

Assessment of the Nutritional and Ethno-medicinal Uses, Domestication, Production and Conservation of *Senecio biafrae* Among Farmers in Ekiti State, Southwestern NigeriaSamuel O Baiyeri,^{1*} Abiodun O. Ajala², Kolawole Olajide³, Bayode J. Kolawole¹Department of Crop Science and Horticulture, Federal University, PMB 373, Oye-Ekiti, Ekiti State, Nigeria²Department of Agricultural Extension and Rural Development, Federal University, PMB 373, Oye-Ekiti, Ekiti State, Nigeria³College of Agriculture, PMB 205, Division of Agricultural Colleges, Ahmadu Bello University, Kabba, Kogi State, Nigeria⁴Department of Animal Production and Health, Federal University, PMB 373, Oye-Ekiti, Ekiti State, Nigeria.**ABSTRACT**

This study assessed the utilization (nutritional and ethnomedicine), domestication, production and conservation efforts of *Senecio biafrae* among farmers in Ekiti State, Southwestern Nigeria. All the *Senecio biafrae* farmers in the area formed the population of the study. A multistage sampling procedure was employed to select 120 respondents for the study. Data were collected through a structured interview schedule and were analyzed to obtain percentages, frequency count and mean scores. The results indicated that the majority (100%) of the farmers use *Senecio biafrae* as food with 63.4 per cent using it multiple times a week. The majority (90.2%) of the farmers use the leaf for medicinal purposes. The major medicinal uses of *Senecio biafrae* included: blood treatment/enhancement, body temperature regulation and in the treatments of indigestion, stooling, convulsion and skin disease. The study found that the majority (73.2%) of the farmers source *Senecio biafrae* from the forest/wild for consumption. 57.7% of the farmers intercrop it while 8.9% of the respondents grow it as a sole crop in their farms. The majority (75%) of the farmers apply organic fertilizer in *Senecio biafrae* production. Half (49.6%) of the farmers grow *Senecio biafrae* continuously as part of its sustainability or conservation strategy. Awareness creation through sensitization campaigns on the nutritional and medicinal benefits, increased production of *Senecio biafrae* and the conservation of its biodiversity are recommended.

Keywords: *Senecio biafrae*, underutilized, production, ethnomedicine, conservation, vegetable

Received 29 May 2024

Revised 19 June 2024

Accepted 19 June 2024

Published online 01 August 2024

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Africa has had an age-long history of healthy local and traditional diets made from indigenous fruits, vegetables and other staple crops. Opazo-Navaette *et al.*¹ noted that World Health Organization (WHO) statistics showed that more than 80% of the rural inhabitants globally depend on indigenous plants as a means of primary health care and nutrition. Today, most African middle and low-income countries are experiencing a dietary transition from traditional food crops that include vegetables to highly processed foods; mostly driven by urbanization and globalization.² Foods that are rich in fruits and vegetables are essential for sustainable and healthy diets and are excellent and promising strategies for reducing the risks of non-communicable diseases such as cancers, cardiovascular diseases, diabetes and micronutrient malnutrition.²⁻³ The vitamins, minerals, fibres, proteins and non-nutritive bioactive compounds (flavonoids, phenolic compounds and bioactive peptides) in vegetables have been reported to have proven health-promoting effects.⁴

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Citation: Baiyeri, SO, Ajala, AO, Olajide, K, Kolawole BJ. Assessment of the Nutritional and Ethno-medicinal Uses, Domestication, Production and Conservation of *Senecio Biafrae* Among Farmers in Ekiti State, Southwestern Nigeria. Trop J Phytochem Pharm. Sci. 2023; 2(3): 278 - 283 <http://www.doi.org/10.26538/tjpps/v3i4.5>

Official Journal of Natural Product Research Group, Faculty of Pharmacy, University of Benin, Benin City, Nigeria

Africa especially Nigeria has a large biodiversity of indigenous green leafy vegetables. These vegetables have huge nutritional, economic and medicinal (nutraceutical) advantages that have not been fully explored. Most of these indigenous leafy vegetables are adaptive to the local environmental conditions and the low-input cropping systems in the Nigerian rural communities suggesting the potential for their sustainable production. Some of these indigenous green leafy vegetables are resilient, drought-tolerant and can grow and give some appreciable yield under marginal soil conditions and even when undomesticated in the wild. Women sometimes take the lead in collecting the indigenous green leafy vegetables from the forests and try to grow some in home gardens. Most of the indigenous green leafy vegetables are linked to the culture of the rural people. Despite the enormous usefulness of these indigenous vegetables for dietary and nutrition security, they are still regarded as under-exploited and neglected because most of them have not been improved through hybridization. Their seed systems, value chains and supply chains are either poorly developed or in most cases yet to be developed. In comparison to the exotic or commonly consumed vegetables, there are little or no funding and research activities on them. Large-scale processing and storage facilities for these indigenous vegetables are scarce, hence, post-harvest losses occur when they are produced or harvested in large quantities.

