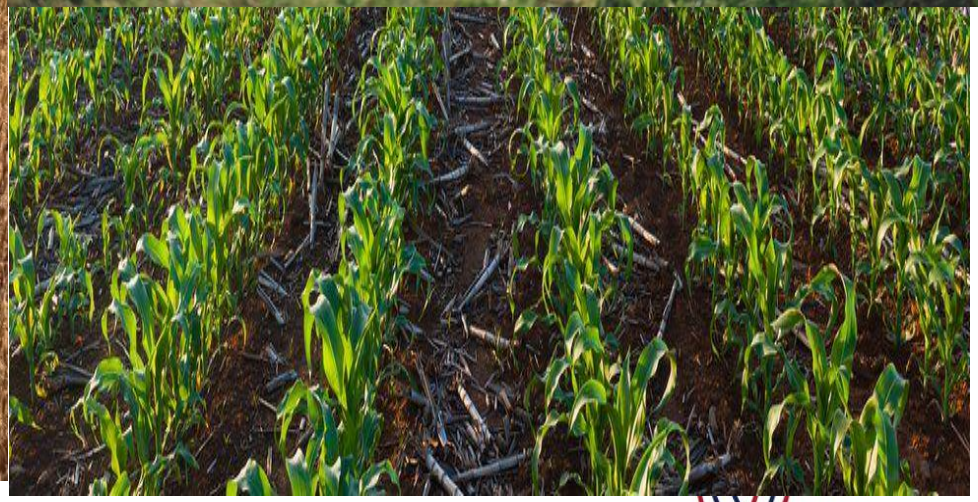
© Copyright reserved Kopiereg voorbehou

UFS UV

EFFECTS OF ADVERSE CLIMATE

© **Copyright reserved** Kopiereg voorbehou

FAVOURABLE CLIMATIC CONDITIONS



© **Copyright reserved** Kopiereg voorbehou

UV

An Overview of effects of climate

- Adverse climatic conditions affect people differently depending on their socio-economic status (Barua et al., 2014)
- Extreme climatic conditions propagate poverty and inequality in under developing and emerging economies(Islam and Winkel, 2017; Andersen and Verner, 2014)
- Adverse climatic conditions can affect consumption patterns of households
- Emerging economies lack capacity to mitigate extreme climatic conditions(Chersich and Wright, 2019).
- Climatic variability can affect agriculture productivity, livelihoods especially of the poor people by way lack of resources such as water, food shortages and advent of diseases (World Bank, 2016).

© Copyright reserved Kopiereg voorbehou

UFS UV

Determinants of Poverty

- Absolute poverty- cannot afford basic human needs such as food and shelter (Allen, 2017)
- Relative deprivation – view poverty in terms of the minimum acceptable standard of living achieved by an individual compared to other citizens in the society(Peng et al., 2019)
- Determinants of poverty can be:
- Micro or Individual (characteristics, behavioural etc)
- Contextual or neighbourhood factors (environment etc)
- Macro or structural level (economic, social,cultural, political etc) (Bradshaw, 2007; Garza-Rodriguez et al., 2021)
- The determinants of poverty have implications on household consumption

© Copyright reserved Kopiereg voorbehou

UFS UV

Some anecdotes

- spatial inequalities in economic development have been explained by a combination of various factors including, climatic conditions, history, endowments, institutions, trade, increasing returns to scale, imperfect information, and transaction costs (Krugman, 1991; Martin & Sunley, 1996; Boschma & Frenken,2006).
- Donadelli et al., (2017), found out that climate change reduces welfare and increases inequality within and between communities using subnational data selected from 12 American countries.
- Andersen and Verner, (2009) found that climatic changes have contributed to an increase in inequality and poverty in Bolivia, poor and indigenous peoples in the highlands were among the most severely affected populations.
- (Dasgupta, Emmerling and Shayegh, 2020)using SA data concluded that there is a U-shaped relationship between inequality/poverty indices and local mean temperatures.
- David, et al. (2018) noted that areas that are historically characterized by low economic and welfare outcomes still experience significantly higher poverty and deprivation levels.
- poverty is both spatially unequal and autocorrelated; the municipal poverty levels, local levels of education and economic activity (GDP per capita) (SA cesus at municipal level data)
- Human capital characteristics such as level of education and employment status determine poverty(Garza-Rodriguez et al., 2021; Lekobane & Seleka, 2017; Biyase, 2005)
- Neighbourhood variables such as climatic conditions and geographical location are also known to influence poverty and consumption levels (Urban Vs Rural; temperature variability; rainfall patterns etc) (Antonelli et al. ,2021; Deryugina and Hsiang, 2014)
- Individuals have inadequate managing capacities of controlling or coping with extreme climate conditions (Chersich and Wright, 2019).

