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Systematic review of the contribution of Wild Edible Plants to household food security within the context of climate change

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ADMINISTRATIVE INFORMATION

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INTRODUCTION

Review question / Objective To assess the extent to which WEPs have been studied in Africa, the extent to which WEPs are generally supporting current food security efforts and the extent to which WEPs are climate smart.

Rationale In sub-Saharan Africa, with dual economies, some rural folks who live in forest-fringed communities depend on wild foods (Appiah & Kyeremeh, 2019). Their closeness to nature has led them to gather crucial knowledge about these wild foods, which might be useful for complementing the nutritional gaps of households (Clemente-Villalba et al., 2024). In an era of climate change, a surging world population and food insecurity, wild food seems to offer a glimpse of hope for the world to fill the gap left by the limitation of agriculture (Hansen et al., 2019). However, there seems to be less attention on how WEPs contributes to food security under climate change. In recent times, there have been reviews of the WEPs literature some of which focused on single plants or plant groups (Chawafambira et al., 2020; Maroyi, 2014), how WEPs could be leveraged to target women's empowerment and nutrition (Conti et al., 2019), and antiviral remedies of WEPs with the potential to prevent and manage COVID-19 (Attah et al., 2021). Earlier reviews that covered many WEPs focused on nutritional composition, consumer perception and incomes (Duguma, 2020; Mashau et al., 2022; Mushaphi et al., 2022, Ngigi et al., 2023; Uusiku et al., 2010) leaving out a direct link to how WEPs fared within the context of climate change. Majority of these reviews were also limited to single or few countries which does not give holistic picture of how WEPs are faring in larger geographic locations like SubSaharan Africa. This review therefore attempts to answer the following direct questions:
To what extent have WEPs been studied in Africa? To what extent are WEPs generally supporting current food security efforts? To what extent are WEPs climate smart? Results of the systematic

review are geared towards finding research gaps in WEPs studies for further research.

Condition being studied Current happenings such as increase in atmospheric GHGs concentrations to warm oceans to the depletion of snow and ice and the rising of sea levels, all points to the occurrence of anthropogenic climate change (Hansen et al., 2016; Ivanov, 2023) requiring adaptation of human populations and their food systems to survive. Global efforts through the sustainable development goals particularly goals 1,2, 12 and 13 points to the need to synergize nature based foods like wild edible plants (WEPs) in climate change adaptation (FAO, 2022). Wild food has always been part of human survival from the hunter-gatherer stage till the adoption of agriculture (Crittenden & Schnorr, 2017). Several historical evidence suggest that many cultures have relied on wild food for millennia, especially in the pre-agricultural and pre-industrial eras (Shirsat & Koche, 2024). The evolution of humans into complex societies developed agriculture from gathering to its modern forms. The result has been more domesticated agricultural systems that favour monoculture with its attendant need for high inputs for production (Sulaiman et. al., 2023).

METHODS

Search strategy The search strategy involved developing a search string for string 1: "wild edible plants" OR "non-cultivated foods" OR wild edible plant foods wild edible plant cereals OR wild edible plant roots and tubers or "adaptation to climate change"; string 2: traditional knowledge OR traditional ecological knowledge OR Wild edible plants OR wild foods OR wild foods consumption OR non-cultivated food. We then combined string 1 or 2 in string 3. In string 4, we limited the search to Sub-saharan geographical area and in string 5, String 3 AND String 4. Further limiters like Language _ English,
Humans and Period: 1992-2024 were applied. The review was limited to only Africa to ensure that knowledge gathered on WEPs and climate change adaptation will be relevant to climate impacts in Africa as climate models predict similar impacts for the African geographical area; shorter seasons, unpredictable rainfall, drought, floods in contrast to other continents' expected climate impacts. It is also to ensure that local context of traditional knowledge on WEPs and adaptation relevant to the African continent are harnessed.

Participant or population The main types of participants of the review are Wild edible plants and the populations that depend on them.

Intervention The adoption of wild edible plants as part of the climate change adaptation of affected populations.