Senecio biafrae is one of these Indigenous green leafy vegetables, notable for its promising nutritional, nutraceutical and economic potentials. It grows naturally in various parts of Africa including Nigeria. In Nigeria, it is called Ota eke in Igbo and Worowo in Yoruba while it is known as Bologi in Sierra Leone.⁵ According to Baiyeri *et al.*⁶, in South-Western Nigeria, the demand for this vegetable exceeds the quantities supplied in the markets; this makes it relatively costlier

than other green leafy vegetables in the region. *Senecio bialfrae* is still harvested from the wild and in the fields of plantation crops such as cocoa and coffee plantations.⁷⁻⁸

Baiyeri et al.⁶ found that this vegetable is rich in micronutrients such as iron, magnesium, potassium, copper, zinc, calcium, vitamins, fibre and very low in fat and anti-nutrients. Ethnobotanical investigation established that the leaves are employed in treating diabetes, infertility, cough, rheumatism, hypertension, dysentery, piles, and sore eyes and the leaf extract is also used to stop bleeding from injury.⁹ The root has been utilized in treating liver diseases.¹⁰

Senecio bialfrae is at risk of going into extinction because it has not been fully domesticated and brought into the regular cropping systems like the commonly consumed vegetables like amaranth and spinach. Rapid urbanization as a result of population explosion and the lack of conscious efforts to protect numerous plant species have led to their genetic erosion.¹¹⁻¹³ There is poor availability of planting materials and poor awareness of its nutritional values. There is limited information on its agronomy and poor funding for investigating various aspects of *Senecio bialfrae*.⁷⁻⁸ Documented information on its utilization, domestication, conservation and production especially in Ekiti State is still scanty in the literature. The value and supply chains of this important vegetable are still under-developed. Hence, there is a need for urgent conservation and domestication of the vegetable. Eiki et al.¹⁴ stressed the need to conserve food and herbal plants for future generations. In achieving this, identifying plants that have food and medicinal value is required. The parts of the plant used, the method of preparation, the nature of diseases they treat and methods for herbal remedies are needed.¹⁵⁻¹⁶

Baseline surveys that reveal the present knowledge about *Senecio bialfrae* utilization, domestication, conservation and production efforts are required to maximize the potential of *Senecio bialfrae*, and develop sustainable and demand-driven value and supply chains. This baseline study was therefore carried out to document the utilization (nutritional and medicinal), domestication, conservation and production efforts of farmers in Ekiti State (one of the states in Southwestern Nigeria, where it is largely collected from the wild and utilized).

Materials and Methods

Study area: The study was carried out in Ekiti State, Nigeria. Ekiti State is one of the major *Senecio bialfrae* producing areas in southwestern Nigeria. Ekiti State has 16 Local Government Areas and a total population of 3,785,001 people consisting of 1,917,759 males and 1,867,242 females.¹⁷

Population and sample for the study: The population of the study included all the *Senecio bialfrae* farmers in the study area. A multistage sampling procedure was employed for the study in selecting respondents. In the first stage, the three agricultural zones (zones 1, 2 and 3) in the State were selected. In the second stage, two blocks were randomly selected in each of the agricultural zones making 6. In the third stage, two circles were randomly selected in each of the blocks. In the fourth stage, ten *Senecio bialfrae* farmers were randomly selected from each of the 12 blocks making 120 respondents. Data were collected using a structured interview schedule.

