

REVIEW

Home gardening in sub-Saharan Africa: A scoping review on practices and nutrition outcomes in rural Burkina Faso and Kenya

Lea-Sophie Hansen¹  | Raissa Sorgho¹ | Isabel Mank^{1,2} | Patricia Nayna Schwerdtle^{1,3} | Erick Agure¹ | Till Bärnighausen^{1,4} | Ina Danquah¹

¹Heidelberg Institute of Global Health (HIGH), Faculty of Medicine and University Hospital, Heidelberg University, Heidelberg, Germany

²German Institute for Development Evaluation (Deval), Bonn, Germany

³Monash Nursing and Midwifery, Faculty of Medicine, Nursing and Health Sciences, Monash University, Clayton, Victoria, Australia

⁴Africa Health Research Institute (AHRI), KwaZulu-Natal, South Africa

Correspondence

Lea-Sophie Hansen, Heidelberger Institute of Global Health (HIGH), Universitätsklinikum Heidelberg, Im Neuenheimer Feld 324, Heidelberg 69120, Germany.

Email: lea-sophie.hansen@uni-heidelberg.de

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Abstract

Home gardening is promoted as an adaptation strategy to ameliorate the increasing food insecurity from climate change impacts among subsistence farming families in rural sub-Saharan Africa. Yet, the geographic distribution of home gardens, their setup, management, and the effects on nutrition outcomes have not been fully described. This scoping review aimed to map and synthesize recent evidence on home gardening for two exemplar countries: Burkina Faso and Kenya. Between June and August 2020, we searched, screened, and extracted evidence about home garden projects in both countries, following the PRISMA guidelines for scoping reviews. Peer-reviewed scientific publications, and gray literature in English and French that reported about subsistence horticulture in rural settings of Burkina Faso or Kenya were included. The characteristics of the documents and the data pertaining to our research objectives were extracted into predefined spreadsheets. The data were synthesized in the form of a narrative review. Our search yielded 949 documents, of which 20 documents were included in the synthesis (Burkina Faso: 8, Kenya: 12). While the gardens varied in composition and size, the majority provided green leafy vegetables and indigenous horticultural crops. The challenges for successful home garden implementation comprised unfavorable climatic conditions, access to and affordability of inputs, water and land, and lack of know-how. We identified trends for improved food security, diet quality, and nutritional status among the target populations. This scoping review found that there is limited evidence on home garden practices in rural Burkina Faso and Kenya. To enhance the sustainability of home gardens, research and resources should be invested in codesigning context-specific home gardening projects. Pending rigorous impact evaluation, home gardens appear to be a promising tool for climate change adaptation while simultaneously improving food security and the nutritional situation among women and young children in these two exemplar countries of sub-Saharan Africa.

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KEYWORDS

agriculture, child undernutrition, climate change, food security, horticulture

1 | INTRODUCTION

Despite global actions to achieve the “Zero Hunger” Sustainable Development Goal (SDG) by 2030, food security is far from being reached in sub-Saharan Africa (SSA) (FAO, IFAD, UNICEF, WFP, & WHO, 2020). “Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 1996). In 2014, 18% of the population living in SSA experienced food insecurity, which increased to 21% in 2019 (FAO et al., 2020). Food insecurity at the household level is a major determinant of child undernutrition (Black et al., 2013). Child undernutrition is differentiated between chronic (stunting) and acute (wasting) undernutrition. While the prevalence of child undernutrition and mortality declined significantly with the introduction of global actions since the 1990s, efforts are threatened to reverse with population growth and climate change (FAO et al., 2020; Mbow et al., 2019). Both acute and chronic undernutrition of children under 5 years of age have severe short- and long-term health and economic consequences for the affected individual, their families, and the society as a whole (UNICEF, WHO., & WorldBank, 2021).

Climate change is projected to fuel this problematic nutrition situation in SSA through a number of exposure pathways (Haines et al., 2019; Phalkey et al., 2015). Such pathways include extreme weather events, water quality, and quantity, as well as food supply and safety (Haines et al., 2019). This is particularly true for subsistence farming families in rural areas, where rainfed agricultural production defines their livelihood and income (FAO, 2014). The characteristics of climate change comprise increased temperature and rainfall variabilities, rising atmospheric carbon dioxide (CO₂) levels, which contribute to an increase in global temperature, as well as more frequent occurrences of weather extremes. These changes impact agricultural production, food security, and population health (Mbow et al., 2019; Myers et al., 2017). In a medium-to-high climate change scenario (A2 scenario according to IPCC based on a global warming of 3.4°C and a high population growth of 15 billion by 2100 [IPCC, 2000]), an additional 10.5 million under-fives in SSA are projected to be undernourished by 2050 (Nelson et al., 2009; Phalkey et al., 2015).

Burkina Faso in West Africa and Kenya in East Africa both experience a high prevalence of child undernutrition

and frequent occurrence of climate change-related hazards such as flooding or plant diseases (AGRICA, 2021; UNICEF, WHO., & WorldBank, 2020). Both countries face changes in their rainfall patterns and record high decreases in the total annual amount of precipitation (Ayugi et al., 2016; De Longueville et al., 2016; Ibrahim et al., 2014). The prevalence of chronic undernutrition among under-fives was 25% (2018) in Burkina Faso and 26% (2014) in Kenya (UNICEF et al., 2020). At the same time, Burkina Faso and Kenya differ in their climatic (number of rainy seasons), geographic (altitude), vegetation-related (crop types), and socioeconomic (low versus middle income) characteristics (CIA, 2021; Lange, 2016; UNDP, 2020). Such differences in agro-ecological and socioeconomic conditions underscore the need to gather location-specific evidence for the design of viable adaptation strategies in SSA.

Clearly, adaptation strategies are urgently needed to counteract adverse climate change impacts on the nutritional situation of rural subsistence farming families and their young children in SSA. Adaptation as defined by the IPCC is actions and strategies for adjusting to actual or projected climate change-related impacts and their deleterious consequences (IPCC, 2018). Home gardening constitutes a potential adaptation strategy to counter food insecurity in rural SSA (Linger, 2014; Nguyen et al., 2012). Home gardening is one of the oldest known production systems worldwide and an integral part of the livelihoods of rural populations (Kumar & Nair, 2004; Marsh, 1998). Garden characteristics may vary based on its location (central vs. decentral), the management procedures applied (low vs. high input), and their production purposes (self-sufficiency vs. surplus). Mitchell and Hanstad (2004) summarized five basic characteristics of home gardens: (1) They are found near the homestead; (2) they comprise a high biodiversity/species richness; (3) their yields are used for household supplementary consumption and income (not as primary purpose); (4) they consist of a “small” land area; and (5) they represent production systems, in which poor populations are able to enter (Brownrigg, 1985; Marsh, 1998; Mitchell & Hanstad, 2004). Owing to these characteristics, home gardens are considered a promising adaptation strategy that can provide adequate nutrition, while simultaneously serving as a proactive means to cope with climatic consequences (Galhena et al., 2013; Lutaladio et al., 2010; World Vegetable Center, 2016). Previous studies suggest that home gardens can be resilient food production systems in the face of climate-related weather and environmental changes. This

is particularly true for tree-based gardens, which are less impaired by extreme weather events, such as droughts or floods (Nyong et al., 2020; Sobola et al., 2015). In some countries such as Cameroon, home gardens are already prevalent as climate change adaptation measures by smallholder subsistence farmers, comprising diverse resilient species for household nutrition, animal fodder, and cash income (Nyong et al., 2020). However, the research highlighted the importance of local know-how and management capacities to enhance the resilience of home gardens and maintain their biodiversity (Adhikari et al., 2015; Taye et al., 2020). This includes different planting dates, soil, and water conservation, as well as adopting new technologies, e.g. installing irrigation equipment (Weerahewa et al., 2012).

