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# Traditional African Vegetables Knowledge Translation: A Scoping Review

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**Abstract:** Traditional African vegetables (TAVs) are an important component of an ecologically sustainable approach to addressing food and nutrition security in Africa. 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. The Web of Science, Scopus, Science Direct, and ABI/Inform databases were searched to identify the relevant studies which were then screened using the Covidence 2024 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 pertains to 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 the nutrient content of TAVs, with the production phase of the TAV value chain being the most studied. This review found that, although a breadth of knowledge about TAVs has been generated, there is still little documentation about transferring and utilizing this knowledge across the TAV value chain. This review identified that more research is needed to document the strategies and practices for the transfer and utilization of knowledge to ensure that it is utilized to enhance nutritional outcomes across Africa.

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

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## 1. Introduction

Hunger and malnutrition are significant challenges facing communities and populations, especially in poor 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 populations [4]. In sub-Saharan countries, the triple burden of malnutrition also exists within and across households [5,6], with undernutrition and micronutrient malnutrition being the 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% were 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 during a specific period, typically in the preceding 24 h [10]. In addition to being reflective of access to a variety of foods, dietary diversity is also a representation of nutritional adequacy in a household's or individual's diet [10–13]. Dietary diversity in Tanzania is low, with 70% of calorie intake comprising starchy foods with few other food types, especially vegetables, which are a significant source of vitamins and some minerals [14]. Recent studies have shown that there is low dietary diversity within the Tanzanian population, particularly in children under the age of five and women of reproductive age [12,14–17]. Only 28% of pregnant women and 26% of children aged between 6 and 23 months in Tanzania met the minimum dietary diversity (MDD) requirements, with 40% of them not consuming vegetables and fruits [8].

While the WHO recommends 280 g of vegetable consumption per day, Tanzanians consume on average much less, at around 132 g [18]. 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 old in the southeastern part of Tanzania were vitamin A deficient, with children in remote rural areas at five times greater the risk of deficiency [19].

### *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" [20]. These vegetables are rich in micronutrients, minerals, vitamins, and fibre, and have the potential to make a significant contribution to improving diets [21–23]. Traditional African vegetables also thrive under harsher conditions than exotic vegetables, providing opportunities for improved nutrition at a lower cost for poor communities, especially in the increasingly adverse climate [13,24,25]. Traditional African vegetables are a rich source of micronutrients and minerals, as presented below in Table 1 [26], which can contribute to dietary diversity and improve nutritional status. Exotic vegetables were introduced into Africa in recent decades and are the dominant variety in commercial outlets [27–29]. Although there are various varieties of TAVs, including leafy vegetables and non-leafy vegetables, the commonly produced and consumed TAVs across Africa are the leafy TAVs, and these are the TAVs that have been a focus of research and development [30–32].

### *1.2. Value Chain Concept for Knowledge Translation Across the TAV Value Chain*

This review adopted the value chain framework to explain the flow of knowledge across the entire TAV value chain, from where and how the knowledge is created, how it is transferred across the chain with the support of other stakeholders, and how the main value chain actors utilize the knowledge.

A value chain is an interconnected system collaboratively working to create and deliver products and services that consumers seek and value [33]. As explained by [34], 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 [34]. Value chains also emphasize relationships and the flow of information or sharing of knowledge between chain members to facilitate the creation and delivery of consumer-valued products and services [35]. 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 the final consumers, but also knowledge and strategic information need to be shared between members of the chain, including those playing supportive roles to the chain [36].

