Review Article

Investigating theeffects of droughton*Anacardium Occidentale* L. (cashew)andadaptation options to climate changein Burkina Faso (West Africa):a review

Abstract

The objective of this researchwas to undertake a literature review for investigating the effects of drought on cashew and to identify options for cashew adaptation to drought in the aim to maintain and/or improve its productivity in plantation and in agroforestry under climate change in Burkina Faso.Drought is a major factor causing land degradation and limiting crop productivity in the sahel and particularly in Burkina Faso. The cashew contributes in creating jobs and generating revenues mainly for women employed in the cashew nuts processing units established in Burkina Faso.The cashew sensitivity to drought was reported through changes in some physiological parameters under water stress conditions.In order to maintain and/or improve cashew productivity in plantations and in agroforestry systems and the rural households socio-economic conditions under drought with climate change, it is urgent to develop and implement cashew adaptation options. This research recommended adaptation actions to reduce the vulnerability of the effect of cashew to drought under climate change.

Keywords : climate change,cashewadaptation, drought, agroforestry

INTRODUCTION

The cashew (*Anacardium Occidentale* L.)was considered for a long time as a forest specie used to fight against land degradation [1]but these last years in Burkina Faso it is considered as an important agricultural crop due to its great social and economic potential for farmers and its significant contribution in the country GDP[1]. Drought is a major factorcausingland degradation andlimiting crop productivity in the sahel and particularly in Burkina Faso [2].

Comment [A1]: small

Comment [A2]: This is a review paper so replace this with review

Comment [A3]: was to investigate

Comment [A4]: capital S

Comment [A5]: replace with manuscript

Comment [A6]: small o

Comment [A7]: species

Comment [A8]: S

Therefore, using cashew for a long timeto combat land degradation suggests that this speciewas considered drought tolerantas reported by several authors[3, 4, 5]. However, others relevant research studies reported that cashew productivity was reduced under drought conditions[6, 7, 8, 9, 10]. The cashew production as others agricultural crops largely depends on rainfall in Burkina Faso. Drought which is prevalent, is expected to becomesmore frequent and severe under climate change in Burkina Faso [11] and this calls to understand the potential impacts of drought on cashew and to identify adaptation options. The objective of this research was to undertake a literature review for investigating the effects of drought on cashew and to identifyoptions forcashew adaptation to drought in the aim to maintain and/or improve its productivity in plantation and in agroforestry under climate change in Burkina Faso.

Comment [A9]: species

Comment [A10]: replace with other

THE SOCIO-ECONOMIC CONTRIBUTION OF CASHEW IN BURKINA FASO

The cashew is widely expandedin the agricultural systems in Burkina Fasodue to the economic opportunities provided this tree specie[1, 12, 13]. In Burkina Faso, the cashew is mainly cultivated in 04 administrative regions including Cascades, Hauts-Bassins, South-West andCentre-West regions.The maximum of cashew farmers are in the South-West region due to the fact that its production requires a rainfall amount higher to 800 mm/an [14]. The Cascades region is composed of Comoe and Leraba districts. The Hauts-Bassins region is composed of Houet and Kenedougou districts. TheSouth-West region is composed of Poni, Ioba and Bougouriba districts and the Centre-West region is composed of Ziro and Sissili distcricts.The figure 1 below presents these different districts in the 04 administrative regions of cashew production in Burkina Faso.

