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Notes on some potential new and noteworthy first hand ethnomedicinal herbal drug dosimetry interviewed with the Gorkha Nepalese Community of Darjeeling Hills (India)

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Present paper deals with 20 selected potential ethnomedicinal wild plants and an insect taxon which may be used to cure a good number of human diseases based on oral interviews with ten different Gorkha-Nepalese community of Darjeeling hills. Diseases like piles, skin irritation, diarrhoea, jaundice, old wounds, gastric problems including chronic acidity and gas, arthritis, pyorrhea or toothache, snakebite polyherbal formulations, fevers, urinary problem including kidney disorder, energy tonic, earache, anaemia, bone fracture and ligament injury, abdominal pain, high blood pressure, diabetes melitus, body pain reliever, throat pain, cold and cough, labour pain reliever and vomiting etc. are either cured or relieved by using different parts of these plants documented during oral interviews since December 2011 till December 2022. The efficacy of these ethno medicinal plants needs to be subjected to pharmacological validation. Maximum number of ethnomedicinal first hand information was documented from *Rhododendron arboreum* Sm. Minimum number of information documented from *Boehmeria clideminoides* Miq. var. *diffusa* (Wedd.) Hand.-Mazz. Maximum number of informants belonged to Rai, Tamang and Thami communities followed by Chhetri, Sherpa and Gurung communities, respectively. Most of these validated authentic information are not recorded earlier, when reportedtheir dosimetry and plant parts are different.

Keywords: Darjeeling, Ethnomedicinal plants, Gorkha Nepalese, ITKs

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Darjeeling hills fondly called "Queen of the hills"[1], lie in the heart of the lesser Himalayas. It provides not only the rich heritage of its unique flora and fauna in the Eastern Himalayas, but is also a treasure trove of potential ethnomedicinal herbal practices by the Nepalese Gorkha communities. As Darjeeling hills are often regarded as the richest repository of medicinal plants[2], the Gorkha Nepalese of remote villages continue to favour traditional herbal treatment methods with a particular folk dosimetry. Lives of these people are inseparably bonded to the rich wild plant resources that sustain them and serve as the kingdom of the herbal ethomedicine since time immemorial. Although basic medical and healthcare facilities have been provided mostly to the urban areas in Darjeeling hills, people from remote areas, which account for approximately 78% of the total population[3], have become habituated and dependent on their own system of traditional medication.

Ethnomedicine in reality is the medicinal formulations by the ethnic people, mostly based on locally available plant parts. Herbal medicines are considered to be proficient among many ethnic communities[4]. Ethnomedicinal investigations in Darjeeling hills have been previously reported by several workers[3,5-14]. However, still lot of novel ethnomedicinal uses remain unexplored. As a part of four state-funded research projects conducted throughout Darjeeling hills, several ethnobotanical field visits were made. A good number of novel first hand ethnomedicinal herbal drug dosimetry were documented as a result of it depending upon verbal interrogations of mostly elderly knowledgeable Gorkha Nepalese people of Darjeeling hills.

It has been observed that ethnomedicinal practices including ethnic dosimetry or formulations were not

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studied in detail previously[3,5-14]. Therefore, present study embodies some unique ethnomedicinal ITKs including ethnic herbal drug dosimetry not reported earlier, and aimed to document the ethnomedicinal usage of these wild plant parts and their formulations as practiced by the Nepalese Gorkha people since time immemorial.

Methodology

Study area

With an area of about 2,092 sq. km, present Darjeeling district consists of four subdivisions *viz.*, Darjeeling Sadar, Kurseong, Mirik and Siliguri (plain areas). The foothills of Darjeeling Himalaya that comes under Siliguri subdivision, is known as Terai, while areas of the rest three subdivisions mostly come under the hills of Eastern Himalaya are called Darjeeling hills (Fig. 1). Geographically, the district is located 27°02´N Lat. and 88°10´E Long. The district is demarcated by Kishanganj district of Bihar on the south, Sikkim on the north, Kalimpong and Jalpaiguri on the east and Nepal on the west. The district is characterized by its varying altitudes ranging from 90 m (Khoribari area) to 3780 m (Sandakphu) harbouring diverse elements of tropical, subtropical, temperate and alpine vegetation. Five hilly blocks *viz.*, Darjeeling-Pulbazar, Jorebunglow-Sukhia Pokhri, Rongli-Rangliot, Kurseong and Mirik were surveyed.

