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Review Article

Potential and Transformation of Indigenous Floral Foods in Africa: What Research Tells Over the Past Two Decades (2000–2022)

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Indigenous foods are the ancestral diet endemic to and consumed by the local people for ages, but there has been a recent discrepancy in their acceptability, growth and development. While some research suggested frequent consumption and growth of indigenous foods, others reported poor development and declining consumption despite their rich nutrition content. Moreover, research has failed to investigate and compile indigenous foods' growth and developmental trends in whole and niche areas to ensure their promotion and competitiveness with their exotic counterparts due to reports highlighting their rambling and anecdotal pictures of economic significance and nutritional potential. The study reviewed literature and collated past research to examine and forecast the developmental growth of indigenous foods for more than two decades (2000–2022). It identifies niche areas that have received more or less growth of indigenous food, and the type of research (review, data, and experimental research) contributing to its growth and development. Through the review of related literature, this study demonstrates that indigenous foods contribute to improving household health, food, and nutritional security. For example, 80% of South Africans depend on indigenous foods for medicinal purposes. It also enhances the dietary diversity of household and reduces poverty through income generation and employment. Some indigenous foods (green leafy vegetables) are richer sources of mineral elements than their exotic crops counterparts. Some indigenous foods play a crucial role in the cultural identity of people/ethnic groups. Indigenous foods are beneficial in terms of income, as research shows that some households generate more than 25% of their income from the sales of indigenous foods harvested from the wild. Indigenous foods agribusiness is dominated by rural dwellers, the poor, and vulnerable people, with most (75%) of the stakeholders being elderly women. Most indigenous foods transactions occur in an open market structure and are overshadowed by vendors and middlemen. 951 articles were used to investigate the growth show steady growth and development of indigenous foods research. However, the growth is skewed toward a few niche areas. Medicinal, food, and nutritional composition analysis are some niche areas witnessing indigenous foods' rapid growth and research development. Some indigenous foods have also seen growth in research development in a domestication niche area, but growth and development are lacking in the genetic improvement of many indigenous foods. Lack of awareness campaigns, value addition, marketing, and private/entrepreneurial investment and managerial/logistic techniques are other niche areas slowing the growth of indigenous foods, as revealed by the limited research. In decades (2000–2022), only 5.99% and 3.79% of research focused on indigenous foods value addition and awareness campaigns. More pragmatic research, policies, promotions, and value-additions approaches are needed.

1. Introduction

Many societies have a large proportion of the poor human population. A report by the World Economic Forum (WEF) [1] states that, aggregately, a quarter of the world population lives in poverty. On the other hand, 9.2% of the world population is estimated to live below the $1.90 per person per day index of the international poverty line [2].

It appears that poverty levels are more prevalent in Sub-Saharan Africa and South Asia. For instance, South Asia and Sub-Saharan Africa record about 90% of its population living in poverty, with two-thirds of the poor occupying higher

absolute poverty lines [1]. In South Africa, the adult population has an average of 49.2% of people living below the upper-bound poverty line (R1,335 per person per month, which is equivalent to 46 US dollars as at when this research was conducted) despite government support through grants [3]. A similar poverty trend seems to be present in Kenya. The World Bank Report of 2021 Economic Inclusion states that above 40% of the population lives in extreme poverty [4]. Whereas, recent research also shows that the trend of people living in extreme poverty has been downward since 2016 in Kenya but has increased in 2020 and 2021 [5]. The increase in the number of people living under the extreme poverty line is exacerbated by the outbreak of COVID-19 [5]. A survey conducted between 2021 and 2022 using the Multidimensional Poverty Index (MPI) by Nigeria's National Bureau of Statistics reported that 63% of its population is poor [6, 7]. The analysis of the MPI, which included food security, work type, and shocks (negative, economic, and unforeseen shock) to the three global MPI (Living Standards, Education, and Health), states that 63% (133 million Nigerians) of Nigeria's population that is poor exceeds the World Bank poverty projection for 2022 [7]. It has also been supported by evidence indicating that the global possibility of reducing the number of people living under the poverty line is getting slimmed, with past progress made in reducing poverty plodding due to the challenge of climate change and increasing human population [2]. As a result, calls have been made on the importance of promoting, consumption, farming, and selling of indigenous foods as a strategy for alleviating poverty levels.

Indigenous foods can contribute to reducing poverty incidence levels and improving household income generation. A study of hundred household heads in rural Nigeria showed that each household head generated income from indigenous foods [8]. Ironically, the advantages of indigenous foods have not been harnessed by many households to improve their poverty and food security. The poverty conditions of many households impacts their food security because they have little money to purchase the needed food items due to the clear link between poverty and food security [9].

Food security covers all times individuals' physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and preferences for an active and healthy living [10]. This encompasses various dimensions, including affordability, people's access to choice food for a healthy life, stability, and utilization [11]. Ensuring food security is a fundamental human right and aim of all governments, especially the member states of the United Nations, as expressed in the constitution of the United Nations charter [12]. This makes food security a top priority for many nations, governments, and world leaders [13]. However, many households still face food security challenges due to its complex nature and wide range of factors linked to the food security phenomenon [13].

Irrespective of the United Nations' declaration on food security since 1996, and the subsequent effort to tackle food insecurity, many African households are still food insecure [14, 15]. However, some households have used indigenous food to improve food security [16, 17].

Ironically, a report by Nengovhela et al. [18] indicates that the consumption frequency for indigenous food remains low, stating that some rural people consume indigenous food at least once a week. Another similar report states that larger proportions of household members lag in consuming indigenous foods other than household heads [19]. Therefore, it remains critical to investigate the potential roles that indigenous food in Africa play in terms of income and food security due to the extant and severe food insecurity and income generation challenges among the growing population [20].

The increasing exotic food production has not remedied the food insecurity challenges in the existing human population [21]. Ironically, the human population is steadily increasing, especially in developing nations [14]. A report forecasted that the African population is projected to grow to 1.4 billion by 2100 [22]. This increase growth in population will impact on food security and general development, which its consequences will have negative spillover as global challenges in the next few decades [22, 23].

While population growth poses the risk of more households falling into food insecurity and poverty challenges, it also has a vast market prospect and opportunity [24, 25]. In fact, the agricultural sector has been recognized as a potential employment platform for a growing population, especially for the youth [26]. Ironically, scientific, and developmental knowledge of how to harness the potential of indigenous foods to reduce food insecurity challenge is lacking in many areas [27]. For example, there is a gross lack of knowledge in investment and genetic development of many indigenous foods [27].

The challenge in exploiting indigenous foods' potential for income, food security, and other economic benefits of the growing population and many households in developing nations, especially in Africa, is due to different reasons [28]. Nevertheless, the unique challenge of indigenous foods is that they are mainly neglected for exotic foods [29]. This is because of stigmatization, including referring to them as foods for people experiencing poverty [28, 30]. Some indigenous foods are referred to as food for the poor and sick because some are mainly used as herbs and first aid by many rural communities and urban poor. In addition, wrongly labeling some indigenous foods as weeds or poisonous foods and the lack of recognition of their great diverse attributes have affected their adequate use [31]. Based on the numerous challenges of indigenous foods, different recommendations have been suggested by research on the developmental pathway [28, 32]. While the challenges linked to indigenous foods have been identified, the extent to which the challenges affect their growth and the extent to which those challenges are being addressed have not been investigated by research.

