Review

Traditional African Vegetables Knowledge Translation: A Scoping Review

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Posted Date: 1 September 2024

doi: 10.20944/preprints202408.2268.v1

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Traditional African Vegetables Knowledge Translation: A Scoping Review

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Abstract: Traditional African vegetables (TAV) are an important component of an ecologically sustainable approach to addressing food and nutrition security in Africa (countries?). This review aims to identify the scope of the knowledge translation literature that exists across multiple aspects of the TAV value chain and to identify gaps in knowledge translation research. A scoping review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) was conducted. The Population, Concept, and Context (PCC) framework was used to guide the development of inclusion and exclusion criteria for this review. Web of Science, Scopus, Science direct and ABI/Inform databases were searched to identify relevant studies which were then screened using the Covidence online software to select studies and extract information for analysis and reporting. A total of 182 studies/articles were selected and examined. The most significant knowledge documented about TAVs is their vast genetic diversity contributing to their rich nutritional and medicinal properties, their ability to withstand harsh environmental conditions such as drought, pests, and diseases as well as the effects of various post-handling techniques on nutrient content of TAVs with the production phase of TAVs value chain being the most studied. This review found that although there is a breadth of knowledge created about TAVs, there is still little documentation of transferring and utilizing of this knowledge across the TAVs value chain. This review identified that more research is needed to document strategies and practices for the transfer and utilisation of knowledge to ensure it is utilized to enhance nutritional outcomes across Africa.

Keywords: traditional African vegetables; value chain; knowledge translation; promotion

1. Introduction

Hunger and malnutrition are significant challenges facing communities and populations especially the poor in low- and middle-income countries with almost 30% of the population living with one or more forms of malnutrition [1]. This problem is more prevalent in Sub- Saharan African (SSA) countries than in higher income countries [1–3]. In the global context, the triple burden of malnutrition - overnutrition (overweight and obesity), undernutrition (stunting, wasting and underweight) and micronutrient deficiencies (often referred to as 'hidden hunger') coexist within the same population [4]. In Sub-Saharan countries, the triple burden of malnutrition also exists within and across households [5,6], with undernutrition and micronutrient malnutrition most prevalent [7]. In Tanzania, the triple burden of malnutrition is a major public health concern. The recent Tanzania Demographic and Health Survey and Malaria Indicator Survey found that 30% and 12% of children under 5 years of age were stunted and underweight, respectively [8]. In addition, 28.8% of women of reproductive age were anaemic and 31.7% overweight [9].

One cause of sub-optimal nutrition is low dietary diversity, which, is a qualitative measure of the combination of foods from across food groups consumed by an individual or a household in a specific period of time, typically in the preceding 24 hours [10]. As well as reflecting access to a variety

 doi:10.20944/preprints202408.2268.v1

of foods, dietary diversity is also a representation of nutritional adequacy in the household or individual's diet [10–13]. Dietary diversity in Tanzania is low with 70% of calorie intake comprised of starchy foods with few other food types, especially vegetables, which are a significant source of vitamins and some minerals [14]. Recent studies showed that there is low dietary diversity within the Tanzanian population particularly of children under the age of five and women of reproductive age [14–18]. Only 28% of pregnant women 26% of children aged between 6 -23 months in Tanzania met the minimum dietary diversity (MDD) requirements with 40% of them not consuming vegetables and fruits [8].

While WHO recommends 280g of vegetable consumption per day, Tanzanians consume on average much less at around 132g [19]. This low vegetable intake contributes to the high prevalence of micronutrient deficiencies. For example, a recent study revealed that 34.7% of children aged between six and twelve years in the South-Eastern part of Tanzania were Vitamin A deficient, with children in remote rural areas at five times greater risk of deficiency [20].

1.1. Traditional African Vegetables (TAVs)

Traditional African Vegetables are "Plant species that are indigenous or naturalized to Africa, well adapted to or selected for local conditions, whose plant parts are used as a vegetable, and whose modes of cultivation, collection, preparation, and consumption are deeply embedded in local cuisine, culture, folklore, and language" [21]. These vegetables are rich in micronutrients, minerals, vitamins, and fibre, and have the potential to make a significant contribution to improving diets [22–24]. Traditional African vegetables also thrive in harsher conditions than exotic vegetables, providing opportunities for improved nutrition at lower cost for poor communities especially in the increasing adverse climate [13,25,26]. Traditional African vegetables are a rich source of micronutrients and minerals compared to exotic (non-traditional) vegetables [27], which offers the potential to contribute to dietary diversity and improvement of nutritional status. Exotic vegetables were introduced into Africa in the last few decades and are the dominant varieties in commercial outlets [28–30].

1.2. Value Chain Concept for Knowledge Translation across the TAVs Value Chain

This review adopted the value chain framework to explain the flow of knowledge across all the TAVs value chain from where and how the knowledge is created, how its transferred across the chain with the support of other stakeholders and how the main value chain actors utilises the knowledge.