Overall, the scientific evidence on the contribution of home gardens to food security and nutritional status is patchy, particularly in SSA (Berti et al., 2007; Girard et al., 2012; Masset et al., 2012; Ruel, 2001; Ruel et al., 2018; Ruel & Alderman, 2013; Sharma et al., 2021). Because the evidence is sparse, additional formative research is necessary to ensure that home gardens (1) respond to the complex implementation and socio-cultural contexts and (2) comprise sustainable climate-friendly and nutritious solutions (Fralval et al., 2019; Girard et al., 2012; Steinke et al., 2019).

This scoping review aimed to systematically identify and comprehensively synthesize existing evidence on home garden practices and their impacts on nutrition outcomes in rural Burkina Faso and Kenya. The specific objectives were to (i) map the evidence on home garden practices in rural Burkina Faso and Kenya, (ii) describe the composition and management of home gardens, and (iii) summarize the evidence on the impacts of home gardens on nutrition outcomes.

2 | METHODS

The scoping review was conducted following the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR), in order to identify and comprehensively synthesize the broad variety of heterogeneous literature on the subject of home gardening (Tricco et al., 2018). Scientific studies (studies with observational and experimental designs) and gray literature, which reported on home gardens, kitchen gardens, household gardens, or community gardens, were included.

2.1 | Eligibility criteria

Table 1 presents the eligibility criteria for documents included in this review according to the Population – Exposure – Outcome – Study Design (PEOS) framework.

Articles were included that (i) followed an observational or experimental study design, (ii) presented data of home garden practices on the individual, household, or community level, and (iii) covered rural areas of Burkina Faso or Kenya. Multicountry approaches were excluded if the results were not stratified by our two countries of interest. Publications about gardening practices that focused on subsistence horticulture (garden production primarily for household consumption rather than market production) were considered. Documents covering peri-urban or urban gardens, monocultures, and market gardens for profit or employment purposes were excluded. Documents that reported on health and nutrition outcomes from home gardening practices were eligible. With respect to study design, we included observational and experimental projects, as well as reports and university theses, but excluded publications, such as reviews, that did not present primary research. Documents written in English and French and those published between 1999 and 2019 were eligible. If multiple documents were published in the context of one project, all documents that focused on distinct aspects of the project were included. If several documents arising from one project had the same focus, the document that more closely answered the research objectives was selected.

2.2 | Literature search and selection

A three-step search strategy was applied to identify relevant documents, following the approaches by Arksey and O'Malley (2005) and Levac et al. (2010) (Levac et al., 2010). The three-step search strategy was set up as follows: search of (i) databases of scholarly literature from academic publishers, professional societies, online repositories, and universities, (ii) websites of governmental and nongovernmental organizations (NGOs) and international research institutes (gray literature), and (iii) reference lists of included documents. The initial search was conducted in June 2020 to capture an exhaustive list of relevant keywords and MeSH terms (Medical Subject Heading) including the English search terms: garden, home garden, kitchen garden, vegetable garden, community garden, and the French search terms: potager, horticulture, maraîch, jardin, verger, and their grammatical variations. In June 2020, we consulted a librarian of the Medical Faculty Mannheim, University Heidelberg, to advise on appropriate search strings. The search was completed on August 20, 2020.

We selected the databases *PubMed*, *Google Scholar*, and *Web of Science* owing to the focus on nutrition and health outcomes. The search string was developed for PubMed based on the PEOS criteria and initiated by three

TABLE 1 Eligibility criteria for included documents according to the Population–Exposure–Outcome–Study (PEOS) design framework

	Inclusion criteria	Exclusion criteria	Rationale
Population	Individuals, households, communities In rural Burkina Faso and Kenya	Organizations, businesses Peri-urban or urban Outside Burkina Faso/Kenya	Rural subsistence farming families are/ will be hit hardest by adverse climate and the nutritional consequences (IPCC, 2007). Home garden composition differs greatly between geographical locations and environmental conditions (FAO, 2001; Habtemariam et al., 2017; Karyono, 1990; Kehlenbeck & Maass, 2006; Wiersum, 2006)
Exposure	Research focuses on home gardens including kitchen, household, and community gardens for the purpose of 1. (required) self-consumption 2. (optional) income generation, livelihood diversification, other purpose	Commercial/market gardens: for profit Monocultures	Niñez, 1984 categorizes home gardens into four different types, i.a. market gardens, which are distinct as a more systematized farming system (Niñez, 1984). High biodiversity is (should be) a basic characteristic of home gardens (Kumar & Nair, 2004) Commercial home gardens are structurally different, with lesser biodiversity and higher external inputs (Kumar & Nair, 2004)
Outcome	Any outcome reported including food security, income, livelihood diversification, and health outcomes	No article was excluded based on reported outcomes	
Study Design	Any study design (observational or experimental); documents reporting research (using a dataset) in the form of academic articles, peer-reviewed articles, reports, university theses, conference presentations, and posters	Documents not reporting research (no dataset included); synthesis research: systematic literature reviews/scoping review; other gray literature types e.g. brochures, guidelines, commentary, editorials, or blogs	Locally specific studies might differ in scope and study design, to broaden the evidence base, all study types reporting data were included
Timeline	1999–2019	Before January 1999 and after December 2019	Home gardens are a constantly changing system, to gather current relevant characteristics the timeline has to be restricted (Kumar & Nair, 2006)
Language	English and French	Other languages	

authors (LSH, IM, and AS). It was then adapted to the other databases and websites. The full search string is presented in the (see Table S1). In addition, the websites of the United Nations (UN) organizations, international research institutes, and the national ministries of Burkina Faso and Kenya were searched. The UN organizations included the Food and Agricultural Organization (FAO), the International Fund for Agricultural Development (IFAD), the UN Development Program (UNDP), the UN Environment Program (UNEP), the World Food Programme (WFP), the UN Children's Fund (UNICEF), the World Health Organization (WHO), and the World Bank. The international research institutes included the

International Food Policy Research Institute (IFPRI) and the International Centre for Tropical Agriculture (CIAT).

For literature selection, the first author (LSH) identified documents based on the search strategy and imported them into the literature managing web-tool Rayyan (Ouzzani et al., 2016). After the removal of duplicates, two independent authors (LSH, PNS) selected the documents for inclusion according to the eligibility criteria in an iterative two-step procedure: title and abstract screening, followed by full-text screening. Disagreements between the two authors were solved on a consensus basis or through consultation of a third author (RS or ID).

2.3 | Data extraction and synthesis of findings

The process was initiated by the first author (LSH), who extracted the data into a preformatted spreadsheet (Excel, Microsoft Office 10.0), while a second author (RS or PNS) selectively verified the extractions (Peters et al., 2017; Tricco et al., 2018). When mapping the evidence about home garden practices in rural Burkina Faso and Kenya (objective 1), one author (LSH) extracted the following from each document: document type, authors, year of publication, title, journal, language, aim and objectives, study design, study duration, country, location in the country, target population, garden type and definition, involved actors, sample size, sampling/selection of study participants, age range, and percentage of male gender.