Comment [A11]: species

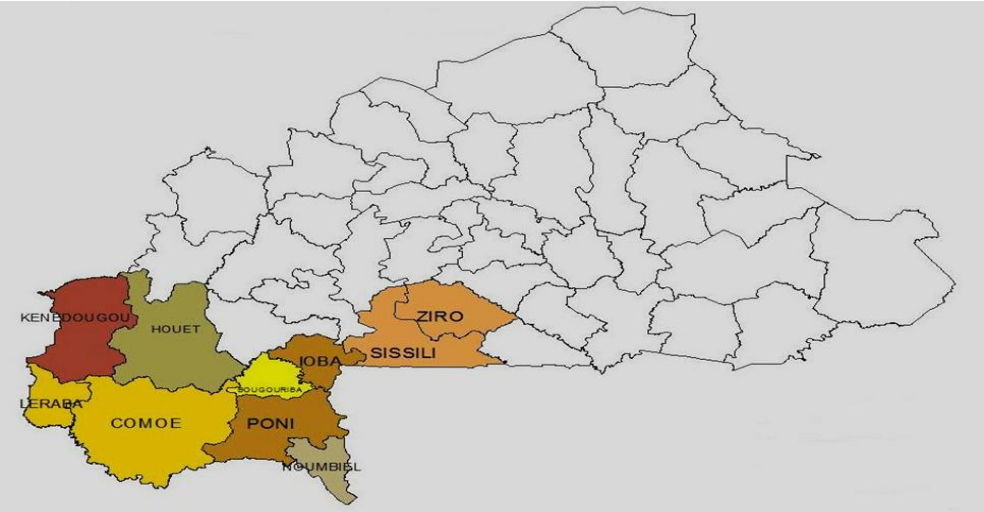

Figure 1 : The different districts in the 04 administrative regions of cashew production in Burkina Faso [15].

The total production of the cashew nuts is estimated at11124 tonswith about 45000 households involved in the cashew production in Burkina Faso[1,15]. The cashew nuts are the 3rd agricultural export products after the cotton and the sesame in Burkina Faso[15]. The volume of cashew nuts exported was 13747 tons in 2008 and 10337 tons in 2009 for an amount of 1. 419 and 1. 262 billions CFA collectedrespectively[16]. Thefigure 2 belowindicates thata large proportion of cashewsin cultivation are very young suggesting that cashew production in Burkina Faso is expected to increase very rapidly around 200000 tons/year in 2025due to the double effect of increased yields because of the young cashewscoming up atthe maximum of their potential production and the increase in planted areas [17].

Comment [A12]: insert ,

Comment [A13]: delete

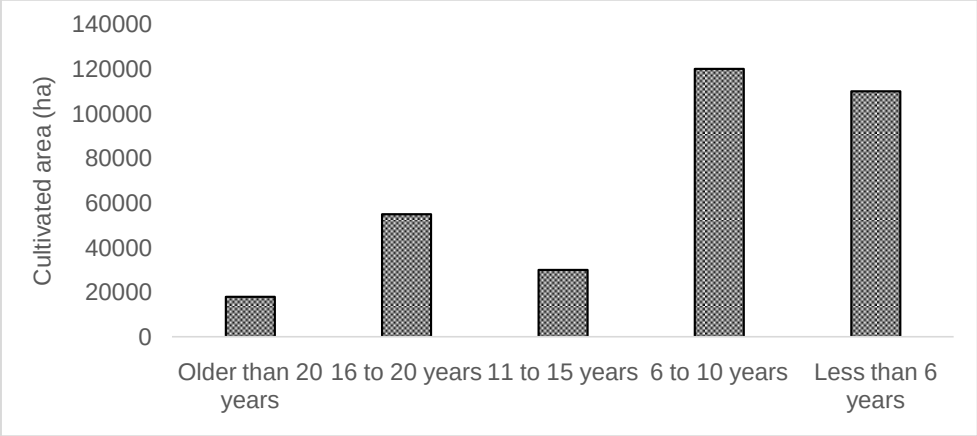

Figure 2 : Distribution of the cashew age in planted areas of Burkina Faso [17]

The cashew contributes in creating jobs and generating revenues mainly for women employed in the cashew nuts processing units established in Burkina Faso. The wouol association in the Comoe district of the Cascades administrative region established cashew nuts processing units that are employing about2500 people among this 70% are women receivinga monthly salary of about 48000 FCFA which is above to the guaranteed inter-professional minimum salary in Burkina Faso of 30,000 FCFA[18]. The revenues provided to the farmers through selling the cashew nuts is also very important. For example with a market price of cashew nuts in the farms of about 700 FCFA/kg in 2016, the mean net benefits for farmers and per hectare were estimated respectively at 424000 FCFA/farmerand 77000 FCFA/ha[17]. Also, the cashew farmers that have a large area of cashew-based agroforestry systems or cashew plantationsrecruit occasional workers for pay in rural areas to help them in themaintenance of the farms orin the collection of cashew nuts[18]. Due to the socio-economic importance of the cashew sector, the government of Burkina Faso decided in 2019 to establish the Burkinabe Cashew Council (CBA)with the mandateto regulate, monitor and develop activities in the cashew sector.