Comparator Indirectly compared to cultivated crops characteristics that make them climate smart.

Study designs to be included The review targeted qualitative, quantitative and mixed methods designs as articles to be reviewed.

Eligibility criteria Articles were exported to Endnote where the abstracts and titles were screened; titles and abstract needed to include wild edible plants or synonym and or adaptation to climate change or subsets like conservation agriculture, climate smart agriculture or on-farm or non-farm adaptation to climate change. Duplicates in terms of titles were removed from the list of articles. Further screening was conducted which sorted articles into climate change adaptation studies (these aryicles have been part of a larger review study but excluded here), WEPs studies and studies that were not explicitly clear but included aspects of adaptation and WEPs. The screening also excluded papers on biophysical aspects of climate change adaptation and Studies without stated methodology. Apart-from the excluded articles and adaptation studies that did not include any aspects of WEPs, all WEPs studies articles were included in the final analysis.

Information sources 260 articles were retrieved from bio one, 970 from web of science, 88 from Ovid and 35 fromPubMed. There was no contact as they were open access articles.

Main outcome(s) The nutritional composition, potential health benefits and income generating value chains of WEPs make them suitable for supporting food security during climate impacts. WEPs promise several advantages including wider diversity in diet with nutritional, medicinal and income guarantees, easily available and accessible through local forest resource base, time-tested reliable and need for little or no management to sustain. Promoting more utilisation of WEPs have been shown to contribute to environmental sustainability with the potential to lessen the footprints of agriculture, ensure a more sustainable food system by providing food security under climate change. There is less understanding around how intensified utilization of WEPs will have on the well-being of particularly vulnerable rural populations that traditionally depended on WEPs. Off all the studies reviewed, only one assess self-reported food security of people engaged in WEPs,

This does not give a clear picture about how WEPs directly influence food security of households who engage in WEPs value chains.
Governments and non-governmental organisations should pay more attention to enact policies that expand the value chains of notable WEPs like baobab by encouraging local demand and use and how to export market to more health conscious populations world wide. Policy is also needed in the regulations of WEPs harvesting to prevent over-exploitation with synergistic approach to maintaining traditional resource management techniques and values into future programmes to ensure sustainable utilisation. There is also the need for further research on less studied areas like how climate change adaptation can throw more light on understanding the nexus between WEPs and food security in climate change; especially how intensified consumption of WEP by the general public will impact vulnerable populations that traditionally depend on them.

Additional outcome(s) Despite the promise of WEPs to contribute to food security, there are social and biochemal reasons that may limit their consumption. Shai et al. (2020) and Vinceti et al. (2013) have shown that social values and ethnic traditions including land tenure and secure land access among many poor and marginalized communities may have significant effect on how WEPs are consumed and conserved in different communities. Other limiting factors to WEPs consumption are expansion of agricultural and other land use changes like road construction and urbanization and harmful livelihoods like timber harvest, fuel wood collection, and unregulated wildfire hunting, over harvesting of WEPs, and overgrazing and climate change (drought) which result in the natural habitat destruction and a lack of reliable data to evaluate the contribution of WEPs to food and nutrition security at local, national and international levels (Duguma, 2020; Ngigi et al., 2023; Vinceti et al., 2013). Others are the perception of WEPs being alternative food, dwindling WEPs knowledge, and inadequate awareness of the nutritional value of WEPs products (Duguma, 2020). The less developed value chains with almost nonexistent marketing and related regulations and high barriers to exports are limting limiting factors identified in literature (Saeed et al., 2023).
There is also a reported high concentration of nitrites, oxalate, tannins, and some other toxic compounds in some WEPs (Ceccanti et al., 2018; Loukou et al., 2018). Another concern for WEPs consumers is the undetectable levels of selenium and higher amounts of strontium and aluminium in some WEPs (Glew et al., 2010). This require moderate consumption of WEPs as a general rule unless studies on harmful chemical compositions have been carried out on them to prove otherwise. Refer to figure 3 for diagrammatic representation of the theme WEPs contribution to food security.