For describing the composition and management of home gardens (objective 2) and summarizing the evidence on nutrition outcomes (objective 3), additional data were extracted according to guidelines and manuals from institutions experienced in setting up home garden projects (BFN, 2014; Weimer, 2008; WorldVegetableCenter, 2016). Information on the following was transferred into the spreadsheet: type of intervention (if experimental study), use of yields, number or distribution of gardens, average size of garden(s), setup of garden(s), water source or irrigation, agricultural inputs, vegetables and fruits planted,

training components, barriers and enabling factors to implementation, and nutrition outcomes.

The extracted data points were synthesized in an iterative process for each study objective (Peters et al., 2017), using quantitative (numeric summaries) and qualitative (thematic) analysis (Arksey & O'Malley, 2005; Levac et al., 2010; Peters et al., 2017; Tricco et al., 2018). The findings are presented as single frequency counts for quantitative data (Pham et al., 2014) and as narrative summaries for qualitative data. For comparison between Burkina Faso and Kenya, the findings are shown by country and separately for observational and experimental studies. For nutrition outcomes, we present findings on food security at the household level, and findings for diet quality and nutritional status at the individual level.

3 | RESULTS

3.1 | Documents included

Figure 1 presents the flowchart of the articles included. The initial search yielded 949 documents from literature databases and websites. After the removal of duplicates, 673 documents were subjected to title and abstract screening. From these, 38 documents were included in the full-text review, and 20 articles were obtained that ultimately

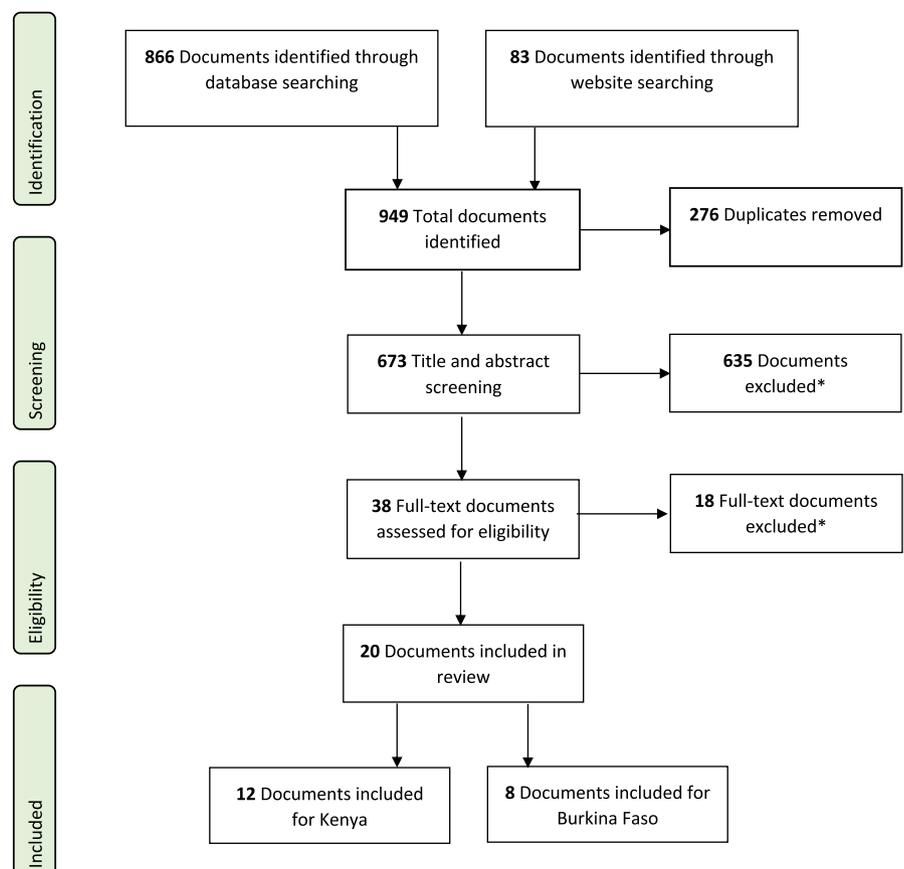


FIGURE 1 PRISMA flow diagram.

* reasons for exclusion: (1) not country specific, (2) urban/suburban area, (3) no focus on home gardening, (4) commercial production (market gardening), (5) monoculture

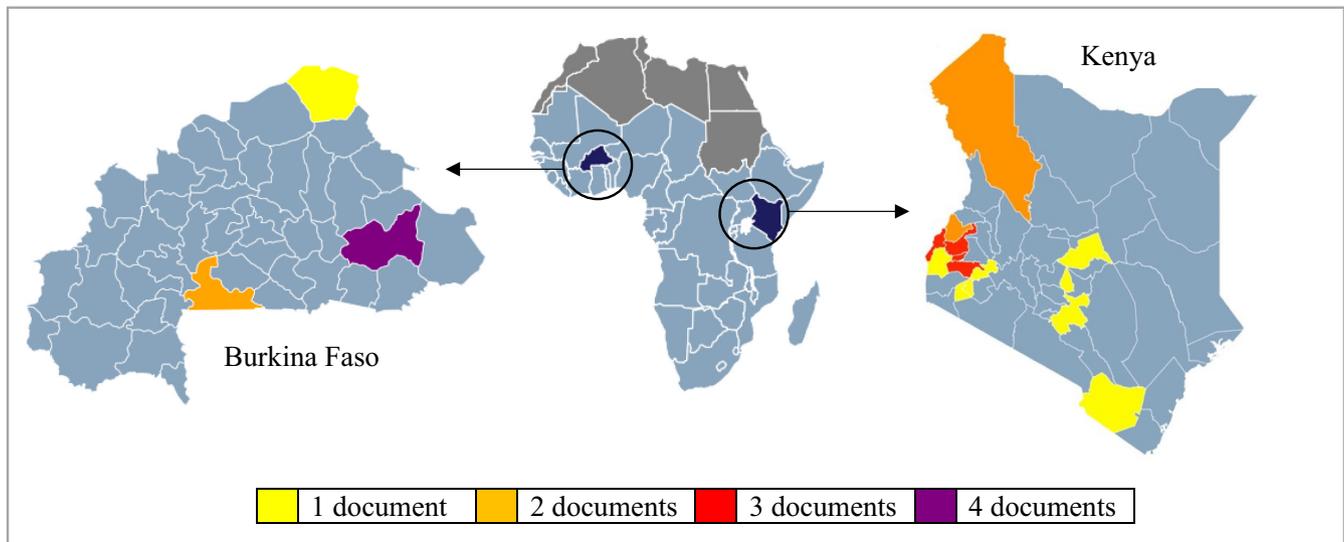


FIGURE 2 Geographic distribution of studies and projects for Burkina Faso (per province) and Kenya (per county). Note: One document for Burkina Faso did not specify the study province (Ouedraogo et al., 2016)

TABLE 2 Characteristics of included documents for Burkina Faso and Kenya, sorted by year of publication