Measurement of variables: To determine the uses of *Senecio bialfrae* among farmers (objective 1), respondents were asked to indicate its different household uses by ticking from the options provided. Also, they were asked to indicate either yes/no to questions like: "Do you use *Senecio bialfrae* as food?", "Do you use *Senecio bialfrae* for feeding animals?" etc. To assess the domestication of *Senecio bialfrae* among farmers (objective 2), the respondents were asked to indicate among options sources of obtaining the vegetable. They were also asked to indicate either yes/no to questions relating to its production and harvesting practices (objective 3). Also, respondents were asked to indicate either yes/no to questions like; have you ever planted *Senecio bialfrae* in your farm? etc. Respondents were asked to indicate ways they ensure *Senecio bialfrae* does not disappear (go into extinction). To ascertain the conservation of *Senecio bialfrae* among farmers (objective 4).

Statistical Analysis

Data collected through structured interview schedules were analyzed to obtain percentages, frequency count and mean scores using SPSS Statistics 20 (2021).

Results and Discussion

Data in Figure 1 reveals that all (100%) of the farmers use *Senecio bialfrae* as food, an average (of 55.3%) of the farmers use it as feed while 60% of the farmers use it as herbs.

Figure 2 also shows that a greater proportion (63.4%) of the respondents use *Senecio bialfrae* multiple times in a week, 13% of them use it seldomly while 11.4% and 10.4% of the farmers use *Senecio bialfrae* once in 2 weeks and once in a week, respectively. The results have revealed that all the farmers (100%) consume *Senecio bialfrae* as food. This indicates its huge importance for nutrition and dietary purposes. The findings on the utilization of this vegetable were in line with Adepoju and Aka¹⁸ who noted that vegetables make up a major portion of the human diet and play a significant role in human nutrition, especially as sources of vitamins, minerals, dietary fibre and phytochemicals. Its utilization multiple times a week suggests its acceptability, palatability and preference when compared to other vegetables in the study area. This study found out that every part of the *Senecio bialfrae* plant is being used by the farmers for one purpose or the other but that the leaf is largely used for nutritional purposes which further emphasized its benefits to households. This finding corroborated the report of Adeyemi¹⁹ who found that consumption of the leaves of *Senecio bialfrae* in Nigeria is associated with their roles in nutrition and health which exceed the routinely cultivated leafy vegetables which could encourage its domestication for regular cultivation.

Nutritional/medicinal uses of *Senecio bialfrae*

Results in Table 1 reveal that the majority (90.2%) of the farmers use the leaf of *Senecio bialfrae* for nutritional purposes, while 12.2% and 0.8% of them use the stem and root of *Senecio bialfrae* as a medicine, respectively. Also, Table 1 shows that 44.7% of the respondents prepare two delicacies from *Senecio bialfrae*, 24.4% of the farmers prepare about three delicacies from it, only 12.2% of the respondents prepare about five delicacies from it, and a small proportion (8.9%) of them prepare one and five delicacies from *Senecio bialfrae*. Entries in Table 1 also indicate that 24.4% of the farmers use *Senecio bialfrae* for blood treatment/enhancement, while 13.8% and 11.4% of the farmers use it for body temperature regulation and reported that it aids digestion/stooling, respectively. A small proportion (5.7%) of the farmers use it to treat convulsions. About 3.3% of them use *Senecio bialfrae* to relieve pain and help in childbirth. Only 2.4% of them use it for skin treatment/care.

The multipurpose value of this vegetable was revealed in the various uses of *Senecio bialfrae* in the preparation of delicacies or soups in the study area. The responses of the farmers showed that *Senecio bialfrae* has ethnomedicinal and therapeutic properties which the respondents explore in curing various diseases and ailments. The finding was in tandem with Bello et al.²⁰ and Ayoola et al.²¹ who reported that *Senecio bialfrae* has both hypoglycemic and anti-anaemic properties. The hypolipidemic and antioxidant activities of its aqueous leaf extract have been reported.²¹ The aqueous leaf extract was found to reduce glucose levels. It is used to treat oedema, cough, heart troubles and as a rheumatic pain reliever.⁹ These results have revealed that *Senecio bialfrae*, despite being a neglected leafy vegetable, has huge potential for nutrition, health and income generation potentials. More research and funding efforts should therefore be focused on it. There is an increased awareness of the health benefits of indigenous crops and a shift in diets towards healthier and safer foods from indigenous plant species. A good number of indigenous plants have also been reported in Morocco and Thailand with huge therapeutic values and the sensitization for their conservation is also ongoing.^{22,23} Neglected and underexploited crops are currently being researched owing to their potential to contribute to food and nutrition security, improved human health and livelihoods, employment creation and sustainable rural development.²⁴ Utilizing the numerous underutilized plant species

would provide a more diversified agricultural system and food sources necessary to solve food and nutrition security problems in the face of climate change.²⁵