Demography

As per 2011 Census, total population of present Darjeeling district including plain areas comprises about 15,95,191, of which about 6,24,071 from Darjeeling hills. According to 2011 census, the sex ratio in Darjeeling hills is about 970 females per 100 males. Literacy rate is about 79.56%. The major religion is Hinduism (Nepalese Hindu) followed by Buddhism. Original inhabitants of the Darjeeling hills were the Lepchas or Rongpa. Other Gorkha-Nepalese communities with a long history in Darjeeling hills include Kami, Damai, Mukhia, Thapa, Limbu, Bahun, Tamang, Gurung, Moktan, Thami, Chhetri, Rai, Sarki and Sharma, however, some populations belonging to Lepchas or Rongpa (the ravine folks), Bhutias and Tibetans are also noticed at different localities of Darjeeling hills. Nepalese is the predominant spoken language.

Field visits, verbal interrogations and data gathering

During ethnobotanical field survey since December 2011 till December 2022 throughout Darjeeling hills first hand mostly new information on various human diseases were documented for 20 wild plant species. It also includes healthy nutrition-rich disease-free potable drinking water source in presence of one Trichopteran insect from Alubari Jungle Busty area. These first hand information were collected through oral interviews with knowledgeable and aged Gorkha people of 10 different castes such as, Moktan, Pradhan, Sarki, Sherpa, Tamang, Rai, Chhetri, Thami, Sharma, and Gurung (total=52) including forest guards (04) and local Nepalese medicinemen (04) who often acted as the field guides. Prior organizing verbal interrogations, Prior Informed Consent (PIC) was taken from every informant of Jungle Busty villages each time during data documentation.

Due approvals were collected from all knowledgeable persons in the form of declaration along with sample questionnaire (Supplementary Fig. S1). Total 52 aged and knowledgeable Gorkha people belonging to ten different castes were verbally interrogated with the age groups mostly between 60-80 years (some belong to 30-60 age groups) that include both males (total=40) and females (12). The data thus collected were further cross-checked among different castes of Gorkha people in a particular area for a particular plant species and finally verified and authenticated with the help of available published references[3,5-20]. Detailed data about vernacular name(s), part(s) used, mode of direction and formula and doses, were written in the field note book. The potentiality of plants and supplements used for medicinal ameliorative purpose were not estimated. Scientific names were validated at Central National Herbarium (CAL). Voucher specimens were deposited at Darjeeling Govt College (DGC) and Maulana Azad College (MAC) herbaria. The methodology followed in this work is as prescribed by Jain[21].

Result and Discussion

Maximum number of ethnomedicinal first hand information was documented from Laliguras plant (*Rhododendron arboreum* Sm.). Among 52 people, 48 revealed that inner bark of this plant used to cure piles; 42 people revealed that corolla used to cure viral fever during COVID-19 pandemic; 18 people revealed that inner bark used to cure jaundice and liver disease and only 10 people revealed that inner bark used to cure arthritis. Minimum number of information documented from Chiple Jhar plant (*Boehmeria clideminoides* Miq. var. *diffusa* (Wedd.) Hand.-Mazz.) from a single locality by Jai Kumar