Authors	Year of publication	Document type	Study design	Study type	Study duration
Burkina Faso					
Dillon et al.	2018	Peer-reviewed scientific	Randomized controlled trial	Experimental	2 years
Nielsen et al.	2018	Peer-reviewed scientific	Qualitative	Experimental	2 years
Olney et al.	2016	Peer-reviewed scientific	Randomized controlled trial	Experimental	2 years
Ouedraogo et al.	2016	Project report	Randomized controlled trial	Experimental	2 years
Olney et al.	2015	Peer-reviewed scientific	Randomized controlled trial	Experimental	2 years
Guuroh et al.	2014	Peer-reviewed scientific	Mixed methods	Observational	<1 year
Guuroh et al.	2012	Peer-reviewed scientific	Mixed methods	Observational	<1 year
Nielsen & Reenberg	2010	Peer-reviewed scientific	Qualitative	Observational	1 year
Kenya					
Boedecker et al.	2019	Peer-reviewed scientific	Non-randomized	Experimental	2 years
Chepkirui	2019	Thesis	Mixed methods	Observational	<1 year
Muthee	2018	Thesis	Non-randomized	Experimental	1 year
Mbura et al.	2016	Scientific	Cross-sectional	Experimental	3 years
Waswa et al.	2016	Scientific	Qualitative	Observational	<1 year
Grasso et al.	2015	Poster	Not reported	Experimental	Not reported
Omam et al.	2015	Peer-reviewed scientific	Qualitative	Observational	<1 year
Murphy	2014	Peer-reviewed scientific	Qualitative	Observational	2 years
Musotsi et al.	2008	Peer-reviewed scientific	Qualitative	Observational	<1 year
Abukutsa-Onyango	2007	Peer-reviewed scientific	Mixed methods	Observational	1 year
Wanjohi	2006	Thesis	Cross-sectional	Observational	Not reported
Cheatle et al.	2001	Scientific	Qualitative	Experimental	1 year

met the inclusion criteria. The reasons for exclusion were (1) not specific to the target countries, (2) not originating from rural areas, (3) not focusing on home gardening, (4) dealing primarily with commercial production (market gardening), or (5) concerning monocultures. No additional document was included based on searching the documents' reference lists.

The majority of documents included were published between 2014 and 2019. Overall, eight documents presented data about home gardens in rural Burkina Faso, and 12 documents reported about home gardens in rural Kenya. We found that several documents reported about the same project for Burkina Faso, but not for Kenya. For Burkina Faso, the eight included documents reported about four different projects that were mainly conducted in the southern parts of the country: two observational studies and two randomized controlled trials (RCTs). For Kenya, the 12 documents reported on individual projects

that were conducted in the western areas of the country: seven observational studies and five non-randomized experimental studies. Figure 2 shows the number and the geographic distributions of the documents and corresponding projects in the two target countries.

3.2 | Characteristics of the documents included

Table 2 presents the characteristics of the documents included. For Burkina Faso, seven of eight documents were peer-reviewed scientific articles; there was one project report. Five documents presented experimental data on two RCTs conducted by the NGO Hellen Keller International (HKI). These RCTs aimed at determining the impacts of home gardens on food security and nutritional status among women and young children over a 2-year project

Study aim	Target population	Sample size
To improve food security/nutritional status	Women and young children	1767 households (baseline); 1481 households (endline)
To examine program impact pathways	Women and young children	375 participants
To determine the influence on food security/nutritional status	Women and young children	1767 households (baseline); 1481 households (endline)
To determine the influence on food security/nutritional status	Women and young children	2494 participants
To improve food security/nutritional status	Women and young children	1767 households (baseline); 1481 households (endline)
To analyze garden setup and effects	Rural households	199 households
To determine the influence on income and which crops are commonly sold	Rural households	199 households
To show barriers to CC adaptation	Rural households	104 participants
To improve livelihoods	Woman and young children	498 households
To determine the influence on food security/nutritional status	Women	193 participants
To determine the influence on food security/nutritional status	Women's groups	48 participants
To improve food security/nutritional status	Pregnant and lactating women	200 households
To improve food security/nutritional status	Woman and young children	487 households
To build capacity in agriculture	women in women's groups	not reported
To determine gardening practices	Heads of households (male/female)	140 households
To associate changes in gardens to HIV and AIDS	HIV/AIDS-affected gardeners	21 participants
To determine the influence on food security/nutritional status	Rural households	100 households
To document local vegetable diversity	Community	80 participants
To improve food security/nutritional status	Young children	2242 participants
To improve/conservate livelihoods	Rural households	2050 participants

TABLE 3 Composition and management of home gardens for Burkina Faso and Kenya as reported by respective documents

Characteristics of home gardens	Burkina Faso	Kenya
Size	43% between 1000 and 15,000 m ² , 35% between 16,000 and 30,000 m ² , and 22% over 30,000 m ² (Guuroh et al., 2012; Guuroh et al., 2014)	0.3 to 7200 m ² (Cheatle & Shaxson, 2001; Wanjohi, 2006)
Garden type/method	Intercropping, water-saving technologies: mulching, plants with low water requirements, and short growing cycles (Nielsen et al., 2018)	Intercropping, double-digging, terracing, ratooning, increased diversity; mandala, keyhole, sack gardening; integrated gardens (Abukutsa-Onyango, 2007; Cheatle & Shaxson, 2001; Chepkirui, 2019; Grasso et al., 2015; Mbura et al., 2016; Murphy, 2008)
Inputs/Equipment	Observation studies: fertilizers, seeds/seedling, animal feed/barn (Guuroh et al., 2012) Intervention studies: seeds/seedling, wheelbarrows, small gardening tools, fence (Olney et al., 2015; Ouedraogo et al., 2016)	Observation studies: hand hoes, pangas, fertilizers and pesticides (organic and chemical), fence (Abukutsa-Onyango, 2007; Chepkirui, 2019) Intervention studies: seeds/seedlings, fertilizer, water storage tanks, drip irrigation lines (Mbura et al., 2016; Muthee, 2018)
Plants	29 plant varieties by 3 projects including sweet potatoes, sesame, watermelon, beans, spinach, carrot, tomatoes, okra, potatoes, onions (2 references each; Dillon et al., 2018; Nielsen et al., 2018; Nielsen & Reenberg, 2010; Olney et al., 2016; Ouedraogo et al., 2016)	101 plant varieties by 8 projects including amaranth, banana, kale, gourd (5 references each); nightshade, spinach, spider plant, cowpea, sweet potatoes, tomatoes, crotalaria (4 references each) (Abukutsa-Onyango, 2007; Chepkirui, 2019; Murphy, 2008; Musotsi et al., 2009; Muthee, 2018; Omam & Apudo, 2015; Wanjohi, 2006; Waswa, 2016)
Labor	Preparation and planting: no distinct cut-month, poor use of animal or machinery support, average of 5 people (adults), women are primarily responsible, ≈3.5 working days/week with average of 7.6 h per day (Guuroh et al., 2012; Guuroh et al., 2014) or 3–4 h per day (Nielsen et al., 2018)	Preparation and planting: with hand hoes & pangas, 2×/year during long rains & short rains (Abukutsa-Onyango, 2007), with support of cattle and donkeys (Waswa, 2016) Weeding: every two weeks (Chepkirui, 2019) Harvesting: 4–5 weeks after sowing (Abukutsa-Onyango, 2007)
Fertilization	Chemical: 70%* (Guuroh et al., 2012) Organic: 74%* (animal manure) (Guuroh et al., 2012)	Chemical: 45%* (Chepkirui, 2019) Organic: 42.9%* (Chepkirui, 2019) or 100%* (Abukutsa-Onyango, 2007; farmyard, green, compost, animal manure (Abukutsa-Onyango, 2007; Cheatle & Shaxson, 2001; Chepkirui, 2019; Murphy, 2008)) None: 12%* (Chepkirui, 2019)
Pest control	Organic: biopesticides (Ouedraogo et al., 2016)	Chemical: 57.5%* (Chepkirui, 2019) Organic: 22.3%* (Chepkirui, 2019) i.e. wood ash, pesticide teas, rabbit urine (Chepkirui, 2019) None: 20.2%* (Chepkirui, 2019)
Irrigation	Intervention: access to pumps and boreholes, provision of drip irrigation (access to a dry season water source was an inclusion criterion for project participants) (Dillon et al., 2018; Nielsen et al., 2018; Olney et al., 2016)	Observation: Mostly rainfed, during the dry season: manual irrigation from (mostly) natural water sources, lack of sufficient boreholes (Abukutsa-Onyango, 2007; Murphy, 2008; Waswa, 2016) Intervention: installation of drip irrigation and water storage tanks (Muthee, 2018)