**Table 1.** Micronutrient and antinutrient content of the selected TAVs.

| Vegetable Parameter | Mokiki (Bitter Cucumber) *Momordica foetida* | Kikundembala (Wild Cowpea) *Vigna vexillata* | Sunga (Bitter Lettuce) *Launea cornuta* | Inyiri (Malabar Spinach) *Basella alba* |
|---|---|---|---|---|
| Moisture content (%) | 95 ± 0:00 $^{c}$ | 78 ± 1:41 $^{a}$ | 84 ± 1:41 $^{b}$ | 92:5 ± 0:71 $^{c}$ |
| Minerals (mg/100 g) | | | | |
| Ca | 421:03 ± 3:61 $^{c}$ | 85:28 ± 4:67 $^{ab}$ | 60:29 ± 4:26 $^{a}$ | 134:11 ± 17:16 $^{b}$ |
| Fe | 21:05 ± 1:77 $^{c}$ | 4:28 ± 0:23 $^{a}$ | 6:04 ± 0:43 $^{a}$ | 13:4 ± 1:70 $^{b}$ |
| Mg | 1151:91 ± 49:47 $^{c}$ | 191:12 ± 19:64 $^{a}$ | 301:56 ± 21:31 $^{a}$ | 524:5 ± 121:08 $^{b}$ |
| Zn | 21:1 ± 1:84 $^{c}$ | 4:28 ± 0:23 $^{a}$ | 6:05 ± 0:42 $^{a}$ | 13:4 ± 1:70 $^{b}$ |
| Vitamins (mg/100 g) | | | | |
| Beta carotene | 5:5 ± 0:77 $^{b}$ | 2:5 ± 0:40 $^{a}$ | 3:84 ± 0:50 $^{a}$ | 6:67 ± 0:30 $^{b}$ |
| B vitamins | | | | |
| B1 | 58:34 ± 2:67 $^{a}$ | 18:94 ± 0:69 $^{a}$ | 25:22 ± 0:60 $^{a}$ | 182:95 ± 47:76 $^{b}$ |
| B2 | 0:76 ± 0:06 $^{c}$ | 0:18 ± 0:01 $^{a}$ | 0:24 ± 0:02 $^{a}$ | 0:54 ± 0:12 $^{b}$ |
| B3 | 0:12 ± 0:02 $^{a}$ | 0:09 ± 0 $^{a}$ | 0:1 ± 0:02 $^{a}$ | 0:43 ± 0:06 $^{b}$ |
| C | 46:52 ± 3:70 $^{a}$ | 136:71 ± 35:84 $^{b}$ | 120:88 ± 11:26 $^{ab}$ | 198:08 ± 47:46 $^{b}$ |
| Antinutrients (mg/100 g) | | | | |
| Oxalate | 2:74 ± 0:75 $^{a}$ | 1:28 ± 0:71 $^{a}$ | 3:15 ± 0:81 $^{a}$ | 1:34 ± 0:13 $^{a}$ |
| Phytates | 6:18 ± 0:04 $^{c}$ | 1:64 ± 0:06 $^{a}$ | 1:74 ± 0:05 $^{a}$ | 4:31 ± 0:52 $^{b}$ |

Values are expressed as means ± SD ($n$ = 2). Mean values with different superscripts in a column are significantly different ($p < 0.05$).

### *1.3. Knowledge and Knowledge Translation Across the TAV Value Chain*

Knowledge comprises what a person understands to be facts and the information a person acquires from other sources [37]. To ensure that knowledge is put into action and fulfils its goals (knowledge translation), it needs to be created and effectively transferred to enable its utilization by the intended audience [38,39]. According to the Canadian Institute of Health Research [38,40], "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 various aspects of TAVs is necessary across the value chain to increase production, marketing, and consumption for the 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 enabling 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 the increased knowledge of TAVs, such as the availability of improved seeds for higher productivity [41] and an understanding of the nutritional value of TAVs and how they can improve dietary diversity [42]. 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 [20,24,43].

There is good evidence for 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 [23–25,44]. However, less is known about the extent of the literature on the 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 TAV value chain from input supply, production, harvesting and post-harvest handling, trading, and preparation up to consumption. For the purpose of this review, knowledge translation comprises knowledge creation, transfer, and utilization. A scoping review format was used because this can 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 [45].