Alam and Singh [33], Dweba and Mearns [34], Musinguzi et al. [35], and van Rensburg et al. [36] observed that there is a decline in the consumption of indigenous foods. The fast rate of decline in the consumption of indigenous foods is largely coming from the society's middle and upper-class households,

especially the elites [37]. While research has reported the decline and frequency of consumption of indigenous foods Research has failed to point out the level and trend of growth in each niche area of indigenous foods, and the areas that are largely less developed have not been stated by existing literature [38]. On the other hand, a significant number of people depend on indigenous food products to meet their needs, especially for medical purposes [39]. Therefore, this research seeks to investigate indigenous foods' growth status in Africa over the past two decades (2000–2022). This research contributes to filling the gap in the literature by identifying the niche areas less addressed by indigenous foods research. More so, while research on the nutritional content of a few indigenous crops is not new, there is a paucity of information on the sensory analysis of many indigenous foods regarding proximate composition, minerals, and vitamin contents [40]. There is also a scarcity of research comparing indigenous foods' nutritional compositions with their exotic food counterparts. Therefore, the broad objective of this study is to investigate the growth of indigenous foods and their contribution to households' welfare in Africa for more than the past two decades (2000–2022).

Specifically, the study aims to achieve the following objectives:

(1) Investigate indigenous food contribution to households' income;
(2) Investigate indigenous food contribution to households' food diversity, security, and nutritional security;
(3) Investigate the nutritional richness of selected indigenous foods by compiling and comparing the proximate composition and analysis of the selected foods with their exotic crop counterpart.
(4) Investigate the health benefits of indigenous foods to the household;
(5) Investigate the combined growth and developmental trend of indigenous foods through research from the year 2000 to 2022; and
(6) Investigate the growth of indigenous foods in selected niche areas from the year 2000 to 2022
(7) Forecast the change that might likely occur in the developmental trend of indigenous foods.

2. Methodology

The study reviews the literature using various research reports from the internet and scholarly sites. Our searches were more web based, but we also used research from hard-copy materials on indigenous foods to broaden the consultation of materials. We identified online materials and articles using Microsoft Edge, Chrome, and Mozilla Firefox search engines. Google Scholar, SpringerLink, Wiley Online Library, ScienceDirect, SANB (SABINET), CAB Direct, Scopus, Research Gate, and University of Fort Hare Database resources were some of the research platforms from which materials were obtained. The study referenced related literature worldwide on the subject area, but the analysis of the indigenous foods' research developmental trend was done using studies from four selected African countries. The four countries selected based on geographical location are South Africa from Southern Africa, Nigeria from West Africa, Kenya from East Africa, and Egypt from North Africa, respectively.

The analysis of the indigenous foods' growth in each niche area was done using objectives and results from literature on selected topics over two decades (2000–2022) to analyze the trend. The objective of each past research from the four selected countries that addresses each niche area is given a score of one for the trend and growth analysis. The sourcing of literature materials used for the study was guided by different indigenous foods topics and keywords relating to wild foods and forest plants.

The selected topics were food security, income, marketing, nutritional composition, consumption, cultivation, health benefits, and value addition of indigenous. We did not discriminate by searching using only keywords, but we also framed different titles on indigenous foods to cover a wide range of materials. We discussed and profiled all research on the selected topics using their specific objective to see the developmental trend. Considering that some studies cover more than one objective, we analyzed such a study on the objectives covered in the trend analysis. For example, if a study investigated income and food security, through one study, we analyzed the trend as two separator substudy to ensure adequate representation for each subtopic. Note that the research in which the area (location of study) was not stated was excluded from the trend analysis. At the end of our search, 951 articles on indigenous foods from the countries are used for the trend, growth, and forecast analysis.

3. Literature Review

3.1. Income Potential of Indigenous Foods to Household. Different scholars have tried to describe the concept of income. Income is the increase in equity associated with either gain from an asset or a decrease in liability that is not an equity contribution of the participant [41]. However, the income description of Henry Simons in 1930, who observed that it is money value consumed plus the accumulation of taxable at a specific period, is more generally accepted [42]. Distinct concepts of income types include personal, national, taxable, investment, total/comprehensive, and household income [43]. The variation in the spread of income and household income pattern evidence in inequality distribution has intensified interest in this subject [42].

It is almost impossible to have a uniform definition of household income due to its various measurement elements, such as the geographical location and nature of public/private schools in some countries. In fact, some countries give their citizens in-kind social insurance benefits (measurement of household income), which some households with higher incomes in other countries cannot access [44]. However, excluding the component of measuring household income, the United States Department of Commerce describes household income as the income of the householder and any

individual 15 years and older living in the household at that particular time, irrespective of their relationship status to the householder [45].

As pointed out earlier, most households in developing countries are poor due to meager income generation [1]. Still, indigenous fruits harvested from the wild are used as an income-generation stimulant [17]. For instance, in Kenya, the trading of indigenous food harvested from the wild is used as a strategic alternative livelihood income source by farmers during drought and other natural disasters [17]. Whereas, in Botswana, its marketing reduces interhousehold income inequality in rural communities [46]. It provides income and employment for vendors in Gaborone, a populous city of Botswana [47]. Indigenous food sales from nontimber forest products, including scrubs, fruits, and animals, are primary/supplementary fallback livelihood strategic options for some rural households' income generation in South Africa [48] and Cameroon [49].

In South Africa, Williams [50] showed that an estimated 20,000 tons of indigenous medical plants harvested from the wild are traded annually for income generation. An estimated amount of R27 million worth of indigenous medicinal plants was traded annually in the Eastern Cape [51]. Income is generated from the sales of indigenous medical plants directly or indirectly by some households across different provinces of South Africa [50]. Vendors who sold traditional medicines from wild indigenous medicinal plants in the Mpumalanga Province generated gross income ranging between R34 and R3,985 per month [52]. However, vendors in KwaZulu-Natal seem to generate lesser earnings from the sales of traditional medicines from indigenous plants. For example, earlier research in (1998), which might have less inflation compared to (2004), expressed that the vendors in Durban, a major city in Kwazulu-Natal only earned a maximum of R501 per month from the sales of traditional medicines from indigenous plants [53]. Some traditional medicines produced from wild indigenous medicinal plant species were sold at a value ranging from R5 to R100 per teaspoon in some parts of the Limpopo Province of South Africa [54]. Reporting on the income generated from the sales of indigenous vegetables by farming households in urban and peri-urban areas of South Africa, Shackleton et al. [55] state that a modal income of R30 per month was received.

In the Northwestern Coastal Desert, Egypt, indigenous plants provide pivotal economic activities and income sources for collecting indigenous medicinal plants from the wild and vendor dealers who purchased those plants for resale [56]. A study of hundred household heads in Nigeria showed that indigenous foods contributed not less than 25% of income to total income generated by each household head [8]. Another study conducted in Oyo, Osun, Ondo, and Ekiti of Nigeria revealed that 62% of traders, mainly women who engaged in the sales of indigenous food, funded their children's education and sustained their entire family using the income generated from the business [57]. This is irrespective of the fact that these traders have an average household size of seven members, with 50% having household members ranging between 3 and 6 [57]. However, a report in Uganda states that income derived from indigenous foods sales by households is small [35].

3.2. The Relationship between Indigenous Foods and Households' Food Security. Indigenous foods have attributes that meet household food security requirements. It meets food access requirements, especially among rural dwellers. It also meets the availability requirement. A study in Botswana reported a negative correlation between the number of indigenous foods accessed and household food insecurity using access scores [16]. That is, household food insecurity decreases as indigenous food access increases [16]. Many rural and urban households in Uganda have difficulty purchasing exotic foods; however, indigenous food access enabled them to improve their food security need, and household with less access to indigenous food has higher household food insecurity challenge [58]. In South Africa, households in the Sekhukhune district municipality of Limpopo Province used the availability of indigenous foods to improve their food security needs [59]. In Tanzania, an average of 114 indigenous food species of forest plants helped achieve the availability dimension of households' food security [60].