Table 1: Nutritional/medicinal uses of *Senecio biafrae*

Nutritional/medicinal purposes	Frequency	Percentage (n=120)
Parts of <i>Senecio biafrae</i> used		
Leaf	111	90.2
Stem	15	12.2
Root	1	0.8
Number of delicacies that can be prepared from <i>Senecio biafrae</i>		
One	11	8.9
Two	55	44.7
Three	30	24.4
Four	11	8.9
Five	15	12.2
Major medicinal uses of <i>Senecio biafrae</i>		
Blood treatment/enhancement	30	24.4
Body temperature regulation	17	13.8
Skin treatment/care	3	2.4
Aids digestion/stooling	14	11.4
Aids childbirth	4	3.3
Convulsion	7	5.7
Pain relief	4	3.3

Source: Field survey, 2022

Sources, domestication and production of *Senecio biafrae*

Table 2 shows that the majority (73.2%) of the farmers source *Senecio biafrae* from the forest/wild for household consumption. A greater proportion (65%) of the farmers source it from farms while 38.2% and 13.8% of the farmers source *Senecio biafrae* from the market and home garden for their household's consumption. Table 2 also reveals that a little above half (57.7%) of the farmers intercrop *Senecio biafrae* in their farms, while a small proportion (8.9%) of the respondents grow *Senecio biafrae* as a sole crop in their farms. Furthermore, Table 2 indicates that a small proportion (10.6%) of the farmers carry out their *Senecio biafrae* production on less than one acre. About 5.7% and 4.1% of the farmers plant their *Senecio biafrae* on less than four acres and one to two acres of land, respectively. Table 2 reveals that a greater percentage (87.8%) of the farmers indicated the use of stem as *Senecio biafrae* planting material while 7.3% and 0.8% of the farmers indicate root and leaf as their planting materials for the cultivation of *Senecio biafrae* in the area, respectively. Results in Table 2 further show that the majority (82.1%) of the farmers indicated that only one accession of *Senecio biafrae* was known to them while only 16.3% of the respondents indicated that two accessions of *Senecio biafrae* were known to them in the area. The results revealed that the major source of *Senecio biafrae* for consumption is the wild/forest which is an indication of its neglected state due to the inability of the vegetable farmers to tap into the production opportunities in their farms and home gardens in the study area. The ones gotten from the market are sourced from the forest and brought to the market for sale. This finding aligned with Baiyeri et al.⁸ who reported that *Senecio biafrae* is an important underutilized leafy vegetable that is majorly harvested from the forests.

Many neglected and underutilized plant species are mainly harvested from the wild.²⁶ Several underutilized indigenous vegetables are generally growing in the wild without any attempt to cultivate them.¹⁹ They found that in the forest, there is a massive exploitation without replacement. This implies that the biodiversity of *Senecio biafrae* might have been decimated and this green leafy vegetable is therefore becoming endangered. Also, the results on types of cropping systems of *Senecio biafrae* showed that a little above half of the respondents who have started planting the vegetable in the study area intercrop it. Vegetable farmers will want to maximize their parcel of land for optimal use; so the possibility of intercropping it with other crops is a promising prospect for its production and conservation. The results on farm size (under sole cropping system) depicted that 10.6% of the farmers committed a little fragment of land (less than one acre) to the production of *Senecio biafrae*. This suggests an increasing commitment to the production of this vegetable as a sole crop in the study area when compared with its former state of being completely left in the wild.

According to the farmers' responses on the types of planting materials used during the planting of *Senecio biafrae*, the majority (87.8%) of them indicated that the use of stem was a better means of propagation of *Senecio biafrae*. *Senecio biafrae* has been propagated vegetatively from vines for ages hence, the use of its cuttings with two and three nodes that are 20 cm long was found to be adequate.²⁷ Based on the cultivars (accessions) of *Senecio biafrae* known to the farmers, the results reveal that only one cultivar of *Senecio biafrae* is known to the farmers in the area. It could mean that soil and environmental factors were favourable to the production of the cultivar which has made the farmers prefer its continuous production. It could also mean that the various accessions (biodiversity) of this vegetable are still left in the wild, not conserved and could go into extinction if they are not urgently collected and properly conserved. The government should therefore encourage the farmers that are growing it by giving them credit facilities as an incentive for enhancing the production and conservation of this vegetable. *Senecio biafrae* might be important in the near or far future and considering their therapeutic/medicinal and nutritive values and the potential economic value, encouraging farmers to produce this vegetable could help to improve their livelihoods.