A value chain is an interconnected system collaboratively working to create and deliver products and services that are sought and valued by consumers [31]. As explained by [32], value chains encompass all actors from pre-production to consumption, and the secondary actors that provide an enabling environment, such as policies, financial services and research. Value chains also emphasise relationships and flow of information or sharing of knowledge between chain members to facilitate the creation and delivery of consumer valued products and services [33]. For a value chain to thrive, not only do products and services need to move from pre-production through the various actors who perform different activities to final consumers, but also knowledge and strategic information needs to be shared between members of the chain, including those playing supportive roles to the chain [34].

1.3. Knowledge and Knowledge Translation across the TAVs Value Chain

Knowledge comprises what a person understands to be facts and the information a person acquires from other sources [35]. To ensure that knowledge is put into action and fulfils its goals (knowledge translation), it needs to be created and effectively transferred to enable utilization by the intended audience [36,37]. According to the Canadian Institute of Health Research [36,38], "Knowledge translation is the dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge to improve health, provide more effective health services and products, and strengthen the health care system". Knowledge of

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various aspects of TAVs is necessary across the value chain to increase production, marketing, and consumption for potential realisation of better nutritional outcomes.

All actors in the value chain, including the primary actors who handle vegetables and the secondary actors who create the enable environment, need to cooperate in the creation, dissemination, and utilization of the relevant knowledge for the TAV value chain to thrive. Indeed, the production and consumption of TAVs tend to increase with increased knowledge of TAVs, such as availability of improved seeds for higher productivity [39] and understanding the nutritional value of TAVs and how they can improve dietary diversity [40]. The existence of marketing information such as price, demand for TAVs and production capacity also influences the activities of farmers and those who engage in the marketing of the vegetables [21,25,41].

There is good evidence on the nutritional benefits of TAVs and their role in improving the nutrition of populations, especially women and children who are most adversely affected by malnutrition [24–26,42]. However, less is known about the extent of literature on aspects of the TAV value chain related to inputs, production, post-harvest handling, processing, trading, and consumption. The extent of evidence on the transfer and utilization of knowledge across the chain is also not known.

Therefore, this scoping review aims to map the available evidence of the knowledge translation across the TAVs value chain from input supply, production, harvesting and post-harvest handling, trading, preparation up to consumption. For the purpose of this review, knowledge translation comprises of knowledge creation, transfer, and utilization. A scoping review format was used because they are able to assist in the understanding of the broad literature available for a field of research that has not been extensively studied or a topic of heterogeneous nature [43].

1.4. Objective

An overarching objective of this review is to map the available literature about Traditional African Vegetables (TAVs) knowledge translation. This includes the type and extent of knowledge created about the TAVs' value chain from inputs to consumption and the transfer and utilization of this knowledge by TAV value chain actors.

1.5. Review Question

This scoping review therefore seeks to answer the general question: "What evidence is available about knowledge translation of various aspects of TAVs across the value chain"—Specific questions will include:

- What evidence is available concerning TAV? (Type of evidence, how/where the evidence was created)
- What is the focus of the evidence? (phase of value chain, attributes of TAVs investigated)
- What knowledge translation components are covered in the literature? (creation, transfer, utilization)
- What are the research gaps in relation to the TAVs' knowledge translation across the value chain? (discussion)

2. Materials and Methods

A scoping review was conducted using the framework developed by Arksey and O'Malley [44], which includes the following 5 stages: identifying the research question; identifying relevant studies; study selection; charting the data; and collating, summarizing, and reporting the results.

The population included all studies that reported on any TAVs whose leaves are consumed, including wild-collected and cultivated leafy vegetables. Studies on TAVs that were specific to particular locations in Africa and those that are common across the continent were eligible for inclusion. Studies on African traditional or indigenous fruits or non-leafy vegetables were excluded.

The concepts explored and analysed included features of TAVs value chain from input supply to consumption. This includes breeding, inputs supply, production, harvesting, post-harvest

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handling, processing, trading, preparation/cooking, and consumption. Creation of knowledge, pathways used to transfer and utilize knowledge was the main focus of the review. The context of the evidence focused on the whole African continent, including studies conducted outside Africa but focusing on TAVs from one or more African country. Table 1 below summarises the inclusion and exclusion criteria for this scoping review.

Table 1. Inclusion and exclusion criteria for scoping review.

PCC	Inclusion criteria	Exclusion criteria
Population	All TAVs (leafy only)	Non-leafy TAVs
	Country or location specific TAVs (within Africa), common TAVs	Traditional/indigenous fruits
Concept	From Input supply to Consumption. All value chain activities, in English language	Non-English language
Context	African continent. Studies conducted outside Africa but focusing on TAVs for Africa	Studies focusing on non-African countries

2.1. Literature Identification and Data Sources

The search was performed between 23rd November and 4th December 2023, for all published primary studies and reviews, unpublished papers, thesis, case studies, and Government, national and international organisations' project reports - all limited to those written in English. A search was conducted on Web of Science, Scopus, and ABI/Inform databases to identify literature on this topic. There was no limit of the dates of the evidence searched. The key words identified from the initial search of literature were used to build the search strategy in the mentioned databased to obtain the relevant literature.