### *1.4. Objective*

The overarching objective of this review is to map the available literature about knowledge translation along the TAV value chain. This includes the type and extent of knowledge created about the TAV value chain from inputs to consumption and the transfer and utilization of this knowledge by TAV value chain actors.

### *1.5. Review Questions*

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

- What evidence is available concerning TAVs? (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 TAV 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 [46], which includes the 5 following stages: identifying the research question; identifying relevant studies; study selection; charting the data; and collating, summarizing, and reporting the results. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Supplementary Materials) were used for this review. A priori protocol was developed to guide the scoping review process, and all authors agreed not to register the protocol.

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 the features of the TAV value chain from input supply to consumption. This includes breeding, input supply, production, harvesting, post-harvest handling, processing, trading, preparation/cooking, and consumption. The creation of knowledge and pathways used to transfer and utilize knowledge was the main focus of this review. The context of the evidence focused on the whole African continent, including studies conducted outside Africa but focusing on TAVs from one African country or more. Table 2 below summarizes the inclusion and exclusion criteria for this scoping review.

**Table 2.** Inclusion and exclusion criteria for this 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, theses, case studies, and government, national, and international organisations' project reports—all limited to those written in English. A search was conducted in Web of Science, Scopus, and ABI/Inform databases to identify literature on this topic. There was no limit on the dates of the evidence searched. The keywords identified from the initial search of literature were used to build the search strategy in the mentioned database to obtain the relevant literature.

The reference lists of the included studies were also reviewed to identify other relevant studies that might have been missed by the searched databases. The key terms used to develop the search string and a final search string for the Scopus database are presented below, whilst Appendix A Table A1 presents the search conducted in the three databases for this scoping review.

The key terms used to develop the search string are as follows:

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

The final search string for the Scopus database was as follows:

(({Traditional African Vegetables} OR {African indigenous vegetables} OR {African leafy vegetables} OR {African Underutilized Vegetables})) AND (LIMIT-TO (EXACTKEY-WORD, "Vegetable") OR LIM-IT-TO (EXACTKEYWORD, "Vegetables") OR LIMIT-TO (EXACTKEY-WORD, "Human") OR LIMIT-TO (EXACTKEY-WORD, "Traditional African Vegetables") OR LIMIT-TO.

### *2.2. Study Selection*

Citations from all studies identified in the searches were imported into EndNote v.20, and then duplicates were removed using Covidence [47,48]. The remaining citations' titles and abstracts were screened against the inclusion and exclusion criteria and the full texts of potential studies were obtained and reviewed for inclusion.

### *2.3. Data Charting and Reporting*

The 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 about the included studies, such as the study title, authors, year of publication, and type of study/study design. More specific information was extracted based on the headings corresponding to the review's objectives and questions. Since the data extraction process was iterative, the data extraction form was modified as other relevant information was obtained during extraction, and the data extraction form was finally exported to Microsoft 365 Excel, for data cleaning and reporting. As advised by [49], there was no critical 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 A, Table A2.

Since this scoping review aimed 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 the characteristics of the evidence concerning 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 [50] and later updated by [49] (see Figure 1). Descriptive results are presented in graphs and tables to show the extent of the literature about TAV knowledge translation where relevant.

A narrative summary of the results of each included study is presented to support the descriptive analysis.