Note: The data in the table refer to unique projects and do not represent a meta-analysis for the respective country; * percentage refers to participants of the respective study who used this method as reported by the document.

duration (Dillon et al., 2018; Nielsen et al., 2018; Olney et al., 2015; Olney et al., 2016; Ouedraogo et al., 2016). Three documents presented observational data using mixed-methods or qualitative approaches. These studies aimed

at in-depth understanding of impact pathways, such as economic benefits (Guuroh et al., 2012) and cultural barriers to the implementation (Nielsen & Reenberg, 2010) of home gardens over a 1-year project duration. The sample

FIGURE 3 Word cloud of home gardening barriers in rural Burkina Faso and Kenya. Note: The size of the words reflects the frequency of barriers reported in documents



sizes for studies in Burkina Faso ranged between 104 and 2494 participants. The projects targeted either individual persons or whole families.

For Kenya, of the 12 included documents, seven constituted gray literature, including university theses ($n = 3$), non-peer-reviewed articles ($n = 3$), and a poster ($n = 1$). Seven of 12 documents presented observational studies that mostly employed qualitative approaches ($n = 4$) and were conducted by local universities ($n = 3$). Five experimental projects used qualitative ($n = 2$) or non-randomized experimental approaches ($n = 2$) and were often conducted by or with NGOs ($n = 5$). The poster did not report on the exact study design. The experimental projects lasted between 1 and 3 years, while all observational studies had durations of <1 year. The sample sizes in experimental studies ranged between 48 and 2050 participants, whereas it was 80 to 2242 participants for the observational studies. The home gardens were cultivated either by individual persons or by whole families.

For both study sites, the target groups were mainly women and their young children. Most projects aimed to improve food security and the nutritional status of their participants. However, there were also some projects that reported on cultural barriers to climate change adaptation (Nielsen & Reenberg, 2010) or local vegetable diversity and production (Abukutsa-Onyango, 2007).

3.3 | Composition and management of home gardens

Table 3 summarizes the findings on the composition and management of home gardens in Burkina Faso and Kenya. In rural Burkina Faso, Guuroh et al. (2012)

observed that home gardens were not settled constructs, but rather continually adjusted to the needs of the community (Guuroh et al., 2012). The size of home gardens varied considerably from 1000 to over 44,000 m² (Guuroh et al., 2012; Guuroh et al., 2014). However, small home gardens dominated, with approximately 43% of gardens being between 1000 and 15,000 m² (Guuroh et al., 2012; Guuroh et al., 2014). These low-input gardens comprised trees, food crops, and livestock. Mainly women were engaged in gardening activities and used simple technologies for planting, irrigation, and harvesting (Guuroh et al., 2012; Guuroh et al., 2014). Yet, the application of chemical or organic fertilizers was common, while some households used both types (Guuroh et al., 2014; Ouedraogo et al., 2016). Plants with low water requirements, short growing cycles, and high nutrient density were preferred by intervention projects (Nielsen et al., 2018). These provided access to water either through constructing irrigation infrastructure during the project lifetime or selected participants based on their access to a water source (Nielsen et al., 2018; Olney et al., 2015; Olney et al., 2016). Of the 29 plant varieties in rural Burkina Faso, the dominating crops were green leafy vegetables, tomatoes, potatoes, carrots, and onions (Dillon et al., 2018; Nielsen et al., 2018; Nielsen & Reenberg, 2010; Olney et al., 2016; Ouedraogo et al., 2016). The main reported purpose of home gardens in Burkina Faso was a self-sufficient food supply.

In rural Kenya, Cheatle and Shaxson (2001) noted that home gardens expanded rapidly and autonomously among neighbors once established in communities, arguing for the potential of continued scale-up in the future (Cheatle & Shaxson, 2001). In Kenya, when compared to Burkina Faso, horticultural plots were smaller, ranging from 0.5 to

7000 m² with a mean size of 20.5 m² (Wanjohi, 2006). In addition, these gardens were more complex in their composition and inclusion of plant varieties. Of the 101 plant varieties in rural Kenya, the dominating crops were amaranth, banana, kale, and gourd, as well as nightshade, spinach, spider plant, cowpea, sweet potatoes, tomatoes, and crotalaria (Abukutsa-Onyango, 2007; Chepkirui, 2019; Murphy, 2008; Musotsi et al., 2009; Muthee, 2018; Omam & Apudo, 2015; Wanjohi, 2006; Waswa, 2016). The garden types included terrace (on multiple levels), ratoon (part of the stem remains after harvesting and forms the basis for subsequent growth), mandala (a circular form of planting different varieties), keyhole (a special form of a raised bed with an indentation in the middle), and sack gardening (tall sack filled with soil as the basis for planting). Some patches of the gardens contained cereals, legumes, green leafy vegetables, and fruit trees, and were often mixed with areas for keeping livestock, fish ponds, or bee stocks (Abukutsa-Onyango, 2007; Cheatle & Shaxson, 2001; Chepkirui, 2019; Grasso et al., 2015; Mbura et al., 2016; Murphy, 2008). The households mainly used organic fertilizers and manure from their own production (Abukutsa-Onyango, 2007; Cheatle & Shaxson, 2001; Chepkirui, 2019; Murphy, 2008). However, one study also reported that 45% of the study beneficiaries ($n \approx 87$) applied chemical fertilizers, while 38% used animal manure ($n \approx 73$), and 12% ($n \approx 23$) did not use any substance to fertilize their garden (Chepkirui, 2019). In Kenya, water access was critical for managing home gardens and was determined by a household's physical proximity to a source of water or by their use of simple irrigation techniques (Murphy, 2008). Like in Burkina Faso, home gardens in rural Kenya supported households' food self-sufficiency (Chepkirui, 2019; Muthee, 2018; Wanjohi, 2006; Waswa, 2016), while surplus productions were put up for sale (Abukutsa-Onyango, 2007; Cheatle & Shaxson, 2001; Chepkirui, 2019; Musotsi et al., 2009; Waswa, 2016).