© Copyright reserved Kopiereg voorbehou

UFS UV

A case of South Africa

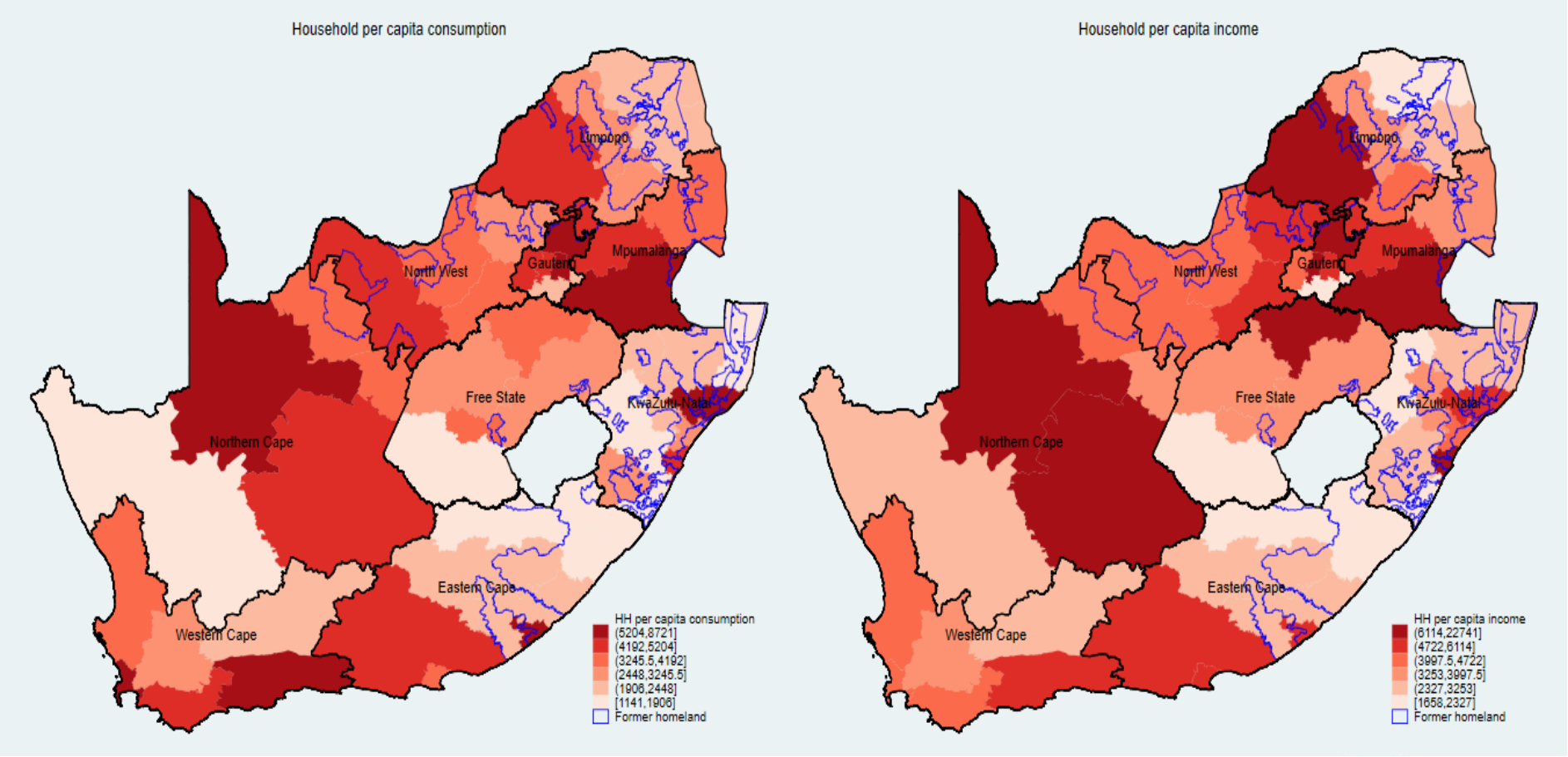
- We examined the relationship between household poverty (measured by household per capita consumption) and local climate conditions (defined as local variability in temperature and rainfall) in South Africa.
- The spatial geographical arrangement of South Africa shows that different places experience different climatic conditions ranging from flooding and very cold temperatures to extremely high temperatures.
- In SA poverty is more prevalent in rural than urban areas (due to aparithed spatial arrangement, homelands) (Mudiriza and Edwards, 2021; Kwenda, Ntuli and Mudiriza, 2021)
- The relationship between poverty and regional specific factors such as climatic conditions which vary by regions in SA has received little attention
- Western Cape, for example, has experience drought, waterborne diseases, Rift Valley Fever and schistosomiasis, due to global warming that manifests through extreme climatic conditions.
- Females are more likely to be in poverty when compared to males (education, jobs, responsibilities, discrimination etc) (M. Biyase et al., 2017).