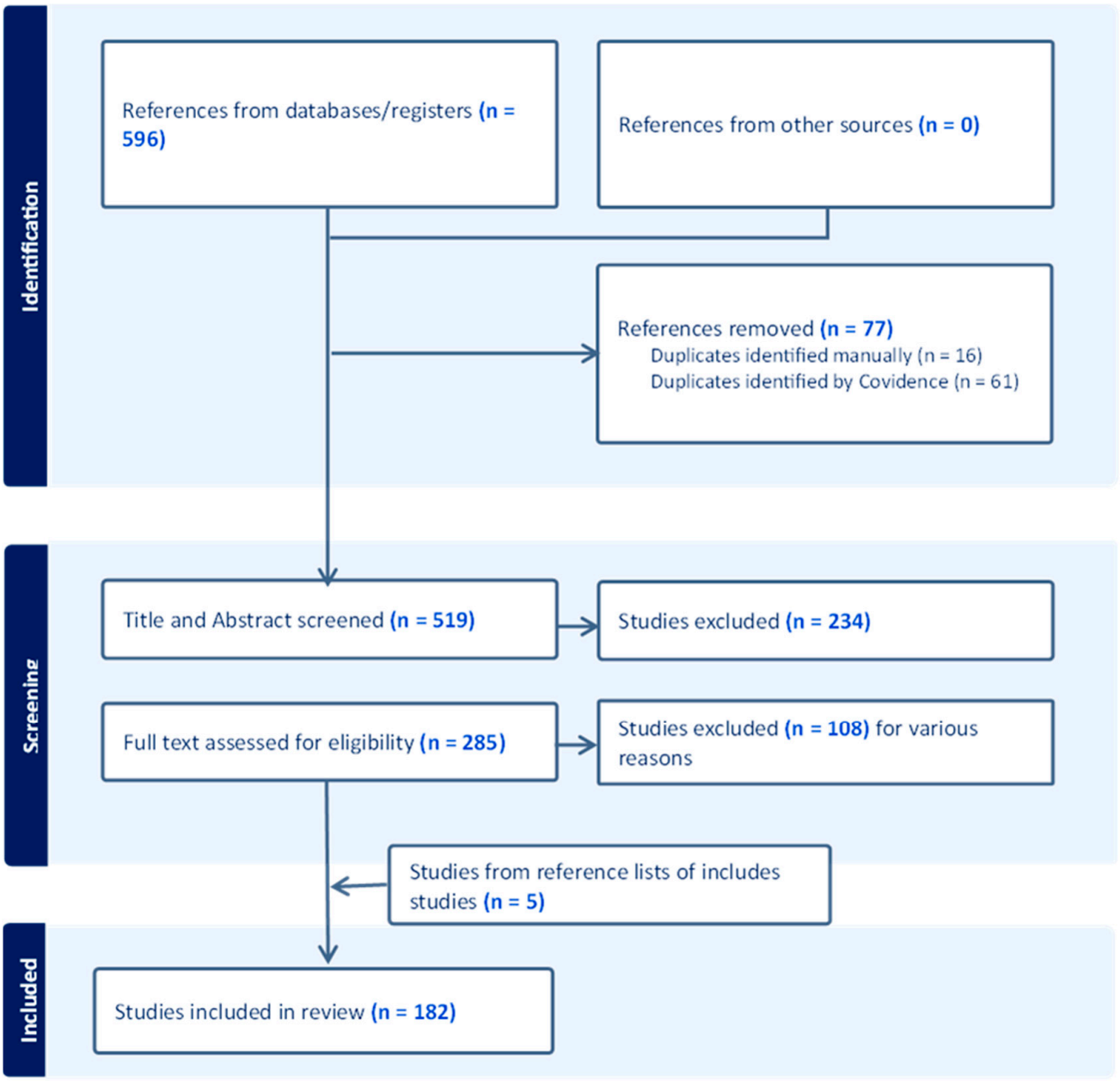



**Figure 1.** Study identification and selection flow chart for the scoping review.

## 3. Results

### *3.1. Overview of Included Studies*

Figure 1 summarizes 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 the Web of Science, and 16 from ABI/Inform. A total of 76 duplicate records were removed. Of the remaining 519 records, 234 were excluded following the title and abstract screening. A further 108 records were excluded, and the remaining 177 records were selected to be included in this review. Five additional studies were included following bibliographical searches.

### *3.2. What Is the Available Evidence? (Type of Evidence, How/Where the Evidence Was Created (Review Question 1)*

#### Distribution of TAV Publications

The included studies were published between 2003 and 2023, with 82% of publications since 2013, as shown in Figure 2 below. Among 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 (RCTs) ($n$ = 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 reports ($n$ = 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 eight studies were conducted in countries outside Africa, particularly the laboratory experiments that were conducted in Germany and Italy in collaboration with African researchers.