Indigenous foods have constantly stimulated and contributed to food security, especially at the household level [35]. A study in Gaborone, Botswana, revealed that more than half of the households sampled consumed not less than three different types of indigenous foods [16]. However, a glance within the South African context indicated that despite the frequency of indigenous food consumption by some of the households in South Africa this was only up to three or four times a month [18].

A study in rural Limpopo, South Africa by Nepfumbada et al. [61] showed that all household members, including children, accepted the diet developed from indigenous food. Collaborator research with Early Childhood Development centers in Limpopo finds that a designed diet from indigenous foods served twice a week was well accepted by children as an inclusive meal [61]. The research, which used the community-based participatory research approach and the nominal group technique ranking method to analyze the acceptability level of indigenous diet formulated through the inclusion of 16 different indigenous foods, improved the eating habits of children under the age of 5 years [61].

3.3. Contribution of Indigenous Food to Households' Nutritional Intake and Dietary Diversity. Indigenous foods from the wild provide food diversity, minerals, and vitamins in rural households and dietary needs in most African countries. Indigenous foods are used as a coping strategy to promote food diversity by mainly low-income earners in Kenya [17]. In Nigeria, various wild indigenous vegetables and fruits play a crucial role in food and nutritional security by enriching the diet of the rural people [62]. In a study within the North East region of Nigeria only, not less than 67 wild indigenous food are consumed, making indigenous food to contribute less to dietary and nutritional diversity as food sources with the various communities [63].

The term nutrition is vital in the description and analysis of food security. It explains how food is healthier in addressing security and adequate nutritional components [64]. Nutrition security is appropriate and secures access to a nutritious diet that promotes and guarantees an active but healthy lifestyle for all household members in a hygienic environment [65]. Nutritious foods rich in macro and micro elements are needed for healthy growth. However, lack of nutritious food has been a recurring problem in many countries, especially developing and less developed countries [66]. The challenge of unhealthy food consumption lifestyles, malnutrition, and obesity remain unabated due to an increase in food globally [67]. One of the challenges that derailed the larger share of the population in developing countries from transition toward healthy lifestyles and diet is the replacement of indigenous foods with growing income-generated foods that are high in carbohydrates [67]. Unnecessary discrimination of indigenous foods' disease-preventing ability has resulted in many people not considering them and eating them as part of a healthy balanced diet for their nutritional benefits [67]. This is despite research showing that many indigenous foods are rich in macro and microelements but the problem lies in inadequate nutrient databases which result in limiting their effective utilization [38]. Tables 1 and 2 present common indigenous crops (green leafy vegetables) naturally grown, sometimes cultivated, and consumed in different African countries and two exotic vegetables [40, 62, 79]. Table 1 shows the proximate analyses, indicating the percentage of some indigenous foods' nutritional composition. Table 2, on the other hand, shows the number of determined nutritional elements of the indigenous foods.

Indigenous foods (vegetables) do not enjoy the same the social and culinary status as compared to cabbage and spinach, which are their exotic counterpart [80]. Ironically, some indigenous food crops, using vegetables and nuts, as presented in Table 1, are rich in moisture, protein, ash, carbohydrate, fat, and crude fiber, compared to their exotic counterparts that are generally more accepted. For example, the proximate composition of *Spinacia oleracea* [68] and *Talinum triangulare* [71] show that both the exotic vegetable (*S. oleracea*) and the indigenous vegetable (*T. triangulare*) have similar moisture contents. However, a g/100 g of *T. triangulare* has more protein than g/100 g of *S. oleracea* even though both vegetables have similar methods of preparation. In another example, *Cleome monophylla* Odhav et al. [40] has a higher protein content than green cabbage Ashfaq et al. [69].

Some of the indigenous foods (green leafy vegetables) are rich sources of mineral elements. They appear to have a higher mineral concentration compared to their exotic green leafy vegetable counterparts. As shown in Table 1, research indicates that some indigenous foods contain more essential mineral elements. An example is the case of *Vernonia amygdalina*, which has higher 483.06 ± 6, 19.50 ± 0.50, $12{,}641.76 \pm 1{,}458$, 322 ± 67, 627.98 ± 7.81, and $6{,}813.6 \pm 400$, amount of sodium (Na), copper (Cu), calcium (Ca), iron (Fe), potassium (K), and magnesium (Mg), respectively, at an mg/100 g than *S. oleracea* with the value of 126.38 ± 2.23, 0.240 ± 0.02, 2.17 ± 0.15, 145.47 ± 4.50, and 0.047 ± 0.01, respectively. Therefore, indigenous foods are rich sources of valuable minerals and vitamins crucial for the excellent healthy living and wellness of humans and would contribute to dietary needs if consumed. Hence, indigenous food is integral to provide some bioactive compounds that help in immunity while providing micro and macro nutrients to reduce malnutrition and support local food security [81].

3.4. Health and Medicinal Benefits of Indigenous Foods. Different studies have reported that there are large numbers of indigenous plants in various regions of Africa with medicinal benefits [56, 82]. The findings of Bidak et al. [56] reported that of the 236 plant species studied in the Northwestern Coastal desert of Egypt, an average of 73% of the species were used for medicinal purposes. Heneidy and Bidak [82], while reporting the outcomes of their study in the same region of Egypt, stated that 206 out of 230 plant species investigated had medicinal benefits besides other economic uses. Meanwhile, research done in Nigeria also shows that a large percentage of localities in Nigeria consumed indigenous foods as the most common sources of mineral elements and compounds, such as carotenoids, flavonoids, ascorbic, and folic acid that provide huge health benefits [83]. For instance, *V. amygdalina*, a common indigenous green vegetable consumed across Nigeria and some other African countries, contains phytochemical compounds such as Anthraquinone, Alkaloids, Flavonoids, Oxalate, Tannins, Saponins, Cyanogenic glycoside, Steroid, Phytate, and Phenol [84]. The presence of phytochemical and bioactive compounds in some indigenous foods, for example, *V. amygdalina*, stimulates their rich health benefits. Research indicates that *V. amygdalina* is used traditionally to treat health challenges such as sexually transmitted infections, gastrointestinal disorders, diabetes, infertility, and malaria [85]. It has also been used as Ethno-medical to treat bacteria and parasitic infectious disease ailments of animals such as goats, sheep, and horses in Nigeria [86] and chimpanzees in Tanzania [87].

In South Africa, indigenous crops, including rooibos and moringa, due to their potential to curb high diabetes challenges and cardiovascular diseases, have gained a level of global recognition from pharmaceutical laboratories and health-related organizations [88, 89, 90]. *Aponogeton distachyos* is another South African indigenous food with substantial health benefits [76]. Being a good source of dietary fiber, Vitamin C, iron, protein, and folic acid, and with the fact that it is cholesterol-free and low lipid, *A. distachyos* is used more by vegetarians and vegans natural healthy maintaining food [91].

3.5. African' Indigenous Food Research Development Transformation and Growth Over the Past Two Decades. Figure 1 shows the authors' composed bibliometric analysis from the 951 research literature objectives. For clarification purposes, we considered it necessary to emphasize that the indigenous food literature used for the entire review or the research developmental trend analysis is not the only research on the subject in the selected countries or across Africa over the past two decades. However, we tried to cover

Table 1: Per 100 g proximate composition of some exotic and indigenous vegetables.