The reference lists of the included studies were also reviewed to identify other relevant studies that might have missed by the searched databases. The key terms used to develop the search string is presented below and appendix 1 presents the search conducted in the three databases for this scoping review.

The key terms used to develop the search string are

1. Traditional African vegetables, African indigenous vegetables, Africa underutilised vegetables, African leafy vegetables
2. Knowledge transfer, knowledge translation, knowledge management, tactic knowledge
3. Value chain

2.2. Study Selection

Citations from all studies identified in the searches were imported into EndNote v.20, and then duplicates removed using Covidence [45,46]. The remaining citations' titles and abstracts were screened against the inclusion and exclusion criteria and the full text of potential studies obtained and reviewed for inclusion.

2.3. S Data Extraction, Synthesis, and Reporting

Data extraction of specific information about the population, concept, and context relevant to the scoping review objectives were extracted from each included study. A data extraction form was created in Covidence and used to populate general information of the included studies, such as study title, authors, year of publication and type of study/study design. More specific information based on the headings corresponding to the review's objectives and questions were also extracted. Since the data extraction process was iterative, the data extraction form was modified as other relevant information was obtained in the course of extraction, and the data extraction form was finally exported to Microsoft Excel for data cleaning and reporting. As advised by [47], there was no critical

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appraisal of the included studies in this scoping review as its main objective was to map the breadth of evidence as opposed to the quality of the studies. A copy of the data collection form is provided in appendix 2.

Since the aim of this scoping review was to understand the extent of the available evidence about the review topic and to identify research gaps, the analysis of the data was mainly on the frequency counts of the concepts and population, and characteristics of the evidence in relation to the objectives of the review.

Findings were reported using the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) developed by [48] and later updated by [47] (see Figure 1). Descriptive results are presented in graphs and tables as well as maps where relevant to show the extent of the literature about TAVs knowledge translation. A narrative summary of the results of each included study is presented to support the descriptive analysis.

4. Results

4.1. Overview of Included Studies

Figure 1 summarises the PRISMA flow chart for the process of identifying, screening, and selecting studies to include in this review. A total of 596 potential records were found through the search from the three databases., including 375 records (63%) from Scopus, 205 (34%) from Web of Science and 16 from ABI/Inform. A total of 76 duplicate records were removed. The Of the remaining 519 records 234 were excluded following title and abstract screening. A further 108 records were excluded, and the remaining 177 records were selected to be included in the review. Five additional studies were included following bibliographical searches.

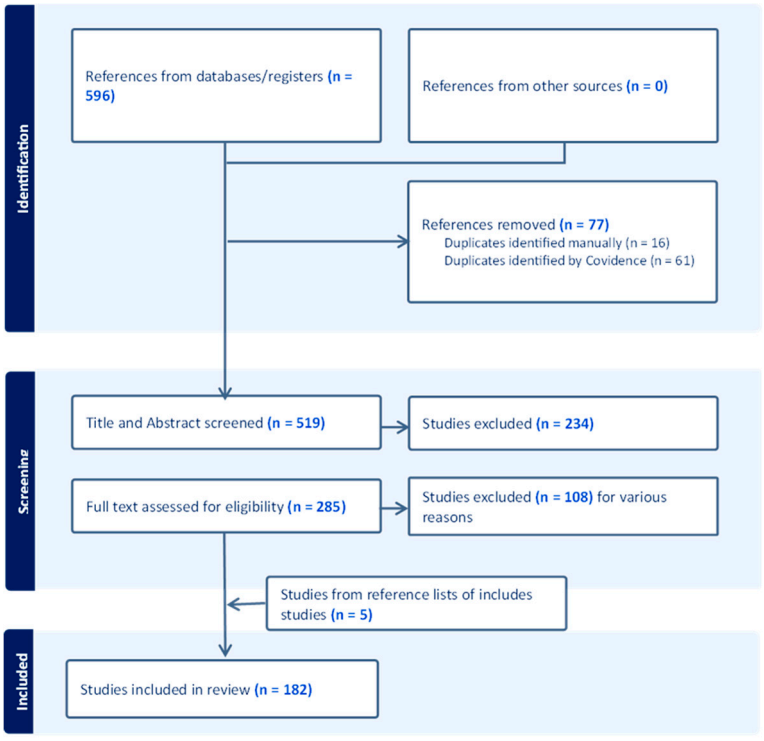

Figure 1. Study identification and selection flow chart for the scoping review.