3.4 | Barriers to home gardens

The successful establishment and maintenance of home gardens in rural Burkina Faso and Kenya was shaped by a multitude of barriers. Figure 3 highlights the barriers to home gardening, reaching from climate-related factors to irrigation infrastructure and management of know-how.

Climate-related factors, including erratic rainfall patterns, droughts, soil erosion, and shifting rainy seasons, constituted important barriers to establishing or maintaining home gardens in both countries (Abukutsa-Onyango, 2007; Cheatle & Shaxson, 2001; Guuroh et al., 2012; Musotsi et al., 2009; Nielsen et al., 2018). Water stress due to a lack of irrigation systems or a general water scarcity was enumerated as an element of failure for home gardens (Cheatle & Shaxson, 2001; Chepkirui, 2019; Murphy, 2008; Nielsen et al., 2018; Ouedraogo et al., 2016). Thus, intervention programs responded to these needs by providing irrigation infrastructure and know-how on alternative watering practices (Nielsen et al., 2018). The irrigation infrastructure included setting up new gardening wells, boreholes, pedal pumps, pipe irrigation systems, drip irrigation systems, and relocating gardens closer to the water source (Nielsen et al., 2018). In regard to know-how, the intervention project prepared lessons on mulching, planting in dry and rainy seasons, and selecting species with shorter growing cycles and lower water requirements (Nielsen et al., 2018). The affordability of (high quality) inputs marked an additional issue for horticultural gardens in both regions (Chepkirui, 2019; Dillon et al., 2018; Murphy, 2008; Nielsen et al., 2018). This concerned the availability and affordability of seeds, fertilizers, and manure, as well as access to small-scale loans and funds (Chepkirui, 2019; Dillon et al., 2018; Murphy, 2008; Nielsen et al., 2018). Equally, a lack of know-how about horticultural production and garden maintenance, as well as access to arable land, constituted additional challenges;

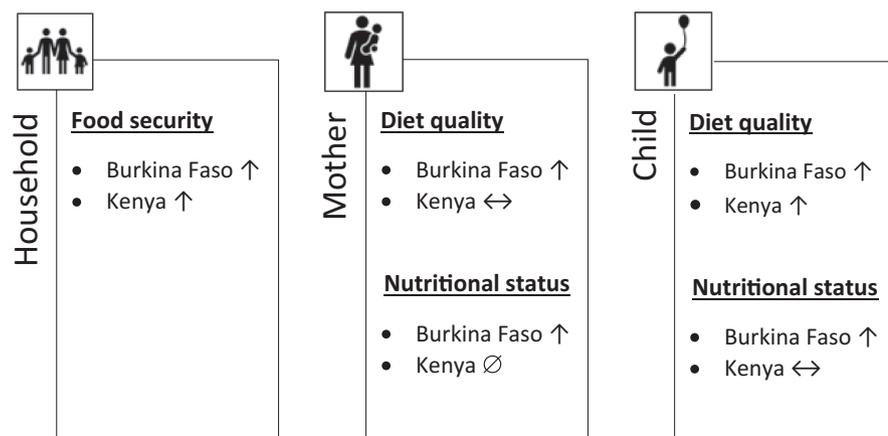


FIGURE 4 Direction of impacts of home gardening projects on nutrition outcomes among households, mothers, and young children. Note: ↑ improvement; ↔ no change; ∅ no data available

the latter concerned particularly women (Cheatle & Shaxson, 2001; Guuroh et al., 2012; Guuroh et al., 2014; Murphy, 2008; Waswa, 2016).

3.5 | Impacts of home gardens on nutrition and health outcomes

Of the 20 included documents from 16 different projects, we identified six documents (= six projects) for Kenya (Boedecker et al., 2019; Chepkirui, 2019; Mbura et al., 2016; Musotsi et al., 2009; Muthee, 2018; Wanjohi, 2006) and four documents (= two projects) for Burkina Faso (Dillon et al., 2018; Olney et al., 2015; Olney et al., 2016; Ouedraogo et al., 2016) that investigated impacts on nutrition and health outcomes. Figure 4 presents the direction of impacts of home gardens on households' diets and food security, as well as diet quality and nutritional status of mothers and young children based on the 10 documents.

On the household level, Nielsen et al. (2018) determined in Burkina Faso that integrated gardening interventions improved the perceived diet quality and food access among participating households. Also, Dillon et al. (2018) reported beneficial impacts on food self-sufficiency, food safety, and food quality (Ashby et al., 2016) but limited impacts on availability and access among households in Burkina Faso (Dillon et al., 2018). Similarly, two projects from Kenya observed a lower prevalence of food insecurity (Muthee, 2018) and experienced hunger upon integrated gardening interventions (Cheatle & Shaxson, 2001). Yet, the same study showed similar levels of food insecurity, as assessed by the Household Food Insecurity Access Scale (HFIAS), between women with and without enhanced kitchen gardens (Muthee, 2018).

Concerning women as the target group of home gardening projects, Olney et al. (2018) found positive impacts among mothers who participated in a home garden intervention in Burkina Faso: Their consumption of nutrient-rich foods increased, while the prevalence of maternal underweight decreased (Olney et al., 2016). In Kenya, two projects determined beneficial effects of home gardens on diet quality, i.a. through the enhanced consumption of vegetables rich in vitamin A and vitamin C (Muthee, 2018), and on dietary diversity (Boedecker et al., 2019; Muthee, 2018). Chepkirui (2019) related the quality of women's diet directly to the composition of home gardens. More specifically, she found positive correlations between the garden size and the number of crops with dietary diversity and micronutrient adequacy. This contrasted findings by Boedecker et al. (2019) who did not detect significant impacts on indicators of diet quality among mothers in Kenya.

For nutrition and health outcomes among young children, Olney et al. (2015) found for Burkina Faso that their home garden project improved dietary diversity and increased the consumption of legumes, vitamin A-rich foods, and other fruits and vegetables. The prevalence of chronic child undernutrition remained unchanged in one project in Burkina Faso, but measures of acute undernutrition improved (Dillon et al., 2018). For young children in Kenya, positive impacts of home garden interventions on diet quality were seen in four projects, particularly on the dietary diversity of young children (Boedecker et al., 2019; Chepkirui, 2019; Mbura et al., 2016; Olney et al., 2015; Wanjohi, 2006). However, no such effects were observed for nutrient adequacy (Boedecker et al., 2019; INDDEx-Project, 2018). In regard to child nutritional status in Kenya, the results were inconclusive: Mbura et al. (2016) demonstrated that a 3-year integrated home gardening project contributed to improvements in measures of acute child undernutrition (Mbura et al., 2016). Also, Wanjohi (2006) found promising trends for improved nutritional status among young children in Busia, Kenya, including acute and chronic undernutrition, as well as vitamin A status. Yet, these results were not statistically significant (Wanjohi, 2006).