Vegetable	Proximate composition (a g/100 g), but energy is measured in kJ							
	Moisture	Protein	Ash (g)	Carbohydrate	Fat	Crude fiber	Energy	Author
Spinacia oleracea	6.7 ± 0.07 g	2.99 ± 0.4	6.61 ± 0.4	75.5 ± 0.07		4.6 ± 0.4	334.04 ± 0.8	Agarwal et al. [68]
Green cabbage	91.29 ± 4.29	0.92 ± 0.03	0.69 ± 0.01	4.13 ± 0.14	0.02 ± 0.01	2.95 ± 0.11	–	Ashfaq et al. [69]
Amaranthus caudatus	10.50 ± 0.04	13.4 ± 0.2	2.89 ± 0.01	55.30 ± 0.7	6.43 ± 0.09	11.30 ± 0.5	–	Nascimento et al. [70]
Talinum triangulare	6.73 ± 0.02	19.97 ± 0.02	8.03 ± 0.05	53.99 ± 0.05	0.34 ± 0.01	8.97 ± 0.02	1.57 ± 0.05	Jimoh et al. [71]
Wahlenbergia undulata	80	5	2.05	12.8	0.3	1.33	75	Odhav et al. [40]
Tiger nut	8.50%	5.08%	2.23%	45.73%	30.01%	14.80%		Bazine and Arslanoğlu [72], Gambo and Da'u [73], and Kizzie-Hayford et al. [74]
Cleome monophyla	88	5	3.01	03.40	0.7	2.14	39	Odhav et al. [40]
Momordica balsamina	85	5	2.07	6.82	0.5	2.75	53	Odhav et al. [40]
Vernonia amygdalina	9.32 ± 0.67	22.81 ± 0.17	16.65 ± 0.09	38.03 ± 0.06	4.34 ± 0.04	18.17 ± 0.06		Usunobun and Ngozi [75]
Aponogeton distachyos	89.9	1.3	0.8	3.5	0.2	3.1	160.0	Pieterse et al. [76]

Note. n.d, not determined. Author's composed (2023) from different sources as reference in Table 1.

Table 2: Mineral nutritional composition of some exotic and indigenous vegetables.

Vegetable	Mineral composition (mg/100 g)												Author
	Sodium (Na)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Calcium (Ca)	Iron (Fe)	Potassium (K)	Phosphorus (P)	Magnesium (Mg)	Manganese (Mn)	Zinc (Zn)	Cobalt (Co)	
Spinacea oleracea	126.38 ± 2.23	14.55 ± 0.94	n.d	0.240 ± 0.02	n.d	2.17 ± 0.15	145.47 ± 4.50	n.d	0.047 ± 0.01	0.004 ± 0.00	n.d	n.d	Yunus and Abdullahi [77]
Green cabbage	9.87 ± 0.39	n.d	n.d	0.05 ± 0.00	19.88 ± 1.29	0.75 ± 0.03	53.42 ± 1.87	n.d	22.60 ± 0.81	0.12 ± 0.01	0.31 ± 0.01	0.14 ± 0.00	Ashfaq et al. [69]
Amaranthus caudatus	<LoQ	n.d	n.d	0.51 ± 0.01	165 ± 9.3	9.62 ± 0.12	530 ± 20	527 ± 13	231 ± 6.9	1.51 ± 0.05	5.55 ± 0.36	n.d	Nascimento et al. [70]
Talinum triangulare	52.34 ± 0.02	n.d	n.d	0.06 ± 0.00	60.31 ± 0.02	0.20 ± 0.01	61.22 ± 0.01	n.d	21.22 ± 0.02	0.01 ± 0.00	0.09 ± 0.00	n.d	Jimoh et al. [71]
Wahlenbergia undulata	374	n.d	n.d	2	1,305	19	n.d	308	193	7	41	n.d	Odhav et al. [40]
Tiger nut	245	n.d	n.d	0.02	155	0.65	216	121	51.2	33.2	0.01	n.d	Gambo and Da'u [73]
Cleome monophylla	25	n.d	n.d	2	3,203	24	n.d	784	371	10	5	n.d	Odhav et al. [40]
Momordica balsamina	376	n.d	n.d	3	2,688	23	n.d	356	613	10	12	n.d	Odhav et al. [40]
Vernonia amygdalina	483.06 ± 6	4.99 ± 0.49	3.75 ± 0.25	19.50 ± 0.50	12,641.76 ± 1,458	322 ± 67	627.98 ± 7.81	n.d	6,813.6 ± 400	–	14.23 ± 0.89	n.d	Usunobun and Okolie [78]
Aponogeton distachyos	45	46	n.d	0.32	n.d	0.92	245	47	21	267	0.14	n.d	Pieterse et al. [76]

Note. n.d, not determined; LoQ, limit of quantification; Na, sodium; Cd, cadmium; Cr, chromium; Cu, copper; Ca, calcium; Fe, iron; K, phosphate, potassium; Mg, magnesium; P, phosphorus, Mn, manganese; Zn, zinc; Vitamin C; Co, cobalt. Author's composed (2023) from different sources as reference in Table 2.

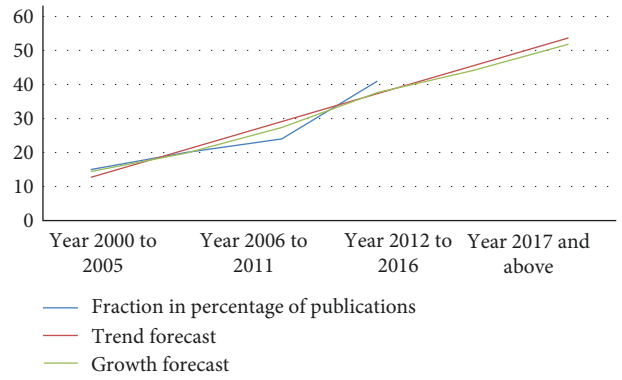

Figure 1: Growth, trend, and forecast of indigenous foods in Africa (2000–2023). *Source*: Authors own composed of bibliometric analysis.

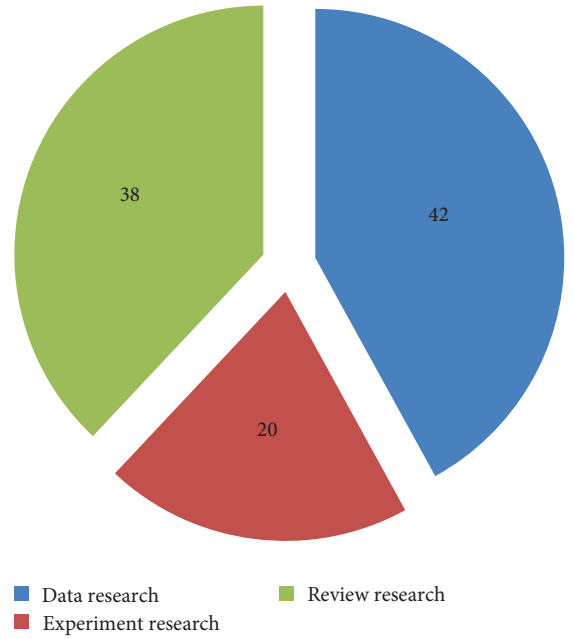

Figure 2: Percentage distribution of indigenous foods conducted in Africa (2000–2023). *Source*: Authors composed from the 951 indigenous foods research.

available literature on the topics and niche areas under discussion. Our findings are based solely on literature. Following the methodology, efforts were made to identify and collect published materials on indigenous foods across Africa using four countries (Nigeria, Kenya, South Africa, and Egypt) from the four regions of Africa. Hence, the materials used for this analysis are restricted to published works on indigenous foods from the four countries over the past two decades. Figure 1 shows the indigenous foods percentage growth, trends, and growth forecast. The trend and growth forecast was computed using the trend and growth exponential functions of Microsoft Excel from the percentage of published material in the four selected countries in the past two decades.

As shown in Figure 1, our findings reveal that African indigenous research development has witnessed tremendous research growth in the past two decades. Generally, indigenous food research development had a 15% increase in the first years of the first decade (2000–2010) used for this study, exceeding the growth forecast by 1%.