Comment [A14]: to be 424000 FCFA and 77000 FCFA, respectively.

Comment [A15]: delete

Comment [A16]: established

THE DROUGHT AND CLIMATE CHANGE

The drought is defined as a lack of water compared to the needsof the plants[19] and according to[20] there are two types of drought, the soil and climaticdrought. The soil drought

Comment [A17]: add this Chopart [20]

Comment [A18]: delete

can be explained by the fact that the useful water fraction defined by the difference between the field capacity and the permanent wilting point in the soils is relatively low due to the high soil infiltration. The climatic drought is due to the fact that the water requirements of the plants are generally poorly covered due to the low rainfall and high evaporation during the rainy season. The climatic drought is expected to become more frequent and severein Burkina Faso due to climate change [11].According to the IPCC report, it is expected a temperature increase ranging from 1.2 up to 3.0°C by 2050 depending on the different greenhouse gas emission pathways with a multiplication of extreme events such as floods and droughts with droughts more frequent in the sahel region and particularly in Burkina Faso[21]. It is reported that climate change in the tropics will createwarmer and drier environments, increasingly variable rainfall regimes and more frequent climate extremes [22, 23].

Comment [A19]: replace with a temperature increase is expected

Comment [A20]: S

THE VULNERABILITY OF CASHEW TO DROUGHT IN BURKINA FASO

The ecosystem based approach considering the vulnerability as a function of exposure, sensitivity and adaptive capacity [24] was used for the vulnerability analysis of the cashew to drought. The climate change exposure factorconsidered in this analysis was drought.

The cashew sensitivity to drought

The literature review revealed controversial results about the effects of drought on cashew. Some research studies reported that cashews are drought tolerant.[25]reported that cashew is drought tolerant due to the deep root system allowing the plant to better access water in the soil. The cashewcompetitiveness to access water and nutrients in the soilunder high soil evaporation was reported as a factor thatexplained its drought tolerance and abilityto grow in adverseenvironments[5, 26].The cashew drought tolerance was explained by [3]because it grows well under dry farming conditions, its cultivation is concentrated in intertropical regions that normally present low soil fertility and sometimes high salinity and these regions are characterized by high temperatures with low and irregular precipitation. It was reported that the cashew is drought tolerantdue to the fact that only nearly 1% of the 3.4 millions of hectares cultivated with cashews in the world are under irrigation [27].Though cashew

Comment [A21]: delete

Comment [A22]: delete

Comment [A23]: insert ,

drought tolerance was reported in the literature, very few research supported this cashew drought tolerance with scientific evidences. The major research studies that have been reviewed based their arguments about cashew tolerance to drought on the fact that it can grow in adverse environments. Even if cashew can grow in adverse environments, it was reported that the cashew that have grown in adverse environments did not develop the same aboveground structure compared to those that have grown in favourable environments [28] and this result suggests that cashew is drought sensitive. The cashew sensitivity to drought was reported through its negative effect on productivity [29].The long dry seasons was reported as one of the major factor limiting current and future cashew climate suitability in West Africa[10].[30]reported that Brazilian farmers though for a long time that cashew is a drought tolerant crop, able to grow in poor soils, with little management and as a result a decline in cashew average nut yields to as low as 200 kg/ha was observed.[30]also reported thatcashew low nut yields are commonly associated with years of low rainfall. According to the table 1the irregular precipitation was reported as the factor explaining the low and fluctuating cashew nut yields obtained over the years since 2009in Burkina Faso [15].

