DROUGHT IN WEST AFRICA

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Key messages

- Natural resources depletion and crop failures due to droughts are widely reported in West Africa causing production losses, rising food prices, and increased hunger and malnutrition;
- In places where dependence on natural resources and agriculture form the foundation of livelihoods, drought could lead to temporal or permanent migration of people;
- Drought-induced conflicts are prevalent between nomadic herdsmen and sedentary farmers in West Africa;
- A number of climate-smart solutions (e.g., climate information services, soil water and conservation practices, rainwater harvesting etc.) are adopted in West Africa to adapt and mitigate drought-related risks on natural resources, food, water and livelihoods;
- In addition to regional strategies, countries in West Africa have submitted their National Communications (NCs) and a National Adaptation Programme of Action (NAPA) to the UNFCCC. These policy documents focus strongly on adaptation and are motivated through the lens of poverty alleviation and drought control.

2. Physical and socio-economic characteristics of West Africa

2.1 Physical characteristics

The region of West Africa includes the southern portion of the bulge of the continent, which extends westward to the Atlantic Ocean[1]. This region is bisected by the African Transition Zone, which borders the southern edge of the Sahara Desert[1]. West Africa is made up of 16 countries distributed along a climatic gradient from the Sahel region in the north to the Guineo-Congolese zone in the south[2]. The countries include Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo. With the exception of Mauritania, these countries are members of the Economic Community of West African States (ECOWAS). Covering approximately one quarter of Africa, West Africa has a land area of about 5 million square kilometers[3].

Rainfall in this region ranges from less than 10 inches (250 mm) in its arid northern reaches to about 50 inches (1,250 mm) in the south[4]. By precipitation, the sub-region is divided into two broad ecological zones - the dry zone and the humid zone. The dry zone includes part of the Sahara (which covers about 22% of the area of the sub-region), with the Sahelian and Sudanian phytogeographic areas. The ecosystem is dominated by steppe vegetation, thorny bush cover and open savannah woodlands. The humid zone is presents varied ecosystems consisting of savannah, semi-deciduous tropical forest and tropical rain forest[5].

The sub-region is characterized by a broad range of ecosystems, bioclimatic regions, and habitats from rain forest to desert. The total forest cover in the West Africa sub-region is estimated at 72 million ha accounting for about 14 percent of the land area. There is considerable variation between countries in the extent of forest cover. Guinea-Bissau, with about 60% of its land area under forests, is the most forested country in the sub-region, while the Niger, with about 1% of its area under forests, is the least forested country. The Guinean Forests of West Africa, and more specifically the Upper Guinean Forests, are areas

[1] https://courses.lumenlearning.com/suny-worldgeography/chapter/7-3-west-africa/
[2] http://www.fao.org/3/y1997e/y1997e0j.htm#fn29
[3] Jalloh, A., Nelson, G.C., Thomas, T.S., Zougmoré, R.B. and Roy-Macauley, H. eds., 2013. *West African agriculture and climate change: a comprehensive analysis*. Intl Food Policy Res Inst.
[4] https://www.britannica.com/place/western-Africa/Muslims-in-western-Africa
[5] http://www.fao.org/3/a-y8732e.pdf

of endemism for birds, plants, mammals, amphibians, and insects[6]. West Africa contains about 47% of Africa's watersheds and 11 transboundary river basins (TRBs) which cover 71% of the total surface of the region[7]. The TRBs include - Corubal, Cross, Gambia, Komoé River, Lake Chad, Niger, Ouémé (Weme), Sassandra, Tanoé, Senegal and Volta with sizes ranging from 2,113,350 km^2 (Lake Chad Basin) to 16,000 km^2 (Tanoé River Basin)[8]. The source of these water resources makes equitable resource allocation and cooperation between upstream and downstream users a primary concern[8].