Based on the number of indigenous food publications from 2006 to 2011, indigenous food research development in Africa grew by 20%, which also slightly exceeded the forecasted growth as presented in Figure 1. In all, indigenous food research development in Africa exceeded growth as envisaged in the past two decades regarding publication numbers, and the trend is also upward. The emerging results align with a finding in Southern Africa that there has been an increasing developmental interest in the commercialization and domestication of indigenous foods for a good number of years [92]. The result can also be argued in the same direction as the findings of Mudau et al. [93], which state that the need to ensure resilient but sustainable food systems has recently driven a renewed interest in indigenous food development.

3.6. Concentration and Growth Pattern of Africa Indigenous Food Research Type. Knowing the factors propelling the growth of indigenous food development in Africa remain vital, so it is necessary to identify the research type that basically addressed the holistic transformation of indigenous food over the past two decades. In doing so, we grouped all the literature in this review into three research methodologies namely: experimental, review, and data research. For example, what is the amount and type of research involving domestication of indigenous food, genetic improvement, and laboratory investigation of nutritional content? Practical processing research is grouped as experimental research. Research involving data collection from humans through interviews, questionnaires, or focus group surveys is grouped under data. As illustrated above, the articles are based on experimental and data research and any published write-up that does not involve experimental and data collection is under review.

Our findings, as shown in Figure 2, indicate that most of the indigenous food research in Africa is about data collection, which could entail getting information about income generation, contribution to food security, perception, and so forth. The second highest proportion of research in Africa emanates from the literature review. This means that a sizeable proportion of research on African indigenous foods' development is either through data collection or from the literature review on data or experimental research.

All research is essential, but the advantage of experimental research is that it is a prototype (shadow) of a product in actual life conditions [94]. Ironically, experimental research contribution to the group and development of indigenous foods transformation is collectively low. Only 20% of research, less than half of the percentage of the review research fraction and equivalent to half of the percentage of data collection research, is an experimental article on indigenous foods in Africa in the past two decades. Thus, it may be inferred that the proportion of experimental and quantitative research involving direct data collection from the respondents in Africa is low and could be attributed to

poor funding of research by the governments of different countries in Africa.

3.7. Dispersion of African's Indigenous Food Research Development in Selected Niche Areas. This research has revealed a growth in indigenous food research development, however, the spread in many niche areas that the research development growth focuses on remains known. As a result, one of the objectives of this review was to analyze the research development growth in their various niche areas. We investigated the spread, concentration, and type of research (experimental, data collection/interview, and literature review) done in those specific niche areas. The selected niche areas of research development that were investigated included: indigenous food domestication, type of indigenous food plant (fruit plant, vegetable, or scrubs), commercialization, income, food security, marketing, policy, diversification, nutrition security, ethnobotanical/medicinal value (Health), processing, value addition, genetic improvement, awareness, perception, cultural use of indigenous food, identification of indigenous food, its efficient use, diseases, and pest related challenges of indigenous food.

The findings in Table 3 show that, the research growth and progress made in the transformation of indigenous foods over the past two decades was dominantly linked to their contributing role on the following: ethnobotanical/medicinal research development purposes are 24.29%, households' income 8.94%, food security 9.14%, and nutrition security and 9.25%, respectively. This could be one of the reasons many households depend on indigenous foods for medicinal, income, food security, and nutrition security benefits in Africa, as discussed earlier.

3.8. Domestication Growth and Limitation of African Indigenous Food. Domestication is unavoidable if sustainable commercialization of indigenous food is to be realized [95]. Domestication quashes the sole dependence on the wild species population for harvest [92]. It provides morphology, pest/disease resistance, and quality improvement. According to Tchoundjeu et al. [96], plant domestication involves different processes. In other words, it is the assurance of the ability to cultivate plants from their wild species. It involves the selection (to take the best tree for propagation), adoption, collection of germplasm, propagation, and improvement in propagation through techniques such as genetic improvement, as the need arises [97].

Table 3 shows that research on the domestication of indigenous African food crops is only 9.78% concentration over the past two decades (2000–2022). However, 9.78% of the research focused on domestication over the past two decades in Table 3 shows that the domestication of indigenous foods is one area that has received more developmental growth and research interest as compared to other niche areas. This result corroborates the findings of Tchoundjeu et al. [96], stated that though there is much need for improvement, there has been expansion around participatory tree domestication in Southern Africa.

To accelerate the growth of indigenous food domestication, a strategy of participatory domestication was improved to include the rapid clonal selection approach in the Miombo eco-region program [98]. Through the Miombo program for developing indigenous food domestication in Southern Africa, tremendous success is recorded in nursery propagation techniques, new cultivars development, species priority setting, provenance trials, and field management [92]. Another domestication success in the selected indigenous foods is reducing their fruiting period. Advancements relating to the superior cones of some selected indigenous plant domestication have been tested and disseminated to farmers [92]. Most improved domesticated indigenous foods released to farmers have gradually been accepted in the local urban markets [99].

The progress made in the domestication of indigenous food saw more than 6,000 farmers being engaged in on-farm testing of the selected indigenous fruit trees in the field and homesteads while another group of farmers numbering more than 12,000 were trained in nursery establishment in five countries (Botswana, Malawi, Zimbabwe, Mozambique, and Zambia) of Southern Africa [100]. As part of the progress made in domestication effort, the training outcome made more than 27,500 farmers cultivate some of these selected experimented domesticated plants in their farms in Tanzania [100].

We further analyzed which type of research (review, interview/data collection, or lab/field experiment) contributes the most to the growth of indigenous food domestication in Africa. The results showed that a high fraction (53.76%) of developmental research growth of indigenous food domestication comes from literature research. This indicates that research done using a review of related literature on the domestication of African indigenous food is higher than experimental research and information research from people in the region through data collection put together. Again, this shows a disparity in the growth of indigenous food domestication research, which could prevent the holistic development of indigenous food domestication. The results corroborate the findings of Akinnifesi et al. [100] who observed an increase in the number of domesticated indigenous foods. Despite the forgoing positive outcome noted by Akinnifesi et al. [100], there remains a disparity in the increment compared to the number of undomesticated indigenous crops in Africa. For example, within the South African context, the proportion of indigenous food domestication shows that only 16 species have been domesticated out of the 56 species collected from the wild [101]. Another study also highlighted that the change occurring in the adoption of indigenous food domestication has not spread across all provinces of South Africa, with only two out of the nine provinces cultivating indigenous food [102]. Besides the large proportion of indigenous foods not being domesticated, there is a limited genetic variation improvement in domesticated indigenous food, predominantly indigenous vegetables [103]. Our search also shows that there is minimal research focused on genetic modification and breeding, which would have impeded the constant growth of indigenous food domestication. As such, it may be suggested that the reason why indigenous foods have not attained the maximum and holistic domestication growth as forecasted could be attributed to various factors such as lack of genetic improvement and limited research on domestication [35]. The application of

Table 3: Spread of indigenous foods articles published in Africa in the past two decades and their focus areas.