4 | DISCUSSION

This scoping review systematically identified and comprehensively synthesized the existing evidence on home garden practices and their impacts on nutrition outcomes in rural Burkina Faso and Kenya. Of the initially retrieved 949 documents, 20 documents were included in this synthesis (Burkina Faso: 8; Kenya: 12). The eight documents for Burkina Faso were derived from four different projects, while all documents for Kenya were based on unique projects. We found that these projects were distinct to specific regions within both countries, neglecting the West of Burkina Faso and the East of Kenya. Among the 16 included projects, the sample sizes ranged from 21 to 2242 participants. A majority of the projects aimed to improve household food security and maternal and child nutritional status. However, only a few studies employed rigorous evaluation through experimental study designs, such as RCTs, to measure the actual impact. Major challenges to successfully implement and maintain home gardens were access to water and land, availability of construction material and seeds, and lack of knowledge about horticultural production and garden maintenance. In both geographic contexts, beneficial trends were seen for home gardening projects on nutrition outcomes among rural populations.

4.1 | Strengths and limitations of this scoping review

This synthesis of home gardening practices in rural Burkina Faso and Kenya provides a comprehensive overview of the current situation and knowledge on this matter. This work has methodological strengths and weaknesses that need to be taken into consideration when interpreting the findings. With regard to strengths, we followed the PRISMA guidelines to coherently conduct and transparently report our work. Three authors independently searched the databases and websites, and two authors screened the documents for inclusion and extracted the data for analysis. This rigorous approach enhanced the objectivity of the scoping review.

There are also some limitations to be recognized. First, only three databases were searched along with selectively chosen online websites, potentially introducing selection bias. Through personal communication with project implementors in both countries, we learned that a considerable number of project reports remain inaccessible to the public. Thus, publication bias cannot be excluded. This limits the generalizability of our findings concerning geographic distributions of home garden projects, as well as their impacts on nutrition outcomes. Second, the mapping identified that previous projects on home gardening in rural Burkina Faso and Kenya were conducted in distinct geographic regions and among specific target populations. The rationale for the selection of certain regions remains speculative. Some authors selected a specific region based on access to natural resources (water and land) or because they had previous experience and work in the region (Olney et al., 2015; Olney et al., 2016; Ouedraogo et al., 2016). Third, a meta-synthesis was only possible in the form of a narrative review owing to the heterogeneous data and results. Lastly, we excluded studies focusing on only one specific type of crop. As a result, publications from the Orange Fleshed Sweet Potato projects, included in other systematic reviews on nutrition-sensitive agricultural interventions, were not included in this study (Hagenimana et al., 1999; Hagenimana et al., 2016).

4.2 | Home gardens as sustainable food systems in sub-Saharan Africa

Home gardens are advocated as a means of climate change adaptation in rural SSA to promote food self-sufficiency for subsistence farming families (Galhena et al., 2013; Lutaladio et al., 2010; Nyong et al., 2020; Sobola et al., 2015; WorldVegetableCenter, 2016). We have synthesized the characteristics of home gardens in rural Burkina Faso and

Kenya with regard to their setup, management, and their effects on nutrition outcomes. Here, we discuss the potential of home gardens to serve as sustainable food systems in SSA. According to the FAO, food systems comprise the complete value chain from food production over refinement to distribution and consumption including the involved operators and their interactions (Nguyen, 2018). Sustainable food systems specifically deliver food security and healthy nutrition to the whole population in such a way that the environmental, economic, and social resources for future generations are not compromised (Nguyen, 2018). In this sense, sustainable food systems embrace four domains: the environmental, the economic, the socio-cultural, and the nutrition and health domains (Herrero et al., 2020).

4.3 | Environmental sustainability of home gardens

For environmental sustainability, our findings indicate that there is room for improvement with respect to the composition and management of home gardens in rural Burkina Faso and Kenya. While home gardens can serve as a tool for adaptation to climate change impacts on agriculture (Linger, 2014; Nguyen et al., 2012), this adaptation strategy should avoid any additional emission of greenhouse gases (GHG), soil degradation, water pollution, and biodiversity loss (Braun et al., 2021). In their recent review on lifecycle assessments and emission factors for fertilizers, Walling and Vaneekhaute (2020) acknowledged the challenges to quantify the exact amount of GHG emissions from synthetic fertilizers (nitrogen, phosphorous, and potassium) used in agricultural production and management due to the high variability in the products' life cycles. Still, it remains evident that inorganic fertilizers (in combination with the application of livestock manure) used in agriculture account for more than 80% of the anthropogenic nitrous oxide (N_2O) and 70% of the anthropogenic ammonia (NH_3) emissions and thus contribute significantly to global warming (IPCC, 2014). To date, a considerable number of home gardening projects in rural Burkina Faso and Kenya already employed alternative organic fertilizers and pesticides (see Table 3). Yet, at least one-third of the participants of the included studies have used chemical compounds for horticultural cultivation and pest control. In addition to their contribution to GHG emissions, chemical fertilizers and pesticides remain in the soil and water for extended periods of time. This adversely affects soil structure and microflora, as well as nutrient content and toxic substances in the food crops. While the latter has negative implications for human health, the former contributes to the extinction of plant and insect species (Baweja & Kumar, 2020).

Our scoping review identified climatic factors as major barriers to home gardens, precisely, water scarcity, drought, and soil erosion (Abukutsa-Onyango, 2007; Cheatle & Shaxson, 2001; Guuroh et al., 2012; Musotsi et al., 2009; Nielsen et al., 2018). Burkina Faso and Kenya both experience high climate variability with rising temperature, changing precipitation, and biodiversity loss (AGRICIA, 2021). Studies from Burkina Faso show that, due to these changes, farmers' ability to predict and act according to traditional weather signs is diminishing, further exacerbating their vulnerability to the changing climate and the risk of failed crops (Ingram et al., 2002; Sorgho et al., 2020). This illustrates the need for such populations to receive training on horticultural practices to address the particularities of a changing climate on a local level.

4.4 | Economic sustainability of home gardens

With regard to economic sustainability, a majority of articles in our review presented economic challenges of home garden establishment and maintenance, including access to and affordability of inputs (Figure 3). Subsistence farmers across SSA have long faced financial difficulties, exacerbated by a lack of financial capital and poor access to credits, loans, and technologies. For rural farmers, this results in a limited ability to purchase agricultural inputs (fertilizers, pesticides, and seeds of resistant varieties), which are increasingly important for successful gardening in difficult climatic conditions (Akinagbe & Irohibe, 2015; Juana & Okurut, 2013). In September 2020, the Kenyan Ministry of Agriculture, Livestock, Fisheries & Cooperatives launched a national initiative titled *1-Million Kitchen Garden Initiative* (<https://kilimo.go.ke/>), which aims to mitigate undernutrition by enabling resource-poor families to establish home gardens. In order to address some of the challenges households might face taking up home gardening, the initiative will provide households with home garden starter kits (seeds, water tanks, and shade nets). Another solution to the problem could be a transition toward organic inputs. This would serve a double purpose, as they provide an option to achieve environmental and economic sustainability in the horticultural food system. Knowledge and production of homemade organic fertilizers and pesticides may serve as an affordable alternative to chemical inputs. In addition to access to input, limited infrastructure for irrigation, lack of market access, and high opportunity costs from numerous working hours constitute the main economic challenges in previous home gardening projects (Fernandes & Nair, 1986; Galhena et al., 2013; Ninez, 1987). Proposed

solutions for these challenges include i.a. collaborative approaches with community land and group saving schemes, capacity building on preservation and processing techniques, and the inclusion of men in the project groups to lower the labor burden on women (Cheatle & Shaxson, 2001; Guuroh et al., 2014; Musotsi et al., 2009; Wanjohi, 2006).