2.2 Socioeconomic characteristics

The human population of Western Africa is 400,513,644 equivalent to about 5.16% of the total world population[9]. The sub-region has a population density of 66 per Km^2 (172 people per mi^2) with about 47.7 % of the population living in urban areas. West Africa is mostly youthful with a median age of 18.2 years[9]. There are wide disparities in youth (15-24 yrs.) literacy among countries in the sub-region. Consistent with the general situation of sub-Saharan Africa, a recent data from the UNESCO Institute of Statistics revealed an average of about 65% youth literacy with a gender parity index of 0.90[10]. Compared to other regions in Africa, West Africa has the greatest number of countries with more than 30 percent of the population living on less than $1.90 a day[11]. Most countries in West Africa have a low human development index (HDI). Recent data from the United Nations Development Programme show only Cape Verde and Ghana recording medium HDI[12]. The key upcoming development challenges in West Africa include: (1) improving macroeconomic stability, (2) supporting structural reforms, (3) developing industry, (4) increasing competitiveness (5) supporting agricultural development, (6) building public sector institutions, (7) managing mineral resources better, (8) enhancing regional integration, (9) supporting fragile states, (10) empowering youth through jobs, (11) mobilizing domestic revenue, and (12) strengthening national statistical capacity[13].

[6] Schmidt, R.C., Bart Jr, H.L., Pezold, F. and Friel, J.P., 2017. A biodiversity hotspot heats up: Nine new species of suckermouth catfishes (Mochokidae: Chiloglanis) from Upper Guinean forest streams in West Africa. *Copeia*, *105*(2), pp.301-338.
[7] United Nations Environment Programme (UNEP). (2008). "Africa: Atlas of Our Changing Environment." Division of Early Warning and Assessment (DEWA) United Nations Environment Programme (UNEP).www.unep.org/dewa/africa/africaAtlas/PDF/en/Africa_Atlas_Full_en.pdf
[8] https://www.climatelinks.org/sites/default/files/asset/document/Transboundary%2520River_CLEARED.pdf
[9] https://www.worldometers.info/world-population/western-africa-population/
[10] UNESCO Institute of Statistics. 2017. Literacy Rates Continue to Rise from One Generation to the Next. https://www.sverigesfolkhogskolor.se/globalassets/unesco-fact-sheet-literacy-2017.pdf
[11] Oxfam International. 2019. The West Africa Inequality Crisis: How West African Governments are failing to reduce inequalities, and what should be done about it. https://oxfamilibrary.openrepository.com/bitstream/handle/10546/620837/bp-west-africa-inequality-crisis-090719-en.pdf
[12] http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf

Economically, the Gross Domestic Product (GDP) of West Africa is about US$ 646.5 billion as at 2018[13]. The sub-region's economy depends on just a few countries. Nigeria accounts for over 70 percent of regional GDP, and if Ghana, Côte d'Ivoire, and Senegal are included, the total adds up to 90 percent[14]. The service sector's share in the economy is the largest in most countries, and manufacturing's share is the smallest in all of them[14]. On average, agriculture constitutes 35.5% of the economies of West African countries and employs over 50% of the workforce[15]. As at 2018, the value addition of agriculture to GDP of the sub-region was about US$ 141.1 billion[13]. The sub-region comprises a diversified agricultural base spread over a wide range of agroecological zones with significant potential for improved agricultural productivity[3]. The most important food crops grown and consumed in West Africa are cereals— sorghum, millet, maize, and rice; roots and tubers—cassava, sweet potatoes, and yams; and legumes—cowpeas and groundnuts. Major cash crops are cocoa, coffee, and cotton[3].

The sub-region suffers from chronic food insecurity. FAO estimated a three-year average of 13.9% for prevalence of undernourishment and 17.3% prevalence of severe food insecurity in the total population in the same period[16]. In 2018, the percentage of children under 5 years of age who are stunted and affected by wasting was 29.2% and 8.1% respectively[16]. Regarding water security, data from the Aquastat database of FAO shows West Africa has a total renewable surface water of about 1286.6 (10^9 m^3/year) and renewable ground water of 316.8 (10^9 m^3/year)[17]. Moreover, 76.8% of people in the sub-region has access to safe drinking water, majority of which are in urban areas[17].

