Plants Used by Bapedi Traditional Healers to Treat Asthma and Related Symptoms in Limpopo Province, South Africa

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To the best of our knowledge there are presently no ethnobotanical surveys focusing on the utilisation of herbal remedies for asthma in South Africa. The present study is therefore an attempt to fill this gap in knowledge. A total of 140 Bapedi traditional healers (THs) practicing in the Capricorn, Sekhukhune, and Waterberg districts of the Limpopo Province (South Africa) were queried using semi-structured questionnaires, supplemented by field observations during face-to-face interview. A total of 104 medicinal plant species (92 indigenous and 12 exotics) belonging to 92 genera, distributed across 54 botanical families, mostly the Asteraceae and Fabaceae (18.5%, for each) as well as Malvaceae (12.9%), were used as antiasthmatics and related symptoms by these THs. Most of the plants were trees and herbs (37.5%, for each), with root (57%), leaf (15.8%), and bark (7.5%), respectively, being the saliently used parts for preparation of remedies. Clerodendrum ternatum, Cryptocarya transvaalensis, Lasiosiphon caffer, Enicostema axillare, Mimusops obovata, Sclerocarya birrea, and Stylochaeton natalensis were widely used and valued by all THs across the surveyed districts. Furthermore, these taxa also scored both the highest use value and fidelity level indexes as asthma therapies. Overall, the larger number of species documented in the present study is recorded for the first time in literature as asthma and/or related symptoms remedies. Our study finding generally contributes towards an establishment of South African database of herbal therapies used traditionally against these conditions.

1. Introduction

Asthma is a chronic lung disease that inflames and narrows the airways, affecting people of all ethnic groups worldwide [1]. Its symptoms include amongst others intermittent attacks of wheeze, cough, breathlessness with variable airway obstruction, chest tightness, and cough that occurs more at night and or early in the morning [2]. In 2008 at least three hundred million people worldwide were diagnosed with asthma and over 250,000 asthma-related annual deaths were reported [3].

Despite the above statistics, asthma continues to be a major world problem affecting people in various countries of the world including Australia [4], India [5], Jamaica [6], and Norway [7]. Health impact of this condition is also common in Africa, and studies conducted in Algeria [8], Nigeria [2], Uganda [9], and Zambia [10], amongst other countries, highlighted this. Asthma impact is also prevalent in South Africa. According to the recent report by the Global Initiative for Asthma, this country has the world’s fourth highest asthma death rate amongst people aged five to 34 years [11]. Furthermore, of an estimated 3.9 million South Africans diagnosed with asthma, 1.5% die of this condition annually [12].

Treatment of asthma is focused on ad hoc treatment of acute exacerbations including lifestyle factors and prevention of exacerbations [13]. There are a number of top medications such as short or long acting beta2 agonist (preferably by inhalation) and inhaled steroid that an asthmatic patient can receive during exacerbations [3]. Supplementary medications
for asthma sufferers include leukotriene receptor antagonists and theophylline or slow release beta$_2$ agonist tablets [14]. However, these therapies are often limited and/or not affordable to a common man residing in most developing countries particularly in Africa [15, 16]. Consequently, asthma sufferers in these countries resort to locally available traditional healers (THs) who prescribe affordable herbal remedies.

There are extremely few ethnobotanical surveys reporting on the use of medicinal plants by indigenous people including THs as treatments of asthma and related symptoms in Africa as a continent. To the best of our knowledge the only studies that focused on this subject were conducted in Cameroon [17] and Nigeria [18]. However, general ethnobotanical studies carried out in other African countries, to name a few, Uganda [19], Kenya [20], Lesotho [21], and Botswana [22], highlighted that THs of other cultures do treat asthma and related conditions. South Africa is no exception and studies by Hutchings [23], Thring and Weitz [24], De Beer and Van Wyk [25], York et al. [26], and Bhat [27] also emphasised this. The present study therefore will be the first in South Africa to exclusively focus on ethnobotanical knowledge and practices of plants implicated in the treatment of these conditions.

2. Methodology

2.1. Study Area and Population. This study was carried out in the three districts (Capricorn, Sekhukhune, and Waterberg) of the Limpopo Province and associated municipalities (Figure 1).

A total of five rural villages from each municipality were chosen as study sites. In general, all these settlements are economically and socially marginalized [28]. Therefore, there is inadequate infrastructure, high unemployment, and dependency on natural resources amongst the people to support their livelihoods [28]. Furthermore, larger number of people still rely heavily on traditional methods of health care for treatment of various ailments [29]; thus THs and their services play an important role in the wellbeing of people. The Bapedi tribe who speak Sepedi language is the dominant ethnic group inhabiting the studied districts, representing more than 50% of the total population [30].

2.2. Ethnobotanical Survey and Data Collection. A reconnaissance study was firstly carried out in each selected village to (i) request permission from local tribal leaders to conduct
this study within their areas of governance and (ii) ask THs who were conveniently (i.e., with the help of local leaders and healers) selected to participate in the survey. Both traditional leaders and healers were enlightened about the nature of the project including aim and objectives, using their mother tongue of Sepedi. Consequently, THs who agreed to take part in this study were requested to sign a consent form.

Data was collected from May 2017 to October 2017 using a semi-structured interview with 140 THs during face-to-face interviews, supplemented by field trips for participant’s observation and specimen collections. The questionnaire was designed to capture information on (i) local names of the plants used by Bapedi THs to manage asthma; (ii) plant parts used; (iii) state/s of used plant part; and (iv) mode/s of preparation and administration of remedies. Overall, THs were questioned independently in their consultation rooms using Sepedi dialect.

Field excursions for medicinal plant species identification and collection were conducted with the assistance of each questioned traditional healer. During these trips THs initially identified the species via vernacular names. Subsequently, voucher specimens were collected, prepared, and deposited at the Larry Leach Herbarium (University of Limpopo), wherein a scientific name of plant species was established by a trained taxonomist.

2.3. Data Analysis

2.3.1. Microsoft Excel and Statistical Package for the Social Sciences (SPSS). The data collected in this study were analysed using Microsoft Excel 2000 and SPSS version 14.0. Descriptive statistics using frequencies and cross-tabulations were utilised in constructing tables showing the commonly used plant species by THs, local names of the plants used for asthma and related conditions, plant parts used and state/s of their usage, modes of preparation, and remedy administration.

2.3.2. Fidelity Level (FL). The FL as described by Al-Quran [31] were used to determine the uniformity of plant utilisation amongst the questioned THs. Analysis of FL of each plant species mentioned by Bapedi THs as a treatment of asthma and related symptom followed the formula displayed below:

\[
FL(\%) = \frac{NP}{N} \times 100, \tag{1}
\]

where \( NP \) was the number of THs who claim the use of a particular plant species to treat asthma or related symptom and \( N \) was the total number of THs who mentioned the use of species as a medicine to treat any given ailment/s (asthma or related symptom). Fidelity level expresses the preference a species is given over others in the management of a particular ailment [32].

2.3.3. Use Value (UV). Use values are calculated for an individual plant, in order to objectively give a quantitative measure of its relative importance to the informants [33]. Therefore, the extent of utilisation of each species used therapeutically by Bapedi THs for asthma and related symptoms was determined via UV, following Phillips and Gentry [33] index:

\[
UV = \frac{U}{N} \tag{2}
\]

From the above formulation, \( U \) was the number of curative applications of each species, where \( N \) represented the total number of THs. Generally plant with broad therapeutic uses or those that are highly accepted as cure of a particular ailment will score a high UV.

3. Results and Discussions

3.1. Diversity of Used Plant Species. This is the first study of its kind in South Africa and few of those conducted in other African countries [17, 18] and elsewhere [34] that focused on the utilisation of plants to treat asthma and related symptoms. A total of 104 medicinal plant species (92 indigenous and 12 exotics) belonging to 92 genera, distributed across 54 botanical families, mostly the Asteraceae and Fabaceae (\( n=10 \) spp., for each, 18.5%), Malvaceae (\( n=7 \) spp., 12.9%), Anacardiaceae, and Euphorbiaceae (\( n=4 \) spp., for each, 7.4%), respectively, were recorded as being used by 140 Bapedi THs to treat these conditions. This diversity of plants is higher compared to 46 noted by Sonibare and Gbile [18] in Nigeria, and 29 by Noumi [17] in Cameroon. The observed variation might be attributed to extremely larger sample size of THs and spatial coverage included in our study compared to these two studies. Some of the above-mentioned botanical families documented in our study are repeatedly noted as predominant in various ethnobotanical surveys focusing on asthma. For instance, the Asteraceae, Euphorbiaceae, and Fabaceae were also represented with higher number of species in a study conducted in India [34]. In a similar survey carried out amongst THs in South Western Nigeria, Euphorbiaceae was also dominant [18]. The widespread and higher utilisation of species from all the aforesaid botanical families is an indication that they are widely distributed in various countries of the world. Overall, their high preponderance in the present study might be due to the fact that they contain a relatively higher integer of antiasthmatic taxa locally known by Bapedi THs compared to the rest of plant families which had less than four taxa (Table 1).

3.2. Plant Habit. Plants documented in this study were mainly trees and herbs (\( n=39 \), for each) as well as shrubs (\( n=26 \)). This finding, however, is not surprising because these growth forms are prevailing components of local flora distributed across the studied districts and municipalities. According to Shankar et al. [35] the more common the growth form is in an area, the greater the probability of its popular use is. Therefore, Bapedi THs might prefer the aforesaid habits due to their local availability and familiarity.