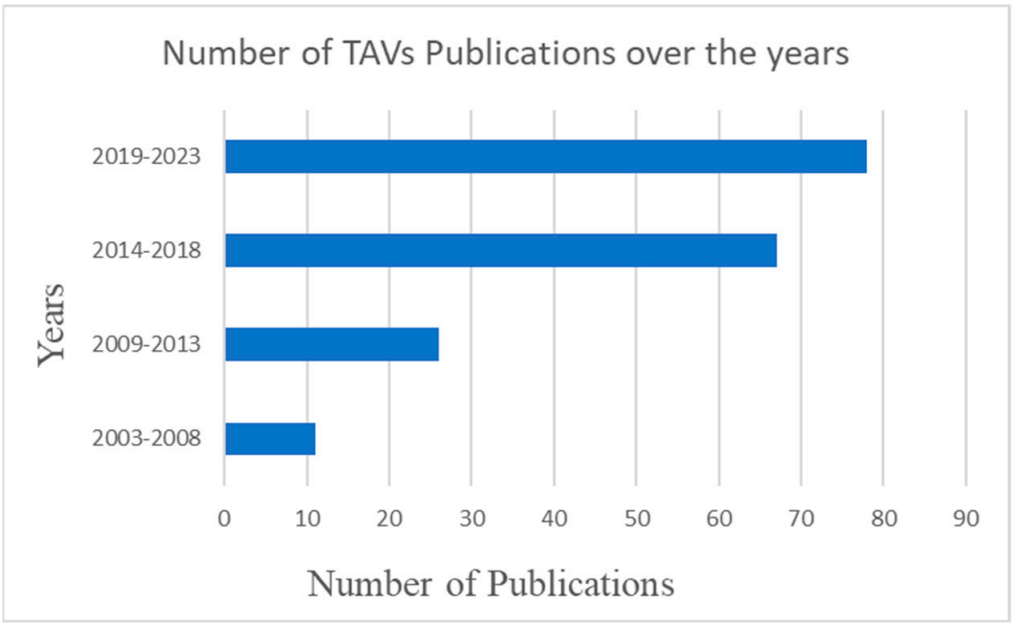



**Figure 2.** Number of publications relating to traditional African vegetables from 2003 to 2023.

### *3.3. What Is the Focus of the Evidence?—Phase of Value Chain, Attributes of TAVs Investigated (Review Question 2)*

#### 3.3.1. Definition of Traditional African Vegetables

The term traditional African vegetables is synonymously known as African indigenous vegetables (AIVs), indigenous leafy vegetables, and underutilized vegetables [51–56]. Traditional African vegetables have been defined differently by different authors, as shown in Appendix A Table A3. Out of 177 studies included in this scoping review, only 22 (12%) publications provided definitions for TAVs. The common components of the definitions are that TAVs either originated in Africa or were introduced many years ago and have been indigenized/integrated into traditional African diets.

#### 3.3.2. 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 the various aspects of the vegetables, as shown in Table 3 below. These two vegetables were also included in

other TAV 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 [28,42,57].

**Table 3.** 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, pest, and disease 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 |

#### 3.3.3. The Traditional African Vegetable Value Chain Components Studied

The TAV value chain is classified as a short chain based on the definition and classification proposed by Aubree et al. [58] based on the concepts of "fresh vegetables", "traditional", "seasonal", "localized", "cultural identity", and "rural and urban" [59]. The short phases of the TAV value chain include the pre-production phase, which mainly consists of the genetic diversity for seed breeding [60] and seed production and supply systems [41,61,62]. The production phase activities are associated with growing, which includes various input management like water, fertilizers, and pest control [63,64]. Harvesting and post-harvest management activities including the processing, transportation, and storage of TAVs [65–67]. The trading phase of the value chain comprises both wholesaling and retailing [68,69], and the last phase is consumption, which is preceded by preparation and cooking [54,70–73]. The included studies included the topics representing all phases of the TAV value chain with some variation in the number of elements covered.