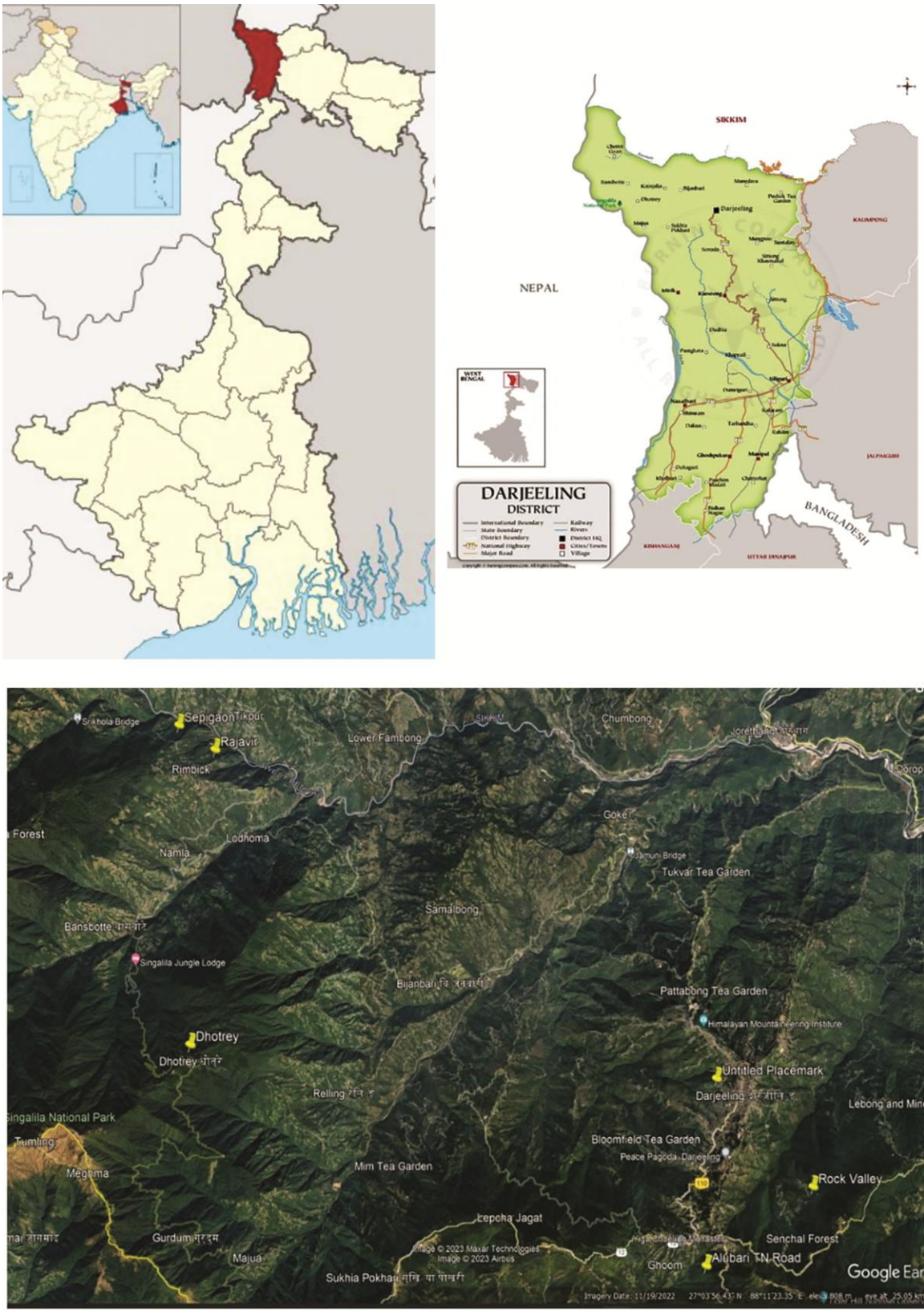

Fig. 1 — Location map of present Darjeeling hills under West Bengal and India map showing study area (Google Earth) (Source: BurningCpmpass.com; en.wikipedia.org/Wiki/Darjeeling_district)

Thami (Thami community). Besides Laliguras plant (*Rhododendron arboretum* Sm.), other 9 species of plants such as, *Rubus ellipticus* Sm., *Astilbe rivularis* D. Don, *Hydrocotyle himalaica* P.K. Mukh., *Mahonia nepaulensis* DC., *Equisetum diffusum* D. Don, *Urtica dioica* L., *Plantago major* L., *Nephrolepis cordifolia* (L.) C. Presl and *Bergenia ciliata* (Haw.) Sternb. are used by the maximum number of local Gorkha-Nepalese people to cure different human diseases. Maximum number of informants belonged to Rai, Tamang and Thami communities followed by Chhetri, Sherpa and Gurung communities, respectively.

Enumeration

20 wild plant taxa and one insect taxon are described alphabetically along their correct scientific names, family, local name(s), knowledge provider(s), mode of use including dosimetry and voucher information. All local names are documented only from the Gorkha Nepalese of Darjeeling hills, therefore, after local name, different castes of Gorkha community are written within parenthesis. One insect taxon is described at the end.