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4.2. What Is the Available Evidence? (TYPE of Evidence, How/Where the Evidence Was Created (Review Question 1)

4.2.1. Distribution of TAVs Publications

The included studies were published between 2003 and 2023, with 82% of publications since 2013 as shown in Figure 2 below. Of the 182 included studies there were 157 journal articles, 20 conference proceedings, 3 book chapters and 2 project reports. The most common research designs used in the studies were laboratory/greenhouse experiments (54 studies) followed by literature reviews, qualitative studies and mixed methods studies (28, 26 and 20, respectively). The remaining research designs included: quantitative (n=10), open field trials (n=9), Randomized Control Trials (RCT) (n=8), on-station trials (n=7), case studies (n=1), cross sectional studies (n=5), farmer/community involved trials and systematic reviews (n=3 each), Scoping review and project report (n=1 each) and traditional reviews (n=1). The majority of included studies were conducted in Kenya and South Africa (48 and 46 studies respectively). Of the remaining studies 16 were conducted in Tanzania, 8 in Nigeria, and 18 from other African countries including some that were multi-country studies. A total of 8 studies were conducted in countries outside Africa, particularly the laboratory experiments that were conducted in Germany and Italy in collaboration with African researchers

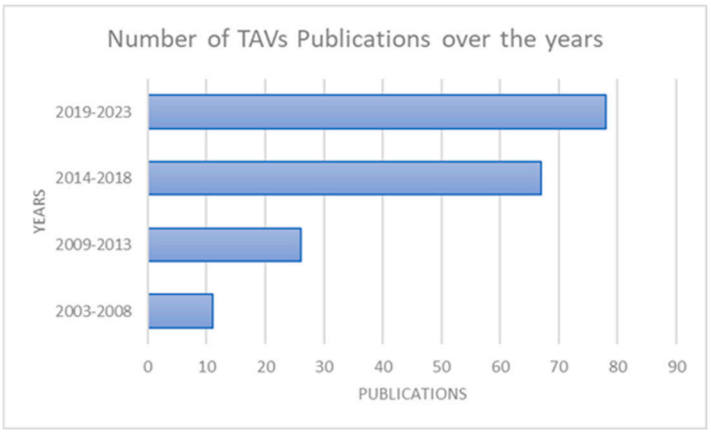

Figure 2. Number of Traditional African vegetables publications from the year 2003 and 2023.

4.3. What is the focus of the evidence? – phase of value chain, attributes of TAVs investigated (review question 2)

4.3.1. Definition of Traditional African Vegetables

The term Traditional African Vegetables are synonymously known as African Indigenous vegetables (AIVs), Indigenous leafy vegetables and underutilized vegetables **[49–54]**. Traditional African vegetables were defined differently by different authors as shown in Appendix 3. Out of 177 literatures included in this scoping review, only 22 (12%) publications provided definitions of TAVs. The common components of the definitions are that TAVs either originated in Africa or were introduced many years ago and indigenized/integrated into traditional African diets.

4.3.2. Traditional African Vegetables Mostly Studied

African nightshade (Solanum scabrum) and Amaranth (Amaranthus spp.) were the most studied TAVs with 23 and 35 studies respectively, investigating various aspects of the vegetables as shown in **Table 2** below. These two vegetables were also included in other TAVs studies that combined more than one TAV. This accentuates the importance of these TAVs and explains their top rankings among the most produced and consumed TAVs Across Africa [29,40,55].

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Table 2. Attributes of African nightshade and Amaranth covered in studies.

TAV attribute	Number of African nightshade studies	Number of Amaranth studies
Nutritional properties	12	9
Medicinal properties	1	1
Genetic diversity	5	10
Drought and pests and diseases tolerance and management	0	5
post-harvest handling and their impact on their nutritional properties	6	2
Yield	0	5
Consumption patterns across African countries	0	3

4.3.3. The Traditional African Vegetables Value Chain Components Studied

The TAVs value chain is classified as a short chain based on the definition and classification proposed by Aubree et al. [56] based on concepts of "fresh vegetables", "traditional", "seasonal", "localised", "cultural identity" and "rural and urban" [57]. The short phases of the TAV value chain includes the pre-production phase, which consists mainly of the genetic diversity for seed breeding [58] and seed production and supply systems [59–61]. The production phase activities are associated with growing, which includes various input management like water, fertilizers, and pests control [62,63]. Harvesting and post-harvest management activities including processing, transportation, and storage of TAVs [64–66]. The trading phase of the value chain comprises both wholesaling and retailing [67,68] and the last phase is consumption, which is preceded by preparation and cooking [52,69–72]. The included studies included topics representing all phases of the TAVs value chain with some variation in the number of elements covered

Table 2 below summarises the phases of the TAVs value chain covered in the included studies. The production phase was the most common focus of the included studies (37%). This includes studies that focused on activities such as water, pests, and the management of other inputs. Out of 66 studies focused on production, 42 included other sections of the chain. Consumption patterns of TAVs were explored in 10 of 177 included studies. Only 15 (9%) of included studies focused on all the phases of the value chain. Table 3 below summarises the phases of the TAVs value chain covered in the included studies included in this review.