Publication related areas/objective 2000–2022	Proportion of research type in niche areas	Fraction of research type/design of the article in each niche area		
		Review	Interview/data collection	Lab/field experiment
	Frequency/per	Frequency/per	Frequency/per	Frequency/per
Domestication	93 (9.78)	50 (53.76)	18 (19.35)	25 (26.88)
Genetic improvement and related issues	11 (1.16)	4 (36.36)	2 (18.18)	5 (45.45)
Awareness/perception	36 (3.79)	5 (13.89)	29 (80.56)	2 (5.56)
Ethnobotanical/medicinal value	231 (24.29)	93 (40.26)	112 (48.48)	26 (11.26)
Food security	182 (19.14)	71 (39.01)	111 (60.99)	0 (0)
Nutrition security	88 (9.25)	41 (46.59)	18 (20.45)	29 (32.95)
Processing and value addition	57 (5.99)	25 (43.86)	23 (40.35)	9 (15.79)
Cultural use	9 (0.95)	3 (33.33)	6 (66.67)	0 (0)
Income	85 (8.94)	45 (52.94)	40 (47.06)	0 (0)
Market structure/marketing of indigenous foods	47 (4.94)	31 (65.96)	16 (34.04)	0 ()
Commercialization	40 (4.21)	26 (65.00)	14 (35.00)	− 0 (0)
Policy, law, and programmed	13 (1.37)	8 (61.54)	5 (38.46)	0 (0)
Econometrics analysis such as efficiency, profitability, and cost analysis	4 (0.42)	0 ()	4 (100.00)	0 (0)
Diseases and pest related challenge	6 (0.63)	3 (50.00)	3 (50.00)	0 (0)
Management of indigenous crops	16 (1.68)	5 (31.25)	8 (50.00)	3 (18.75)
Diversification	33 (3.47)	18 (54.55)	14 (42.42)	1 (3.03)
Total	951 (100.00)	406 (45.01)	394 (43.68)	102 (11.31)

Note. Authors 2023 composed of 951 published articles in four African countries between 2000 and 2022.

biotechnique in embryo genesis, genetic engineering, another culture, meristem culture, protoplast culture, prevention of abiotic and biotic stresses, and in vitro selection in the domestication process of indigenous foods remain a challenge [27].

Aside from stigmatizing indigenous foods as cheap food sources, other problems that frustrate the domestication of indigenous foods are associated with slow growth and a long period of fruiting as compared to their exotic species counterparts [104]. The reason is that most farmers delight in high income rewarding crops they are familiar with their cultivation techniques [35]. Indigenous foods domestication in Mniombo woodlands showed that domestication strategies involved long-term germplasm selection, improvement, and integration [98]. Lack of commitment to breeding and seed supply by agricultural stakeholders, including policymakers, limits indigenous food domestication's pace [99]. In Kenya, the lack of a breeding program using molecular techniques to improve taste while optimizing indigenous food production through domestication resulted in insufficient indigenous food species with genetic variance [103]. One of the challenges resulting from the lack of indigenous foods genetic improvement in Nigeria is limited resources [105].

3.9. Identification of Indigenous Foods. Many indigenous foods, including fruit plants, vegetables, and tubers, and their uses have been identified in Africa. Mongalo and Makhafola [106] in profiling the medicinal indigenous plants in Limpopo Province, South Africa, identified 82 species of 42 families used in the area. However, most indigenous food research objectives have not recently concentrated on indigenous food identification. Thus, despite evidence of some research studies trying to number and name the indigenous foods they have worked on, their objectives were not to profile the names and number of indigenous foods in those areas. Therefore, one of the outcomes of this review was to highlight that a very small fraction of indigenous food research objectives have focused on identification in the past two decades.

Maroyi [107], in investigating the traditional uses of the indigenous wild plant, named some indigenous crops from 163 indigenous plant species used for various purposes by the population studied in the Eastern Cape, South Africa. Similarly, Odhav et al. [40], though not reporting on the objective of indigenous food identification, stated the names of the twenty indigenous vegetables assessed for their nutritional position. The reason most current research objectives do not capture the identification of indigenous foods could be because those indigenous foods are not new. In other words, previous research before the year 2000 might have addressed issues relating to indigenous identification. However, there is still a need to identify and profile current indigenous foods, particularly, plants according to their specific use and availability and geographical location.

3.10. Indigenous Foods Awareness and Perceptions. Awareness creation is a market-driven strategy aimed at altering the perception of the public/targeted audience about a product [108]. It is a planned communication tactic carried out using physical or media displays to achieve a recognition of predetermined objectives by the public [109]. Awareness campaigns are essential in changing market demand, negative disposition, behavior, and acceptability [110]. Furthermore, these programs are meant to stimulate, inform, and educate the public about their action on a product [111]. Despite the importance of awareness campaigns, the level of awareness campaigns and efforts that could result in a positive change of attitude and market demand for indigenous foods is low. Studies in Kenya show that awareness campaigns showcasing the significance of indigenous foods is next to minimal, resulting in most indigenous food plants being regarded as a weed [112].

From all the reviewed literature of the study over the past 20 years, only 3.8% of the literature objectives covered public awareness and perceptions of indigenous food. Out of the 3.8% of literature review on data, experimental, and review research development in the past two decades, it could be deduced that, 80.6% revolved around data collection on public perception and knowledge of various niche areas on indigenous foods. For example, Cloete and Idsardi [19], Modi [113], Ngcoya and Kumarakulasingam [80], Adesiyan [114], Agbontale et al. [115], and Ayanwale et al. [116] are among those whose research investigated household indigenous foods awareness and perception using data in South Africa and Nigeria. On the other hand, little research has been done on how to raise indigenous foods awareness and promotion via public outreach, social media, broadcast media, and demonstration on the significance of indigenous foods. Though little effort is committed to promoting indigenous foods through broadcast, the adoption of innovative land preparation for indigenous foods cultivation is higher amongst farmers who received awareness campaigns through broadcast media such as the radio, than those who received awareness campaigned through print media [117]. Similarly, the proportion of households who consumed indigenous foods is higher among those who received awareness campaign on indigenous foods through broadcast media than those who received their awareness through print media [117]. On a broader scale, experimental display work that creates awareness and promotion to the wider population to allow their greater participation in and acceptability of indigenous foods is lacking [118].

3.11. The Role of Research in Linking Indigenous Foods and Culture in Africa. Indigenous foods play a crucial role in cultural identity across the globe, including the native people of America [119]. It is also reported that these foods play a significant cultural role in Australia [120]. In Africa, indigenous foods also serve many ethnic groups as fundamental and integral means of identity and culture [121]. Asides from other critical roles of indigenous foods, it serves as a trademark and symbol of heritage in the contemporary world [122]. Some indigenous foods aid the preparation and consumption of other food on a cultural level. Unfortunately, the cultural food preparative mechanism knowledge is at risk of extinction recently [30]. This is despite local culture being a leading driving force of indigenous foods consumption. However, the influence of culture has not stopped the reason

for the growth and development of indigenous foods in the past two decades [76]. This study found minimal research linking present challenges, progress of indigenous foods with culture in Africa, which could contribute to the extinction risk facing some indigenous foods. Less than 1% of research focus on indigenous foods and issues surrounding research on culture has the probability of making the growth of indigenous foods through the niche area of cultural research insignificant.

One of the sole reasons indigenous food knowledge areas about culture face the risk of less improvement could be because culture is no longer a significant motivating factor driving indigenous food consumption [19]. It could also be that less attention is being given to cultural activities in Africa in the face of modernization, which is driving the trend of cultural research.

3.12. Market Challenges Associated with Indigenous Foods. Very little research has explored African indigenous foods' market potential, marketing, and structure. In this section, we include research on the marketing, market structure, market demand, supply, and so forth, of indigenous foods. Our findings from the literature reviewed shown in Table 3 indicate that indigenous foods marketing research development is another area that has not witnessed speedy growth. With indigenous foods research having only 4.94% focusing on marketing in the past two decades indicates that the market behavior, demand, price, and structure of many indigenous foods might not have been investigated. This could be one of the reasons Jansen van Rensburg et al. [123] state that despite the significance of indigenous foods, they have been neglected by different types of marketing research and others.