Comment [A24]: Oliveira et al. [30]

Comment [A25]: Replace with though able to grow cashewfor a long time in poor soils that is a drought tolerant cropwith little management as a result, a decline in cashew average nut yields to as low as 200 kg/ha was observed

Comment [A26]: Modify as low nut yields of cashew

Comment [A27]: Insert ,

Table 1 : Variation of the cashew nuts yields in Burkina Faso between 2009 and 2014 [15]

Years	2009	2010	2011	2012	2013	2014
Yield (tons)	320	129	170	199	262	221

The cashew sensitivity to drought was reported through changes in some physiological parameters under water stress conditions. The cashew stomata closureunder dry conditions to maintain a favourable leaf water potential was reportedby [31]. The difference of gas exchange rates between irrigated and unirrigated cashew 03 or 04 months after the end of the rainy season was reported with a better gas exchange rate observed for irrigated cashew [31].The drought has negatively affected the cashew relative water content and its ability to maintain high relative water content at plant level in the conditions of water stress[32, 33,34, 9].The cashew growth parameters were reported to be negatively affected by drought. Drought was reported as one of the main constraints limiting the cashew growth in Benin[35,

36, 8], in Senegal[6] and in Burkina Faso[7].The cashew survival rate and growth werenegatively affected and differently by the application of water stress according to the provenance of the seeds [9]. The cashew biomass and height were reduced and differentlyby the application of water stress according to the provenance of the seedsand the root system development decreased for all theprovenance of the seeds with the application of water stress[9].The literature review revealed that the cashew as the others cereal crops have their physiological, growth and yield parameters negatively affected by drought.

Comment [A28]: Modify as responded differently

The socio-economic implications of cashew sensitivity to drought in Burkina Faso

The cashew productivity decline due to the negative effects of drought could lead to a reduction of cashew nuts production and consequently the export volumes leading to a decrease ofthe rural households incomes and the national economy. The few cashew processing units as a result of reduced cashew nuts productionmay lack sufficient cashew nuts to process which could result to the unemployment of several women working in these processing units or tothe reduction of the employees revenues.This reduction or loss of incomes will negatively affect the households living standards such as housing and cooking fuel [37], children access to education[38, 39] and consequentlyexacerbatingthe children labour [40, 41] and rural households health[42]. The CBA isgetting funding from the government through thetaxes collected during the cashew nuts exportation for the implementation of its activities to support the cashew sector. The volumes reduction of export cashew nuts will lead to a decrease of the taxes collected and consequently the CBA will receive less funding from the government which could negatively affect the investments for the developmentof the cashew sector.The cashew cultivation by the farmers allows them to diversify their source of revenue increasing their resilience to climate shocks like drought as reported by [43]. The reduction of cashew production due to droughtwill consequently reduce the farmers resilience to climate change. The adaptative capacity analysis to address the drought effect on cashew in Burkina Faso showed the existence of relevant institutional and technical capacities. Indeed, the institutions such as the Institute of Environment and Agricultural Research (INERA) and the National Centre of Forest Seeds (CNSF) are

recognized and leading research centres conducting research on cashew. However, the current research topics on cashew in these research centres are mainly focusedon identifying more productive cashew varieties and cashew good agricultural practices that better improve productivity. These institutions have researchers with the relevant profile to address the issue of the effects of drought on cashew but the lack of appropriate equipments for cashew physiological parameters under drought was reported. In terms of awareness and capacity building the major activities carried out by the different partners working in the cashew sector are focused on the cashew good agricultural production practices vulgarisation withfew or any activities regarding the effects and adaptation of cashew to drought. However, we noted a strong political will to strengthen the development of the cashew sector by the government of Burkina Faso through the establishment of CBA. In terms of financial resources, we noted that several partners as well as the government of Burkina Faso have mobilised important financial resources to implement a large number of projects in the cashew sector but any project is currently addressing the effects of drought on cashew for adaptation. The combined effects of cashew sensitivity to drought and the relative low country adaptive capacity to address the effect of drought on cashew reveal that the cashew is vulnerable to drought under climate change as reported by [44, 45].There is then an urgent need to develop and implement cashew adaptation options to drought in Burkina Faso.

Comment [A29]: Replace with certainly

THE CASHEW ADAPTATION TO DROUGHT

The literature review reported that selecting cashew drought tolerant varieties helps to improve its productivity under climate change [9, 10].The literature review did not allow to identify research projects currently implemented in Burkina Fasofor selecting cashew drought tolerant varieties suggesting future research for identifying cashew drought tolerant varieties in Burkina Faso. The high trees transpiration rate in dry conditions increase their sensitivity to drought and tree pruning was reported to reduce transpiration[46]and then it could contribute to increase adaptation to drought but such research was not yet conducted on cashew in Burkina Faso. Undertakingresearch to identify cashew pruning fraction that allows to