Table 3. Summary of traditional African vegetables value chain phases and elements covered in the included publications.

TAVs value chain phase	Focus of included studies	Number of studies
Pre-production	Genetic diversity of TAVs, breeding, variety testing, selection, and conservation of genetic resources at the gene banks for future breeding	16
Input supply	Seed production and supply systems in various countries. Challenges of availability of certified seeds, importance of farmer involvement in seed production through contraction by private and public seed agencies and farmer-led Quality Declared Seeds (QDS) production	12
Production/growing	Various production systems of TAVs, home gardening of TAVs, farmer preferences on	66

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	production of TAVs, effects of various production systems on TAVs nutritional content. Water and fertilizer management for optimizing yield and nutritional traits of TAVs.	
Post-harvest handling	Analysis of nutritional and economic losses from harvesting to marketing, various processing methods like boiling, sun-drying, fermenting and their impact on nutritional content and medicinal traits of TAVs, improving shelf life and various storage techniques to preserve nutrients	16
Marketing (wholesale/retail)	Consumer demand for TAVs, consumers' willingness to pay premium for TAVs, social networks and commercialization of TAVs, policies governing marketing, improving marketing of TAVs (challenges and opportunities), TAVs farmers market competitiveness and market outlets choices for TAVs consumers	15
Consumption patterns	Various TAVs consumed and consumption patterns in different locations across Africa. Factors influencing consumer preferences for particular species of TAVs and	12
Whole chain	Analyzing the TAVs value chains to identify various actors and their roles for potential to alleviating poverty through commercialization and market linkages, contributing to better nutrition through increased consumption, TAVs value chain governance, various strategies to promote TAVs.	15

4.4. Knowledge Translation Components That Are Covered in the Literature

Although knowledge was created through primary research, reviews, conference proceedings, book chapters and other types of publications in all publications included in this review, not all publications reported on either transferring, utilization or all three components of Only 3 included studies reported on the transference of knowledge across the chain **[73–75]** and 2 reported on utilization of TAVs knowledge [76,77]. In addition, 9 studies reported on all three components of KT and 4 discussed the transfer and utilization of TAVs knowledge **[51,78–80]**. Table 4 below summarizes the coverage of the three components of knowledge translation within the included literature for this study.

Table 4. Summary of publication covering TAVs knowledge translation components.

KT component	Synopsis of publication	Publication author
Knowledge transfer	Social networks facilitate information sharing and enable commercialization of TAVs. Farmers with	[73,74]

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	stronger social connections extending outside the village that they talk to have reported to sell more TAVs	
Knowledge transfer/utilization	TAVs demand was stimulated by nutritional awareness campaigns as well as contributing to increased QDS seeds production by farmers in collaboration with formal seed sector	[75]
Knowledge transfer	Strengthening the existing cluster farming and stronger farmer groups can foster knowledge transfer to enhance technical efficiencies	[78]
Knowledge transfer/utilization	Use of community nutritional outreach programs and integrating nutrition communication in agricultural extension services is effective in transferring knowledge of TAVs and their benefits. To combine the outreach and extension program with provision of seed kits increase the utilization of the TAVs knowledge received hence improve consumption of TAVs	[51,79]
Knowledge transfer/utilization	Despite the seasonal differences causing unfavorable weather conditions, the households that received nutrition and culinary intervention (NCI) plus production interventions (PI) increase both production and consumption of TAVs	[80]
Knowledge creation/ transfer/utilization	The paper Showcase how universities and other research institutes can play a role in not only creating new knowledge through research, but also transferring the knowledge through collaboration with other stakeholders like farmers, policy makers, input suppliers and	[81–85]

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	motivate utilization of knowledge through demonstration plots with farmers, providing seed kits and community outreach programs to promote TAVs. Multidisciplinary projects with research components are important avenues to the creation, transferring and utilization of TAVs knowledge	
Knowledge transfer/utilization	The transfer and utilization of TAVs knowledge is challenged by lack of knowledge of various aspects like seed production skills, production systems, pos-harvest processing and preserving. Nutrition education and other strategies applied in communities have shown to impart new knowledge to households resulted in producing and consuming more TAVs	[52,86,87]
Knowledge creation/ transfer/utilization	There is vast traditional knowledge among the elderly population in communities, but there is limited strategies to transfer this knowledge to the younger generation. This was revealed by the lack of knowledge about various aspects of TAVs by the younger generation, hence decreased utilization of TAVs. When this knowledge was reported to be passed on to younger generations, there has been an increase in knowledge and utilization of TAVs	[88–91]

5. Discussion

Scoping reviews are mostly used to map the existing published and unpublished literature, and grey literature, including important government documents. Scoping reviews are also used to explore the volume of literature available, the nature and the extent to which the issues or topics have been studied [45]. With regards to this research, a scoping review is used to explore a broad range of TAVs knowledge and its translation into and across the TAVs value chain. This includes the extent,

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volume, and nature of literature available about a) knowledge of various aspects of the TAVs value chain across the African continent, b) transfer of this knowledge into and across the chain, c) utilization of the TAVs knowledge by various TAVs value chain actors for potential for improving nutrition status through dietary diversity and d) to identify research gaps on TAV knowledge translation across the chain.