© Copyright reserved Kopiereg voorbehou

UFS UV

CLIMATIC PATTERNS AND INCOME DISTRIBUTION IN SOUTH AFRICA

Figure 1. Spatial distribution of household per capita consumption and income across districts in South Africa, 2017.

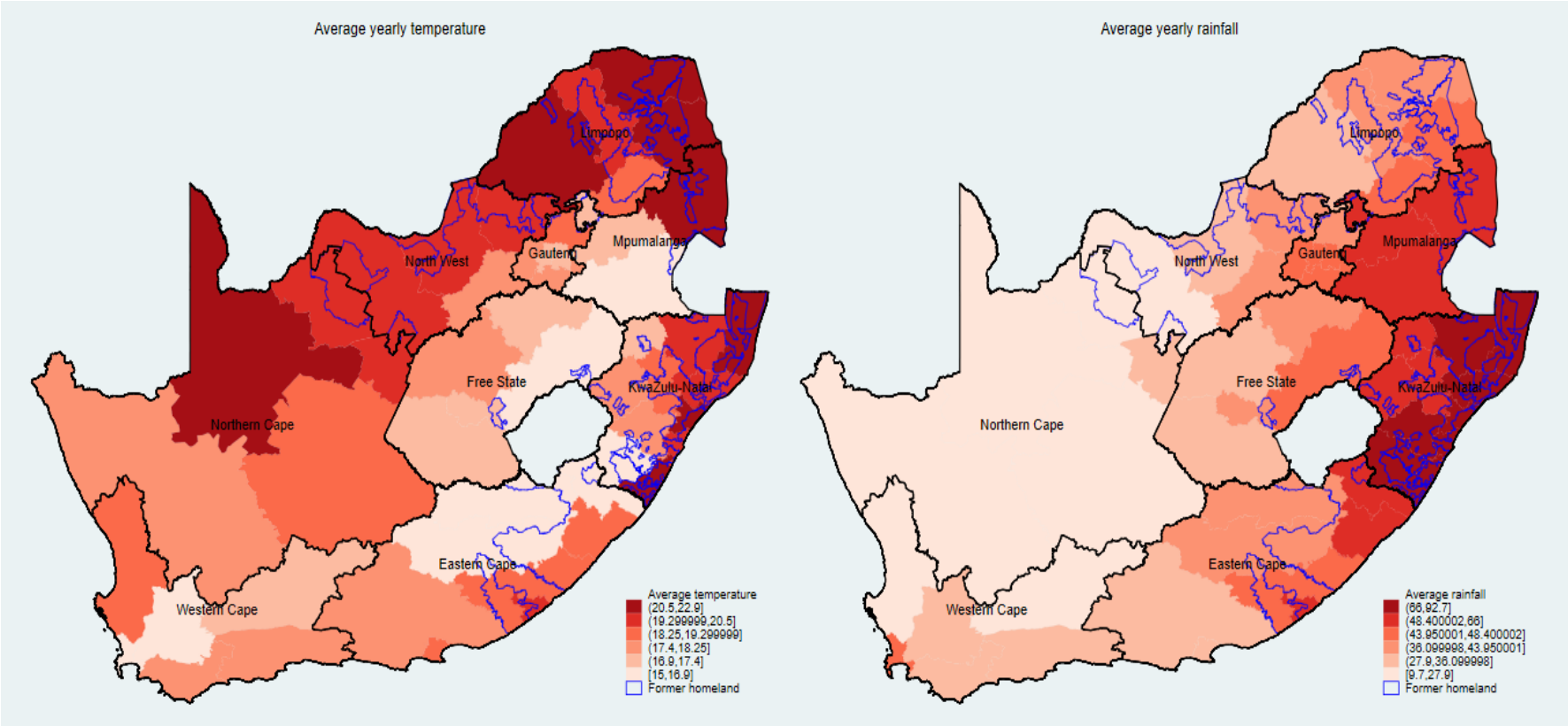