1. *Ageratina adenophoran* (Spreng.) R.M. King & H. Rob. (Asteraceae) [Fig. 2 (a-b)]

Local name: *Banmara/Bonmara* (Tamang, Thami, Rai); *Kalijhar* (Sarki, Pradhan, Gurung). *Knowledge Provider*(*s*): Mr. J.K. Thami (age 79: Darjeeling), Mr. Polma Rai (age 65: Sepigaon), Mr. Sanjit Tamang (age 36: Manebhanjang) and other 7 Gorkha Nepalese people of Darjeeling hills. *Mode of use and dosimetry*: Dosimetry-I: extract of tender leaves (50 g fresh) are used as bandage on ligament-injured bones for maximum 15 days to cure (reported by Mr. Sanjit Tamang who himself applied on his heavily injured middle finger of his right hand and it took 6 days to dry and cure). Dosimetry-II: extract of fresh leaves (25 g) in a glass of normal water are administered to take in the morning for 6 days to cure pneumonia fever (reported by Mr. Polma Rai & Mr. J.K. Thami). *Reference specimen*: Sepigaon, Darjeeling district, 5900 ft, 05.12.2022, S. Panda, D. K. Som, P. Roy & M. Elachouri00117 (MAC); Alubari T. N. Road, Darjeeling district, 6400 ft, 19.09.2019, S. Panda & JK Thami 163 (DGC).

2. *Artemisia indica* Willd. (Asteraceae) [Fig. 2 (c-d)]

Local name: *Titepate* (Tamang, Thami, Rai, Gurung, Pradhan). *Knowledge Provider*(*s*): Mr. J.K. Thami (age 79: Darjeeling), Mr. Polma Rai (age 65: Sepigaon), Mr. Kundan Tamang (age 58: Dhotrey), Indra Gurung (age 75: Manebhanjang) and other 12 Gorkha Nepalese people of Darjeeling hills. *Mode of use and dosimetry*: Dosimetry-I: extract of fresh leaves and twigs (1 teaspoon) or leaves and twigs are boiled in water and after cooling extract is taken to cure throat pain, cold & cough and any types of fever and administered for 3 to 7 days preferably in the morning after food (reported by Jai Kumar Thami and others). *Reference specimen*: Alubari T. N. Roadside forest, Darjeeling district, 6200 ft, 07.12.2022, S. Panda, D.K. Som, P. Roy & M. Elachouri20 (MAC).

3. *Astilbe rivularis* Buch.-Ham. ex D. Don (Saxifragaceae) [Fig. 2 (e-f)].

Local name: *Buro Okhati* (Chhetri, Thapa, Sarki, Rai); *Ban Supari* (Thami, Tamang). *Knowledge Provider*(*s*)*:* Mr. J.K. Thami (age 79: Darjeeling), Mr. Avijit Sharma (age 34: Alubari TN Road), Mr. Polma Rai (age 65: Sepigaon), Mr. Kundan Tamang (age 58: Dhotrey) and other 12 Gorkha Nepalese people of Darjeeling hills. *Mode of use and dosimetry*: Dosimetry-I: rhizomes are cut into pieces and allowed for sun dry. These dried pieces are then ground finely, which are then mixed (2 teaspoon) with dal and other vegetables to prepare the soup and taken for 7 days (reported by Jai Kumar Thami) or Dosimetry-II: dried rhizomes are boiled and its extract are taken, which in turn given to the women after child birth to reduce their labour pain (reported by J.K. Thami and others). It is a traditional practice among the Gorkha Nepalese since time immemorial in the remote villages in Darjeeling hills. Dosimetry-III: rhizomes are cut into pieces and allowed for sun dry, then ground into powder for use, or extract of fresh rhizome after cleaning, is used; dried powder (25 g) or fresh extract (1 teaspoon) mixed with a cup of mild warm boiled milk and taken any time of a day for 15 days, administered mainly to those patients who are anaemic. This extract along with milk helps to increase blood and haemoglobin percentage (reported by Polma Rai, Sepigaon: this is a common practice in Rai community since time immemorial). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 05.12.2022, S. Panda, D. K. Som, P. Roy & M. Elachouri 0012A (MAC); Alubari T. N. Roadside forest, Darjeeling district, 6200 ft, 07.12.2022, S. Panda, D.K. Som, P. Roy & M. Elachouri23 (MAC).

4. *Bergenia ciliata* (Haw.) Sternb. (Saxifragaceae) [Fig. 2 (g-h)].

Local name: *Pakhanbet* (Chhetri, Thapa, Sarki, Rai, Thami, Tamang). *Knowledge Provider*(*s*): Smt.