This scoping review provides a comprehensive analysis of the body of knowledge regarding TAVs knowledge translation across the value chain. It highlights the breath of research and other types of evidence available on the creation, transfer, and utilization of knowledge about various aspects of TAVs.

The finding that most studies were authored by scientists in three African countries is interesting. The country bias in publication could be associated with the location of the World Vegetable Centre Eastern and Southern Africa regional office in Arusha, Tanzania (a city bordering Tanzania and Kenya), which is an international research institute working to improve and promote TAVs across Africa through research, breeding, and other public programs. In the case of South Africa, the Water Research Commission of South Africa and Department of Science and Technology, and the Agriculture Research Council provide most of the research funding aiming at scaling up TAVs. The restriction of language to English may have excluded francophone countries particularly those from west Africa and the African-Arabic countries of North Africa

Within the TAVs value chain knowledge is essential to enhance the performance of the whole chain [92]. This review shows that the production phase of the TAVs value chain is the most common topic of research with little attention paid to consumption patterns and input supply. it is argued that when a holistic focus is put in ensuring the whole chain is benefiting from knowledge sharing and interventions, potential for better outcomes are more imminent [32,93,94]. A project aimed at strengthening the neglected and underutilized species in Bolivia and Peru observed that, when a whole of chain approach was used focusing on every phase of the chain, economic and nutritional benefits were attained by all actors of the chain through sharing of knowledge and implementation of project activities [95].

There are many TAVs across the African continent, some are very localised to specific regions or countries [96,97] and some are more spread across the continent and so are more grown and consumed. The two TAVs that are covered most in research as shown in this review, Amaranth and African nightshade are also among the most common across the African continent [98,99]. No study covered all TAVs which could be due to the diverse nature of TAVs being different not only across different African countries but also withing one country [58]. This is important when deciding which TAVs to focus strategies on as different African populations uses different TAVs based on their cultural heritages.

Not all studies investigated a phase of the value chain, as some studies investigated other aspects of TAVs such as their nutritional and medicinal traits, which was the focus of most of the studies in this review with 51% of all selected studies covering these aspects. This emphasises the valuable contribution of TAVs in enhancing micronutrients and mineral availability through dietary diversity [100–102]. Although women are involved more in all activities across the TAVs value chain [103], only 5 studies investigated women inclusiveness in the TAVs value chain. Studies have shown that women play a big role in agricultural value chains throughout Africa from production phase of crops to marketing of the produce through to the food preparation and consumption [104–107]. Women are the dominating chain actors in the TAVs value chain handling not only production of TAVs but also post-harvest processing, and almost exclusively the marketing and home preparation [98,108]. A recent study conducted in four sub-Saharan countries found that, when agricultural extension services and training is provided to both men and women, it results in better agricultural practices and performance than when only men receive the knowledge [109]. This shows that documenting the involvement of women in Agricultural value chains including TAVs value chain could help in strategies to ensure women access the relevant knowledge about TAVs that could enhance utilization.

In terms of knowledge translation of various aspects of TAVs across the chain, this study observed that although knowledge is being created and is covering all important aspects of the TAVs

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themselves and the value chain activities, there is still a gap on studies that showcase or explore strategies to transfer and utilize the vast created knowledge. Most of the knowledge remains in the hands of specialists in the form of journal articles, books, or reports with some presented in academic conferences. The traditional knowledge that does exist within the communities that have been utilizing TAVs for generations continues to erode [89]. Minimal efforts were documented to preserve and transfer this knowledge to the younger generation as well as to the scientific community for use in TAVs improvement strategies. It was highlighted by [110] that for knowledge translation to be effective, it is important for the knowledge to be co-created with the stakeholders including researchers, community elders, farmers, mothers and those that are influential in communities who are most listened to, that way the transfer of knowledge happens iteratively, and utilization of knowledge becomes more dynamic and suitable for the whole chain. In this review however, there is little documentation of knowledge co-creation about TAVs, which leave the stakeholders that the knowledge intend to reach out of reach of the created knowledge. For example, there was only one study that was conducted with the farmers involvement to evaluate the drought tolerance of mutant germplasm of two TAVs that could observe various growth habits and different yield patterns [111]. While this knowledge could enhance their decision making in which lines to grow, as well as gaining skills on the production of these TAVs, not including farmers during the study to have a firsthand experience of different germplasms could result in choosing weaker varieties hence negative outcomes to farmers and subsequent members of the chain.