Source: Authors' calculation based on 2017 NIDS, wave 5 data aggregated to 52 districts.

© Copyright reserved Kopiereg voorbehou

TEMPERATURE AND RAINFALL

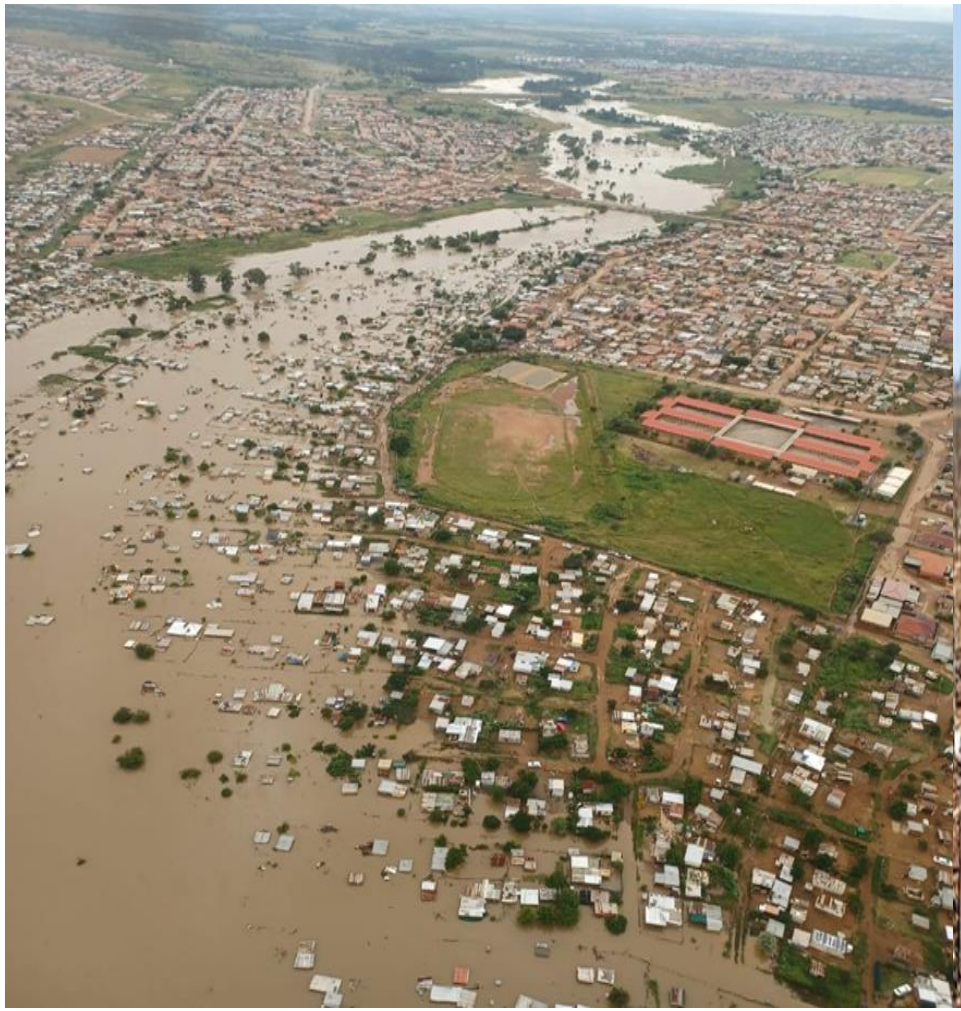
Figure 2. Spatial distribution of average temperature and rainfall across districts in South Africa, 2017.