West Africa generally has poor and inadequate infrastructure in all key sectors. A recent publication from UNECA showed infrastructure shortage in West Africa generates an annual loss of 2 percentage points of growth and severely impedes the productivity of businesses[18]. Access to electricity in West Africa is at 52 percent, with shortages of up to 80 hours per month, and yet electricity there remains among the costliest in the world, at $0.25 per

[13] FAO. 2020. FAOSTAT. Macro Indicators. http://www.fao.org/faostat/en/#data/MK
[14] African Development Bank. 2018. West Africa Economic Outlook 2018. https://allafrica.com/download/resource/main/main/idatcs/00120257:2ab5ff0713e0fcc6b3e66e42b2f87fd5.pdf
[15] Oxfam International. 2019. The West Africa Inequality Crisis: How West African Governments are failing to reduce inequalities, and what should be done about it. https://oxfamilibrary.openrepository.com/bitstream/handle/10546/620837/bp-west-africa-inequality-crisis-090719-en.pdf
[16] FAO. 2020. FAOSTAT. Suite of Food Security Indicators. http://www.fao.org/faostat/en/#data/FS
[17] FAO. 2016. AQUASTAT Main Database - Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/nr/water/aquastat/data/query/results.html. Website accessed on [11/06/2020 11:11].
[18] https://www.uneca.org/stories/improve-transport-infrastructure-and-competitiveness-west-africa

kilowatt-hour, more than twice the global average[19]. The sub-region reportedly has a road network density of only 2.8 Km/100Km² and ranks last among the five sub-regions of the continent, far behind Southern Africa which has 13.5 Km/100Km² against an African average of 7.6 Km/100Km². Moreover, the rate of access to a road in West Africa is only 34%, against an average of 50% developing countries[18]. UNECA reports the density of the railway network is about 1.9 km/1000 km² compared with a continental average of 2.5 km/1000 km². Regarding maritime transport, the sub-region represents less than 1% of the world container traffic and just over 2% of the entire African traffic. Even though the domestic air transport market is the second largest in Africa, it conceals a relatively weak intra-West African market[18].

3. Drought characteristics and impacts on agriculture, livelihoods and the environment

3.1 Drought trends, projections and socioeconomic implications

Climate experts report climate change is happening in West Africa with its impacts felt across sectors. Recent studies involving climate data from 1983 to 2010 showed variations in temperature rise and precipitation in the sub-region. While the Coastal and the Western Sahel areas like Côte d'Ivoire, Ghana, Guinea and Senegal showed between 0.2 °C to 0.5 °C temperature rise per decade, the southern Sahara and northern Sahel areas like southern Mauritania, Mali and Niger and northern Burkina Faso showed no significant changes[20]. For precipitation, studies showed a significant increasing trend of about 0.2–1.0 mm/day per decade in parts of the Sahel (e.g. Senegal, Burkina Faso and certain parts of southern Mauritania, Mali, Niger and Chad). While this indicates an improving wetter conditions of the Sahel, experts report the recorded positive recovery of seasonal precipitation over the Sahel do not reach the levels of the period preceding the drought episodes of the 1970s and 1980s[20].

Meanwhile, drought frequency in West Africa is expected to be intense causing reduction in agriculture production. It is estimated that crop growing periods in West Africa may shorten by an average of 20% by 2050, causing a 40% decline in cereal yields and a reduction in cereal biomass for livestock[21]. Increased length of intense dry spells and drought owing to

[19] https://www.worldbank.org/en/news/feature/2018/04/20/regional-power-trade-west-africa-offers-promise-affordable-reliable-electricity
[20] Sylla, M.B., Nikiema, P.M., Gibba, P., Kebe, I. and Klutse, N.A.B., 2016. Climate change over West Africa: Recent trends and future projections. In *Adaptation to climate change and variability in rural West Africa* (pp. 25-40). Springer, Cham.
[21] Partey, S.T., Zougmoré, R.B., Ouédraogo, M. and Campbell, B.M., 2018. Developing climate-smart agriculture to face climate variability in West Africa: challenges and lessons learnt. *Journal of cleaner Production*, *187*, pp.285-295.

a projected 5% decline in rainfall is likely to increase the area of arid and semi-arid land by 5–8% by 2050.[22]. In addition, projected drought events over West Africa using the Regional Climate Model (RCM) showed that areas north of 12°N of West Africa will be hot spot area for mildly and moderately dry events, while the southern part of West Africa will witness pronounced severe and extreme dry events[23]. Similarly, a study on the possible impacts of four global warming levels (GWLs: GWL1.5, GWL2.0, GWL2.5, and GWL3.0) on drought characteristics over Niger River basin and Volta River basin revealed severe drought characteristics (i.e., magnitude and frequency) over the basins which have implications on future water supply from the two regional water systems[24].