Data management The articles were imported to Nvivo for analysis. The final articles were read in Nvivo to farmiliarize with the data. Initial codes on the objectives of the review such as types of WEPs, geogrophical locations of the studies, sociodemographics of the studied populations-education, age, gender, rural versus urban, household sizes; the roles of gender and nutrient composition of WEPs among others were generated which formed the basis for reconstructing knowledge on WEPs according to the objectives of the review. The initial codes were merged with others to generate themes. The themes and codes were further reviewed where the role of gender changed to the role of women in response to the dominant role women role women play in the WEPs value chains according to data and others like limiting factors to the consumption of WEPs were added in order to make room for new themes and codes emerging as more articles were being read and reflected upon. After the review of themes, the final themes of the analysis that were defined are general WEPs study focus dimensions, food security and climate change adaptation. General WEPs study focus dimensions was defined as the geographical coverage representing the countries in which the WEPs studies were carried out, the sociodemographic characteristics of WEP actors studies and the roles of women in WEPs. The final food security theme was defined as the dimensions of food security such as availability, accessibility, utilisation and stability including food and nutrition compositions value chain, prices and uses of WEPs. The climate change adaptation theme was defined as the climate smart characteristics of WEPs such as drought tolerance, flood tolerance, water stress, semi arid conditions, socio-ecological resilience and all human actions that support the adaptive capacities of populations that utilize the WEPs reviewed under climate change. The analysis ended with writing the report of the review.

Quality assessment / Risk of bias analysis We adopted CASP for qualitative and quantitative studies and mixed methods appraisal tool for mixed methods studies.

Strategy of data synthesis We adopted narrative synthesis. The articles were imported to Nvivo for analysis. The final articles were read in Nvivo to farmiliarize with the data. Initial codes on the

objectives of the review such as types of WEPs, geographical locations of the studies, sociodemographics of the studied populations-education, age, gender, rural versus urban, household sizes; the roles of gender and nutrient composition of WEPs among others were generated which formed the basis for reconstructing knowledge on WEPs according to the objectives of the review. The initial codes were merged with others to generate themes. The themes and codes were further reviewed where the role of gender changed to the role of women in response to the dominant role women role women play in the WEPs value chains according to data and others like limiting factors to the consumption of WEPs were added in order to make room for new themes and codes emerging as more articles were being read and reflected upon. After the review of themes, the final themes of the analysis that were defined are general WEPs study focus dimensions, food security and climate change adaptation. General WEPs study focus dimensions was defined as the geographical coverage representing the countries in which the WEPs studies were carried out, the sociodemographic characteristics of WEP actors studies and the roles of women in WEPs. The final food security theme was defined as the dimensions of food security such as availability, accessibility, utilisation and stability including food and nutrition compositions value chain, prices and uses of WEPs. The climate change adaptation theme was defined as the climate smart characteristics of WEPs such as drought tolerance, flood tolerance, water stress, semi arid conditions, socio-ecological resilience and all human actions that support the adaptive capacities of populations that utilize the WEPs reviewed under climate change. The analysis ended with writing the report of the review.

Subgroup analysis The final articles were read in Nvivo to farmiliarize with the data. Initial codes on the objectives of the review such as types of WEPs, geographical locations of the studies, sociodemographics of the studied populations-education, age, gender, rural versus urban, household sizes; the roles of gender and nutrient composition of WEPs among others were generated which formed the basis for reconstructing knowledge on WEPs according to the objectives of the review. The initial codes were merged with others to generate themes.

Sensitivity analysis No strong sensitivity analysis conducted.

Language restriction The search strategy was restricted to English language.

Country(ies) involved Ghana.

Other relevant information The main Author is also the Municipal Director of Agriculture for the Lawra Municipal Department of Agriculture in the Upper West Region of Ghana.

Keywords climate change; adaptation; climate smart; wild edible plants.

Dissemination plans We intend to publish the review to ensure wider readership among researchers.

Contributions of each author

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