maintain optimal cashew nuts production while reducing transpiration is crucial to adapt cashew to drought in Burkina Faso. The research results reported that the cashew polyclonal seeds have greater adaptability and productivity[47, 48] but the literature review did not show the development of such seeds in Burkina Faso suggesting future research to explore the development of cashew polyclonal seeds and to test their adaptation capacityto drought in Burkina Faso.It was reported in the literature by the farmers in Benin that practicing thinning contributes to adaptcashew to drought because it reduces trees density and therefore competition for access to soil water [49]. The literature review did not reveal research studies addressing the effect of cashew density on transpiration in Burkina Faso suggesting to undertake future research to investigate the effects of different cashew densities on transpiration rate for determining the optimal cashew density that reduces transpiration ratewhile maintaining optimal cashew production. [8] showed that irrigation improvedcashew productivity in the conditions of water stress and[30] reported a different positive response of irrigation on cashew nuts yield according to the genotypes used. [31]also reported a positive effect of irrigation on cashew during the period from flowering to the beginning of thefruits harvesting corresponding to the dry season. The literature review did not reveal research studies on the effect of irrigation on cashew in Burkina Faso suggesting future research to assess the effect of different irrigation schemes on cashew growth and productivity. Some soil management techniques that reduce soil evaporation and mitigating the adverse effects of drought were reported by several authors [8, 47, 50]. Future research to test the effect of some of these soil management techniques on cashew performance in the conditions of water stress could help to formulate adaptation options of cashew to drought in Burkina Faso. [51] reported that the application of endogenous cashew adaptation strategy depends on the farmers knowledge about the effects of drought on cashew. It is then required to increase awareness and tobuild capacity of farmers,policy makers, technical and financial partnersabout the effects of drought on cashew and the adaptation options for their support to increase cashew adaptation to drought.

CONCLUSION

The cashew is a very important socio-economic crop in Burkina Faso used in plantation or in agroforestry systems. The literature search revealed that the multiplication of the occurrence and the increase in the magnitude of drought under climate change could undermine several years of investments to improve cashew productivity and rural households socio-economic conditions in Burkina Faso. In order to maintain and/or improve cashew productivity in plantations and in agroforestry systems and the rural households socio-economic conditions under drought with climate change, it is urgent to develop and implement cashew adaptation options. This research recommended adaptation actions to reduce the vulnerability of the effect of cashew to droughtunder climate change.

Comment [A30]: delete

REFERENCES

Comment [A31]: strictly follow pattern of Journal

[1] Audouin S, Gonin A. Cashew: product of globalization, driving force of territorialization, the example of southern Burkina Faso. EchoGeo 2014. 29:1-15.

Doi: https://doi.org/10.4000/echogeo.13926

[2] Doso-Jnr S. Land degradation and agriculture in the Sahel of Africa: Causes, impacts and recommendations. J. Agric. Sci. Appl. 2014 ; 3 : 67–73

Doi: 10.14511/JASA.2014.030303

[3] Bezerra MA, Claudivan FL, Filho EG, Carlos EBA, José TP. Physiology of cashew plants grown under adverse conditions. Bras. J. Plant Physiol. 2008;19(4):449-461

Doi: https://doi.org/10.1590/S1677-04202007000400012

[4] Pitono J, et al. Water Transport and Growth of Cashew (Anacardium Occidentale L.) Under Soil Mechanical Impedance. Ind. Crops Res. J. 2015; 21 (3): 117-124

Doi: 10.21082/littri.v21n3.2015.117-124

[5] Capelari EF, Dos Anjos L, Rodrigues NF, Sousa RMJ, Silvera JAG, Margis R. Transcriptional profiling and physiological responses reveal new insights into drought tolerance in a semiarid adapted species, Anacardium occidental. Plant. Biol. 2021; 23(6):1074-1085

Doi: 10.1111/plb.13312

Comment [A32]: all the names

[6] Mbow AFB, Diop SS, Tounkara A, Gueye B, Seck ML. Climate change: between resilience and resistance. Agridape 2009; 24(4): 4-5

[7] Bambara D, Bilgo A, Hien E, Masse D, Thiombiano A, Hien V. Peasant perceptions of climate change and their socio-environmental consequences in Tougou and Donsin. Sahelian and Sahelo-Sudanian climates of Burkina Faso. Bull. Search Agron. Benin 2013; 74(1): 8-16