3.3. Distribution of Used Plants within the Municipalities and Districts. The recorded 104 plant species were not used by all THs who diagnosed asthma and its symptoms...
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|------------------|---------------|-----------------|-------|-------------------|-------------|-----------------------------------------------|------------------|---------------------------------|----|----|
| Acanthaceae      | *Blepharis diversispina* (Nees) C.B.Clarke | Setlwatlwa | Shrub | Root | Dry | Boiled for 3–5 minutes. Extract is taken orally. Thrice a day | Fatigue | 6 | 4.2 | 100 | 0.04 |
| Acanthaceae      | *Blepharis subvolubilis* C.B.Clarke | Mookapitsi | Shrub | Root | Dry | Boiled for 5–6 minutes. Extract is taken orally. Thrice a day | Fatigue | 1 | 0.7 | 100 | 0.00 |
| Alliaceae        | Tulbaghia violacea Harv. var. violacea | Moeve-ya-naga | Herb | Bulb | Fresh | Boiled for 3 minutes. Steam inhaled (nasally) under blanket. Thrice a day | Nasal congestion | 2 | 1.4 | 100 | 0.01 |
| Amaryllidaceae   | *Amaryllidaceae* | Khonofolo | Herb | Bulb | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 1 | 0.7 | 50 | 0.01 |
| Amaryllidaceae   | Clivia aurea R.A.Dyer | Maimo | Herb | Root | Dry | Boiled for 4–10 minutes. Extract is taken orally. Thrice a day | Asthma | 1 | 0.7 | 50 | 0.01 |
| Anacardiaceae    | Harpetholium affruminum Bernh. ex Krauss | Motshidi-tshwene | Tree | Root | Dry | Boiled for 5 minutes. Extract is taken orally. Thrice a day | Asthma | 1 | 0.7 | 100 | 0.00 |
| Anacardiaceae    | *Mangifera indica* L | Momenko | Tree | Root | Fresh | Boiled for 3 minutes. Extract is taken orally. Thrice a day | Asthma | 1 | 0.7 | 100 | 0.00 |
| Anacardiaceae    | *Schinus molle* L | Thoba/Mokwepere | Tree | Leaf | Fresh | Boiled for 5–7 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 1 | 0.7 | 14.2 | 0.05 |
|                  |               |                 |       |       |               | Fatigue Laboured breathing | 4 | 2.8 | 57.1 | 0.05 |

Table 1: Plant used to treat asthma and related symptoms in the Capricorn, Sekhukhune and Waterberg districts of Limpopo Province, South Africa.
| Botanical family | Species names                        | Vernacular name  | Habit | Used plant parts | State of use | Methods of herbal preparation and administration                                                                                                                                                                                                 | Aliment(s) treated | Frequency of use; n = THs (140) | FL | UV |
|------------------|-------------------------------------|------------------|-------|------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------------|-----|-----|
| Anacardiaceae    | *Sclerocarya birrea* (A.Rich.) Hochst. subsp. caffra (Sond.) | Morula/Mokano    | Tree  | Bark             | Dry          | Pounded and mixed with dried powdered roots of *B. discolor* and *S. italica*, and dried bark of *P. africanaum*. Powdered is poured in to the boiled water and steam is inhaled (nasally) under blanket. Thrice a day.                                                                 | Asthma            | 1                               |     |     |
|                  |                                     |                  |       | Fruit            | Fresh        | Pounded and mixed with dried powdered roots of *A. erioloba*, *X. caffra* and dried bark of *P. afericanum*. Taken orally with warm water. Pounded and taken orally with warm water. Thrice a day.                                                                                                                                   | Asthma            | 1 100 100 1                      |     |     |
|                  |                                     |                  |       |                  |              | Juice is squeezed (raw), dried and pounded. Powder is poured in the hot water. Steam is inhaled (nasally) under blanket. Thrice a day.                                                                                                                                                                                                 | Asthma            | 1                               |     |     |
|                  |                                     |                  |       |                  |              |                                                                                                                                                                                                                                                                                                                                                             | Asthma            | 137                             |     |     |
| Apiaceae         | *Aepselea amatymbica* Eckl. & Zeyh. var. amatymbica | Leokwane         | Herb  | Rhizome          | Dry          | Pounded and taken orally with warm water. Thrice a day                                                                                                                                                                                                                                                                                                       | Asthma            | 11 7.8 100 0.07                  |     |     |
| Apocynaceae      | *Schizoglossum nitidum* Schlr         | Phenyskga        | Herb  | Root             | Dry          | Boiled (until water gain colour) and extract is taken orally. Thrice a day.                                                                                                                                                                                                                                                                                      | Asthma            | 2 1.4 66.6 0.02                  |     |     |
|                  |                                     |                  |       |                  |              |                                                                                                                                                                                                                                                                                                                                                             | Asthma            | 1 0.7 33.3 0.02                  |     |     |
| Apocynaceae      | *Strophanthus speciosus* (Ward & Harv.) Reber | Morarwane        | Shrub | Root             | Dry          | Boiled for 6–12 minutes. Extract is taken orally. Thrice a day.                                                                                                                                                                                                                                                                                                     | Asthma            | 15 10.7 100 0.10                |     |     |
| Araceae          | *Stylochaeton natalensis* Schott      | Mokunys/Mokushete| Herb  | Root             | Dry          | Boiled for 5 minutes. Extract is taken orally. Thrice a day.                                                                                                                                                                                                                                                                                                    | Asthma            | 140 100 100 1                   |     |     |
| Araceae          | *Zantedeschia aethiopica* (L.) Spreng. | Mothebe          | Herb  | Root             | Dry          | Boiled for 5–6 minutes. Extract is taken orally. Thrice a day.                                                                                                                                                                                                                                                                                                   | Asthma            | 7 5 100 0.05                    |     |     |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliments treated | Frequency of use; n = THs (140) | FL | UV |
|-----------------|---------------|----------------|-------|-----------------|-------------|-----------------------------------------------|----------------|----------------------------------|-----|-----|
| Asphodelaceae   | *Aloe spp.*   | Thogo/Marobadibogale | Shrub | Leaf | Fresh | Mixed with dried pounded leaf of *D. senecoides*. Boiled for 2 minutes. Extract is taken orally. Thrice a day. | Asthma | 3 | 2.1 | 37.5 | 0.02 |
|                 |               |                |       |      |       | Macerated in warm for 3–24hrs. Decoction is taken orally. | Fatigue | 5 | 3.5 | 62.5 | 0.03 |
| Asphodeloideae  | *Aloe falcata* Baker | Sekgopha | Shrub | Leaf | Fresh | Macerated in warm water 2–3 hrs. Decoction is taken orally. | Fatigue | 1 | 0.7 | 100 | 0.00 |
| Asteraceae      | *Artemisia afra* Jacq. ex Willd. var. afra | Legana/Loilanši | Herb | Leaf | Dry | Boiled for 3–7 minutes. Extract is taken orally. Thrice a day. Mixed with fresh leaf of *C. sativa*. Boiled for 5 minutes. Extract is taken orally. | Wheezing | 2 | 23.5 | 6 |
|                 |               |                |       |      |       | Pounded and mixed with dried powered bark of *P. africamum*. Taken orally with Syrup®. | Asthma | 8 | 17.8 | 75.7 | 0.23 |
|                 |               |                |       |      |       | Boiled for 4–5 minutes. Steam is inhaled (nasally) under blanket. | Asthma Nasal congestion | 16 | 4.2 | 18.1 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|------------------|---------------|----------------|-------|------------------|-------------|--------------------------------------------------|-----------------|---------------------------------|-----|-----|
| Asteraceae       | Callilepis laurolii DC. | Phela/Hlonya/ Makuru/Pedipekanto | Herb | Root | Dry | Boiled for 4–6 minutes. Extract is taken orally. Thrice a day | Asthma | 10 | 9.2 | 86.6 | |
|                  |               |                |       |                  |             | Pounded and mixed with dried powdered root of Z. capense. Taken orally with warm water. Thrice a day | Asthma | 1 | 0.10 | |
|                  |               |                |       |                  |             | Mixed with fresh leaf of C. edulis. Boiled for 5 minutes. Extract is taken orally. Thrice a day | Asthma | 1 | 1.4 | 13.3 | |
|                  |               |                |       |                  |             | Pounded and mixed with dried powdered root of L. javanica. Boiled for 4 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 1 | 2.1 | 100 | 0.02 |
| Asteraceae       | Dicoma anomala subsp. gerrandii | Phelana/ Makuwaneng | Herb | Root | Dry | Boiled for 3–8 minutes. Extract is taken orally. Thrice a day | Asthma | 3 | 0.7 | 100 | 0.00 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|-----------------|--------------|----------------|-------|-----------------|-------------|-------------------------------------------------|------------------|---------------------------------|-----|-----|
| Asteraceae      | *Helichrysum gymnocomum* DC. | Mpepho | Herb | Whole plant | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 2 | 1.4 | 100 | 0.01 |
| Asteraceae      | *Pseudognaphalium luteo-album* (L.) Hilliard & B.L. Burtt | Unknown | Herb | Leaf | Dry | Boiled for 5 minutes. Extract is taken orally. Thrice a day | Fatigue | 2 | 1.4 | 100 | 0.01 |
| Asteraceae      | *Psidia punctulata* (DC.) Vatke | Lesolane/ Monotletšane/lesodi | Shrub | Root | Dry | Pounded and taken orally with warm water. Boiled for 5–7 minutes. Steam is inhaled under (nasally) blanket. Thrice a day | Asthma | 7 | 5 | 53.8 | 0.05 |
| Asteraceae      | *Schkuhria pinnata* (Lam.) Kuntze ex Thell. | šathume/ Mosášane/Seralane | Herb | Whole plant | Fresh | Pounded and mixed with dried powdered root of *P. grandiflora*. Powder is poured in the boiled water. Steam inhaled (nasally) under blanket. Thrice a day | Asthma | 1 | 0.7 | 100 | 0.00 |
| Asteraceae      | *Senecio serratuloides* DC. | Legatuludi | Shrub | Leaf | Dry | Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 4 | 2.8 | 33.3 | 0.18 |
| Asteraceae      | *Vernonia natalensis* Sch.Bip. e x Walp. | Moshula | Herb | Leaf | Leaf | Boiled for 3–8 minutes and steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 14 | 19.2 | 51.8 |
| Cactaceae       | *Opuntia ficus-indica* (L.) Mill. | Motloro | Tree | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 1 | 0.7 | 100 | 0.00 |
| Canellaceae     | *Warburgia salutaris* (G.Bertol.) Chiov. | Molaka | Tree | Bark | Dry | Boiled for 4–11 minutes. Extract is taken orally. Thrice a day | Asthma | 4 | 2.8 | 36.3 | 0.07 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV  |
|------------------|---------------|----------------|-------|------------------|-------------|-----------------------------------------------|------------------|--------------------------------|-----|-----|
| Cannabaceae      | *Cannabis sativa* L. var. indica (Lam.) Wehmer | Lebake/Patie | Herb | Leaf | Fresh Dry | Mixed with dried leaf of *A. afra*. Boiled for 5 minutes. Extract is taken orally. Thrice a day | Asthma | 8 | 5.7 | 42.1 | 0.13 |
|                  |               |                |       |                  |             | Pounded and taken orally with warm water. Thrice a day | Tight chest | 11 | 7.8 | 57.8 |
|                  | *Capparaceae*  | *Maerua juncea* Pax subsp. crustata (Wild) Wild | Diragadibonwe | Shrub | Root | Dry | Boiled for 5 minutes. Extract is taken orally. Thrice a day | Asthma | 3 | 2.1 | 50 | 0.02 |
|                  |               |                |       |                  |             | Mixed with fresh bulb of *D. elata*, dried bark of *C. abbreviata*. Boiled for 6 minutes. Extract is taken orally. Thrice a day | Fatigue | 1 | 2.1 | 50 | 0.02 |
| Celastraceae     | * Catha edulis* (Vahl) Forssk. ex Endl. | Lehlâtse/Lewang/Molomononate | Tree | Root | Dry | Boiled for 5 minutes. Extract is taken orally. Thrice a day | Fatigue | 1 | 0.7 | 100 | 0.00 |
| Convolvulaceae   | *Ipomoea albivenia* (Lindl.) Sweet | Moópe | Shrub | Root | Dry | Boiled for 4–5 minutes. Extract is taken orally. Thrice a day | Asthma | 1 | 0.7 | 100 | 0.00 |
| Crassulaceae     | *Kalanchoe brachyloba* Welw. ex Britten | Moethi/Moimane/wanagam/ Môritsîkana | Shrub | Leaf | Fresh | Rubbed (raw) between hands and vapour is inhaled (nasally). Thrice a day | Nasal congestion | 13 | 9.2 | 100 | 0.09 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|------------------|---------------|----------------|-------|------------------|-------------|-------------------------------------------------|------------------|---------------------------------|-----|-----|
| Cucurbitaceae    | *Cucumis metuliferus* E.Mey. ex Naudein | Tˇshitˇshi | Herb | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 4 | 2.8 | 100 | 0.02 |
| Cyperaceae       | *Cyperus sexangulans* Nees | Mohlahla | Herb | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 7 | 5 | 10.7 | 0.46 |
| Dioscoreaceae    | *Dioscorea yohimba* Eckl. var. brevipes (Butt Davy) Burkill | Kgato | Herb | Tuber | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 10 | 7.1 | 100 | 0.07 |
| Euphorbiaceae    | *Croton gratissimus* Burch. var. *gratissimus* Moologa/Sologane | Mookologa/Sologane | Tree | Root | Dry | Boiled for 6–10 minutes. Extract is taken orally. Thrice a day | Asthma | 12 | 8.5 | 48 |
| Euphorbiaceae    | *Euphorbia schinzii* Pax | Ngaka-dianya | Herb | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Wheezing | 8 | 5.7 | 32 | 0.17 |
| Euphorbiaceae    | *Jatropha zeyheri* Sond. | Sephabaditya | Herb | Root | Dry | Boiled for 5–8 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 19 | 13.5 | 100 | 0.13 |
| Euphorbiaceae    | *Tingia durica* Sond. | Bogopa/ Mabatsane | Herb | Leaf | Dry | Boiled for 5 minutes. Extract is taken orally. Thrice a day | Asthma | 1 | 0.7 | 100 | 0.00 |