Indigenous foods face various market challenges, but market formalization and structure are fundamental impediments [124]. It is mainly of the open market structure of free entry and exit; however, the open market structure in Kibosw of Kenya provided the platform for selling most indigenous foods; 95% of the available vegetables are indigenous and in high demand [125]. Nevertheless, the indigenous foods market is failing to yield maximum market rewards due to the lack of an effective market structure. The market structure challenges made few households earn significant income from trading indigenous foods [126]. However, commonly recognized consumed indigenous food such as Marula has good market income because of well-structured market support leading to their international market penetration [19]. *Aspalathus linearis* Fabaceae (red bush tea), popularly known as Rooibos tea, is indigenous to South Africa but has penetrated the international markets to bring good income as well as economic benefits to Cedarberg and neighboring communities after certification by the International Fairtrade System to improve its market structure [127]. This is despite the fact that, the market structure of many indigenous foods is such that sales are carried out by intermediaries in semi-urban and urban areas [128]. For instance, a study of the indigenous foods market in Benin, Côte d'Ivoire, Senegal, Kenya, Tanzania, Uganda, and South Africa states that the indigenous foods market is characterized by many intermediaries performing several marketing activities in the marketing chain [129].

Market formalization incorporating international standardization guidelines could also restrict the market penetration and commercialization of indigenous foods by people experiencing poverty who are more into the indigenous foods business [130, 131]. Rampa et al. [31] argue that the formalization and standardization policy could see the rich to medium or large-scale commercial farmers hijacking the growing opportunities in indigenous food development. The upscaling of indigenous foods through formalization and standardization is likely to increase the affordability challenge, especially by poor consumers that are most likely to bear a larger scale of the trickle-down effect of price increase from the upscaling policy [31]. For example, the local forest policy that restricted and prevented adequate harvest of indigenous foods from the wild increased the price but also contained large quantities to be harvested for the market by those who depended on the wild species [132]. Therefore, an appropriate and well thought out policy is needed for formalization and standardization purposes of indigenous foods [31].

Some indigenous foods have high commercialization market potential, but most are still being sold at the local market [133]. For instance, in many countries of West Africa, including Nigeria, only a few indigenous foods, especially fruit crops, have benefited from the existing niche potential of the international market. At the same time, the majority are sold at local or regional markets despite their market value [96]. Indigenous *Telfairia occidentalis*, commonly referred to as fluted pumpkin, has in many years been essential within the local food market of the South Eastern people (Igbos) and other ethnic groups around the Niger Delta region, Nigeria for vegetable consumption, soup preparation, and medicinal value [134]. However, it is still of low commercial importance without international marketing penetration, irrespective of their frequent consumption in the region over the years [134]. In the local market, most indigenous food sales are carried out by street vendors using door-to-door market strategy, roadside marketing, park hawking, and selling around shopping centers [128]. Indigenous foods are sometimes sold in hard-to-locate markets [135]. This is worsened by the fact that 75% of the stakeholders in the marketing chain structure are older women with limited market-driven potential [57]. Rural women dominate the indigenous foods production and market in Benin, Côte d'Ivoire, Senegal, Kenya, Tanzania, Uganda, and South Africa than male household heads [129]. In Cameroon, more women participated in the indigenous foods market than men because it required little start-up capital [136]. The slow realization of the full economic potential of some indigenous foods is their low competitive price and seasonal availability in the market [125]. This is because most indigenous foods are considered in the market for alternative food and therapeutic need options [127].

3.13. Value Addition and Commercialization of Indigenous Foods. Poor value addition is among the key reasons that impede the market penetration of most indigenous foods, especially more rewarding and international markets [57]. The poor value addition of indigenous food is partly caused by the pitiful disposition of policymakers, policies, and throttled research [93]. The development of indigenous foods' value chain is often impacted by the lack of agroindustries' involvement in processing indigenous foods because most of their production is shallow to sustain those industries' demand [93]. In Nigeria, the indigenous food value-addition process is challenged by inadequate and inappropriate technology usage, low working capital, and poor electricity supply [62]. The inability to figure out the practical and sustainable procedure of indigenous foods' value addition and processing using improved technology and innovative research is a significant challenge for many agrifood stakeholders in their commercialization [137]. In reality, many primary and secondary indigenous foods' value addition does not meet international standards as their exotic foods' counterparts, which have international standardized certification [55]. The nature of primary or secondary indigenous foods' value addition is in dismal progress in commercializing indigenous foods.

Adding value to indigenous and traditional foods through fermentation food processing fosters commercialization and entrepreneurial orientation [138]. The abundance and value addition of indigenous prickly pears and marula wild fruits propelled their commercialization [139]. Ensuring the value addition of indigenous foods is synonymous with rural households' income increment, food security, rural community development, and prevention of postharvest losses [62]. In Limpopo Province of South Africa, the entrepreneurial training and empowerment established in 2006 by Molemole Indigenous Food Processing Cooperative (MIFPC) increased the knowledge of indigenous food processing [139].

As shown in Table 3, only 5.99% of the 951 articles used in the analysis addressed indigenous foods processing and value-added. This shows a general lack of value addition, processing knowledge, and skill required for most indigenous foods' transformations. This is evident in the research of Mbugua et al. [112], which observes that the lack of improvement by farmers involved in indigenous foods harvesting includes processing and value-addition production techniques. The slight growth in indigenous food improvement could have limited experimental value-added research on the subject matter. The result shows that despite the numerous indigenous foods available across Africa, little (15.7%) experimental research is done on processing and value addition. The experimental research development has the lowest contribution to the growth of indigenous food processing and value addition in Africa. This outcome corroborates the findings of Nyembe [140], which point to a dearth of empirical research on the consumers' acceptance and preferences of sundry and oven-dry (processing and value addition methods) indigenous vegetables.

Among the techniques used for processing and preserving indigenous foods in value-addition, the experimental research reveals that more than 80% of those involved in processing and value addition of indigenous foods used traditional methods of frying (firewood or sun-drying), roasting, boiling, and packing with leaves and plastic bags. In some cases, juices from indigenous foods are traditionally extracted using overnight soaking and fermentation for 2–3 days as processing methods [141]. An extant literature also shows that, indigenous foods' traditional value addition and packaging involved using leaves from the wild and plastic bags [100, 107, 141–143]. Some of the research studies that reported the traditional methods of processing and preserving as a means of adding value to indigenous foods include Aworh [62], Oloko [144], and Van den Heever and Venter [145]. There is also untapped experimental research relating the outcome of the saved laboratory processed and value-added products of indigenous foods with consumers' perceptions [146]. To this end, most indigenous foods and those involved in indigenous agribusiness require value-addition skills for speedy growth and development [99].

The result of this study, as shown in Table 3, indicates that commercialization is one area that has received little research developmental progress in the past two decades. This result corroborates the findings in Southern African by Van Wyk [147], which revealed that despite diverse plant species in the region, very few of them, especially those with medicinal value, have hitherto been commercialized. We further support our findings using the research of Street and Prinsloo [39], which states that even though there is a growing demand for an indigenous medicinal plant that sees 80% of South Africans' population use traditional medicines from indigenous foods, few of those medicinal plant commercialization potentials have been exploited.

3.14. Lack of Managerial Technique for Indigenous Food. Research has shown that managerial knowledge is increasingly becoming an integral, complex, and formalized aspect of a business, especially concerning organizational structure [148]. Research on managing indigenous foods focuses more on fertilization applications for some domesticated indigenous foods [149]. Emphasis is also growing on the need for specific management skills in all stages of domestication [92]. However, little research has been channeled into investigating managerial practices and logistic strategies needed to improve personnel involvement in indigenous foods activities [150]. The 1.68% of research from all the research reviewed targeting the managerial issues of indigenous foods in the past two decades indicates that more knowledge is needed to cover the numerous managerial aspects of indigenous foods. These findings are similar to a study in Uganda, which states that managerial knowledge of indigenous foods plants is not widespread [151].