Figure 3 shows that a greater proportion (70%) of the farmers use stem cutting method to harvest *Senecio biafrae* in the area while 30% of the respondents use leaf picking method to harvest *Senecio biafrae*. The harvesting of *Senecio biafrae* using the stem harvesting method has implications for its increased yield and sustainable production. Harvesting green leafy vegetables by uprooting them from the soil normally takes away the possibility of harvesting thereafter from the harvested stands of the vegetables. Harvesting by stem cutting or leaf picking gives room for regeneration of the vegetable and enhances profuse branching and the production of large biomass of the leaves of the vegetable resulting in increased yield.

Figure 4 reveals that half (50.4%) of the farmers indicated that they harvest *Senecio biafrae* for household use while 49.6% of them indicated that they did not harvest *Senecio biafrae* for household use. Some of the farmers in the study area normally sell their harvested *Senecio biafrae* primarily to make money. This indicates that the vegetable has both food and economic values. The development of the value and supply chains of *Senecio biafrae* in Ekiti State therefore has the potential of not just enhancing food and nutrition security but it could be contributing significantly to the livelihoods of the farmers that grow it.

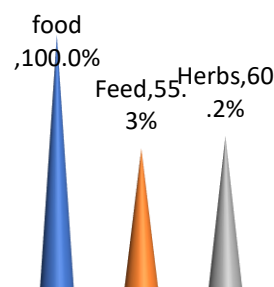


Figure 1: Uses of *Senecio biafrae*

Table 2: Sources, domestication and the production of *Senecio biafrae*

Sources of <i>Senecio biafrae</i>	Frequency	Percentage (n=120)
Sources		
Farm	80	65.0
Forest/wild	90	73.2
Home garden	17	13.8
Home garden	17	13.8
Market	47	38.2
Type of cropping system		
Sole crop	11	8.9
Intercrop	71	57.7
Farm size (under sole cropping system)		
1 acre	13	10.6
1-2 acre	5	4.1
3-4 acre	1	0.8
>4 acre	7	5.7
Resistance of <i>Senecio biafrae</i>		
Resistant to drought	16	13.0
Resistant to water logging	73	59.3
Pest attack	6	4.9
Types of planting material		
Stem cutting	108	87.8
Root	9	7.3
Leaf	1	0.8
Types (accessions) of <i>Senecio biafrae</i> known to the farmer		
One	101	82.1
Two	20	16.3

Source: Field survey, 2022

Conservation of *Senecio biafrae*

Entries in Table 3 show that below average (49.6%) of the farmers plant *Senecio biafrae* continuously as a strategy for its conservation and only 8.9% of the respondents use irrigation as a strategy for *Senecio biafrae* sustainability in the area. Also, results in Table 3 reveal that 30.1% and 26.8% of the respondents allowed *Senecio biafrae* 5 weeks and 4 weeks before cutting the leaves for household use, respectively. Only 15.4% of them allowed *Senecio biafrae* 2 weeks before cutting the leaves for household use, while 5.7% and 4.1% of the farmers allowed *Senecio biafrae* 1 week and 3 weeks before cutting its leaves for household use, respectively. Additionally, table 3 indicates that 29.3% of the farmers harvested *Senecio biafrae* twice a month, and about 27.6% of them

harvested *Senecio biafrae* once a month. Only 8.1% of the farmers harvested *Senecio biafrae* three or four times a month. The remaining 3.3% of the respondents harvested *Senecio biafrae* five times a month. Table 3 further shows that only 28.3% of the farmers apply fertilizer in *Senecio biafrae* production in the area. The majority (75%) of the respondents apply organic fertilizer in *Senecio biafrae* production while 25% of the respondents apply inorganic fertilizer in *Senecio biafrae* production in the area. The 29.3% of the farmers in the study area that responded they harvested *Senecio biafrae* every fortnight suggesting it has a good regenerative capacity. The high regenerative capacity of this vegetable as earlier mentioned is a promising prospect for its sustainable production. The majority of the farmers harvest *Senecio biafrae* by using stem-cutting methods which is the most appropriate means of harvesting other vegetables because it maximizes yield and minimizes leaf losses and quality deterioration. This finding agrees with Adeyemi¹⁹ who reported that harvesting was done by cutting tender stems of *Senecio biafrae* at the experimental sites in Ado-Ekiti, Southwestern, Nigeria.