Available:

http://www.slire.net/download/2173/article_2_brab_n_74_d_cembre_2013_bambara_et_al_percept_ions_paysannes.pdf

[8] Bello DO, Ahoton LE, Saidou A, Akponikpè IPB, Ezin VA, Balogoun I, Aho N. Climate change and cashew (Anacardium occidental L.) productivity in Benin (West Africa): perceptions and endogenous measures of adaptation. Int. J. Biol. Chem. Science. 2017; 11(3): 924-946

Doi: https://dx.doi.org/10.4314/ijbcs.v11i3.1

[9] Djighaly PI, Ndiaye S, Dieme JS, Dieng F, Gueye M, Zazou AZ, et al. Comparative study of drought stress tolerance of four provenances of Anacardium Occidentale L. grown under semi controlled conditions. Int. J. Agric. Approximately. Bio-Res. 2021; 06 (03): 245-256

Doi: https://doi.org/10.35410/IJAEB.2021.5642

[10] Grüter R, Trachsel T, Laube P, Jaisli I. Expected global suitability of coffee, cashew and avocado due to climate change. PLoS One 2022; 17(1): 1-24

Doi: https://doi.org/10.1371/journal.pone.0261976

[11] Traore S, Owiyo T. Dirty droughts causing loss and damage in Northern Burkina Faso. Int. J. Globe. Warm. 2013; 5: 498–513

Doi: https://doi.org/10.1504/IJGW.2013.057288

[12] Marlos BA, Claudivan F, lacerda DE, Enéas gomes F, Carlos de abreu B, José Prisco T. Physiology of cashew plants grown under adverse conditions. Brazilian J. of Plant Physiol. 2007; 19 (4): 449-461

Doi: https://doi.org/10.1590/S1677-04202007000400012

[13] Sali B, Madou C, Nome A, Kuate J. Socio-economic characterization of large cashew (Anacardium occidental L.) production basins and behavioral study of their population in northern Cameroon. Int. J. Biol. Chem. Science. 2020; 14(6): 2094-2111
Doi: 10.4314/ijbcs.v14i6.13
[14] Kankoudry B N, Djibo O, Constant P, Sanon B. Value chain analysis of the cashew sector in Burkina Faso. Ouagadougou, Burkina Faso, GIZ, African Cashew Initiative. 2010; 44
Available: http://africancashewinitiative.org/files/files/downloads/aci_burkinafaso_frz_150.pdf
[15] DGPER (Direction Générale de la Promotion de l'Economie Rurale/Burkina Faso General Directorate of Rural Promotion). Brief presentation of the cashew sector. 2015 ; 25.
[16] INSD (National Institute of Statistics and Demography/Burkina Faso National Institute of Statistics and Demography), Statistical Yearbook. 2011; 424
Available:
http://www.insd.bf/contenu/pub_periodiques/annonces_stat/Annuaires_stat_nationaux_BF/Annuaire_stat_2011.pdf
[17] Ouédraogo A. Productivity of cashew orchards in Burkina Faso. Farako-Bâ – INERA. 2015; 21
[18] AfDB (Groupe de la Banque Africaine de Développement/African Development Bank Group). Evaluation report of the pada-redd+ project in Burkina Faso. 2016; 136
Available:
https://www.cif.org/sites/default/files/meetingdocuments/fip_pssa_burkina_faso_afdb_503a_climate_change_mitigation-pada_redd_volume_of_annexes.pdf
[19] Coulibaly YN. Research of drought tolerance and sensitivity parameters of sorghum (Sorghum bicolor (L) Moench) at seedling stage. Master thesis, Cheikh Anta Diop University of Dakar, Senegal. 2005; 43
Available: http://bibnum.ucad.sn/viewer.php?c=mmoires&d=MemS%5f3082

[20] Chopart JL. Field study of the main rainfed crops roots systems in Senegal (groundnuts, millet, rainfed rice and sorghum). Doctoral thesis of the polytechnique institute of Toulouse. 1980; 204

Available: http://www.secheresse.info/spip.php?article33241

[21] IPCC. Summary for Policymakers. In: Masson-Delmotte V, Zhai P, Pirani A, Connors SL, Péan C, Berger S, et al., editors. Climate Change 2021: The Physical Science Basis Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. 2021. pmid:34040008

Available

:https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf

[22] Serdeczny O, Adams S, Baarsch F, Coumou D, Robinson A, Alexander H, et al. Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions. Regional Environ. Change 2017 ; 17 : 1585–1600.