| | | | | | | Pounded and mixed with dried powered | | | | |
| | | | | | | whole plant of *H. caespititium*, leaf of *L. javanica* and roots of *O. lanceolata* and *C. lauroea*. Taken orally with warm water. Thrice a day | Fatigue | 1 | 0.7 | 100 | 0.00 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs | FL | UV |
|-----------------|---------------|----------------|-------|-----------------|-------------|------------------------------------------------|-----------------|--------------------------|----|----|
| Fabaceae        | *Acacia erioloba* E.Mey. | Mogoblo/ Mošu | Tree  | Root            | Dry         | Pounded and mixed with dried powdered bark of *P. africanaum* and *S. birrea*, and root of *X. caffra*. Taken orally with warm water. Thrice a day | Asthma           | 1 | 0.7 | 100 | 0.00 |
| Fabaceae        | *Acacia sieberiana* DC., var. woodii (Burtt Davy) Keay & Brenan | Mošu | Tree  | Root            | Dry         | Pounded and taken orally with warm water. Thrice a day | Asthma           | 1 | 0.7 | 100 | 0.00 |
| Fabaceae        | *Acacia senegal* (L.) Willd. var. rostrata Brenan | Mokgaripe | Tree  | Root            | Dry         | Boiled for 6–11 minutes. Extract is taken orally. Thrice a day | Asthma           | 2 | 1.4 | 100 | 0.01 |
| Fabaceae        | *Albizia adianthifolia* (Schumach.) W.Wight var. adianthifolia | Mafahla-nare | Tree  | Root            | Dry         | Boiled for 5–12 minutes. Extract is taken orally. Thrice a day Or Pounded and taken orally with warm water. Thrice a day | Fatigue          | 3 | 2.1 | 100 | 0.02 |
| Fabaceae        | *Cassia abbreviata* Oliv. subsp. beareana (Holmes) Brenan | Monepenepne | Tree  | Bark            | Dry         | Boiled for 5–9 minutes. Extract is taken orally. Thrice a day | Asthma           | 3 | 2.1 | 100 | 0.02 |
| Fabaceae        | *Elephantorrhiza burkei* Benth. | Mošišane/ Batwetsi | Shrub | Root            | Dry         | Pounded and mixed with dried powdered stem of *A. spinoasa* and root of *P. africanaum*. Taken orally with warm water. Thrice a day Boiled for 5–8 minutes. Extract is taken orally. Thrice a day | Fatigue Asthma  | 1 | 2.1 | 50  | 0.04 |
| Fabaceae        | *Elephantorrhiza goetzei* (Harms) Harms subsp. goetzei | Mošišane | Shrub | Root            | Dry         | Mixed with fresh bulb of *E. autumnalis*. Boiled for 6 minutes. Extract is taken orally. Thrice a day | Fatigue          | 1 | 0.7 | 100 | 0.00 |
Table 1: Continued.

| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|------------------|---------------|-----------------|-------|-----------------|-------------|------------------------------------------------|-----------------|---------------------------------|----|----|
| Fabaceae         | *Erythrina lysistemon* Hutch. | Sebalo/ Mmale | Tree | Bark | Dry | Boiled for 5–8 minutes. Extract is taken orally. Thrice a day | Wheezing | 10 | 7.1 | 100 | 0.07 |
|                  | *Peltophorum africanum* Sond. | Mosehla | Tree | Bark | Dry | Pounded and mixed with dried powdered leaf of *A. afra*. Taken orally with Syrup®, Thrice a day | Asthma | 1 | 2.1 | 21.4 | 0.1 |
|                  |               | Root |       |       |     | Boiled for 5–11 minutes. Extracts taken orally. Thrice a day | Asthma | 1 | 7.8 | 78.5 | 1 |
| Fabaceae         | *Senna italica* Mill. subsp. arachoides (Burch.) Lock | Monoteladithoisi | Herb | Root | Dry | Pounded and mixed with a dried powdered root of *B. discolor*, dried bark of *S. italica*, and dried bark of *S. birrea*. Powered is poured in to the boiled water and steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 1 | 6.4 | 100 | 0.06 |
|                  |               | Root |       |       |     | Boiled for 4–8 minutes. Extract is taken orally. Thrice a day | Asthma | 8 | | | |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = TIs (140) | FL | UV |
|-----------------|---------------|-----------------|-------|------------------|-------------|-----------------------------------------------|-----------------|---------------------------------|-----|-----|
| Gentianaceae    | *Enicostema axillare* (Lam.) A.Raynal subsp. Axillare | Makgonotiohle/Mphedu-ya-thaba | Herb  | Whole plant      | Dry         | Boiled for 5–14 minutes. Extract is taken orally. Thrice a day Or Pounded and taken orally with warm water. Thrice a day | Asthma 140 100 100 1 | Fatigue 1 0.7 8.3 |
| Hyacinthaceae   | *Drimia elata* Jacq. | Sekanama | Herb | Bulb | Fresh | Boiled for 6 minutes. Extract is taken orally. Thrice a day | Fatigue 3 2.1 25 0.08 | Wheezing 4 2.8 33.3 |
| Hyacinthaceae   | *Eucomis autumnalis* (MILL.) Chitt. | Mathubadifala | Herb | Bulb | Fresh | Boiled for 5 minutes. Extract is taken orally. Thrice a day Mixed with dried root dried of *E. goetzei*. Boiled for 6 minutes. Extract is taken orally. Thrice a day | Nasal congestion 8 5.7 88.8 0.05 |
| Hyacinthaceae   | *Eucomis pallidiflora* Baker subsp. pole-evansii (N.E.Br.) Reyneke ex J.C.Manning | Mathubadifala | Herb | Bulb | Fresh | Boiled for 5–8 minutes. Steam is inhaled (naso) under blanket. Thrice a day | Nasal congestion 11 7.8 52.2 0.15 |
| Hypoxidaceae    | *Hypoxis hemerocallidea* Fisch., C.A.Mey. & Avê-Lall | Hlakudiboya/Titikwane/ Sekgekolwana | Herb | Tuber | Fresh | Mixed with fresh bulb of *S. aethiopics*. Boiled for 5 minutes. Extract is taken orally. Thrice a day | Asthma 1 10 77.7 0.12 | Fatigue 4 2.8 22.2 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|------------------|---------------|----------------|-------|------------------|--------------|-------------------------------------------------|------------------|---------------------------------|-----|-----|
| Hypoxidaceae     | Hypoxis obtusa Burch. ex Ker Gawl. | Monna maledu | Herb | Tuber | Fresh | Boiled for 4–7 minutes. Extract is taken orally. | Fatigue | 2 | 1.4 | 100 | 0.01 |
| Icacinaceae      | Cassiopis ilicifolia (Hochst.) Kuntze | Mohufi/Mohufe | Tree | Root | Dry | Boiled for 5–7 minutes. Extract is taken orally. | Fatigue | 2 | 1.4 | 100 | 0.01 |
| Icacinaceae      | Pyrenaantha grandiflora Baill. | Bjere | Shrub | Root | Dry | Pounded and mixed with dried powdered entire plant of *S. parnata*. Powder is poured in the boiled water. Steam inhaled (nasally) under blanket. | Asthma | 1 | 0.7 | 100 | 0.01 |
| Kirkiaceae       | Kirkia wilmsii Engl. | Modumela/mogaba | Tree | Bark | Fresh | Boiled for minutes. Steam is inhaled (nasally) under blanket. | Asthma Nasal congestion | 2 | 1.4 | 66.6 | 0.02 |
| Lamiaceae        | Clerodendrum gladrum E.Mey. var. angustifolium E.Mey. | Mohlokohloko | Tree | Leaf | Fresh | Boiled for 5–8 minutes. Extract is taken orally. | Asthma | 4 | 2.8 | 100 | 0.02 |
| Lamiaceae        | Clerodendrum ternatum Schinz | Sebokane | Herb | Whole plant | Dry | Pounded and taken orally with warm water. | Asthma | 140 | 100 | 100 | 1 |
| Lamiaceae        | Leonotis leonurus (L.) R.Br. | Lebake | Shrub | Root or leaf | Dry | Pounded and taken orally with warm water. | Asthma | 14 | 10 | 100 | 0.1 |
| Lauraceae        | Cryptocarya transvaalensis Burtt Davy | Kgospua | Tree | Bark | Dry | Boiled for 5–9 minutes. Extract is taken orally. | Asthma | 140 | 100 | 100 | 1 |
| Malvaceae        | Abutilon galpinii A.Meeuse | Mmotelja | Shrub | Root | Dry | Boiled for 5–8 minutes. Extract is taken orally. | Asthma | 5 | 3.5 | 100 | 0.03 |
| Malvaceae        | Adansonia digitata | Mogo | Tree | Root | Dry | Boiled for 6–10 minutes. Extract is taken orally. | Fatigue | 68 | 48.5 | 100 | 0.48 |
| Malvaceae        | Dombeya rotundifolia (Hochst.) Planch. var. rotundifolia | Mokgoba | Tree | Root | Dry | Pounded and extract is taken orally with warm water. | Fatigue | 3 | 2.1 | 100 | 0.02 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|------------------|---------------|-----------------|-------|------------------|-------------|------------------------------------------------|------------------|----------------------------------|----|-----|
| Malvaceae        | Gossypium herbaceum L. subsp. africanum (Watt) Vollesen | Katluni/Leokodi/ Mohlare-wa-mawisi | Shrub | Root | Dry | Pounded and extract is taken orally with warm water. Thrice a day | Asthma | 70 | 50 | 100 | 0.5 |
| Malvaceae        | Grewia hispida Harv. | Mogwete/ Mogoši/Lefelo | Shrub | Root | Dry | Pounded and extract is taken orally. Thrice a day | Nasal congestion | 2 | 1.4 | 100 | 0.01 |
| Malvaceae        | Grewia sulcata Mast. var. sulcata | Mogwete/Mogoto | Tree | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 2 | 1.4 | 100 | 0.01 |
| Malvaceae        | Sida cordifolia L. | Mohutasela | Shrub | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 3 | 2.1 | 100 | 0.02 |
| Mesembryanthemaceae | Carpobrotus edulis (L.) L. Bolus subsp. edulis | Mošhipse | Herb | Leaf | Fresh | Chewed (orally) as raw and juice is swallowed. Thrice a day | Asthma | 3 | | 2.8 | 100 | 0.02 |
| Moringaceae      | *Moringa oleifera sensu Exell & Mendon | Moringka | Tree | Leaf | Dry | Pounded and taken orally with warm water. Thrice a day | Fatigue | 17 | 12.1 | 100 | 0.12 |
| Myrtaceae        | *Eucalyptus camaldulensis Delatt | Mopilikomo | Tree | Bark | Dry | Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 1 | 0.7 | 100 | 0.00 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|------------------|---------------|----------------|-------|------------------|-------------|------------------------------------------------|------------------|----------------------------------|-----|-----|
| Olacaceae | *Ximenia caffra* Sond. var. natalensis Sond. | Motshidi-kgomo | Tree | Root | Dry | Pounded and mixed with dried powdered roots of *A. A. erioloba*, dried bark of *P. africatum* and *S. birrea*. Taken orally with warm water. Thrice a day. | Asthma | 1 | 5.7 | 100 | 0.05 |
| | | | | | | | | | | | |
| | *Olea europaea* L. subsp. africana (Mill.) P.S. Green | Mohlware/Mo-olive | Tree | Root | Dry | Pounded and taken orally with warm water. Thrice a day. | Asthma | 4 | 3.5 | 100 | 0.03 |
| | | | | | | | | | | | |
| | *Panica granatum* L. | Mokgarenate | Tree | Fruit scale | Fresh | Chew as raw (orally). | Asthma | 1 | 0.7 | 100 | 0.00 |
| | | | | | | | | | | | |
| | *Adenia fruticosa* Burtt Davy subsp. fruticosa | Mopowane | Shrub | Root | Dry | Boiled for 5–13 minutes. Extract is taken orally. Thrice a day. | Asthma | 9 | 9.2 | 69.2 | 0.09 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Table 1: Continued.
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) |
|------------------|---------------|----------------|-------|------------------|-------------|-----------------------------------------------|-------------------|--------------------------------|
| **Passifloraceae** | *Adenia spinosa* Burtt Davy | Monna-apare/ Pisayabatiumi/ Mothema | Shrub | Stem | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 25 17.8 30.4 |
| | | | | | | Pounded and mixed with dried powdered roots of *E. burkei* and *P. africanum*. Taken orally with warm water. Thrice a day | Fatigue | 56 40.7 69.5 0.58 |
| **Pedaliaceae** | *Dicerocaryum seneiosium* (Klotzsch) Abels | Momphati | Herb | Leaf | Dry | Pounded and mixed with fresh leaf of *Aloe app.* Boiled for 2 minutes. Extract is taken orally. Thrice a day | Asthma | 3 2.1 100 0.02 |
| **Plumbaginaceae** | *Plumbago zeylanica* L. | Mašimabe/ Mašegomabe | Shrub | Root | Dry | Boiled for 6–13 minutes. Extract is taken orally. Thrice a day | Asthma | 4 2.8 80 |
| | | | | | | Nasal congestion | 1 0.7 20 0.03 |
| **Poaceae** | *Sorghum bicolor* (L.) Moench subsp. *arundinaceum* (Desv.) de Wet & Harlan | Mabele-thoro | Herb | Seed | Dry | Pounded and taken orally with Mageu* drink or soft porridge. Thrice a day | Fatigue | 6 4.2 100 0.04 |
| *Zea mays* subsp. *mays* L. | Mabele | Herb | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 1 0.7 100 0.00 |
| **Polygonaceae** | *Securidaca longipedunculata* Fresen. var. *longipedunculata* | Mphesu/ Mpijxmaramago | Tree | Root | Dry | Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 2 1.4 100 0.01 |
| **Proteaceae** | *Protea caffra* Meisn. subsp. *caffra* | Modumela | Tree | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 8 5.7 88.8 0.06 |
| | | | | | | Fatigue | 1 0.7 11.1 |
| **Ptaeroxylaceae** | *Ptaeroxylon obliquum* (Thunb.) Radlk. | Mogabaletswana | Tree | Root | Dry | Pounded and mixed with powdered dried bark of *S. birrea* and *P. africinum*, and dried root of *S. itaisa*. Powder is poured in boiled water and steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 25 17.8 100 0.17 |
| **Rhamnaceae** | *Berchemia discolor* (Klotzsch) Hemsl. | Moneyee/ Mogokgoma | Tree | Root | Dry | Pounded and mixed with powdered dried bark of *S. birrea* and *P. africinum*, and dried root of *S. itaisa*. Powder is poured in boiled water and steam is inhaled (nasally) under blanket. Thrice a day | Asthma | 1 0.7 100 0.00 |
| Botanical family | Species names                        | Vernacular name | Habit  | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|-----------------|-------------------------------------|-----------------|--------|------------------|--------------|------------------------------------------------|------------------|----------------------------------|----|----|
| Rhamnaceae      | Ziziphus mucronata Willd. subsp. mucronata | Mokgalo         | Tree   | Root             | Dry          | Pounded and taken orally with warm water. Thrice a day | Asthma           | 1                               | 0.7 | 100 | 0.00 |
| Rutaceae        | * Citrus limon (L.) Burm.f.          | Moswiri         | Tree   | Fruit            | Fresh        | Boiled for 4–5 minutes. Extract is taken orally. Thrice a day | Tight chest      | 2                               | 1.4 | 100 | 0.01 |
| Rutaceae        | Vepris reflexa I. Verd.             | Pharagobe       | Tree   | Root             | Dry          | Pounded and taken orally with warm water. Thrice a day | Fatigue          | 2                               | 1.4 | 100 | 0.01 |
| Rutaceae        | Zanthoxylum capense (Thunb.) Harv.   | Monokwane/ Moregakgaka | Tree  | Root             | Dry          | Pounded and mixed with dried powdered root of C. laurina. Taken orally with warm water. Thrice a day | Asthma           | 1                               | 0.7 | 100 | 0.00 |
| Santalaceae     | Osyris lanceolata Hochst. & Steud.   | Mphera          | Tree   | Root             | Dry          | Pounded and mixed with dried powdered root of C. lanceolata and O. lanceolata, whole plant of H. caespititium and leaves of L. javanica and T. dioica. Taken orally with warm water. Thrice a day | Asthma           | 14                             | 11.4 | 87.5 | 0.11 |
| Sapindaceae     | Dodonaea viscosa Jacq. var. angustifolia (L.F.) Benth. | Mofentshe       | Tree   | Root             | Dry          | Pounded and taken orally with warm water. Thrice a day | Laboured breathing | 1                              | 0.7 | 100 | 0.00 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; \( n = \text{THs (140)} \) UM % FL UV |
|-----------------|---------------|----------------|-------|-----------------|-------------|------------------------------------------------|-----------------|----------------------------------|
| Sapotaceae      | *Englerophytum magalismontanum* (Sond.) T.D.Penn. | Mohlatshwa | Tree  | Root            | Dry         | Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma          | 3 2.1 100 0.02 |
| Sapotaceae      | *Mimusops obovata* Nees ex Sond. | Mmupudu | Tree  | Root            | Dry         | Mixed with (spider's web). Pounded and taken orally with warm water. Thrice a day | Asthma          | 140 100 100 1 |
| Scrophulariaceae| *Buddleja salviifolia* (L.) Lam | Moketla | Shrub | Root            | Dry         | Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma          | 3 2.1 100 0.02 |
| Solanaceae      | *Solanum catombelese* Peyr. | Mothola-o-momokwibidu | Herb  | Whole plant     | Dry         | Pounded and taken orally with warm water. Thrice a day | Asthma          | 2 1.4 100 0.01 |
| Solanaceae      | *Solanum panduriforme* E.Mey. | Mothola-o-mosenolwane | Herb  | Root            | Dry         | Pounded and taken orally with warm water. Thrice a day | Asthma          | 3 2.1 100 0.02 |
| Solanaceae      | *Withania somnifera* (L.) Dunal | Mosalasupeng | Shrub | Root            | Dry         | Pounded and taken orally with warm water. Thrice a day | Fatigue Laboured breathing | 6 4.2 85.7 0.04 |
| Thymelaeaceae   | *Lasiosiphon caffer* Meisn. | Nkekologe | Shrub | Root            | Dry         | Pounded and mixed with dried powdered root of *O. lanceolata*. Taken orally with warm water. Thrice a day | Asthma Tight chest | 140 100 100 1.12 |
| Velloziaceae    | *Xerophyta retinervis* Baker | Thuse | Herb  | Root            | Dry         | Pounded and taken orally with warm water. Thrice a day | Asthma          | 4 2.8 100 0.02 |
| Verbenaceae     | *Lantana rugosa* Thunb. | Bokokotane/mokokotane | Shrub | Leaf            | Fresh       | Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day | Asthma          | 5 3.5 100 0.03 |
| Botanical family | Species names | Vernacular name | Habit | Used plant parts | State of use | Methods of herbal preparation and administration | Aliment/s treated | Frequency of use; n = THs (140) | FL | UV |
|----------------|---------------|----------------|-------|------------------|-------------|-------------------------------------------------|-----------------|----------------------------------|-----|-----|
| **Verbenaceae** | **Lippia javanica** (Burm.f.) Spreng | Mošunkwane/motlaba-dipoo | Shrub | Leaf | Dry | Fresh: Pounded and mixed with dried powdered root of *C. laureola*. Boiled for 4 minutes and steam is inhaled (nasally) under blanket. Thrice a day.  
Dry: Boiled for 5–13 minutes. Steam is inhaled (nasally) under blanket. Thrice a day  
Pounded and mixed with dried powdered roots of *C. laureola* and *O. lanceolata*, whole plant of *H. caespititum*, and leaf of *T. dioica*. Taken orally with warm water. Thrice a day  
Boiled for 5–14 minutes. Extract is taken orally. Thrice a day  
Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day  
Boiled for 5 minutes. Steam is inhaled (nasally) under blanket, but while eyes open. Thrice a day | Asthma | 1 | 7.1 | 55.5 |
| **Vitaceae** | **Rhoicissus tomentosa** (Lam.) Wild & R.B.Drumm. | Terebe-ya-nageng | Herb | Root | Dry | Pounded and taken orally with warm water. Thrice a day | Asthma | 4 | 2.8 | 100 | 0.02 |
| **Zingiberaceae** | **Siphonochilus aethiopicus** (Schweinl.) B.L.Burtt | Serokolo | Herb | Bulb | Fresh | Mixed with fresh bulb of *H. hemerocallis*. Boiled for 5 minutes. Extract is taken orally. Thrice a day | Asthma | 1 | 0.7 | 100 | 0.00 |