Responses on fertilizer application showed that the majority (75%) of the farmers indicated that they apply organic fertilizers in *Senecio biafrae* production in the area. This suggests that this vegetable is still organically produced in the study area. Organic fertilizer will encourage its growth and enhance soil and crop health. This finding agrees with Akintola et al.²⁸ who reported that *S. biafrae* grown using poultry manure showed better growth performances. The current organic production practice for *Senecio biafrae* by farmers further suggests the consumption of this green leafy vegetable will greatly enhance human nutrition and health and should have no negative effects on the environment. Organically produced foods are currently being encouraged for consumption for sustainable food and nutrition security.

Table 3: Conservation strategies, harvesting and fertilizer application in the production of *Senecio biafrae* by farmers in Ekiti State

Variables	Frequency	Percentage (n=120)
Conservation strategies		
Planting continuously	61.0	49.6
Large scale planting	2.0	1.6
Home gardening	8.0	6.5
Irrigation	11.0	8.9
Maintaining existing plant	4.0	
Intervals (weeks) allowed before picking edible leaves		
1 week	7.0	5.7
2 weeks	19.0	15.4
3 weeks	5.0	4.1
4 weeks	33.0	26.8
5 weeks	37.0	30.1
Frequency of harvesting in a month		
Once	34.0	27.6
Twice	36.0	29.3

Three times	10.0	8.1
Four times	10.0	8.1
Five times	4.0	3.3
Fertilizer application		
Yes	4.0	3.3
No	116.0	96.7
Type of fertilizer applied		
Organic fertilizer	3.0	75.0
Inorganic fertilizer	1.0	25.0

Source: Field survey, 2022

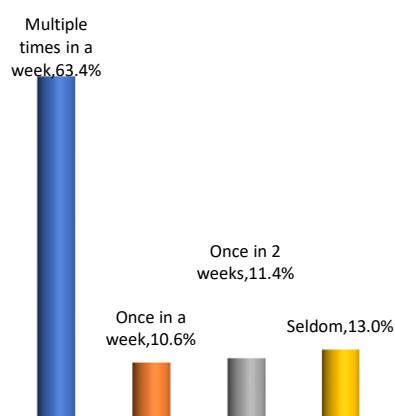


Figure 2: Frequency of use of *Senecio bialfrae*

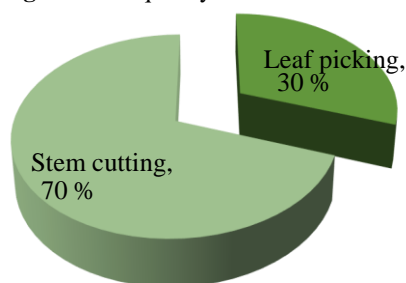


Figure 3: Method of propagating *Senecio bialfrae*

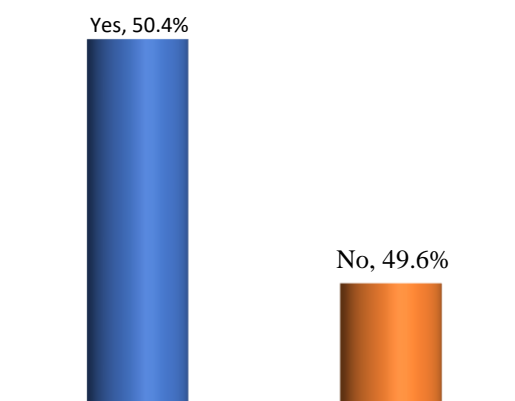


Figure 4: Harvesting of *Senecio bialfrae* for home use

Conclusion

The study revealed that *Senecio bialfrae* is a multipurpose vegetable that has enormous nutritional value and medicinal properties that include: blood treatment/enhancement, body temperature regulation, treatment of indigestion and stooling, treatment of convulsion, skin disease treatment, etc. Deliberate and continuous planting of the vegetable has been a major conservation strategy to keep it from becoming extinct. *Senecio bialfrae* was mostly organically produced by farmers in Ekiti State. The interest in producing it is gradually increasing. Domestication, production and conservation of *Senecio bialfrae* should therefore be increased and encouraged thereby mitigating the extinction threat it faces. Government and donor agencies should make funding available to enhance research into various aspects of this invaluable green leafy vegetable. Agronomists should come up with production and crop management practices that will enhance its sustainable production. The extension agents should extend available information on the production practices to farmers. Sensitization campaigns by researchers and extension agents on the numerous benefits of *Senecio bialfrae* are required to create awareness about its nutritional, medicinal and economic potentials.