Pabitra Rai (age 67: Sepigaon), Mr. Kundan Tamang (age 58: Dhotrey) and other 3 Gorkha Nepalese people of Darjeeling hills. *Mode of use and dosimetry*: Dosimetry-I: roots and rhizomes cut into pieces and allowed for sun dry. These dried pieces are then powdered. 1 teaspoon full powder is mixed in a glass of mild hot water and administered to take after food, preferably in the morning for 3 days to cure pyorrhea or any type of toothache (reported by Smt. Pabitra Rai of Sepigaon: this is a common practice in Rai community since time immemorial). Dosimetry-II: roots and rhizomes cut into pieces and allowed for sun dry. These dried pieces are then made into powder. Half teaspoon powder is mixed in a glass of mild hot water (or 25 g fresh extract is mixed in a cup of mild hot water) and administered to take after food, preferably in the morning for 15 days (but may be taken one month in case of chronic cases) to cure piles and relieving pain during toilet (reported by Kundan Tamang, Dhotrey). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 05.12.2022, S. Panda, D. K. Som, P. Roy & M. Elachouri 0016 (MAC).

5. *Boehmeria clideminoides* Miq. var. *diffusa* (Wedd.) Hand.-Mazz. (Urticaceae) [Fig. 2 (i-j)].

Local name: *Chiple Jhar/Phusrey Kamalay* (Thami). *Knowledge Provider*(*s*)*:* Mr. J.K. Thami (age 79: Alubari TN Road, Darjeeling). *Mode of use and dosimetry*: Dosimetry-I: leaves and twig (amount depending upon area of the affected part: varying from 100 g to 500 g) are made into paste which acts as the bandage for bone fracture, ligament injury and other related injuries. After 15 days fractured bones and ligaments become normal (reported by J.K. Thami, Alubari T N Road, Darjeeling). Dosimetry-II: tender leaves and twigs are consumed as vegetables, sometimes mixed with dal and other vegetables, which relieves gastric problems and acts as appetizer (reported by J.K. Thami). Dosimetry-III: extract of tender leaves (1 teaspoon full)is mixed in a cup of normal water and administered to take daily in any time forrelieving abdominal pain (reported by J.K. Thami). *Reference specimen*: 1 km down Alubari T. N. road toward Jungle busty, Darjeeling district, 6000 ft, 07.12.2022, S. Panda, D. K. Som, P. Roy & M. Elachouri 24 (MAC).

6. *Clematis buchananiana* DC. (Ranunculaceae) [Fig. 2 (k-l)].

Local name: *Pinase laharo* (Thami). *Knowledge Provider*(*s*): Mr. J. K. Thami (age 79: Alubari T N Road, Darjeeling). *Mode of use and dosimetry*: Dosimetry-I: leaves (preferably tender leaves) are crushed repeatedly for 30 seconds to 1 min, then its smell is inhaled to cure migraine. This practice may be continued up to 3 months depending upon condition of the disease (reported by J. K. Thami, Alubari T N Road, Darjeeling). Dosimetry-II: Fresh leaves are heated for 30 sec, then crushed, finally its smell is inhaled to cure migraine (this is more effective as reported by J. K. Thami who himself practiced on several patients of Alubari T N Road, Darjeeling). *Reference specimen*: Alubari T. N. roadside forest, Darjeeling district, 6700 ft, 07.12.2022, S. Panda, D. K. Som, P. Roy & M. Elachouri19 (MAC).

7. *Equisetum diffusum* D. Don (Fern-allies: Equisetaceae) [Fig. 2 (m-n)].

Local name: *Kurkure Jhar* (Thami, Tamang, Rai). *Knowledge Provider*(*s*): Mr. J. K. Thami (age 79: Alubari TN Road, Darjeeling), Smt. Bishnupriya Rai (age 89: Alubari TN Road), Mr Kundan Tamang (age 58: Dhotrey), Mr. Polma Rai (age 65: Sepigaon), Mr. Sanjit Tamang (age 36: Manebhanjang) and other 11 Gorkha Nepalese communities in Darjeeling hills. This plant indicates water source below, so local people avoid to build houses where plenty of naturally grown *Equisetum* spp. [populations] seen (Informer: Mr. J. K. Thami, Alubari TN Road). *Mode of use and dosimetry*: Dosimetry-I: Whole plants after cleaning allowed to boil and its extract is prescribed to drink [half teaspoon per cup per day in any time a day] to cure any type of urinary problem including dissolving kidney stones [Mr. J. K. Thami, Smt. Bisnupriya Rai, Mr. Polma Rai, Mr Sanjit Tamang). Dosimetry-II: extract of whole plant is taken at least 3 months continuously in the morning time with empty stomach to cure 'asthma' and other type of respiratory problem [Polma Rai: Sepigaon]. Dosimetry-III: extract of rhizome (1 teaspoon full in the morning with empty stomach with a glass of normal water) is taken to cure Diabetes mellitus (reported by Sanjit Tamang, Manebhanjang). Dosimetry-IV: extract (two teaspoon full in any time of the day with or without food with a glass of normal water) is taken before long walk or during trekking for getting energy as reported by Sanjit Tamang). Dosimetry-V: extract of whole plant [two teaspoon full in the morning in a glass of normal water with or without food] is taken to cure any type of kidney disorder (reported by Jai kumar Thami and Sanjit Tamang). *Reference specimen*: 1 km below