6. Limitations

Although TAVs include other vegetables and fruits, this review focused on the leafy parts of the TAVs only, meaning that there could be other literature that investigated the non-leafy

TAVs and the fruits or other parts of the TAVs. This review was limited to studies conducted in African countries or studies conducted outside African continent but conducted for African traditional vegetables for African countries. In line with the aims and scope of scoping reviews, this review neither analysed the quality of the studies included, nor did it perform a critical assessment of the results of the studies included.

7. Conclusions

The key findings from this review are.

1. There is considerable amount of knowledge created about different aspects of TAVs particularly their genetic diversity and nutritional benefits

2. Most of the research done on TAVs focuses on the production phase amongst other phases of the value chain, especially the demand and consumption phase.

3. There is not much documentation of how this created knowledge is being transferred and utilised by various TAVs value chain actors

This means that although considerable efforts have been made to create valuable knowledge about TAVs, there is still a big gap in documenting transfer of this knowledge from research into action/utilization, including the rich traditional knowledge from community elders. This results in TAVs continuing to be referred to as “neglected crops” with decreasing demand particularly within the younger population despite their potential for improving food security. Accordingly, it is important to invest in knowledge translation research to ensure that the relevant knowledge is created, transferred and utilised effectively for sustainable strengthening of TAVs and TAVs value chains. Increasing the cultivation, distribution, and Traditional African Vegetables (TAVs), could potentially contribute to the attainment of Sustainable Development Goals (SDGs) by improving food and nutrition security, increasing the dietary diversity to reduce micronutrient deficiencies [18,112] through increased knowledge translation across the whole TAVs value chain

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Author Contribution: Conceptualization, MM and PT, methodology, MM and PT, formal analysis, checking, draft preparation, MM, review and editing, All authors, Supervision, PT, SR, BD, and JM. All authors have read and agreed on the submitted version of the manuscript.

Funding: This scoping review is funded by the University of Queensland as part of the Doctor of Philosophy program research and training scholarship awarded to the corresponding author.

Conflict of Interest: There is no conflict of interest to be declared by the Authors.

Informed consent statement: Informed consent was not required to conduct this scoping review.

Data Availability: All data is available on request from the authors of this scoping review.

Appendices

Table A1. Search syntax for each database searched.

Date final search conducted	Database / resource		Search terms / search string	Results	Notes
02/12/23	Web of Science	Exact & Topic search	(("Traditional African Vegetables" OR "African indigenous vegetables" OR "African leafy vegetables" OR "African Underutilized Vegetables")	199	Exported to EndNote, Downloaded PDFs
02/12/23	Web of Science	Exact & Topic search	(("Traditional African Vegetables" OR "African indigenous vegetables" OR "African leafy vegetables" OR "African Underutilized Vegetables") AND (knowledge OR "knowledge transfer") AND "value chain")	6	Exported to EndNote, Downloaded PDFs

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02/12/23	Web of Science	Exact & Topic search	((“Traditional African Vegetables” OR “African indigenous vegetables” OR “African leafy vegetables” OR “African Underutilized Vegetables”) AND (“knowledge utilization”)	0	
04/12/23	Scopus	TITLE-ABS-KEY	(({Traditional African Vegetables} OR {African indigenous vegetables} OR {African leafy vegetables} OR {African Underutilized Vegetables}) AND (knowledge OR {knowledge translation} OR {knowledge management} OR {tacit knowledge}) AND [128re]) AND (LIMIT-TO (EXACTKEYWORD , “African Indigenous Vegetables”))	9	Exported to EndNote
04/12/23	Scopus	TITLE-ABS-KEY	(({Traditional African Vegetables} OR {African indigenous vegetables} OR {African leafy vegetables} OR {African Underutilized Vegetables})) AND (LIMIT-TO (EXACTKEYWORD , “Vegetable”) OR LIMIT-TO (	366	Exported to EndNote

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			EXACTKEYWORD , "Vegetables") OR LIMIT-TO (EXACTKEYWORD , "Human") OR LIMIT-TO (EXACTKEYWORD , "Traditional African Vegetables") OR LIMIT-TO (EXACTKEYWORD , "African indigenous vegetables"))		
04/12/23	ABI/Inform	All fields	(("Traditional African Vegetables" OR "African indigenous vegetables" OR "African leafy vegetables" OR "African Underutilized Vegetables") AND (knowledge OR "knowledge translation" OR "knowledge management" OR "tacit knowledge") AND "value chain")	16	Most results out of scope

Table A2. Sample data collection form for data extraction.