References

- Opazo-Navaette M, Burgos-Diaz C, Soto-Cerda B, Barahona T, Anguita-Barrales, F. Mosi-Roa Y. Assessment of nutritional value of the traditional vegetables from Southern Chile as potential sources of natural ingredients. *Plt Foods Hum Nut.* 2021;76: 523-532.
- Afshin A, Sur PJ, Fay KA, Cornaby I, Ferrara G, Salama JS, Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet.* 2019; 393:1958–72.
- Wallace TC, Bailey RL, Blumberg JB, Burton-Freeman B, Chen CO, Crowe-White KM. Fruits, vegetables, and health: a comprehensive narrative, umbrella review of the science and recommendations for enhanced public policy to improve intake. *Crit Rev Food Sci Nut.* 2020; 60:2174–211.
- Zhang L, Lib Y, Liang Y, Liangc, K, Zhang, F, Xua, T, Wanga, M, Songa, H, Liub X, Lua B, Determination of phenolic acid profiles by HPLC-MS in vegetables commonly consumed in China. *Food Chem.* 2019; 276:538–546.
- Olubode OS. Johnson AS. Performance of *Senecio bialfrae* (Oliv. & Hiern) J. Moore under Varying Light Intensities and Compost Rates in Ibadan, Southwestern Nigeria. *Ibadan J Agric Res.* 2019; 15(1):39-47.
- Baiyeri SO, Samuel-Baiyeri CCA, Ndukwe OO. Proximate, mineral, vitamin, and anti-nutrient content of *Senecio bialfrae*. *J Agric Sci. (Belgrade).* 2023a; 68(1):67-79.
- Baiyeri SO, Oluwole TI, Osakwe UC, Effects of Fertilizers on the Growth Performance of *Senecio bialfrae* Accessions. *J Agric Food Env.* 2022; 9(3):11-21.
- Baiyeri SO, Okoro JC, Oluwasegun FO, Fakunle OO, Okoronkwo DJ Aladesiun R Constraints to the production of *Senecio bialfrae* (worowo) in Ekiti State, Southern Nigeria. *J Austrian Soc Agric Econ.* 2023b; 19(5):1729-1740.
- Osiyemi OA, Adejoh OP, Ugbogu AO. Comparative therapeutic phyto-constituents of *Senecio bialfrae* (Oliv. And Hiern) J. Moore and *Vernonia amygdalina* Del. (Ed) in: Nkiru T. Meludu, Eucharia A. Obidiebube, Onyekachi Chukwu and Chika F. Ikeogwu. Proceedings of the First Faculty of Agriculture International Conference, Nnamdi Azikiwe University, Awka, Nigeria. held at Nnamdi Azikiwe University, Awka Campus, Anambra State, Nigeria between 22nd-24th March, 2023. Pp. 372-377.
- Okoro IO, Kadiri HK. Anti-Oxidant and Hepatoprotective Effects of *Senecio bialfrae* on CCl₄-induced Liver Damage in Rats. *Iran J Toxicol.* 2019; 2:31-35.