Fig. 2 — Ethnomedicinal plants of Darjeeling hills: – (a-b) leaves, twigs and natural habitat of *Ageratina adenophora* (Spreng.) R.M. King & H. Rob. along with Knowledge informants; (c-d) *Artemisia indica* Willd. plant with knowledge informant and herbarium voucher specimen (c); (e-f) Fresh plant with rhizome and roots as well as dried rhizome of *Astilbe rivularis* Buch.-Ham. ex D. Don; (g-h) *Bergenia ciliate* (Haw.) Sternb. plant along with knowledge informants; (i-j) leaves and twigs of *Boehmeria clideminoides* Miq. var. *diffusa* (Wedd.) Hand.-Mazz. along with knowledge informant; (k-l) leaves and twigs of *Clematis buchananiana* DC. along with knowledge informant; (m-n) *Equisetum diffusum* D. Don plant along with knowledge informant; (o) *Hydrocotyle himalaica* P. K. Mukh. plant

Alubari T. N. roadside forest, Darjeeling district, 6000 ft, 07.12.2022, S. Panda, D.K. Som, P. Roy & M. Elachouri 17 (MAC).

8. *Hydrocotyle himalaica* P.K. Mukh. (Apiaceae) [Fig. 2 (o)].

Local name: *Golepata* (Tamang, Thami). *Knowledge Provider*(*s*): Mr. Kundan Tamang (age 58: Dhotrey), Mr. Sanjit Tamang (age 36: Manebhanjang) and other 7 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: whole plants except roots (10 to 15 leaves per day) are boiled for 2 to 3 min. After cooling, extract is taken preferably in the morning with or without food for 1 month to cure tonsilitis and throat swelling due to cold (reported by Kundan Tamang). Dosimetry-II: 4 to 5 drops of liquid extract from fresh leaves are administered to cure any type of earache (reported by Sanjit Tamang: it is a common practice in Tamang Gorkha Nepalese of Manebhanjang). *Reference specimen*: Sepigaon, Darjeeling district, 5900 ft, 05.12.2022, S. Panda, D. K. Som, P. Roy & M. Elachouri 009 (MAC).

9. *Isodon coetsa* (Buch.-Ham. ex D. Don) Kudo (Lamiaceae). A potential herbal drug to cure skin diseaselike Ringworm[Fig. 3 (a-c)].

Local name: *Mire* (Thami); *Phusre Jhar* (Rai). *Knowledge Provider*(*s*): Mr. J. K. Thami (age 79: Alubari T N Road, Darjeeling), Mr. Polma Rai (age 65: Sepigaon) and other 2 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: extract of leaves [5-7] are applied on diseased skin, such as ringworm, eczema and other fungal skin diseases, maximum for 15 days. It will cure approximately 90% skin diseases (reported by J. K. Thami who himself applied on diseased skin, and fortunately it was cured approx. 90% after 6 days). Dosimetry-II: extract of 3-4 leaves are used for dyeing purpose as well as to cure skin irritation like ringworms (reported by Polma Rai). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 06.12.2022, S. Panda, D. K. Som, P. Roy & M. Elachouri 17 (MAC).

10. *Luculia gratissima* (Wall.) Sweet (Rubiaceae) [Fig. 3 (d-e)].

Local name: *Doware phool* (Rai community of Sepigao). *Knowledge Provider*(*s*): Mr. Polma Rai (age 65: Sepigaon, Darjeeling). *Mode of use and dosimetry*: Dosimetry-I: Flowers are sun dried and powdered. 1 teaspoon full flower powder is mixed with a glass of mild hot water and administered to take preferably in the morning to check loose motion and diarrhoea (reported by Polma Rai). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 06.12.2022, S. Panda, D.K. Som, P. Roy & M. Elachouri 0019 (MAC).

11. *Mahonia nepaulensis* DC. (Berberidaceae) [Fig. 3 (f-g)].