Key: Exotic plant species: asterisk (*), fidelity level; FL, use mention; UM and use value; UV.
across the studied municipalities and districts. Overall the most widely distributed medicinal plant species (6.7%, n=7) used in all these geographical areas were *Clerodendrum ternatum*, *Cryptocarya transvaalensis*, *Lasiosiphon caffer*, *Enicostema axillare*, *Mimusops obovata*, *Sclerocarya birrea*, and *Stylochaeton natalensis*. The widespread utilisation of these species shows that they are popular, safe, and well-known as asthma therapies in Bapedi traditional healing sectors.

An overwhelming majority (40%, n=42) of species comprising *Abutilon galpinii*, *Acacia erioloba*, *Acacia senegal*, *Acacia sieberiana*, *Albizia adianthifolia*, *Allium sativum*, *Aloe falcata*, *Berchemia discolor*, *Blepharis diversispina*, *Blepharis subvolubilis*, *Buddleja salviifolia*, *Cassinopsis ilicifolia*, *Catha edulis*, *Clivia caulescens*, *Diceroscaryum senecioide*, *Dicoma anomalana*, *Dodonaea viscosa*, *Dombeya rotundifolia*, *Elephantorrhiza goetzei*, *Eucalyptus camaldulensis*, *Grewia hispida*, *Grewia sulphata*, *Harpephyllum caffrum*, *Helichrysum caespititium*, *Helichrysum gymnoconium*, *Hypoxis obtusa*, *Ipomoea albivenia*, *Jatropha zeyheri*, *Mangifera indica*, *Opuntia ficus-indica*, *Panica granatum*, *Pyrenacantha grandiflora*, *Rhoicissus tomentosa*, *Schkuhria pinnata*, *Sida cordifolia*, *Siphonochilus aethiopicus*, *Sophremum bicolor*, *Tragia dioica*, *Tulbaghia violacea*, *Zantedeschia aethiopica*, and *Zea mays*. Ziziphus mucronata was used in a single municipality located within one of the three studied districts (Table 2). This finding might be attributed to the natural distribution of these taxa in the studied districts or variation with respect to THs indigenous knowledge related to their applications as antiasthmatic medicines.

The above could also be said for 19.3% (n=20) of plants, namely, *Adansonia digitata*, *Adenia fruticosa*, *Aloe spp.*, *Citrus limon*, *Clerodendrum glabrum*, *Cucumis metuliferus*, *Englerophytum magalismontanum*, *Erythrina lysistemon*, *Eucomis autumnalis*, *Euphorbia schinzii*, *Lantana rugosa*, *Leonotis leonurus*, *Maerua juncea*, *Olea europaea*, *Pseudognaphalium luteo-album*, *Solamnom catombellese*, *Solanum panduriforme*, *Vepiris reflexa*, *Warburgia salutaris*, and *Xerothyte retinervis*, which were utilised by THs in particular municipalities located in one district. The remaining (33.7%, n=35) of the plant species recorded in the present study were also distributed in certain municipalities but in more than one district (Table 2).

### 3.4. Species Utilisation and Literature Comparison

Amongst the 104 plants recorded in the current study, vast majority (50.9%, n=53) were used by THs to exclusively manage asthma, and 25.9% (n=27) for both asthma and the following symptoms: fatigue, nasal congestion, tight chest, wheeze, laboured breathing, nasal congestion and wheezing, fatigue and laboured breathing, as well as fatigue, laboured breathing, nasal congestion, and wheeze. The remaining 24.0% (n=25) of the taxa were used exclusively to heal some of these symptoms (Table 1). Overall all taxa recorded in this study are known medicinal plants in South Africa and thus form part of local traditional ethnopharmacopoeia of various cultures in this country. However, the practice of Bapedi traditional healers to select various plant species to exclusively treat asthma might be attributed to a number of factors including the availability of some plants during certain season of the year and in selected geographical areas. Furthermore, it is perhaps a means to allow them to select more effective asthma remedy or it is traditional practice they learned from their mentors.

#### 3.4.1. Asthma Therapies

Of the 53 (50.9%) asthmatic species, six (11.3%) comprising *C. ternatum*, *C. transvaalensis*, *E. axillare*, *M. obovata*, *S. birrea*, and *S. natalensis* were appreciated by all THs (n=140) who treated asthma across the study sites. To the best of our knowledge, with the exclusion of *S. birrea* which were previously highlighted by Ojewole [36] as being used for asthma in unspecified Southern Africa countries, all the aforesaid taxa are recorded for the first time in our study as remedy for this ailment. However, such species are well-known and widely used as traditional cure for other human diseases across Africa. Hossan et al. [37] observed that medicinal plants that are both highly and widely used for a particular ailment are in most case new sources of medication of such affliction. Taking into account this, we hypothesize that the wide use of the above-listed six taxa in the treatment of asthma by Bapedi THs is due to their effectiveness and thus must be investigated for their potential as new source of asthma medication. In fact utilisation of *E. axillare* by these THs is already supported by scientific studies. For instance, its extract exhibited both anti-inflammatory and antiasthmatic activities [38]. Ethanol extracts of *Clerodendrum serratum* Linn roots showed good antiasthmatic activity in experimental animal [39], thus suggesting that a closely related species *C. ternatum* (used by Bapedi) might also possess same activity.

Most (50%, n=26) of the remaining plants, *A. galpinii*, *A. erioloba*, *A. senegal*, *A. sieberiana*, *B. discolor*, *B. salviifolia*, *C. edulis*, *C. glabrum*, *C. caulescens*, *C. metuliferus*, *D. senecioide*, *Dioscorea sylvatica*, *E. magalismontanum*, *E. schinzii*, *G. sulcatia*, *H. caffrum*, *I. albivenia*, *L. rugosa*, *P. grandiflora*, *R. tomentosa*, *S. pinnata*, *Senna italica*, *S. catombellese*, *S. panduriforme*, and *Strophanthus speciosus*, used in this study to exclusively treat asthma were also documented for the first time in this study as remedies for this condition. These species are also traditionally utilised as medicine to treat different human diseases in South Africa and other African countries. Therefore, their use in this study for asthma is an indication that they might be safe for consumption as remedies. From conservation point of view restricted knowledge of the above-mentioned species to Bapedi THs as therapies for asthma to some extent has advantage, as it decreases the impact of being extensively and recurrently harvested across the countries to manage this chronic disorder.

The utilisation of the rest (38.5%, n=20) of the species, namely, *Alepiodea amatymbica*, *Cassia abbreviata*, *Carpodratus edulis*, *D. anomalana*, *E. camaldulensis*, *Gossypium herbaceum*, *H. gymnoconom*, *L. leonurus*, *M. indica*, *O. europaea*, *O. ficus-indica*, *P. granatum*, *S. cordifolia*, *S. aethiopicus*, *Securidaca longepedunculata*, *Ximenia caffra*, *X. retinervis*, *Z. aethiopicus*, *Z. mucronata*, and *Z. mays*, used for asthma by Bapedi THs was previously culturally validated either in South Africa, in other African countries, or elsewhere. Nonjinge and Tarr [40] who worked with Zulu
Table 2: Use of species to treat asthma (AS) and related symptoms within the districts and municipalities.