Source: Author's calculation based on the aggregation of climate data produced by the Climatic Research Unit (CRU) at the University of East Anglia (see Harris et al., 2020) to 52 districts.

© Copyright reserved Kopiereg voorbehou

VARYING CLIMATIC CONDITIONS IN SOUTH AFRICA



© **Copyright reserved** Kopiereg voorbehou

Data sources

- The study uses the nationally representative 2017 South African National Income Dynamic Study (NIDS), wave 5 (Southern Africa Labour and Development Research Unit, 2018). NIDS, wave 5 was administered to over 47,000 individuals in 13,700 households.
- For our study, we limit our sample to 7,135 households with complete information on all the relevant variables.
- NIDS wave 5 collected a wide range of socio-economic variables at the individual and household level central for our study. These include demographic characteristics (age, gender and race), income, consumption, education level and employment status among others.
- We also used geospatial climate data, mainly temperature and rainfall produced by the Climatic Research Unit (CRU) at the University of East Anglia (Harris et al., 2020).
- we merged the climate data for 2017 with 2017 NIDS, wave 5 data based on the 52 districts in South Africa, so that each household is assigned the average yearly climate data for its corresponding district

© Copyright reserved Kopiereg voorbehou

UFS UV

Descriptive statistics

Table 2: Summary statistics of key variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A: Household variable					
Per capita consumption	7,135	4283.423	9578.363	48.250	260734.00
Per capita income	7,135	5026.936	11752.240	1.000	867666.70
Income poor	7,135	0.314	0.464	0.000	1.000
Age of head	7,135	41.874	13.783	8.000	100.000
Head is black	7,135	0.819	0.385	0.000	1.000
Head is female	7,135	0.450	0.498	0.000	1.000
Mean education level	7,135	10.484	2.764	0.000	18.000
At least one employed adult	7,135	0.800	0.400	0.000	1.000
Children under 6 years	7,135	0.261	0.439	0.000	1.000
Dependency ratio	7,135	0.462	0.705	0.000	7.000
Rural area	7,135	0.271	0.444	0.000	1.000
Homeland status	7,135	0.178	0.237	0.000	0.999
Infrastructure index	7,135	0.463	1.157	-2.599	1.257
Panel B: Climate variables					
Temperature	52	18.519	1.857	14.983	22.875
Rainfall	52	45.912	19.670	9.718	92.659
Vapour pressure	52	13.571	2.764	9.475	20.852
Wet days	52	6.920	2.480	2.387	11.959
Potential evapotranspiration	52	3.849	0.472	3.022	5.060

Note: Panel A reports the summary statistics for key household variables for households with complete information, while Panel B reports the summary statistics of the climate variables aggregated to 52 district councils. Variable definitions are provided in Table 1.

