Climate change adaptation innovation in the water sector in Africa: Dataset

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A R T I C L E   I N F O

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A B S T R A C T

The dataset covers the determinants of adaptation innovation in the water sector in Africa over the period 1990-2016. The data is collected from secondary sources; namely the World Bank, Organization for Economic Co-operation and Development databases and the University of Notre Dame’s Global Adaptation Initiative. The data is focused on susceptibility to water stress caused by climate change and the public response in the form of technology development. The analysis performed on the data focused on the degree to which exposure to the risk of water insecurity is a motivating factor in the public response. In the analysis, an econometric model was specified for a relationship between a measure of water stress induced by climate change and adaptation innovation, along with a series of socio-economic and socio-political indicators as controls. Sustainable development practitioners, environmental and social scientists with research and teaching interests on Africa will find the dataset very useful. Sustainable development practitioners can use the data to chart simple trends and for other summative purposes. The data can also be used to make regional or geopolitical comparisons on the same subject of our analysis. Furthermore, with similar technology innovation data on other sectors exposed to climate change risks, comparisons of public responses can be undertaken to understand relative effectiveness of climate change adaptation responses. Crucially, the simple format of the data makes it a very convenient teaching tool in a statistics or econometrics class.

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Specifications Table

| Subject                           | Economic Development and Growth                                      |
|----------------------------------|------------------------------------------------------------------------|
| Specific subject area            | Sustainable development, technology innovation for climate change adaptation. |
| Type of data                     | Table                                                                   |
| How the data were acquired       | Existing databases were used to collect data. The use of a specific database was determined by (1) reliability and (2) whether or not it contained reliable data on the desired indicator for our analysis. |
| Data format                      | Raw                                                                    |
| Description of data collection   | Secondary data was collected from three main sources: the World Bank, OECD, and Notre Dame's Global Adaptation Initiative (ND-GAIN) databases. The World Bank was the source for the following variables: openness to trade - trade as % of gross domestic product, time required to register property, per capita gross domestic product, employers (total), and gross enrolment ratio. ND-GAIN was the source of data for the vulnerability index and adaptation technology data was extracted from the OECD database. The variables on which data was collected was dictated by the empirical model and the three sources for data on these variables were selected on the basis of data reliability and consistency. Data on the variables of interest was downloaded from these databases first in Excel format. The data was then inspected for compatibility, uploaded on the Stata software and saved as a Stata file for use in statistical analysis of the paper [1]. The data is provided in this article in both the Excel and Stata formats [2]. The structure of the data and how it is arranged is the same in both formats. There are ten variables in total in the dataset, seven of which are used directly in the analyses of the paper after pooling the data across the rest of the three variables (country, country identification and year). The years for which data is collected range from 1990 to 2016. |
| Data source location             | The World Bank                                                     |
|                                 | Washington D.C, U.S.A                                                |
|                                 | https://databank.worldbank.org/home.aspx                              |
|                                 | Organization for Economic Co-operation & Development (OECD)          |
|                                 | Paris, France                                                        |
|                                 | https://data.oecd.org/                                              |
|                                 | University of Notre Dame                                             |
|                                 | Indiana, U.S.A                                                       |
|                                 | https://gain.nd.edu/                                                |
| Data accessibility              | Title: Climate Change Adaptation Innovation in the Water Sector in Africa: Dataset |
|                                 | Repository: Mendeley data                                           |
|                                 | DOI: 10.17632/4f234mww6s.2                                          |
| Related research article        | L. Nyiwal, Innovation and adaptation to climate change: Evidence from the water sector in Africa, Journal of Cleaner Production, Volume 298(2021), 126859, |
|                                 | https://doi.org/10.1016/j.jclepro.2021.126859.                     |

Value of the Data

- Development practitioners can use the data to identify simple trends in water security risks in Africa over time
- Researchers can use the data to make regional or geopolitical comparisons on the same subject of our analysis. Public policy can benefit from potential insights on differences that may emerge from such comparisons.
- Researchers may derive useful insights on the relative effectiveness of climate change adaptation responses by using the data to make comparisons with other sectors exposed to climate change risks, at different levels – local, regional or global.
• The simple format of the dataset makes it a convenient, useful resource for instructors on the subjects of statistics and econometrics.