3.2 Impacts of drought in West Africa

3.2.1 Impacts on agriculture and food security

Historically, extreme and episodic drought events in West Africa has hampered food production in the sub-region challenging food security efforts. In the 1970s and 1980s, the Sahelian zones of West Africa were particularly hit by severe droughts characterized by the southward displacement of isohyets by about 200 km over the whole region, and the intense shrinking of the area occupied by free waters in Lake Chad[25]. This resulted in increased food shortages that called for food aid from the international community. Experts believe the vulnerability of the sub-region to drought-related risks is because of its socioeconomic and biophysical characteristics that result in overdependence of agriculture on rainfall.

The impacts of drought on West Africa's agriculture do not only result in increased crop failure but also reduces the quality of grain and hence their market value[26]. In Nigeria, farmers reported production losses due to drought citing consequences on rising food prices, food scarcity and malnutrition. In addition, drought interacts with multiple stressors such as conflicts, rising agriculture input prices, incidence of pest and diseases, poor infrastructure etc. which disrupts agriculture production and weaken livelihoods[26]. This notwithstanding, populations encounter different impacts on drought on agriculture based

[22] IPCC, 2014. Climate Change 2014:. Impacts, Adaptation and Vulnerability. IPCCWGIIAR5 Technical Summary. Available at http://ipccwg2.gov/AR5/images/uploads/WGIIAR5-TS_FGDall.pdf.
[23] Ajayi, V.O. and Ilori, O.W., (2020) Projected Drought Events over West Africa Using RCA4 Regional Climate Model. Earth Systems and Environment, pp.1-20. https://doi.org/10.1007/s41748-020-00153-x
[24] Oguntunde, P.G., Abiodun, B.J., Lischeid, G. and Abatan, A.A., Droughts projection over the Niger and Volta River Basins of West Africa at specific global warming levels. International Journal of Climatology. https://doi.org/10.1002/joc.6544
[25] Traore, S.B., Ali, A., Tinni, S.H., Samake, M., Garba, I., Maigari, I., Alhassane, A., Samba, A., Diao, M.B., Atta, S. and Dieye, P.O., 2014. AGRHYMET: A drought monitoring and capacity building center in the West Africa Region. Weather and Climate Extremes, 3, pp.22-30.
[26] Gautier, D., Denis, D. and Locatelli, B., 2016. Impacts of drought and responses of rural populations in West Africa: a systematic review. Wiley Interdisciplinary Reviews: Climate Change, 7(5), pp.666-681.

on sensitivity and levels of exposure. For instance, a study conducted in Ghana showed that farming communities in the Afram Plains experienced considerable impacts of drought due to small sizes of farmlands, limited access to agricultural inputs and environmental degradation associated with declining soil fertility.[27]

3.2.2 Impacts on migration and conflict

In places where dependence on natural resources and agriculture form the foundation of livelihoods, drought could lead to temporal or permanent migration. In the literature, drought is cited to be accounted for 4% of the total migration among environmental migrants in West Africa[28]. During intense droughts, changes in the floristic composition of surrounding vegetation often lead to the scarcity of herbage of fair nutritive quality. Shrinking water bodies due to higher temperatures also result in limited water supply for livestock. In some parts of the Sahelian zone of West Africa, nearly 7% and 6% losses of water surface and vegetation cover were respectively recorded between 1986 and 2016[29]. These challenges coupled with poor crop biomass as supplementary feed result in temporal or seasonal migration of herders in search of feed and water for herds. It is reported that during the 1970s and 1980s, drought in the Sahel caused massive migration of people in many areas. For instance, outmigration reached 40% in some villages in Burkina Faso during the 1973 drought[26]. While migration could be a response to drought, it is also an adaptation strategy. Drought may also offer both positive and negative impacts such as reduced consumption, increased remittances, reduced labour force and reduced human capital[26].