Doi : https://doi.org/10.1007/s10113-015-0910-2

[23] Siyum ZG. Tropical dry forest dynamics in the context of climate change : syntheses of drivers, gaps, and management perspectives. Ecol. Process. 2020 ; 9 (25) :1-16.

Doi : https://doi.org/10.1186/s13717-020-00229-6

[24] Metzger MJ, Leemans R, Schroter D. A multidisciplinary multi-scale framework for assessing vulnerability to global change. Int J Appl Geo-inf Earth Observ. 2005 ; 7 :253–267

Doi : https://doi.org/10.1016/j.jag.2005.06.011.

[25] Ohler JG. Cashew. Department of Agricultural Research, Royal Tropical Institute, Amsterdam. 1979 ; 71

Available : https://www.cabdirect.org/cabdirect/abstract/19800572290

[26] Argles GK. Anacardium occidentale (cashew). Ecology and botany in relation to propagation. Paper, Conference of propagation of tropical and subtropical fruits, London, 22-24 September, FAO (Rome).1969 ; 24

[27] FAO (United Nations Organisation for Food and Agriculture). The FAOSTAT core production data. 2007. Available : http//faostat.fao.org

[28] Roe DJ. Some ecophysiological aspects of cashew (Anacardium occidentale L.) with emphasis on possible flower manipulation in maputaland. Master of science in Agriculture, University of Kwazulu Natal. 1994 ; 183

Available

:https://www.academia.edu/26052263/some_ecophysiological_aspects_of_cashew_anacardium_occidentale_l_with_emphasis_on_possible_flower_manipulation_in_maputaland

[29] Djenontin AAM. Farmers perception on climatic factors affecting cashew productivity in the district of Djougou in Benin, Bachelor thesis, Abomey-Calavi, Bénin. 2013 ; 82

[30] Oliveira VH, Miranda FR, Lima RN, Cavalcante RRR. Effect of irrigation frequency on cashew nut yield in Northeast Brazil. Sci. Hortic. 2006 ; 108 (4) : 403-407

Doi : https://doi.org/10.1016/j.scienta.2006.02.003

[31] Carr M. The water relations and irrigation requirements of cashew (Anacardium Occidentale L.) : A review. Exp. Agric. 2014 ; 50(1) : 24-39.

Doi : 10.1017/S0014479713000392

[32] Parida AK, Dagaonkar VS, Phalak MS, Aurangabadkar LP. Differential responses of the enzymes involved in proline biosynthesis and degradation in drought tolerant and sensitive cotton genotypes during drought stress and recovery. Acta Physiol. Plant 2008 ; 30 : 619–627.

Doi : https://doi.org/10.1007/s11738-008-0157-3

[33] Siddiqui MH, Al-Khaishany MY, Al-Qutami MA, Al-Whaibi MH, Grover A, Ali GM, et al. Response of Different Genotypes of Faba Bean Plant to Drought Stress. Int. J. Mol. Sci. 2015 ; 16(5) :10214-10227

Doi : 10.3390/ijms160510214

[34] Khoyerdi FF, Shamshiri MH, Estaji A. Changes in some physiological and osmotic parameters of several pistachio genotypes under drought stress, Sci. Hortic. 2016 ; 198 : 44-51

Available : http://www.sciencedirect.com/science/.