| Species name          | Agomang | Blydeveg | Lepelle-Nkumpi | Molepolo | Polokwane | Sum of ailments (FC) | Districts and municipalities | Waterberg | Sum of overall ailments treated per species |
|-----------------------|---------|----------|----------------|----------|-----------|----------------------|-------------------------------|------------|------------------------------------------|
| Abutilon galpinii     | -       | -        | -              | -        | -         | 0                    | -                            | -          | 0                                        |
| Acacia erioloba       | AS:1    | -        | -              | -        | -         | 1                    | -                            | -          | 1                                        |
| Acacia niglar         | -       | -        | -              | -        | -         | 0                    | -                            | -          | 0                                        |
| Acacia sclerura       | AS:1    | -        | -              | -        | -         | 1                    | -                            | -          | 0                                        |
| Allium sativum        | -       | -        | -              | -        | -         | 0                    | -                            | -          | 0                                        |
| Adansonia digitata    | FA:14   | FA:15    | BA:13           | BA:11    | FA:15     | 68                   | -                            | -          | 0                                        |
| Adenia fruticosa      | -       | AS:2     | AS:6           | -        | AS:1      | 9                    | -                            | -          | 0                                        |
| Adenia spinosa        | AS:1    | AS:5     | -              | -        | -         | 14                   | -                            | -          | 0                                        |
| Aloe falcata          | -       | -        | AS:1           | -        | AS:3      | 14                   | -                            | -          | 0                                        |
| Aloe falcata          | AS:4    | AS:5     | AS:1           | -        | AS:7      | 15                   | -                            | -          | 0                                        |
| Aloe falcata          | -       | NC:6     | -              | -        | -         | 6                    | -                            | -          | 0                                        |
| Aloe falcata          | -       | WH:2     | -              | -        | -         | 2                    | -                            | -          | 0                                        |
| Bapheuma discolor     | -       | -        | -              | -        | -         | 0                    | -                            | -          | 0                                        |
| Blakheura diversa     | -       | -        | -              | -        | -         | 0                    | FA:6                         | -          | 0                                        |
| Blakheura subsolabilis| -       | -        | FA:1           | -        | -         | 1                    | -                            | -          | 0                                        |
| Buddleja globifera    | -       | -        | AS:1           | -        | AS:3      | 3                    | -                            | -          | 0                                        |
| Callistephus incepta  | AS:1    | -        | AS:1           | -        | AS:1      | 2                    | AS:1                         | -          | 0                                        |
| Caragana nana         | AS:4    | AS:5     | AS:1           | -        | AS:7      | 15                   | -                            | AS:1      | 0                                        |
| Caragana nana         | -       | TC:1     | -              | -        | -         | 1                    | AS:1                         | -          | 0                                        |
| Carpobrotus edulis    | -       | AS:1     | AS:2           | -        | AS:1      | 3                    | AS:1                         | -          | 0                                        |
| Cassia abbrevata      | AS:1    | -        | -              | -        | -         | 3                    | AS:1                         | -          | 0                                        |
| Cassia abbrevata      | FA:1    | -        | -              | -        | -         | 5                    | AS:1                         | -          | 0                                        |
| Cassia abbrevata      | -       | -        | -              | -        | -         | 0                    | -                            | -          | 0                                        |
| Catha edulis          | FA:1    | -        | -              | -        | -         | 1                    | -                            | -          | 0                                        |
Table 2: Continued.

| Species name                  | Aganang | Bloodberg | Lepelle-Nkumpi | Mookgophong | Polokwane | Species treated per district and municipality |
|------------------------------|---------|-----------|----------------|-------------|-----------|-----------------------------------------------|
| *Citrus limon*               | 0       | 2         | 0              | 0           | 0         | 0 (FC)                                        |
| *Clerodendrum glabrum*       | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Clerodendrum bracteatum*    | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Clerodendrum zeylanicum*    | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Cressonii graminum*         | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Cryptocarya transvaalensis* | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Cuscuta nitida*             | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Cyphomandra aquatica*       | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Cyphomandra transvaalensis* | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Dioscorea alata*            | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Enicostema axillare*        | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Elephantorrhiza burkei*     | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Elephantorrhiza goetzei*    | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Englerophytum magalismontanum* | 0      | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Enicostema axillare*        | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Eucalyptus camaldulensis*   | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Eugenia corymbosa*          | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Dioscorea zeylanica*        | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Dioscorea nipponica*        | 0       | 0         | 0              | 0           | 0         | 0 (FC)                                        |
| *Dioscorea opposita*         | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Dioscorea opposita*         | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Dioscorea opposita*         | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Dioscorea opposita*         | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Dioscorea opposita*         | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Dioscorea opposita*         | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
| *Dioscorea opposita*         | AS:14   | AS:15     | AS:13          | AS:11       | AS:15     | 0 (FC)                                        |
## Table 2: Continued.

| Species name          | Agamon | Bloemfontein | Lepelle-Nkumpi | Molepolo | Polokwane | Sum of ailments (FC) | Waterberg | Sum of ailments (FC) | Species |
|-----------------------|--------|--------------|----------------|----------|-----------|---------------------|-----------|---------------------|---------|
| Euphorbia schinzii    | -      | -            | -              | -        | -         | 0                   | -         | -                   | Euphorb. |
| Gynophyllum herbaeaceum | AS:8 AS:7 AS:13 | AS:13 | AS:8 | AS:6 | AS:10 | AS:13 | AS:11 | AS:13 | AS:11 | AS:13 | AS:13 | AS:13 | AS:13 |
| Gracian hoplopus      | NC:2   | -            | -              | -        | -         | 2                   | -         | -                   | Gracian  |
| Gracian nubata        | -      | -            | -              | -        | -         | 0                   | -         | -                   | Gracian  |
| Harpephyllum affinis  | -      | -            | -              | -        | -         | 0                   | -         | -                   | Harpeph. |
| Helichrysum capillum   | -      | -            | -              | -        | -         | 0                   | -         | -                   | Helichry. |
| Helichrysum creptionis | -      | -            | AS:2           | -        | -         | 2                   | -         | 0                   | Helichry. |
| Hypoxis herbaeaeaeaeae | -      | -            | AS:1 AS:12    | AS:13    | AS:11     | 13                  | AS:13    | AS:11             | Hypoxis  |
| Homemelidica          | -      | -            | -              | -        | -         | 0                   | -         | -                   | Homemel. |
| Hypoxis obtusa        | FA:2   | -            | -              | -        | -         | 2                   | -         | -                   | Hypoxis  |
| Ipomea eburneaeaeaeae | -      | -            | -              | -        | -         | 0                   | -         | -                   | Ipomea   |
| Isophor cyphus        | AS:1   | -            | -              | -        | -         | 1                   | -         | -                   | Isophor  |
| Kalanchoe brachyloba  | NC:8   | -            | -              | -        | -         | 0                   | NC:1     | NC:2               | Kalanchoe |
| Kokia wilmsii         | -      | -            | NC:1           | -        | -         | 0                   | -         | -                   | Kokia    |
| Lavatera nigran      | -      | -            | -              | -        | -         | 0                   | -         | -                   | Lavatera |
| Leucodendron caffro   | AS:14  | AS:15 AS:13  | AS:13 AS:15   | AS:13    | AS:11     | 68                  | AS:13    | AS:11             | Leucond. |
| Lycium coffeaeaeaeae  | TC:5   | TC:12        | -              | -        | -         | 17                  | -         | -                   | Lycium   |
| Lycium konnersi       | -      | -            | -              | -        | -         | 0                   | -         | -                   | Lycium   |
| Lycium praecox        | LB:2   | -            | -              | -        | -         | 2                   | -         | -                   | Lycium   |
| Maranta juncea       | FA:7   | FA:2         | -              | -        | -         | 3                   | -         | -                   | Maranta  |
| Mangifera indica      | -      | -            | -              | -        | -         | 0                   | -         | -                   | Mangifera|
| Moringa oleifera      | FA:1   | FA:7 FA:3   | FA:1           | -        | -         | 9                   | FA:3     | FA:1               | Moringa  |

Note: The table continues with similar entries for each species, indicating the sum of ailments treated per species.
| Species name        | Agamon | Blundberg | Lepelle-Nkumpi | Molopo | Polokwane | Sum of ailment | Waterberg | Sum of overall ailment treated per species |
|---------------------|--------|-----------|----------------|--------|-----------|----------------|-----------|------------------------------------------|
| Olea europaea       | -      | -         | -              | -      | -         | 0              | -         | 0                                        |
| Opuntia ficus-indica| A S : 1| -         | -              | -      | AS : 4    | 10             | -         | 0                                        |
| Oryzium calota      | L B : 1| -         | -              | -      | -         | 1              | -         | 0                                        |
| Passia granatium    | -      | -         | -              | -      | -         | 0              | -         | 0                                        |
| Pethobophium        | A S : 1| AS : 1    | -              | -      | -         | 2              | -         | 0                                        |
| aepunwass          | FA : 1 | FA : 3    | FA : 1         | -      | FA : 6    | 5              | -         | 0                                        |
| Phorphyte azilianca | -      | -         | -              | -      | -         | 0              | -         | 0                                        |
| Protea auffa        | -      | AS : 1    | AS : 3         | -      | -         | 4              | -         | 0                                        |
| Patiognaphium       | -      | -         | -              | -      | -         | 0              | FA : 1    | 0                                        |
| latro-albus         | -      | AS : 1    | -              | -      | -         | 3              | -         | 0                                        |
| Pialia perpendicula | -      | -         | NC : 6         | -      | 6         | 6              | -         | 0                                        |
| Pharsacristis        | -      | -         | AS : 15        | -      | AS : 30   | 15             | -         | 0                                        |
| Pyreosschus         | -      | -         | -              | -      | -         | 0              | AS : 1    | 0                                        |
| grandis             | -      | -         | -              | -      | -         | 1              | -         | 0                                        |
| Rheozus montementis | -      | -         | -              | -      | -         | 0              | AS : 4    | 0                                        |
| Schinca nolle        | -      | AS : 1    | -              | -      | 1         | -              | 0         | 0                                        |
| Schinus roxburghiana | -      | -         | L B : 1        | -      | 0         | 0              | L B : 1   | 0                                        |
| Schinus anualisidum  | -      | NC : 1    | -              | -      | 1         | 2              | 0         | 0                                        |
| Schinacarpus         | -      | -         | -              | -      | -         | 1              | AS : 1    | 0                                        |
| Schinocarpus         | AS : 1 | AS : 15   | AS : 13        | AS : 13| AS : 15   | 60             | AS : 15   | 33                                       |

Table 2: Continued.
| Species name        | Districts and municipalities | Sum of ailments (FC) | Key |
|--------------------|-------------------------------|----------------------|-----|
| Securidaca longepedunculata |                             | 0                    |     |
| Seneio serrulatoide |                             | 1                    |     |
| Senecio sp.          |                             | 1                    |     |
| Senna sierra         |                             | 1                    |     |
| Sida cordifolia      |                             | 1                    |     |
| Siphonochilus aethiopicus |                       | 1                    |     |
| Solanum ammobacumin |                             | 1                    |     |
| Solanum paradoxiflorum |                         | 1                    |     |
| Stephania hirticulorum |                             | 1                    |     |
| Stylochion masculinum | AS 10, AS 13, AS 15          | 1                    |     |
| Tragia diva          |                             | 1                    |     |
| Tubagia volubilis    |                             | 1                    |     |
| Vipera sifatica      |                             | 1                    |     |
| Vesselia natalensis  |                             | 1                    |     |
| Warburgia adestias   |                             | 1                    |     |
| Withania somnifera   |                             | 1                    |     |
| Xerophyta retinervis |                             | 1                    |     |
| Ximenia caffra       |                             | 1                    |     |
| Zantedeschia aethiopica |                        | 1                    |     |
| Zanthoxylum capense   |                             | 1                    |     |
| Zea mays             |                             | 1                    |     |
| Ziziphus motivatana   |                             | 1                    |     |

Key: Fatigue: FA, laboured breathing: LB, nasal congestion: NC, wheezing: WH. Plain numeric indicate number of healer/s who use a species to treat an ailments whilst numeric with a quotation mark indicate number of healer/s who use a species in combination to treat an ailment/s.
THs of KwaZulu-Natal Province noted *A. amatymbica* as a valued medicine for asthma. In other studies conducted in Zimbabwe [41, 42], this species was amongst the ten most used asthma remedies. However, in the present study, *A. amatymbica* was only used by 7.8% (n=11) of all 58.3% (n=140) THs who treated asthma, which might be attributed to its rare status across the country [43]. In view of this and the fact that asthma is a chronic disorder requiring a readily available medicine for its management, most THs in this study might have less preferred and considered *A. amatymbica* therapies as unsustainable.