Table 3 below summarizes the phases of the TAV 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. The 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 4 below summarizes the phases of the TAVs value chain covered in the included studies included in this review.

### *3.4. 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 the creation, transfer, or utilization, or all three components of knowledge translation. Only three included studies reported on the transference of knowledge across the chain [74–76] and two reported on the utilization of TAV knowledge [77,78]. In addition, nine studies reported on all three components of knowledge translation and four discussed the transfer and utilization of TAV knowledge [53,79–81]. Table 5 below summarizes the coverage of the three components of knowledge translation within the included literature for this study.

**Table 4.** Summary of the traditional African vegetables value chain phases and elements covered in the included publications.

| TAV 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 the 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 in production of TAVs, effects of various production systems on TAVs' nutritional contents. Water and fertilizer management for optimizing the yield and nutritional traits of TAVs. | 66 |
| 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 the nutritional content and medicinal traits of TAVs, improving the 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, the improving marketing of TAVs (challenges and opportunities), TAV farmers' market competitiveness, and market outlets choices for TAV consumers. | 15 |
| Consumption patterns | Various TAVs consumed and consumption patterns in different locations across Africa. Factors influencing the consumer preferences for particular species of TAVs. | 12 |
| Whole chain | Analysing the TAV value chains to identify various actors and their roles for potential to alleviate poverty through commercialization and market linkages, contributing to better nutrition through increased consumption, TAV value chain governance, and various strategies to promote TAVs. | 15 |

**Table 5.** Summary of the publication covering TAV knowledge translation components.

| Knowledge Translation Component | Synopsis of Publication | Publication Author |
|---|---|---|
| Knowledge transfer | Social networks facilitate information sharing and enable the commercialization of TAVs. Farmers with stronger social connections extending outside the village that they talk to have been reported to sell more TAVs. | [74,75] |
| Knowledge transfer/utilization | TAV demand was stimulated by nutritional awareness campaigns as well as contributing to increased QDS production by farmers in collaboration with formal seed sector. | [76] |
| Knowledge transfer | Strengthening the existing cluster farming and stronger farmer groups can foster knowledge transfer to enhance technical efficiencies. | [79] |
| Knowledge transfer/utilization | Use of community nutritional outreach programs and integrating nutrition communication in agricultural extension services is effective in transferring the knowledge of TAVs and their benefits. To combine the outreach and extension program with the provision of seed kits will increase the utilization of the TAV knowledge received, hence improving the consumption of TAVs. | [53,80] |
| Knowledge transfer/utilization | Despite the seasonal differences causing unfavourable weather conditions, the households that received nutrition and culinary intervention (NCI) plus production interventions (PIs) increase both the production and consumption of TAVs. | [81] |

**Table 5.** *Cont.*

| Knowledge Translation Component | Synopsis of Publication | Publication Author |
| --- | --- | --- |
| Knowledge creation/transfer/utilization | The paper showcases how universities and other research institutes can play a role in not only creating new knowledge through research, but also transferring knowledge through collaboration with other stakeholders like farmers, policy-makers, input suppliers, and motivate the 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 for the creation, transfer, and utilization of TAV knowledge. | [82–86] |
| Knowledge transfer/utilization | The transfer and utilization of TAV knowledge is challenged by a lack of knowledge of various aspects like seed production skills, production systems, post-harvest processing, and preservation. Nutrition education and other strategies applied in communities have been shown to impart new knowledge to households, resulting in the production and consumption of more TAVs. | [54,87,88] |
| Knowledge creation/transfer/utilization | There is vast traditional knowledge among the elderly population in communities, but limited strategies exist 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 resulting in the decreased utilization of TAVs. When this knowledge was reported to be passed on to younger generations, there has been an increase in the knowledge and utilization of TAVs. | [89–92] |