1. Data Description

Raw data is provided in both Stata and Excel files [2] in the form of a Table. It contains data on seven variables: year, adaptation technologies, openness to trade (trade as percentage of gross domestic product), time required to register property (calendar days), gross domestic product per capita, employers (total), gross enrolment ratio and the water stress index. The data on all the above variables is then pooled for the following years: 1990, 2000, 2005, and 2010 to 2016. Water-related patent data is used as a proxy for adaptation innovation, specifically tied to climate change adaptation and is collected from the database of Organization for Economic Co-operation & Development (OECD). For exposure to water insecurity tied to climate change, data on the water security score of Notre Dame Global Adaptation Initiative (ND-GAIN) index of vulnerability to climate change is collected. The water score index accounts for indicators such as projected change of annual runoff, projected change of annual groundwater recharge, fresh water withdrawal rate, water dependency ratio, dam capacity, and access to reliable drinking water. ND-GAIN scales these indicators by using the “proximity-to-reference” method, which measures vulnerability by the distance to an ideal status. Each of these indicators is scaled to a score that lies between 0 and 1, with values closer to 0 implying less vulnerability and values closer to 1 implying high vulnerability. This scaling allows for comparisons across countries. The score for each indicator is scaled by subtracting from zero the ratio of the difference between a raw value of the indicator and a reference point, a baseline maximum and baseline minimum. ND-GAIN uses a baseline minimum of 54.99% for access to reliable drinking water and zero for the other five indicators. The baseline maximums are: 1 for projected change of annual runoff, 1 for projected change of annual groundwater recharge, 100 for fresh water withdrawal rate, 73.32 for water dependency ratio, 4932 for dam capacity, and 100 access to reliable drinking water. The reference points are: 100% for projected change of annual runoff, 100% for projected change of annual groundwater recharge, 0% for fresh water withdrawal rate, 0% for water dependency ratio, 4932m³ per capita for dam capacity, and 100% for access to reliable drinking water reference point. The water score index is then obtained by taking the arithmetic mean of the scores of these six constituent indicators. This arithmetic mean for the water sector is the measure of vulnerability to water stress used in the research article. ND-GAIN’s choice of reference points, baseline minimum and maximum is guided by literature.

The data for the rest of the variables is collected from the World Bank database. This includes Gross Domestic Product (GDP) per capita – used as a control for one country’s size relative to others in our sample. Time required to register property records the number of calendar days needed for businesses to secure rights to property and serves as a proxy for institutional effectiveness in our analysis. Openness to trade is the sum of exports and imports of goods and services measured as a share of gross domestic product. Total employers is used as a proxy variable for research and development activity. The education variable is represented by gross enrolment ratio and measures total enrollment in primary education, expressed as a percentage of the population of official primary education age. This variable is used as a proxy for the knowledge base of a country that forms the absorptive capacity necessary for technology transfer and diffusion.

2. Experimental Design, Materials and Methods

The goal in the accompanying research article [1] was to examine the response of the technology sector to the increased exposure to water insecurity induced by climate change in Africa. To do this, the research article draws from the empirical literature on the drivers of innovation in climate change policies and the literature on water innovation as well as resources
management. Data for African countries is then pooled for years between 1990 and 2016. Then an econometric model is specified that estimates the relationship between climate-induced vulnerability in the water sector and water-related adaptation innovations, with controls such as a country’s size, technology transfer environment, institutional and regulatory quality, knowledge base, and research and development activity. In the econometric model, patents constitute our dependent variable in the analysis. As a count variable we use the appropriate count or probability model - the negative binomial model, which is a less restrictive form of the Poisson model. Both models have built-in functions for empirical analysis in the Stata software, which is used to estimate parameters of the models and compare results.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Data availability

Climate Change Adaptation Innovation in the Water Sector in Africa: Dataset (Original data) (Mendeley Data)

CRediT Author Statement

Linus Nyiwul: Conceptualization, Methodology, Data curation, Formal analysis, Writing – review & editing.

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References

[1] L. Nyiwul, Innovation and adaptation to climate change: Evidence from the water sector in Africa, J. Clean. Product. 298 (2021) 126859, doi:10.1016/j.jclepro.2021.126859.
[2] L. Nyiwul, Climate change adaptation innovation in the water sector in Africa: dataset, Mendeley Data V2 (2022), doi:10.17632/4f234mww6s.2.