© copyright reserved UFS 2018 - 2020 - 2021

main results

- **Table 3: Ordinary Least Squares and Quantile Regression Model Estimates.**

	OLS estimates	Quantile regression estimates				
Variables	OLS	q10	q25	q50	q75	q90
Log average temperature	0.293***	0.057	0.247**	0.308***	0.429***	0.387***
	(0.103)	(0.167)	(0.117)	(0.118)	(0.165)	(0.143)
Log average precipitation	0.169***	0.079**	0.090***	0.181***	0.183***	0.233***
	(0.023)	(0.039)	(0.024)	(0.027)	(0.033)	(0.055)
Household head age	0.003***	-0.001	0.001	0.004***	0.005***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Household head is Black	-0.513***	-0.304***	-0.362***	-0.527***	-0.640***	-0.664***
	(0.028)	(0.049)	(0.040)	(0.041)	(0.046)	(0.042)
Household head is female	-0.262***	-0.219***	-0.224***	-0.269***	-0.280***	-0.266***
	(0.020)	(0.025)	(0.020)	(0.029)	(0.032)	(0.034)
Household mean education	0.158***	0.144***	0.153***	0.164***	0.158***	0.142***
	(0.005)	(0.009)	(0.008)	(0.007)	(0.004)	(0.005)
Household adult employed	0.127***	0.154***	0.103***	0.105***	0.127***	0.260***
	(0.023)	(0.032)	(0.022)	(0.025)	(0.027)	(0.051)
Child under 6 in household	-0.601***	-0.498***	-0.557***	-0.612***	-0.667***	-0.700***
	(0.022)	(0.026)	(0.015)	(0.031)	(0.030)	(0.036)
Household dependent ratio	-0.101***	-0.095***	-0.114***	-0.084***	-0.076***	-0.091***
	(0.014)	(0.020)	(0.016)	(0.027)	(0.020)	(0.018)
Reside in rural area	-0.162***	-0.108**	-0.157***	-0.180***	-0.152***	-0.193***
	(0.025)	(0.047)	(0.019)	(0.030)	(0.039)	(0.046)
Household infrastructure	0.133***	0.129***	0.113***	0.117***	0.149***	0.148***
	(0.009)	(0.010)	(0.008)	(0.007)	(0.012)	(0.011)
Constant	4.864***	4.952***	4.743***	4.672***	4.949***	5.536***
	(0.311)	(0.490)	(0.318)	(0.285)	(0.524)	(0.490)
Observations	7,133	7,133	7,133	7,133	7,133	7,133
R-squared	0.510	0.248	0.277	0.300	0.331	0.344
F-test	592.5	312.3	312.3	312.3	312.3	312.3
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

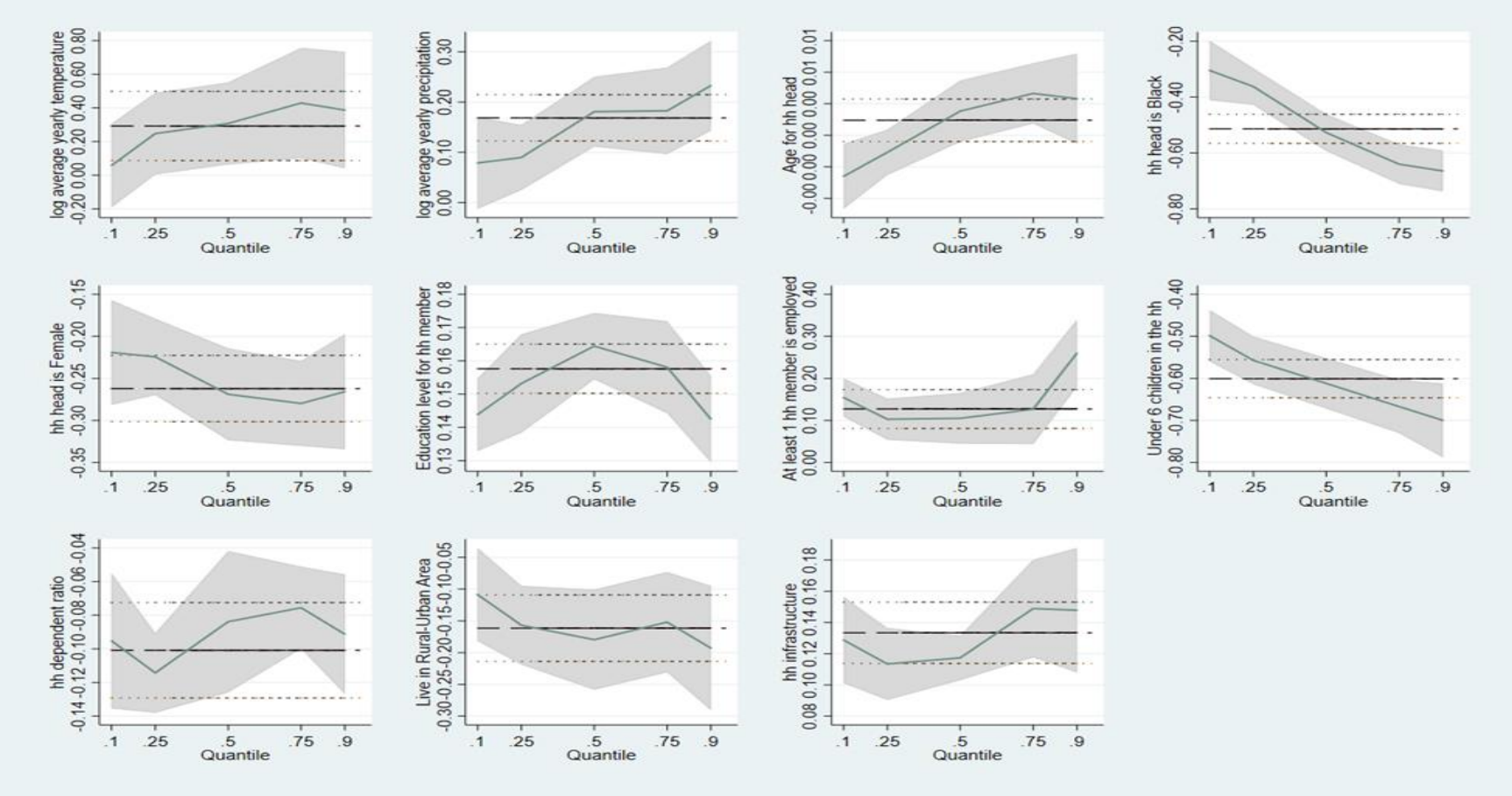
Notes: Heteroscedasticity-consistent standard errors are in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1. The dependent variable in all the columns is log household per capita total consumption expenditure. For the OLS models, R-squared is the adjusted R-squared, while for Quantile regression models, R-squared is the pseudo-R-squared.