Among the managerial and logistics challenges that restrict the integration of some indigenous foods and their farmers into the mainstream agribusiness industries in the Western Cape, South Africa, include complex harvesting techniques and a lack of professional handling of indigenous foods products [152]. They also lack value chain managerial skills and limited market knowledge linking farmers and indigenous foods to distributors and distributing options

[152]. In Kenya, the farmers who are mainly women but involved in the harvesting and marketing of African indigenous vegetables suffered a loss due to poor and inappropriate management during harvest, postharvest treatment, handling, transportation, and preservation [150]. Linked with the foregoing assertions, it may be concluded that, a lack of a clear and systemic managerial pathway that prevents food-borne pathogens and antibiotic-resistant bacteria health risk challenges in the consumption of some indigenous foods militate against their broader acceptability in the food system [153]. Some rural households involved in indigenous food trading poorly managed their available resources [154]. In some cases, the management challenge arises from inappropriate execution and integration of management plans, guidelines, and regulations [155].

3.15. Research Investigation on Indigenous Foods Policy, Law, and Program. In recent years, a few African countries renewed interest in policies and programs targeting indigenous food development [156]. A recent study in the Benin Republic revealed that implementing the government's new policy on the certification of infant formula made from indigenous food enables their general acceptability and sales in supermarkets [31]. A certification policy granting legal backing to indigenous vegetables in Uganda helped to reduce market barriers [31].

In 2014, the Republic of South Africa, through the government gazette national food policy number 37915 in an effort to promote food security induced the neglected indigenous foods production, development, markets, consumption, promotion, conversation, and diets diversification role for households [157]. To achieve the government's policy objective, the Agricultural Research Council, an arm of the government research institute, kick-started the cultivar development program of indigenous food crops [158]. Another policy program by the South Africa Department of Science and Technology and the Department of Agriculture in the Limpopo Province initiated the MIFPC, established in 2006 on skill acquisition using a pedagogy approach to locally produce peanut butter, prickly pear jam, marula jelly, and juice [139]. The MIFPC policy program, which aims to promote indigenous foods and knowledge, states that beneficiaries must belong to a group of eight unemployed women and two men in the communities where those indigenous foods are produced [139]. Implementing a policy program in Kenya increased the consumption and adoption of indigenous vegetables [159]. The policy directive mandating 30% of food prepared for hospitals and schools be made from indigenous foods across the 47 counties of Kenya has transformed their demand, use, and profiles [160].

The outcome of our search on program and policy research development promoting indigenous foods growth in Africa is grossly low despite some governments' renewed interest in indigenous good policy, program, and development. As shown in Table 3, our findings reveal that, only 1% of the government's policy and program has contributed to the growth of indigenous foods in the past two decades. In other words, indigenous foods still lack aggressive policies and programs that could drive their economic maximization. Research also revealed little or no meaningful progress on indigenous foods growth due to program and policy neglect [158]. This suggests that most governments from developing nations, particularly in Africa, do not provide enough bedrock programs and necessary policies for most indigenous foods [161]. Some policymakers and policies depreciate the value of some indigenous foods [38]. The more disappointing issue is that some government agencies, such as the Department of Agriculture and Extension Service, do not often promote indigenous foods [162]. For example, some researchers in Africa, including: Oloko [144] in Nigeria, Aura et al. [155] in Kenya, Mudau et al. [93] in South Africa, and Afari-Sefa et al. [99] who investigated indigenous foods across Africa, have decried the lack of indigenous foods enhancing policy and the extant policies ignored the potentials of most indigenous foods.

3.16. Level of Disease, Econometrics Analysis, and Private Sector Investment Research Development on African Indigenous Foods. There is a low proportion of research development focused on the pest and disease control of indigenous foods. Table 3 shows that less than 1% of research development has contributed to the growth in indigenous foods research progress. The emerging findings corroborate with research done by Kagali [163], which states that little is being done to address the pest and disease challenge of indigenous foods such as amaranth. A possible reason for little effort in addressing indigenous food pest and disease challenges is that most are left to nature in the wild. In addition, postharvest disease and pest problems cause nutritional damage and economic loss in indigenous African leafy vegetables' supply and value-addition chain [150]. The reality is that pest and disease control challenges transcend many areas of African agricultural practices, especially during pest outbreaks, pest resurgence, the application of chemicals, toxicity management, and prevention management of nontargeted organisms [164]. Another area lacking in research development of indigenous foods is economic/econometrics analysis, such as efficiency, profitability, and production cost. The less than 1% of research focus invested in the niche area of indigenous foods economic/econometrics analysis indicates a lack of deep knowledge of the financial viability and risk of producing indigenous foods. The limited understanding of indigenous foods' financial transition and efficiency could also prevent the private entrepreneurs from investing in some indigenous foods. This could be why Logue et al. [32] state that there is rarely a private investor or entrepreneurial information about indigenous foods. However, both private investment and private investors information are necessary for the growth and development of indigenous foods [165].

4. Conclusion

This review has shown that despite numerous challenges associated with indigenous foods, they improve household income, food diversity, and food and nutritional security. Indigenous foods are rich sources of valuable minerals and vitamins crucial for the populace's good health and wellness. Africa has numerous nutritional rich indigenous foods. However, they face a series of challenges in their various

niche areas. These range from negative and poor commitment from most governments in Africa to a dearth of training programs and formulation of policies that address the importance of promoting agricultural activities that will enhance the growth and acceptance of indigenous foods. The review has shown that most indigenous foods' developmental programs and initiatives come from the Western world. The low level of indigenous foods managerial research development in recent times indicates that many of the stakeholders involved in indigenous foods agribusiness are likely to lack updated managerial and logistic skills in cultivation, professional handling, processing, value chain, marketing, and finance.

Indigenous foods transactions are mainly operated in an open market structure with the free entering and exit of its numerous stakeholders. Most of their product's processing, preservation, and value-addition methods involved old local and traditional techniques such as grinding, frying, drying (firewood or sun-drying), roasting, water, and alcoholic extraction, without standard laboratory procedures. In some cases, the packaging is done using folders. The review has shown that their awareness campaign and promotion lack practical demonstration and make little use of socio-media. There is a lack of research revealing the commitment of private investors in many indigenous food developments, indicating the lack of interest from private investors/entrepreneurs in indigenous food agribusiness. In essence, there exists a gap in applying biotechnique in embryo genesis, genetic engineering, another culture, meristem culture, and protoplast culture in many indigenous foods. The prevention of abiotic and biotic stresses and in vitro selection in the domestication of many indigenous crops are still lacking. The forecast trend shows that the growth will continue in the pattern dominated by review and data research with less laboratory, experimental, and practical application research. The decline in the broader acceptance and consumption of indigenous foods could be attributed to less development in their many niche areas.

5. Recommendation

Based on the findings of the study, the following recommendations are made: the government from Africa should commit synergy to investment, policy, and programs targeting all niche areas of indigenous foods' growth and development. Regulation on the market of indigenous foods that will allow private investors to be involved in the developmental process is also proffered. More experiments and practical research should be conducted on indigenous foods. Awareness campaigns should involve a practical demonstration of preparing and consuming the less utilized indigenous foods. There should be an increase in the awareness creation of the nutritional value of indigenous foods through radio and television programs and not just only in print and research media. The promotion and awareness campaign of indigenous foods should target the elite households who think indigenous foods are for the vulnerable. There should also be taste marketing, demonstration, and exhibition of indigenous foods internationally through different channels such as conferences and on-going training workshops. Therefore, more efforts should be made to introduce and promote Africa indigenous foods at local and global stages.

Data Availability

Data for this study is shared among authors and will be made available on request by the ethics and agreement with the University of Fort Research ethics committee.

Additional Points

Limitations of the Study. The literature used for the growth analysis is basically restricted to from year 2000 to 2022. We are also aware that there might be oversight by omitting some work done in the selected areas, but a conscious effort was made to gather as much work as possible.

Conflicts of Interest

The authors declare that there is no conflict of interest in this research.

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