The knowledge of *D. anomala* use by Bapedi THs to treat asthma is supported by finding of Van der Merwe [44] who worked with Zulu THs. In fact most of the previously ethnobotanically validated asthmatic species used in the current study corroborate with those used by Zulu, compared to with other cultures.

Use of *L. leonurus* as recorded in this study was previously noted by Hutchings et al. [23] who questioned Zulu THs and Nzue [45] who worked with Rastafarians of Western Cape Province of South Africa. Similar finding was reported amongst Swati THs residing in Swaziland [46]. The observed similarities regarding the application of *L. leonurus* amongst South African and Swazi healers might be due to a cross-border transfer/exchange of knowledge. This posit is ascribed to the fact that most of Swaziland is locked within South Africa, which might had allowed easy transfers of knowledge amongst THs across geographical borders.

Similarly to Bapedi THs, Zulu also use *S. aethiopicus* as asthma medicine [23]. Widespread use of this species in the treatment of respiratory infections including asthma by Zulu THs has wiped out its entire local population within the communal lands in KwaZulu-Natal Province [47]. However, in the present study extent of use of *S. aethiopicus* specifically for asthma might currently not have profound impact on reduction of its natural population based on the fact that it is only used by 0.7% (n=1) and also in combination with other species, which both put less harvesting pressure on the population.

The utilisation of *X. retinervis* [48] and *Z. mucronata* [49] by Bapedi THs in the treatment of asthma was previously highlighted by the mentioned authors amongst the unspecified South African ethnic groups. Extracts of *X. retinervis* [50] and *Z. mucronata* [51] were active against pathogens causing respiratory infections, which might possibly indicate that they might be helpful in the management of asthma or related symptoms.

With the exclusion of *Z. aethiopicus* which is also used as medicine for asthma by the Xhosa people of South Africa [52], the remaining species, namely, *E. camaldulensis*, *M. indica*, *O. ficus-indica*, *P. granatum*, *S. longepedunculata*, *X. caffra*, and *Z. mays*, used exclusively by Bapedi for this condition, are recorded for the first time in South Africa as asthma therapies. However, their use in the treatment and management of this condition is common in other African countries or elsewhere. For instance, Nigerian THs also use *E. camaldulensis* [53], *M. indica* [54], and *S. longepedunculata* [55] to treat asthma. Comparably to our findings, Naoumi [17] reported the use of *M. indica* and *Z. mays* as medicines for this ailment by THs in Cameroon. Utilisation of *X. caffra* as asthma therapy is also common in Swaziland [56]. These findings support the general notion that Africans share the same indigenous knowledge [57].

To the best of our knowledge ethnobotanical records regarding uses of *G. herbaceum*, *O. europaea*, *O. ficus-indica*, and *P. granatum* in the management of asthma are nonexistent in Africa, thus noted in this study for the first time. However, the taxa *G. herbaceum* [58], *O. europaea* [59], *O. ficus-indica* [60], and *P. granatum* [61] are all used in other continents of the world comparatively to Bapedi THs, subsequently, indicating that these species might be helpful as asthma remedies. Some of the aforementioned taxa, notably *E. camaldulensis*, *M. indica*, *O. ficus-indica*, *P. granatum*, and *Z. mays*, are exotic in South Africa, thus suggesting two things: (i) that the original knowledge of their application for asthma by Bapedi was obtained via interactions with outside THs and/or (ii) was given by ancestors via dreams. The last posit is based on the fact that most of interviewed THs claimed that their ancestors show them new uses of medicinal plants via dreams while asleep. In general, fruits of *M. indica*, *O. europaea*, *O. ficus-indica*, *P. granatum*, *X. caffra*, and *Z. mays* were stated by THs as also being harvested for household consumption. Therefore an investigation into the potential of fruits from these species as asthma therapies will be interesting, and if effective it should be manufactured as beverages that assist in the asthma management. Ethanol extracts (100 mg/kg, p.o.) of *P. granatum* [61] and aqueous extract of *O. europaea* [62] fruits have already demonstrated a significant antiasthmatic activity at experimental model [61].

3.4.2. Asthma and Related Symptoms Therapies. As noted earlier, 25.9% (n=27) of species were multiused by THs to treat asthma and the following symptoms: fatigue, nasal congestion, tight chest, wheeze, laboured breathing, nasal congestion and wheezing, fatigue and wheezing, and fatigue and laboured breathing, as well as fatigue, laboured breathing, nasal congestion, and wheeze (Table 1). Amongst these plants, 37% (n=10) comprising Aloe spp., *A. fruticosa*, *Adenia spinosa*, Callilepis laureola, *Cyperus sexangularis*, *Elephantorrhiza burkei*, Hypoxis *hemerocallidea*, *M. juncea*, Peltophorum africanum, and *Protea caffra* were stated by THs as cure for asthma and fatigue. Of these taxa only use of *H. hemerocallidea* for asthma [63] and fatigue [64], as well as *P. africanum* for the latter condition [65], was previously reported in ethnobotanical literature. Use of *H. hemerocallidea* to cure fatigue by Bapedi THs was expected mainly due to its popularity as effective energy-booster. For instance, in almost every pharmaceutical chemist in Limpopo Province, there are various scientifically authenticated herbal formulations (e.g., Hypo-Plus®) made from *H. hemerocallidea* [66], which are being advertised on local radios and newspapers as effective energy and immune boosters. Thus, Bapedi THs might have had a talk about this and decided to include *H. hemerocallidea* as part of their fatigue treatment in asthma sufferers. On the other hand, use of this species as antiasthma by Bapedi THs might be due to its efficacy in the management of asthma and related conditions, attributed to its antiinflammatory activity [67]. The use of *A. fruticosa*, *A. spinosa*, *C. laureola*,
Species used as medicine for asthma and nasal congestion made up 18.5% (n=5) and included *K. wilmsii, P. punctulata, P. zeylanica, S. nitidum*, and *V. natalensis*. Amongst these species only *P. zeylanica* [68] and *P. punctulata* [69] were previously recorded in literature as asthma treatment but no records of its applications for nasal congestion exist. Restricted uses of *K. wilmsii* to Bapedi THs as medicine for these illnesses might be due to the fact that it is localised in the Capricorn and Sekhukhune districts (Limpopo Province) both mainly inhabited by the Bapedi culture. This might be true since the known general medicinal usage of *K. wilmsii* is presently restricted to this culture.

Only 7.4% (n=2) of species *C. sativa* and *L. caffer* were used to heal asthma and tight chest in this study. Utilisation of *C. sativa* as asthma medication was previously noted by Van Wyk and Gericke [70] amongst the unspecified South African ethnic groups. Its use for tight chest is recorded in our study for the first time in African ethnobotanical literature. However, *C. sativa* is commonly used for this condition by THs in Pakistan [71]. Its restricted uses for tight chest to Bapedi THs across Africa might somewhat be attributed to the fact that it is a legally declared drug; thus any person who is found in its possession without a permit is prosecuted. In favor of this most THs might retaliate to divulge its uses to researchers. No ethnobotanical record of *L. caffer* as treatment of asthma and tight chest was found in literature. However, this species was used by all interviewed Bapedi THs (n=140) as cure for asthma, which might be a reflection of its bioactivity against this condition.

Asthma and wheeze were also treated with two (7.4%) species, namely, *W. salutaris* and *Z. capense*. Amongst these trees only use of *W. salutaris* as antiasthma was previously reported in literature [23, 71]. The remainder of documented uses of both the aforesaid trees is reported for the first time in this study. However, lack of literature based information regarding their use for wheeze is understandable, based on the fact that this condition is one of the key symptoms of asthma. Consequently, THs of other cultures might have realised that a successful asthma treatment or management with *W. salutaris* and *Z. capense* automatically addresses all symptoms. It is also possible that use of these species by Bapedi for wheeze has specific impact on reducing constriction in the airways, and thus contributing towards reduction of wheeze sound.

Species used in the present study for asthma and laboured breathing were only (3.7%, n=1) *A. sativum*. The stated uses of this species are recorded in our study for the first time in South Africa but are common in other countries. For instance, its use as asthma medicine was previously reported in Egypt [72] and Nigeria [73]. However, as far as our literature search went, application of *A. sativum* for laboured breathing is presently restricted to Bapedi THs in Africa but used as such by THs in India [74]. Limited use of this species amongst indigenous people of South Africa might be due to the fact that it is mostly found in the markets. Thus in view of chronic nature of asthma and lack of income to frequently purchase its material, native people might have opted for an alternative species available in free access communal lands. Few (n=2) of Bapedi THs who use *A. sativum* in the present study harvest it from home gardens.

Asthma, nasal congestion, and wheezing were treated with two (7.4%, n=2) aromatic species *A. afra* and *C. gratissimus*. Utilisation of both species for wheezing is currently restricted to the Bapedi THs. However, our finding regarding use of *A. afra* in the treatment of asthma and nasal congestion coincides with that reported by Mukinda [75] amongst Xhosa THs of the Western Cape Province (South Africa). Similarly, application of *C. gratissimus* for asthma as noted in the present study was previously highlighted by Morobe et al. [76] in South Africa. No previous record of *C. gratissimus* as nasal congestion remedy was found in literature; thus it is reported for the first time in the present survey.

A total of two (7.4%) species *D. elata* and *S. serratuloides* were multiused by Bapedi THs to cure asthma, fatigue, and wheezing. Only use of *D. elata* as medicine for the first condition was previously highlighted in ethnobotanical literature [77]. The remainder of the applications of aforesaid species is currently restricted to Bapedi THs. Anti-inflammatory properties of *S. serratuloides* were reported by Fawole et al. [78], therefore suggesting that its use for asthma and related condition in the present study might be effective.

Another 7.4% (n=2) of species (*Schinus molle* and *O. lanceolata*) were multiused by Bapedi THs for asthma, fatigue, and laboured breathing. With the exclusion of using an exotic *S. molle* as asthma medication which was culturally validated in Peru [79], application of the rest of species is reported for the first time in this study across South Africa and Africa as a continent.