© Copyright reserved Kopiereg voorbehou

UFS UV

main results –robust check

- . **Figure 3: Ordinary Least Squares and Quantile Regression Model Estimates.**



© Copyright reserved Kopiereg voorbehou

main results

Table 5: Ordinary Least Squares and Quantile Regression Model Estimates.

	OLS Estimates	Quantile regression estimates				
VARIABLES	loghhpcc	q10	q25	q50	q75	q90
Log average temperature	12.520**	9.886	6.952	11.048*	6.943	21.001***
	(5.511)	(8.430)	(6.715)	(6.172)	(8.268)	(7.701)
Log average temperature^2	-2.022**	-1.649	-1.086	-1.783*	-1.039	-3.477***
	(0.945)	(1.459)	(1.161)	(1.060)	(1.421)	(1.323)
Log average precipitation	3.140***	1.571***	2.677***	3.190***	3.925***	3.518***
	(0.224)	(0.302)	(0.335)	(0.184)	(0.231)	(0.345)
Log average precipitation^2	-0.409***	-0.207***	-0.355***	-0.418***	-0.514***	-0.451***
	(0.031)	(0.040)	(0.046)	(0.026)	(0.031)	(0.048)
Household head age	0.003***	-0.001	0.001	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Household head is Black	-0.601***	-0.351***	-0.476***	-0.639***	-0.743***	-0.722***
	(0.030)	(0.051)	(0.047)	(0.041)	(0.051)	(0.058)
Household head is female	-0.253***	-0.206***	-0.229***	-0.257***	-0.275***	-0.250***
	(0.020)	(0.033)	(0.028)	(0.028)	(0.030)	(0.042)
Household mean education	0.151***	0.146***	0.151***	0.157***	0.145***	0.138***
	(0.005)	(0.009)	(0.006)	(0.008)	(0.007)	(0.006)
Household adult employed	0.137***	0.172***	0.111***	0.108***	0.156***	0.251***
	(0.023)	(0.048)	(0.029)	(0.028)	(0.023)	(0.048)
Child under 6 in household	-0.600***	-0.492***	-0.567***	-0.613***	-0.647***	-0.674***
	(0.022)	(0.027)	(0.023)	(0.030)	(0.040)	(0.043)
Household dependent ratio	-0.101***	-0.099***	-0.111***	-0.077***	-0.077***	-0.101***
	(0.014)	(0.018)	(0.013)	(0.017)	(0.019)	(0.023)
Reside in rural area	-0.156***	-0.105**	-0.158***	-0.145***	-0.178***	-0.148**
	(0.026)	(0.045)	(0.018)	(0.035)	(0.046)	(0.070)
Household infrastructure	0.125***	0.115***	0.102***	0.121***	0.135***	0.153***
	(0.009)	(0.014)	(0.011)	(0.009)	(0.015)	(0.022)
Constant	-18.740**	-12.297	-10.059	-16.638*	-11.677	-30.771***
	(8.044)	(12.019)	(9.603)	(8.944)	(11.971)	(11.069)
Observations	7,133	7,133	7,133	7,133	7,133	7,133
R-squared	0.522					
F-test	535.5	188.6	188.6	188.6	188.6	188.6
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Heteroscedasticity-consistent standard errors are in parentheses. Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1. The dependent variable in all the columns is log household per capita total consumption expenditure. For the OLS models, R-squared is the adjusted R-squared, while for Quantile regression models, R-squared is the pseudo-R-squared.