## 4. 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 available literature, and the nature and the extent to which the issues or topics have been studied [47]. With regard to this research, a scoping review is used to explore a broad range of TAV knowledge and its translation into and across the TAV value chain. This includes the extent, volume, and nature of the literature available about (a) knowledge of various aspects of the TAV value chain across the African continent; (b) transfer of this knowledge into and across the chain; (c) utilization of the TAV knowledge by various TAV value chain actors for potentially improving the nutrition status through dietary diversity; and (d) identify research gaps on TAV knowledge translation across the chain.

This scoping review provides a comprehensive analysis of the body of knowledge regarding TAV knowledge translation across the value chain. It highlights the breadth 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 to scale 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 TAV value chain, knowledge is essential to enhance the performance of the whole chain [93]. This review shows that the production phase of the TAV value chain is the most common topic of research with little attention being paid to consumption patterns and input supply. It is argued that, when a whole-chain approach is used to ensure that

the whole chain is benefiting from knowledge sharing and interventions, the potential for better outcomes is stronger [34,94,95]. A project aiming to strengthen the neglected and underutilized species in Bolivia and Peru observed that economic and nutritional benefits were attained by all actors of the value chain through the sharing of knowledge and the implementation of project activities [96].

There are many TAVs across the African continent, some of which are very localized to specific regions or countries [30,97] and some are more spread across the continent and so are more grown and consumed. The two TAVs that are covered in research the most, as shown in this review, namely 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 within one country [60]. This is important when deciding which TAVs to focus strategies on, as different African populations use 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 studies in this review, with 51% of all selected studies covering these aspects. This emphasizes the valuable contribution of TAVs in enhancing micronutrients and mineral availability through dietary diversity [42,100,101].

Although women are more involved in all activities across the TAV value chain [98], only five studies investigated women's inclusiveness in the TAV value chain. Studies have shown that women play a big role in agricultural value chains throughout Africa from the production phase of crops to the marketing of the produce through to food preparation and consumption [102–105]. Women are the dominating chain actors in the TAV value chain, handling not only the production of TAVs but also post-harvest processing, and almost exclusively managing marketing and home preparation [54,98]. A recent study conducted in four sub-Saharan countries found that, when agricultural extension services and training are provided to both men and women, it results in better agricultural practices and performance than when only men receive the knowledge [106]. This shows that documenting the involvement of women in agricultural value chains, including the TAV value chain, could help in strategies to ensure that women access the relevant knowledge about TAVs that could enhance utilization.

In terms of knowledge translation related to 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 themselves and the value chain activities, there is still a gap in studies that showcase or explore strategies to transfer and utilize the vast amount of 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 [90]. Minimal efforts were documented to preserve and transfer this knowledge to the younger generation as well as to the scientific community for use in TAV improvement strategies. It was highlighted by [107] 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, so that the transfer of knowledge happens iteratively, and the 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 means that the stakeholders that the knowledge is intended to reach remain out of reach of the created knowledge. For example, there was only one study that was conducted with farmer involvement to evaluate the drought tolerance of a mutant germplasm of two TAVs that could observe various growth habits and different yield patterns [108]. While this knowledge could enhance their decision making with regard to which lines to grow, as well as gaining skills in terms of 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 and hence negative outcomes for farmers and subsequent members of the chain.

## 5. Limitations

Although TAVs include other vegetables and fruits, this review only focused on the leafy members of the TAVs, meaning that there could be other studies investigating the non-leafy traditional African vegetables, fruits, or grains.

This review was limited to studies conducted in African countries or studies conducted outside the 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.