In West Africa, drought-induced conflicts are prevalent among pastoralists. As animals feed on nearby vegetation due to scarcity of vegetation, they often cause destruction on farmlands leading to farmer-herder conflicts. In Ghana, sedentary farmers and nomadic herdsmen clashed over such incidences causing deaths and allegations of robbery and rape. On December 7, 2011, destruction of farmlands by grazing livestock migrated from different communities contributed to the conflict between the Konkomba and Fulani ethnic groups in the Gushiegu area of Ghana that resulted in numerous killings, destruction, and displacement of people[30]. In Nigeria, migrating Fulani herdsmen running away from drought

[27] Westerhoff L, Smit B. The rains are disappointing us: dynamic vulnerability and adaptation to multiple stressors in the Afram Plains, Ghana. Mitig Adapt Strat Glob Change 2009, 14:317–337.
[28] Henry S, Piché V, Ouédraogo D, Lambin EF. Descriptive analysis of the individual migratory pathways according to environmental typologies. Popul Environ 2004, 25:397–422.
[29] Traore, O., Chang, W., Rehman, A., Traore, S. and Rauf, A., 2020. Climate disturbance impact assessment in West Africa: evidence from field survey and satellite imagery analysis. Environmental Science and Pollution Research, pp.1-17. https://doi.org/10.1007/s11356-020-08757-6
[30] Olaniyan, A., 2015. The Fulani–Konkomba Conflict and Management Strategy in Gushiegu, Ghana. Journal of Applied Security Research, 10(3), pp.330-340.

often clash with indigenous populations over issues of land grabbing[31]. In a news item published by Quartz Africa – "The fight against Nigeria's northeast terrorism is also a battle against climate change" it emerged that climate change manifestations such as drought have resulted in escalated competition for scarce resources. The publication revealed that between 2016 and 2018 alone, over 3,600 people were killed due to conflict over land use. Such conflicts were said to have caused death six times more than the terror of Boko Haram insurgency[32]. This implies the implementation of climate-smart solutions for pastoralist may contribute to conflict resolution in North East Nigeria.

4. Drought management and adaptation options

4.1 Notable technologies and practices

4.1.1 Seasonal weather and climate forecasting

With overdependence of farming systems on rainfall, the unpredictability of rains and increasing frequency of droughts has made the generation and dissemination of seasonal weather and climate forecast information necessary to support livelihoods in West Africa. The necessity to have strong institutions with the capacity to deliver such weather and climate information services and build the capacities of relevant stakeholders in West Africa was inspired by the several droughts that affected most parts of the Sahel in the 1970s. In 1974, the AGRHYMET Regional Center was created as a specialized institution of the Permanent Interstates Committee for Drought Control in the Sahel (CILSS), to equip and train working groups to monitor the meteorological, hydrological, crops and pastures conditions during the rainy season[25]. Functioning as the West Africa drought monitoring center, it has contributed to developing climate and environmental monitoring tools as decision support systems for farmers in CILSS member states of Burkina Faso, Cape Verde, Chad, Gambia, Guinea Bissau, Mali, Mauritania, Niger, and Senegal against droughts and other climate-related risks[25]. Critical planning decisions such as when to start land preparation, when to plant, crop variety selection, schedules for fertilizer application are all tied to receiving downscaled seasonal forecast information[21]. In the arid and semi-arid areas of Senegal, Mali, Niger, Burkina Faso and Ghana West Africa, over a million farmers are reported to be using CIS delivered through mobile phones and rural radios to effectively manage their farm operations[21]. Bringing together stakeholders in research institutions and the media, farmers receive agro-advisory services that enable them interpret

[31] Ajaero, C.K., Mozie, A.T., Okeke, I.C., Okpanachi, J.P. and Onyishi, C., 2015. The Drought-Migration Nexus: Implications for Socio-Ecological Conflicts in Nigeria. Mediterranean Journal of Social Sciences, 6(2 S1), p.470.
[32]Prager A., Samson, S. 2019. The fight against Nigeria's northeast terrorism is also a battle against climate change https://qz.com/africa/1730868/fighting-boko-haram-and-climate-change-in-nigeria/

information received and adopt the most suitable climate-smart agricultural practices based on local conditions.