© Copyright reserved Kopiereg voorbehou

UFS UV

IMPACT OF AREA-SPECIFIC PRECIPITATION AND TEMPERATURE ON HOUSEHOLD CONSUMPTION IN SOUTH AFRICA

- household poverty, measured by per capita consumption and climate conditions, measured by temperature and rainfall vary significantly across regions in South Africa.
- areas with low per capita consumption tended to also have high temperature and rainfall
- strong positive association between household poverty and regional climate conditions
- Ten per cent increase in average yearly temperature is associated with a 2.93 per cent increase in household per capita consumption
- Ten per cent increase in average yearly rainfall is associated with a 1.69 per cent increase in household per capita consumption
- a robust inverted U-shaped relationship between climate conditions and household consumption consistent with the environmental Kuznets curve.
- household per capita consumption is maximized at an average temperature of 22.1℃ and an average rainfall of 46.6 millimeters but beyond these thresholds, any increase in temperature and rainfall leads to a decrease in household per capita consumption.

© Copyright reserved Kopiereg voorbehou

UFS UV

Mitigatory measures on the impact of climate on household consumption and income

- Apart from focusing on traditional household factors known to influence household poverty, policymakers need to also focus on local climatic conditions in their effort to address household poverty
- there is a need for local-specific adaptation and mitigation strategies to help alleviate household poverty
- To mitigate poverty are the adaptation of conservation techniques, creation of employment, irrigation schemes, drought-tolerant crops and livestock

© Copyright reserved Kopiereg voorbehou

UFS UV

REFERENCES

- Chersich, Matthew F, and Caradee Y Wright. 2019. “Climate Change Adaptation in South Africa: A Case Study on the Role of the Health Sector.” Globalization and health 15(1): 1–16.
- Kwenda, Prudence, Miracle Ntuli, and Gibson Mudiriza. 2021. “Exploring Unemployment Differentials between Former and Non-Former Homeland Areas in South Africa: A Decomposition Approach.” Development Southern Africa: 1–25.
- Mudiriza, Gibson, and Lawrence Edwards. 2021. “The Persistence of Apartheid Regional Wage Disparities in South Africa.” Journal of Economic Geography 0(0): 1–33.
- Stern, David I. 2004. “The Rise and Fall of the Environmental Kuznets Curve.” World Development 32(8): 1419–39. https://www.sciencedirect.com/science/article/pii/S0305750X04000798
- Brophy, Timothy et al. 2018. “National Income Dynamics Study Panel User Manual.” Release 2018. Version 1. Cape Town: Southern Africa Labour and Development Research Unit.

© Copyright reserved Kopiereg voorbehou

UFS UV

Thank you

T: 051 401 9111 info@ufs.ac.za **www.ufs.ac.za**

© Copyright reserved
Kopiereg voorbehou

UNIVERSITY OF THE
FREE STATE
UNIVERSITEIT VAN DIE
VRYSTAAT
YUNIVESITHI YA
FREISTATA

UFS
UV