4.5 | Socio-cultural sustainability of home gardens

Concerning the socio-cultural sustainability of home gardens in rural Burkina Faso and Kenya, strong adherence to the recommendation of planting diverse indigenous and nutritious horticultural crops can be identified (see Table 3). This aligns with the traditional cuisine, food knowledge, and biodiversity of foods and thus supports the acceptance and consumption within the community (Burlingame et al., 2011; WorldVegetableCenter, 2016). We observed a rich diversity of garden types and construction methods of home gardens, highlighting the context-specific and participatory approaches in most home garden projects. The active inclusion of the community in decisions related to and the selection of their home garden structure is an important criterion for empowerment, acceptability, and, thus, the long-lasting utility of gardens (Schreinemachers et al., 2018; WorldVegetableCenter, 2016).

Importantly, the role of women in their communities has emerged as a key factor to the success of home garden projects in both countries. Home gardens can serve as a route to female empowerment through nutrition education and independent food supply (Olney et al., 2016; Patalagsa et al., 2015). However, there are socio-cultural barriers that hinder women's ability to establish and sustainability to manage home gardens in the two study regions. Past home garden projects in Kenya and Burkina Faso showed that women are disadvantaged in regard to land ownership, tenure, control, and access (Guuroh et al., 2012; Murphy, 2008; Nielsen et al., 2018; Ouedraogo et al., 2016). Some cultural norms and traditions hinder women in SSA from owning farmland, thereby excluding them from mortgaging the property and escalating inequalities (Ellis et al., 2005; Kameri-Mbote, 2005; Manda & Mwakubo, 2014). Women in rural areas spend a large share of their time fulfilling extensive domestic tasks and shouldering the majority of childcare responsibilities (IFAD, 2015a, 2015b, 2016). This limits the time women can invest in income-generating activities, in agricultural farming and gardening, and it reduces the time they can access support, such as local extension services (Farnworth & Colverson, 2015; Folbre, 2014; IFAD, 2016).

Furthermore, women will be slowed in all their physical activities by the health impact of climate change, such as increasing temperatures and heat stress, which can result in fatigue, dizziness, and reduced work capacity (Haines et al., 2019; Matsumoto et al., 2021).

To address the consequences of the socio-cultural barriers and resulting disadvantages faced by women, home gardening projects should incorporate women empowerment components. These comprise increased access to land through legislative/legal support, and behavior changing activities such as community events focusing on women's rights and increasing their decision-making power in their homes (IFAD, 2015a). Projects should also invite men (fathers, brothers, partners, and children) to participate in home gardening work, reducing the labor burden on female gardeners and increasing the household's support for the gardening initiative (IFAD, 2015a, 2016; Patalagsa et al., 2015). Furthermore, projects should support women by incorporating and/or facilitating their access to labor- and time-saving technologies such as rain and roof water harvesting tarps and tanks (IFAD, 2015a, 2015b, 2016).

4.6 | Nutrition and health sustainability of home gardens

Lastly, for the nutrition and health domain of sustainable food systems, our findings show that home gardens confer great potential to improve household food security, as well as maternal and child diet quality. Specifically, projects found an enhanced supply of critical nutrients such as protein, vitamin A, iron, and zinc (Boedecker et al., 2019; Chepkirui, 2019; Mbura et al., 2016; Olney et al., 2015; Wanjohi, 2006). On the household level, our review demonstrated positive associations between home gardens and food security. However, not for all categories of food security positive associations were found, that is, availability and access (Dillon et al., 2018). A recent study from India showed positive effects of home gardens on food security in terms of food availability, access, and utilization but found no improvement in terms of food stability (Saediman et al., 2021). For diet quality and nutritional status of women and children, the present review shows positive impacts of home gardens for Burkina Faso and contrasting findings for Kenya. This is consistent with results from a study in Nepal, where undernutrition has been reduced among mothers participating in a combined home gardening program (Osei et al., 2016). While prior studies observed limited changes in child undernutrition with home gardening programs (Girard et al., 2012; Osei et al., 2016), more recent studies from

Guatemala and Ghana demonstrated beneficial effects on child nutritional status by improving anthropometric measures of chronic undernutrition (Guzmán-Abril et al., 2021; Marquis et al., 2018). Other projects, such as the RAIN-project in Zambia (Realigning Agriculture to Improve Nutrition), found no effects of integrated home gardening interventions on stunting in children, but during their baseline assessments, they determined a link between higher production diversity and lower stunting rates in young children (24–59 months old) (Kumar et al., 2015; Kumar et al., 2018).

In the future, diversification of dietary behavior by means of home gardening may become an important tool of resilience to climate change impacts on agricultural systems in SSA. Indeed, diversified home gardens provide an opportunity to buffer the quantitative harvest losses and the qualitative nutrient dilution in major staple crops, which are the consequences of climate change-related weather phenomena and increased ambient CO₂ concentrations, respectively (Myers et al., 2017). The limited effects of home gardening on nutritional status found by previous studies have been attributed to short intervention periods, low participation rates, and insufficient setup of home gardens (Kumar et al., 2018; Olney et al., 2015; Saediman et al., 2021). Kumar et al. (2018) hypothesized that education, information, and market linkage could assist households in increasing their horticultural production and improving their nutrition. Other projects recommended the inclusion of malaria prevention, fortified foods, and hygiene education as supplementary project components, which can support proper nutrition (Kumar et al., 2018; Olney et al., 2015). Therefore, future interventions should also employ strong and consistent monitoring tools and cross-sectoral collaboration (Boedecker et al., 2019; Kumar et al., 2018; Mbura et al., 2016; Waswa, 2016). Through surveys conducted 3 years after the intervention, an integrated home garden study from Bangladesh demonstrated that training on “good gardening practices” (raised beds, inorganic fertilizer, composting, chemical and bio-pesticides, mulching, bagging, pruning, staking, strong fencing, and irrigation), guidance on garden management, and the involvement of the entire family resulted in observed long-term impacts and contributed to significant improvements in yields and nutrition (Baliki, Brück, Schreinemachers, & Uddin, 2019).

5 | CONCLUSIONS

This scoping review contributes to understanding the role of home gardens for climate change adaptation in rural SSA. We found that the evidence on home garden practices in rural Burkina Faso and Kenya is limited and at

times not publicly accessible. First, we conclude that research and resources should be invested in codesigning future home gardening projects and interventions with the target population. Context-specific home gardening projects in remote and rural areas of Burkina Faso and Kenya, which have thus far been overlooked, represent areas that may benefit the most due to their high climate vulnerability and poverty. Second, the utilization of organic fertilizers and pesticides appears to be an attractive alternative to climate-unfriendly and costly chemical inputs for home gardens. Third, we encourage research fellows, funders, and project implementors to acknowledge the importance of home gardens as a means of adaptation to climate change in highly vulnerable populations. This includes their positive contribution addressing the value of indigenous food crops, the importance of functioning infrastructure, and the empowerment of women, in order to achieve food security and prevent child undernutrition. Lastly, we emphasize the need for rigorous evaluation of the impact of home garden projects on food security and maternal and child nutrition across different geographic regions and population groups.

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CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ORCID

Lea-Sophie Hansen  <https://orcid.org/0000-0002-2116-5088>

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SUPPORTING INFORMATION

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