11. Raus RB, Costa LMS, Bered F. Urbanization driving changes in plant species and communities – a global view. *Glob Ecol Conserv.* 2022;38: e02243. <https://doi.org/10.1016/j.gecco.2022.e02243>.
12. Oko PE, Odey DU, Anake CB. Impact of population growth on biodiversity loss in Boki agro-ecological rainforests, Cross River State, Nigeria. *Glob J Pure Appl Sci.* 2022; 28: 99 - 106. <https://doi.org/10.4314/gjpas.v28i1.12>
13. Yu HF, Gao WJ, Yang GF, Wu YQ, Lu YJ. Dynamic change of composition and functions of flora adapting to rapid urbanization: a case study of Hangzhou, China. *Applied Ecol Env Res.*2021;19(5):4007-4023. https://doi.org/10.15666/aeer/1905_40074023
14. Eiki N, Sebola NA, Sakong BM, Mabelebele M. Review of ethnoveterinary practices in sub-Saharan Africa. *Vet Sci.* 2018(6), 1-7 <https://doi.org/10.3390/vetsci8060099>.
15. Ani AO, Onuoha EN, Anaeto FC, Umunakwe PC, Nwakwasi RN, Aja OO. Indigenous Preparation Methods of Medicinal Plants Used for the Treatment of Small Ruminant Diseases in Imo State, Nigeria. *J of Agri Extension* 2024;28(1):81-91 <https://dx.doi.org/10.4314/jae.v28i1.9>
16. Asfaw A, Lulekal E, Bekele T, Debella A, Debebe E, Sisay B. Medicinal plants used to treat livestock ailments in Ensaro District, North Shewa Zone, Amhara Regional State, Ethiopia. *BMC Vet Res.* 2022;18: 235. <https://doi.org/10.1186/s12917-022-03320-6>
17. Ekiti State Bureau of Statistics (EkSBS) (2020). Digest of Local Government Statistics. Published by Ekiti State Bureau of Statistics pp. 4.
18. Adepoju OT, Aka OM. Consumption pattern of neglected and underutilized vegetables among rural households in Akinyele Local Government Area, Ibadan, Nigeria. *Int J Sci.* 2019; 8(06): 105-116. DOI: 10.18483/ijSci.1902.
19. Adeyemi FO. Improving Worowo [*Senecio bialfræ* (Oliv. & Hiern.) S. Moore] Production with Cattle Dung/Sawdust Compost Enriched with Neam Leaf Meal. *Asian SciBullet.* 2024;(3):192-199.DOI: 10.3923/asb.2024.192.199.
20. Bello IO, Ayoola MD, Obembe O, Akinwunmi KF. Antidiabetic and Toxicity Studies of the Extract of Four Nigerian Medicinal Plants. *Euro J Med Plts.* 2022; 33(11), 32-45. DOI: 10.9734/EJMP/2022/v33i1111107.
21. Ayoola MD, Adebajo AC, Zotor FB, Pinkoane MG. Justifying Antidiabetic Ethnomedicinal Claim of *Senecio bialfræ* through Its Antihyperglycemic and Anti-Oxidant Activities. *Annals Compl Alt Med.* 2019; 1(2):1-8.
22. Laohaprapanon S, Jitjum S, Yincharoen K, Panitset T, Sukmak N. Traditional Healing Practices and Folk Medicines in Thailand: A Case Study of Huai Yot District, Trang Province. *Trop J Nat Prod Res.* 2024; 8(3):6537-6543. <https://doi.org/10.26538/tjnpr/v8i3.10>.
23. Mahraz MA, M. Idrissi A, Mzali A, El Mrayej H, Lfatouhi A, Salim R, Loukili EH, Jghaoui M, Rais Z, Taleb M. Ethnobotanical Survey of Medicinal and Aromatic Plants used in the Treatment of Skin Burns in the Province of Sefrou of Morocco. *Trop J Nat Prod Res.* 2024; 8(3):6487-6497. <https://doi.org/10.26538/tjnpr/v8i3.3>.
24. Mudau FN, Chimonyo VGP, Modi AT, Mabhaudhi T. Neglected and Underutilised Crops: A Systematic Review of Their Potential as Food and Herbal Medicinal Crops in South Africa. *Front. Pharmacol.* 2022;12:809866. doi: 10.3389/fphar.2021.809866
25. Mabhaudhi T, Chimonyo VGP, Hlahla S, Massawe F, Mayes S, Nhamo L. Prospects of Orphan Crops in Climate Change. *Planta.* 2019;250:695–708. doi:10.1007/s00425-019-03129-y.
26. Oloyede FM, Ola DS, Iwalewa EA. Biodiversity conservation of the neglected and underutilized Nigerian horticultural crops. *Acta Hort Regiotec.* 2023; 26(1): 64–72. DOI: 10.2478/ahr-2023-0010.
27. Bello OA, Ayanda OI, Aworunse OS, Olukanmi BI, Soladoye MO, Esan EB, Obembe OO. *Solanecio bialfræ*: An underutilized nutraceutically-important African indigenous vegetable. *Pharmacog Revs.* 2018; 12:128–132.
28. Akintola OO, Abiola IO, Akinola OO, Babatunde KO, Ekaun AA, Olajire-Ajayi BL. Effects of Organic and Inorganic Fertilizers on the Growth of *Senecio bialfræ* (WOROWO). *J Appl Sc. Enviro. Manage.* 2020; 25(2):145-149.