Extracted Item	**Example**	**Notes**
Study aspects		
Title of paper	Nutritional value of leafy vegetables of sub-Saharan Africa and their potential contribution to human health: A review	Text

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Type of study	Journal article	Select one that applies
Author/s		
Country in which study was conducted	More than one African country	Select one that applies
Year of Publication	2010	Text
Study design	Review	Select one that applies
Aim of study	To evaluate the nutritional value of TAVs plant species and their potential impact on the nutritional status of the people living in sub-Saharan Africa	Text
TAV aspects		
Definition of TAVs	Not mentioned	Text
TAV crop of focus	All TAVs	Text
Part/section/activity of value chain studied/focused	Processing, Storage, Preparation, Consumption	Select all that applies
Attribute of TAV studied	Nutritional, health, medicinal properties of TAVs	Select all that applies
Aspect of Knowledge translation	Creation	Select All that applies (creation, transfer, utilization)
Other aspects		

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Main argument/ finding/conclusion of study	African leafy vegetables (ALVs) contain significant levels of micronutrients that are essential for human health. The micronutrients are affected differently by processing, depending on the type of processing, as well as the type of vegetable species. Thermal processing of LVs reduces the level of ascorbic acid but enhances the bioavailability of vitamin A. The bioavailability of minerals such as iron and zinc from plant sources is low in the presence of antinutritional factors like phytates, while the presence of vitamin C and protein improves their efficacy.	Text
Study funding sources	Schlumberger Foundation and Third World Organization for Women in Science (TWOWS)	Text

Table A3. Definitions of traditional African vegetables by publication authors.

Author	**Definition of TAVs**
[113]	Traditional leafy vegetables (TLVs), defined as those originally domesticated or cultivated in Africa for the last several centuries
[114]	According to the United Nations Food and Agriculture Organization traditional vegetables are all categories of plants whose leaves, fruits or roots are acceptable and used as vegetables by urban and rural communities through custom, habit, and tradition

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[115]	The word indigenous has been used in generic form to describe crop species, though not native to the area, that have been produced over years for the enhancement of high value of nutritious leafy vegetable. They have been part of the food systems in Nigeria and other SSA countries for generations
[116]	African indigenous leafy vegetables, also referred to as traditional leafy vegetables, are crops that grow wild or are cultivated and are gathered or harvested for food within a particular African ecosystem
[117]	ALVs are vegetables that are either native to the region, or were introduced to it a long time ago to evolve through natural processes or farmer selection, including both wild vegetables and ones traditionally cultivated by the inhabitants of a region
[103]	Traditional African vegetables include those native to Africa, as well as introduced vegetable crops that have been integrated into local food cultures and have become indigenized
[51]	AIVs include all plants that originate on the continent or have a long history of cultivation and domestication to African conditions and whose leaves, fruits, or roots are acceptable and used as vegetables through custom, habit, or tradition
[90]	TAVs are those whose natural habitat originated in Africa and have been integrated into cultures through natural or selective processes
[118]	African leafy vegetables (ALVs) are defined as plant species which are either genuinely native to a particular region, or which were

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	introduced to that region for long enough to have evolved through natural processes or farmer selection
[60],	African indigenous vegetables (AIVs) are a diverse set of over 1000 different species that are either native to Africa or introduced vegetable crops that have been indigenized and integrated into local food cultures
[119]	"African Leafy Vegetables are defined as plant species which are either genuinely native to a particular region, or which were introduced to that region for long enough to have evolved through natural processes or farmer selection"
[21]	Plant species that are indigenous or naturalized to Africa, well adapted to, or selected for local conditions, whose plant parts are used as a vegetable, and whose modes of cultivation, collection, preparation, and consumption are deeply embedded in local cuisine, culture, folklore, and language
[120]	African indigenous vegetables (AIVs) are vegetable crops whose natural habitat originated in Africa
[121]	African indigenous leafy vegetables (AILVs) are part of the African indigenous vegetables (AIVs) whose natural habitat originated in Africa. Traditional African leafy vegetables that were introduced over a century ago and due to long use, have become part of the food culture in the continent
[122]	According to the United Nations Food and Agriculture Organization (FAO), ALVs are all categories of plants whose leaves are acceptable and used as vegetables by communities through custom, habit, and tradition

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[123]	Traditional African Vegetables (TAV) are plant species that are indigenous or naturalized to Africa, well adapted to, or selected for local conditions, whose plant parts are used as a vegetable, and whose modes of cultivation, collection, preparation, and consumption are deeply embedded in local cuisine, culture, folklore, and language
[124]	AIVs are vegetables that originated or got established in Africa for many generations, and their leaves, young shoots, flowers, fruits, seeds, stems, tubers, or roots are consumed as vegetables
[40]	African leafy vegetables consist of all categories of plants whose leaves are acceptable and used as vegetables by rural and urban communities through tradition.
[125]	ALVs are plant species which are either genuinely native to a particular region, or which were introduced to that region for long enough to have evolved through natural processes or farmer selection
[126]	AIVs include all plants that originate on the continent or have a long history of cultivation and domestication to African conditions and whose leaves, fruits, or roots are acceptable and used as vegetables through custom, habit, or tradition
[127]	AIVs refer to vegetable species or varieties genuinely native to Africa or that have been integrated and incorporated into local food cultures and farming systems over a period of time
[80],	AIVs are vegetables that either originated or have a long history of cultivation and domestication in Africa and are locally important for

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economic and human nutrition but have yet to gain regional and global recognition as a major commodity such as carrots or corn

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