Overall an aromatic herb *L. javanica* was the only (3.7%, n=1) species widely used by Bapedi THs. For instance, it was multiused as medicine to heal asthma, fatigue, laboured breathing, nasal congestion, and wheeze. Use of *L. javanica* to treat asthma [80], fatigue, and nasal congestion [26] as well as laboured breathing [81] is common amongst other South African cultures. However, its use for wheeze is presently restricted to the Bapedi THs. In general, wide usage of *L. javanica* for asthma and perceived related symptoms by these THs might be ascribed to its wide local abundance across the Limpopo Province, and its popularity as treatment of respiratory infections [31].

3.4.3. Therapies for Asthma Symptoms. The rest (24.0%, n=25) of the species recorded in this study as part of asthma management were exclusively used by THs to treat various conditions they perceived as being associated with this inflammatory condition (Table 1). Amongst these plants 88% (n=22) were used to treat a single ailment, namely, fatigue (*A. digitata, A. adiantifolia, A. falcata, B. diversispina, B. subvolubilis, C. edulis, C. ilicifolia, D. rotundifolia, E. goetzei, H. caespititium, H. obtusa, M. oleifera, P. luteo-album, S. bicolor, T. dioica, and V. reflexa*), laboured breathing (*D. viscosa*), nasal congestion (*G. hispida, K. brachyloba, and *T.
violacea), tight chest (C. limon), and wheezing (E. lysistemnon). The remainder (12%, n=3) of the species, namely, E. autumnalis (fatigue, nasal congestion), E. pallidiflora (fatigue, nasal congestion, and wheeze), and W. somniﬁera (fatigue and laboured breathing) were multiused. Overall, applications of an overwhelming majority of the above-listed species by THs are recorded for the ﬁrst time in this study. For instance, with the exclusion of A. digitata [82], C. edulis [83], M. oleifera [84], and W. somniﬁera [85, 86], which their utilisation as mentioned by Bapedi were previously highlighted in African literature, use/s of the remaining species are currently restricted to Bapedi THs. Overall, a larger number of the above-mentioned new medicinal use of commonly known species by Bapedi THs would let one believe that they are still experimenting or further exploring other potential uses of local ﬂora with the hope of discovering new effective plants that could contribute towards the wellbeing of asthmatic patients.

3.5. Fidelity Level (FL) and Use Value (UV). Fidelity levels of the recorded plant species differed widely for speciﬁc disease/s. The maximum ﬁdelity level of 100% was reported for 71.1% (n=74) of species, with the majority having extremely lower use-mention (UM) against a particular ailment (Table 1). Indeed Ong and Kim [87], stated that high FL can only imply that a particular plant is most preferred if there is considerable number of use-mentions from participants. Therefore, we have correlated FL and UM in order to establish the accurate FL of each species. In this regard, species with 100% FL coupled with use mentioned of less than 15 times were not considered. Accordingly, S. birrea (UM = 140 and FL = 100; asthma), S. natalensis (UM = 140 and FL = 100; asthma), E. axillare (UM = 140 and FL = 100; asthma), C. ternatum (UM = 140 and FL = 100; asthma), C. transvaalensis (UM = 140 and FL = 100; asthma), M. obovata (UM = 140 and FL = 100; asthma), L. caffer (UM = 140 and FL = 100; asthma, and UM = 17 and FL = 10.8; tight chest), C. saxularis (UM = 58 and FL = 89.2; fatigue), A. digitata (UM = 68 and FL = 100; fatigue), G. herbaceum (UM = 70 and FL = 100; asthma), A. aferfia (UM = 25 and FL = 75.7%; asthma), A. spinosa (UM = 25 and FL = 30.4; asthma and UM = 57 and FLL = 69.5; fatigue), P. obliquum (UM = 25 and FL = 100), E. schinzii (UM = 19 and FL = 100; asthma), M. oleifera (UM = 17 and FL = 100; fatigue), and S. speciousus (UM = 15 and FL = 100; asthma), respectively, scored the highest FL amongst the plants used by Bapedi THs for asthma and related symptoms, thus suggesting their potential as therapies against the noted corresponding speciﬁc conditions. Adenia spinosa and L. caffer which were used to treat two conditions could be of great importance in the management of various ailments.

Relatively high UVs was observed for L. caffer (UV = 1.2; asthma and tight chest), M. obovata (UV = 1; asthma), C. ternatum (UV = 1; asthma), C. transvaalensis (UV = 1; asthma), E. axillare (UV = 1; asthma), S. natalensis (UV = 1; asthma), and S. birrea (UV = 1; asthma). As noted earlier all these species exhibited maximum (100%) FL as antiasthmatics therapies; thus their highest UV for similar treatment further accentuates their prospective in the management of asthma.

3.6. Plant Parts Used, Mode of Preparations, Dosages, and Administrations. The majority of the herbal medicines used by Bapedi THs as asthma and related symptoms therapies were mainly prepared from root (57%, n=61), leaf (15.8%, n=17), bark (7.5%, n=8), bulb and whole plant (5.6%, n=6, for each), fruit and tuber (2.8%, n=3 for each), seed, stem, and rhizome (0.9%, n=1, for each), respectively. Three species, L. leonurus (root and leaf), S. birrea (bark and fruit), and P. africam (bark and root), were harvested for their two different parts. Contrary to the results of the present study, Sonibare and Gbile [18] found that THs in Nigeria prefer stem bark to make asthma remedies. Extensive use of root in this study was based on the perception that it carries more healing power as opposed to other plant parts, a ﬁnding which was previously reported by Semenya [88], who worked with Bapedi THs. Indeed it has been scientiﬁcally demonstrated that plant root contains many bioactive principles [88]. However, extensive exploitation of roots by these THs should proceed with caution as it might endanger the species. Higher usage of leaves by Bapedi THs might be linked to their ease of collection and transportation, both compared with other parts.

The above-mentioned plant parts (n=107) used for herbal preparation were mostly processed by Bapedi THs in their dried states (78.5%, n=84) than when they are fresh (21.4%, n=23). This ﬁnding might be attributed to the fact that these THs preserve most of their medicine in dried form for future uses. Sclerocarya birrea was processed in both dried and fresh states. Overall, a total of 153 recipes were used by Bapedi THs to treat asthma. Of these formulae, monotherapies (75.1%, n = 115) based on a single plant preparation were dominant. A similar ﬁnding was noted by Noumi [17] in Cameroon. On the contrary Sonibare and Gbile [18] found that more of herbal medicine prescribed by THs in Nigeria are made from more than one species (multitherapies) in Nigeria. High use of monotherapies by Bapedi THs is perhaps an indication of the effectiveness of used plant species. This is attributed to the fact that these healers are known to combine species for the increased eﬃcacy [88]. Use of single therapies by Bapedi THs might also be due to simplifying the preparation and because of the nature of asthma. For instance asthma attack is in most cases sudden and thus requires immediate medical attention. In light of this an overwhelming majority of THs in this study might prefer preparing medicine from a single species (which is both straightforward and less time consuming) in case of exigency. Only 24.8% (n=38) of the herbal preparations used by interviewed Bapedi THs were multitherapies (Table 1). Healers who utilised this recipe disclosed that it enhances the eﬃcacy of medicine, which could be due to synergistic effects of several plant compounds that are active singly. However, this postulation warrants further investigations.

Remedies were prepared via boiling, macerating, pounding, squeezing, and rubbing and raw (prescribed as harvested). Harvested parts from certain plant were prepared using more than one method or a same technique was used differently amid THs (Table 1). Boiling (48.3%, n=74), pounding (45%, n=69), pounding and boiling (2.6%, n=4), chewing and macerating (1.3%, n=2, for each), rubbing (0.6%, n=1), and squeezing and pounding (0.6%, n=1), respectively, were
the principal methods of herbal preparation in the present study. Most of these methods are consistently reported in various ethnobotanical surveys conducted in Africa [17, 18] and elsewhere [89] focusing on asthma. High usage of boiling plant parts by Bapedi THs might be due to the simplicity of preparation. Bapedi THs prefer pounded remedies because they have a far longer shelf life for the preparation [90]. Depending on an individual healer’s preference, a minimum of two to a maximum of 14 minutes was used to boil various plant parts. Plant parts were pounded with grinding stones and metal equipment. Preparation times of these parts via maceration technique by Bapedi THs took from three to 24 hours (depending on an individual healer), which could explain its limited preference in this study. On the other hand, limited utilisation of squeezing and rubbing (n=1, for each) amongst Bapedi THs might be attributed to the seasonal availability of fresh fruits and leaves, respectively (Table 1).

The present study further assessed the different modes of application of the prepared remedies. Accordingly, of the 153 recorded recipes used for asthma and related symptoms, 80.9% (n=123) were administered orally, 19% (n=29) nasally, and 0.6% (n=1) topically. Naoumi [17] also found that most of the asthma medicines in his study are administered orally with very few which were taken topically. Distinct preferences of oral as route of herbal administration by Bapedi THs might be attributed to its convenience, for instance, it is straightforward and thus requires no special training. In addition its dosages can easily be premeasured.

Dosage strength of herbal remedy recorded in this study was also determined (Table 1). Overall there was a high consistency with regard to the boiled medicines taken orally. For example, a metal cup (500 ml) full of liquid preparations was prescribed by all THs three times a day (morning, midday, and evening). However, dosage inconsistency amongst interviewed Bapedi THs was noted for some preparations. This included boiled medicines administered nasally under a blanket, the dosage strength of which depended on an individual healer. Similarly, depending on individual healer two to five table spoons of pounded plant parts were mainly prescribed with a metal cup (500 ml) full of warm water. Some THs prescribed pounded plant parts with this cup but full of Mageu® drink or soft porridge. Lack of precision and standardization in the measurement of herbal medicine amongst Bapedi THs is one weakness of their traditional healthcare system.

4. Conclusions

The present study is the first to explore plants used traditionally to treat asthma and related conditions in South Africa. Overall the most widely distributed and highly used medicinal plants by all interviewed Bapedi THs (n=140) who treated asthma were C. ternatum, C. transvaalensis, L. caffer, E. axillare, M. obovata, S. birrea, and S. natalensis. The traditional applications of some species used by these THs to treat asthma and related conditions are comparable to that noted in literature amongst the various cultures in South Africa, other African countries, and elsewhere; thus demonstrating that there is a cultural link between diverse ethnic groups of the world, and exchange of traditional healing knowledge pertinent to these afflictions. Our study also recorded a larger number of new records of known medicinal plants used in traditional healing by various cultures across South Africa and Africa at large, a finding which contributes towards establishments of an African database of antiasthma plants and a new solid lead towards search for bioactive compounds against asthma.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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