[35] Agossou DSM, Tossou CR, Vissoh VP, Agbossou KE. Perception of climatic perturbations, local knowledges and adaptation strategies of farmers in Benin. Afr. Crop Sci. J. 2012 ; 20(1) : 565 – 588

Available : http://www.bioline.org.br/pdf?cs12069

[36] Balogoun I, Saidou A, Ahoton EL, Amadji GL, Ahohuendo CB, Adebo JB, et al. Caractérisation des systèmes de production à base d'anacardier dans les principales zones de culture au Bénin. Agron. Afr. 2014 ; 26(1) : 9-22

Available :file:///C:/Users/HORIZON/Downloads/104427-Article%20Text-281893-1-10-20140618%20(5).pdf

[37] Kumar BM, Nair PKR. The enigma of tropical homegardens. Agroforest. Syst. 2004 ; 61 : 135–152

Doi : https://doi.org/10.1023/B:AGFO.0000028995.13227.ca

[38] Vasey DE. Household gardens and their niche in Port Moresby, Papua New Guinea. Food Nutr. Bull. 1985 ; 7 : 37–43

Doi : https://doi.org/10.1177/156482658500700312

[39] Maroyi A. Traditional homegardens and rural livelihoods in Nhema, Zimbabwe : a sustainable agroforestry system. Int. J. Sustain. Develop. World Ecol. 2009 ; 16 : 1–8.

Doi : https://doi.org/10.1080/13504500902745895

[40] Grootaert C, Kanbur R. Child labor : A review." Washington D.C : The World bank (Policy Research Working Paper). 1995 ; 1454

Available :https://documents1.worldbank.org/curated/en/147041468766206348/pdf/multi-page.pdf

[41] Basu K, Van P. The economics of child labor. Am. Econ. Rev. 1998 ; 88(3) : 450-477

Available : http://www.jstor.org/stable/116842

[42] Nougtara A, Haddad S, Ridde V. The inequal acess to the health services and their determinant in Burkina Faso. Santé, Société et Solidarité. 2004 ; 2 : 199-210.

Available : https://www.persee.fr/doc/oss_1634-8176_2004_num_3_2_1012

[43] Vissoh PV, Rigobert CT, Dedehouanou H, Hervé GH, Olivier CC, Simplice D, et al. Perceptions and adaptation strategies to climate change : the case of the communes Adjohoun and Dangbo in the South-East Benin. Les Cahiers d'Outre-Mer 2015 ; 260 :479-492

Doi : https://doi.org/10.4000/com.6700

[44] Boansi D, Tambo JA, Müller M. Intra-seasonal risk of agriculturally-relevant weather extremes in West African Sudan Savanna. Theor. Appl. Climatol. 2019 ; 135 : 355–373.

Doi : 10.1007/s00704-018-2384-x

[45] Laudien R, Bernhard S, Jillian W, Christoph G. A forecast of staple crop production in Burkina Faso to enable early warnings of shortages in domestic food availability. Sci. Rep. 2022 ; 12 : 1638.

Doi : https://doi.org/10.1038/s41598-022-05561-9

[46] Coulibaly YN, Zombre G. Effect of a climatic gradient on trees transpiration in agroforestry parklands in Burkina Faso (West Africa). J. Appl. Biosci. 2022 ; 175 : 18182 – 18191.

Doi : https://doi.org/10.35759/JABs.175.6

[47] Tandjiekpon A. Characterisation of a cashew-based agroforestry systems in savannah zone of Benin. Master thesis. 2005 ;104

[48] Ndiaye S. New Techniques and Research To Improve and Enhance Production in the Sahel Region (grafting, polyclonal seeds, etc.). Forum on Sahelian cashew (FOCAS), Bamako, Mali. 2019 ; 21

Available :https://www.africancashewalliance.com/sites/default/files/3_focas_2019_seydou_nouvelles_techniques_et_recherche_en.pdf

[49] Rupa TR, Rejani R, Bhat GM. Impact of Climate Change on Cashew and Adaptation Strategies. In Climate-Resilient Horticulture : Adaptation and Mitigation Strategies. 2013 ; 17(5) : 189-198

Doi : 10.1007/978-81-322-0974-4_17

[50] Duangpatra P, Attanandana T. Effects of High Water-Absorbing Polymer on Growth and Drought Endurance of Cashew Nut, Green Mango and Para-Rubber Under Tropical Field Conditions. Agric. Nat. Resour. 1992 ; 26 (1) : 95-102.
Doi : https://li01.tci-thaijo.org/index.php/anres/article/view/241760.
[51] Yabi I. Cashew-based agroforestry study and climatic constraints for its development in the centre of Benin. Doctoral thesis, University Abomey Calavi, Benin. 2008 ; 240