## 6. Conclusions

The key findings from this review are given as follows:

1. There is a considerable amount of knowledge created about the different aspects of TAVs, particularly their genetic diversity and nutritional benefits.
2. Most of the research conducted on TAVs focuses on the production phase of the chain, while other aspects of the value chain, especially the demand and consumption of TAVs, are less covered in the available literature.
3. There is not much documentation in the available literature on how this created knowledge is being transferred and utilized by various TAV 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 the transfer of this knowledge from research into action/utilization, including rich traditional knowledge from community elders. This results in TAVs continuing to be referred to as "neglected crops" for which there is decreasing demand, particularly among younger populations, 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 effectively utilized for the sustainable strengthening of TAVs and TAV 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, as well as increasing dietary diversity to reduce micronutrient deficiencies [17,109] through increased knowledge translation across the whole TAV value chain.

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16219421/s1. Reference [110] is citied in the Supplementary Materials.

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**Data Availability Statement:** All data are available upon request from the authors of this scoping review.

**Conflicts of Interest:** There are no conflicts of interest to be declared by the authors.

## Appendix A

**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 and 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 and 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 |
| 02/12/23 | Web of Science | Exact and 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 [111]) 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 (EXACTKEYWORD, "Vegetables") OR LIMIT-TO (EXACTKEYWORD, "Human") OR LIMIT-TO (EXACTKEYWORD, "Traditional African Vegetables") OR LIMIT-TO (EXACTKEYWORD, "African indigenous vegetables")) | 366 | Exported to EndNote |
| 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 |
| 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 TAV 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, and medicinal properties of TAVs | Select all that applies |
| Aspect of knowledge translation | Creation | Select all that applies (creation, transfer, utilization) |
| Other aspects | | |
| 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 |
|---|---|
| [112] | Traditional leafy vegetables (TLVs) defined as those originally domesticated or cultivated in Africa for the last several centuries. |
| [113] | 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. |
| [114] | 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 the high value of nutritious leafy vegetable. They have been part of the food systems in Nigeria and other SSA countries for generations. |
| [115] | African indigenous leafy vegetables, also referred to as traditional leafy vegetables, are crops that grow in the wild or are cultivated and gathered or harvested for food within a particular African ecosystem. |
| [89] | ALVs are vegetables that are either native to the region, or were introduced to it a long time ago and evolved through natural processes or farmer selection, including both wild vegetables and those that are traditionally cultivated by the inhabitants of a region. |
| [98] | 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. |

**Table A3.** *Cont.*

| Author | Definition of TAVs |
|---|---|
| [53] | 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. |
| [91] | TAVs are those whose natural habitat originated in Africa and have been integrated into cultures through natural or selective processes. |
| [116] | African leafy vegetables (ALVs) are defined as plant species which are either genuinely native to a particular region, or which were introduced to that region long enough ago to have evolved through natural processes or farmer selection. |
| [61] | 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. |
| [117] | "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" |
| [20] | 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. |
| [118] | African indigenous vegetables (AIVs) are vegetable crops whose natural habitat originated in Africa. |
| [119] | African indigenous leafy vegetables (AILVs) are part of the African indigenous vegetables (AIVs) whose natural habitat originated in Africa. Traditional African leafy vegetables were introduced over a century ago, and due to long use, have become part of the food culture in the continent. |
| [120] | 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. |
| [121] | Traditional African vegetables (TAVs) 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. |
| [122] | AIVs are vegetables that originated or became established in Africa for many generations, and their leaves, young shoots, flowers, fruits, seeds, stems, tubers, or roots are consumed as vegetables. |
| [42] | African leafy vegetables consist of all categories of plants whose leaves are acceptable and used as vegetables by rural and urban communities through tradition. |
| [123] | ALVs are plant species which are either genuinely native to a particular region, or which were introduced to that region long enough ago to have evolved through natural processes or farmer selection. |
| [124] | AIVs include all plants that originated on the continent or have a long history of cultivation and domestication under African conditions and whose leaves, fruits, or roots are acceptable and used as vegetables through custom, habit, or tradition. |
| [125] | 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. |
| [81] | AIVs are vegetables that either originated or have a long history of cultivation and domestication in Africa and are locally important for 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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