4.1.2 Drip irrigation

While the potential for irrigation can be enormous, areas equipped with irrigation hardly exceed 5% of total agricultural area[33]. Developments in improving water availability on farmlands are seen in the investments in drip irrigation facilities as a climate-smart option in West Africa particularly for the production of high value vegetables[34]. Solar powered drip irrigation facilities are in particular being promoted in the Sudano-Sahel zones of West Africa due to their cost effectiveness and significant correlation to increased household income and nutritional intake in the region[33]. Evidence from the literature shows farmlands equipped with drip irrigation could record up to 100% increase in yields relative to control fields[35]. In addition, significant savings in water use, up to about 80% could be realized compared with conventional irrigation practices[35]. This notwithstanding, government programs and support of non-governmental organizations will be needed to confront some major challenges (such as lack of reliable water supply; relatively high initial investment costs, limited access to fertilizers and limited access to improved seeds etc.), that frustrate farmers from adopting this useful technology. The consequential effects of water abstraction for irrigation on the local water table and water supply capabilities need thorough investigation in the quest to scale up drip irrigation in West Africa[21].

4.1.3 Use of planting pits for cultivation

In the Sahel areas of West Africa, farmers (particularly in Mali, Niger and Burkina Faso) are using planting pits (such as zai or tassas) and half-moon structures as water harvesting techniques to retain water for sorghum and millet production. Developed from indigenous knowledge, the techniques are being promoted as climate-smart soil and water conservation technologies. Both Zai and half-moons involve digging pits (at 20-40 cm diameter and 10-15 cm depth for Zai and about 2m in diameter for half-moons) to accumulate water before subsequent planting with or without the application of organic resources such as compost, plant residues and animal manure. Farmers use the techniques mainly on bush fields, on dry eroded valley soils as well as on normal and degraded bare lands to maintain soil moisture, reduce soil erosion, and improve soil fertility[21].

[33] Burney, J., Woltering, L., Burke, M., Naylor, R., Pasternak, D., 2010. Solar-powered drip irrigation enhances food security in the Sudanoe Sahel. Proc. Natl. Acad. Sci. 107, 1848e1853.
[34] Wanvoeke, J., Venot, J.P., De Fraiture, C., Zwarteveen, M., 2016. Smallholder drip irrigation in Burkina Faso: the role of development brokers. J. Dev. Stud. 52 (7), 1019e1033.
[35] Maisiri, N., Senzanje, A., Rockstrom, J., Twomlow, S., 2005. On farm evaluation of the effect of low cost drip irrigation on water and crop productivity compared to conventional surface irrigation system. Phys. Chem. Earth A, B,C 30, 783e791.

4.1.4 Diversified production

Diversification either permanent or temporal is one of the main adaptation strategies to droughts in West Africa. It is reported that repeated occurrence of droughts in the Sahel has led to adoption of agro-pastoralism (combination of crop farming and livestock rearing within the same farm) among the pastoralists who were once solely depending on livestock for their livelihood. Similarly, crop farmers have diversified in the past two decades into rearing livestock due to repeated crop failure associated with droughts[36].

4.1.5 Use of improved crop varieties and animal breeds

Farmers now use improved drought resistance crop varieties to reduce the impact of dry spells and increase food production. It is also reported that farmers in the West African Sahel shifted from cattle before the droughts of early 1970s and 1980s to sheep and goats as the latter (small ruminants) are less costly, hardier, require lower feed, reproduce faster and are more resilient to droughts than cattle[36].

4.2 Policy initiatives

In West Africa, drought-specific policy instruments are uncommon. However, the development and promotion of drought-related interventions can be envisioned in regional and national level policies on agricultural and environmental development. Most countries in the CILSS in the ECOWAS region had between 2007 and 2009 formulated and adopted their National Adaptation Programs of Action (NAPA) which included various interventions for climate change mitigation and adaptation[36]. In addition to regional strategies, countries in West Africa have submitted their National Communications (NCs) and Intended Nationally Determined Contributions to the UNFCCC. These policy documents focus strongly on adaptation and are motivated through the lens of poverty alleviation and drought control.

[36] Zougmoré, R., Partey, S., Ouédraogo, M., Omitoyin, B., Thomas, T., Ayantunde, A., Ericksen, P., Said, M. and Jalloh, A., 2016. Toward climate-smart agriculture in West Africa: a review of climate change impacts, adaptation strategies and policy developments for the livestock, fishery and crop production sectors. *Agriculture & Food Security*, *5*(1), p.26.