Local name: *Chutro* (Thami); *Knowledge Provider(s)*: Mr. J.K. Thami (age 79: Alubari T N Road, Darjeeling) and other 12 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: inner barks are allowed to sun dry and made into powdery dust. Half teaspoon powder is mixed in boiled water and stirred (or inner barks are boiled directly for 5 min and the extract is taken) , after cooling the extract can be taken any time of the day (3 to 6 days) to relieve from acute toothache and pyorrhea. This extract also helps to bind loose teeth and reduces pain (reported by Jai Kumar Thami). Dosimetry-II: extract of inner barks are boiled for 5 min, after cooling this extract is administered to the patients suffering with acute toothache for regular washing with this liquid extract in 30 min interval to reduce pain (reported by Mr. J. K. Thami). Dosimetry-III: inner barks are allowed to boil for 5 min. After cooling, this extract is applied on old wounds, mouth ulcer and any other types of skin irritations to cure. This extract is also applied on affected parts as a result of Arthritis which is also curable up to 70% (J.K. Thami). *Reference specimen*: Alubari T N Roadside forest, Darjeeling district, 6400 ft, 27.02.2021, S. Panda, D.K. Som & P. Roy 00106 (MAC).

12. *Nephrolepis cordifolia* (L.) C. Presl. (Nephrolepidaceae Fern) [Fig. 3 (h-i)].

Local name: *Amilo/Amala/Pani Amala* (Tamang). *Knowledge Provider*(*s*): Mr. Sanjit Tamang (age 36: Manebhanjang, Darjeeling) and other 6 Gorkha Nepalese in Darjeeling Hills. Scaly tubers are eaten raw or chewed due to its sweet taste. 10 tubers are equivalent to 10 litre water. *Mode of use and dosimetry*: Dosimetry-I: daily 5 tubers are prescribed to take any time in the day to cure any type of urinary problem including. kidney problem. It cleans urine and relieves body pain. During long walking/trekking, no water is required if anybody takes 10 tubers (reported by Sanjit Tamang). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 06.12.2022, S. Panda, D.K. Som, M. Elachouri & P. Roy14 (MAC).

13. *Plantago major* L. (Plantaginaceae) [Fig. 3 (j-l)].

Local name: *Sime Jhar* (Rai community). *Knowledge Provider*(*s*): Mr. Polma Rai (age 65:

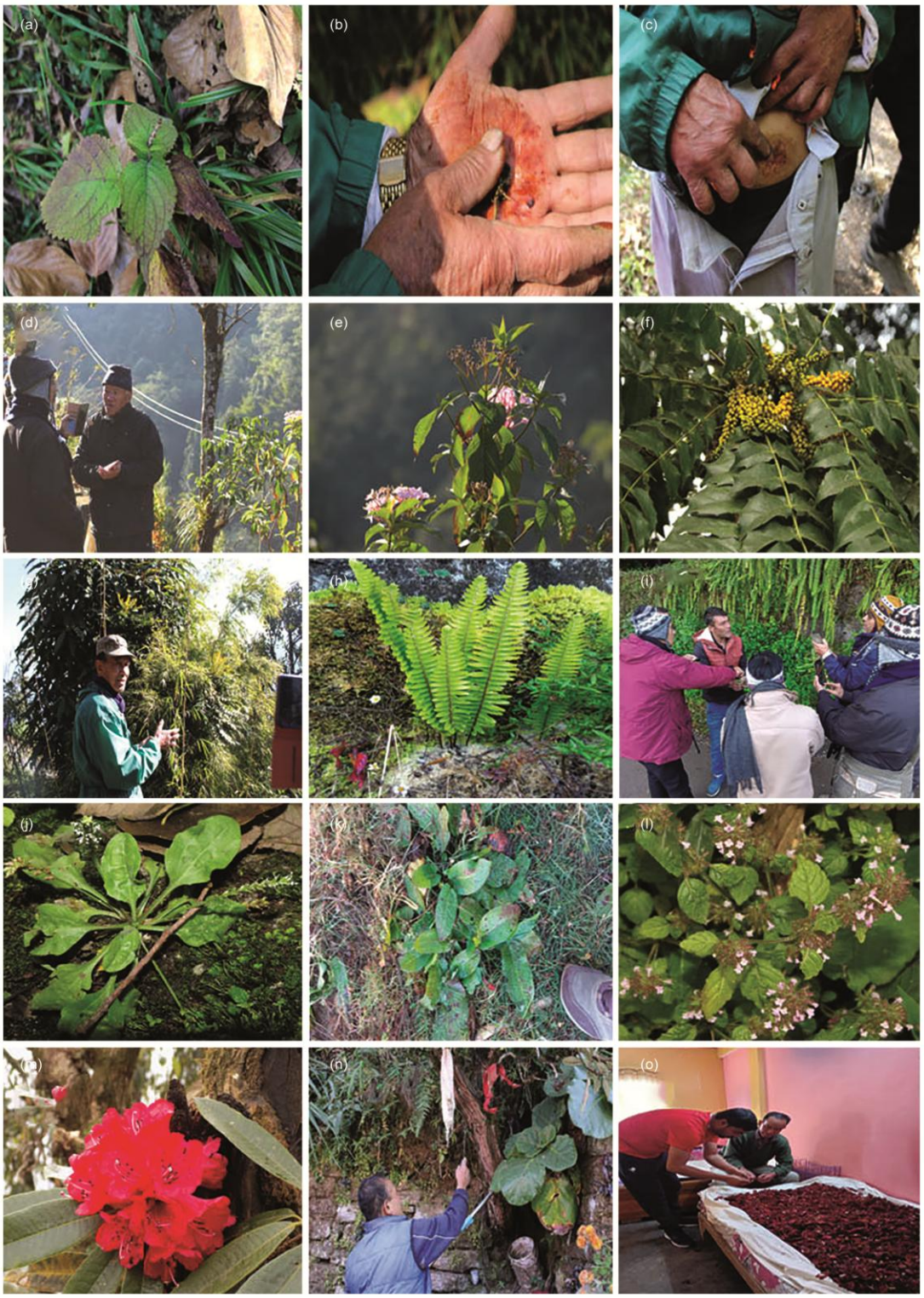

Fig. 3 — Ethnomedicinal plants of Darjeeling hills: – (a-c) leaves and twigs of *Isodon coetsa* (Buch.-Ham. ex D. Don) Kudo. along with Knowledge informant's affected area with this plant extract; (d-e) Inflorescence and twigs of *Luculia gratissima* (Wall.) Sweet, along with with knowledge informant; (f-g) *Mahonia nepaulensis* DC. Along with knowledge informant; (h-i) *Nephrolepis cordifolia* (L.) C. Presl. fern along with its scaly tubers and knowledge informant; (j-l) leaves and twigs of *Plantago major* L. along with other two plants (*Rumex nepalensis* Spreng. and *Clinopodium umbrosum* (M. Bieb.) K. Koch); (m-o) flowering twig, Stem Bark and dried corolla of *Rhododendron arboretum* Sm. subsp. *arboretum* along with knowledge informants

Sepigaon, Darjeeling) and other 7 Gorkha Nepalese in Darjeeling Hills. This plant is used as an important herbal drug for the preparation of polyherbal formulation with other two plants during venomous snakebites. *Mode of use and dosimetry*: Dosimetry-I: preparation of polyherbal formulations for venomous poison is done by applying leaf-extract of following three potential herbs in a particular dose: Halhale [*Rumex nepalensis* Spreng.] + Sime Jhar [*Plantago major* L.] + Phurke Jhar [*Clinopodium umbrosum* (M. Bieb.) K. Koch] in the ratio of 3 leaves: 4 leaves: 10 leaves. These leaf extracts are made into paste and applied on the snakebite area directly (reported by Polma Rai). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 06.12.2022, S. Panda, D.K. Som, M. Elachouri & P. Roy 09, 010 & 011 (MAC).

14. *Rhododendron arboreum* Sm. subsp. *Arboretum* (Ericaceae) [Fig. 3 (m-o)].

Local name: *Laliguras* (Tamang, Lama, Thami, Rai, Pradhan, Gurung, Mukhia, Sherpa). *Knowledge*: Mr. J. K. Thami (age 79: Alubari TN Road, Darjeeling), Mr. Polma Rai (age 65: Sepigaon, Darjeeling), Smt. Usha Rai (age 62: Rajavir, Rimbik, Darjeeling), Smt. Chandrakala Rai (age 55: Sepigaon), Mr. Lalbir Rai (age 74: Rajavir) and other 4 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: Inner barks are cut into pieces and allowed for sun drying and finally made into powdery dust. One teaspoon full of this powder is mixed and well-stirred in a glass of mild warm water, and taken to cure chronic piles and relieving its pain.It is continued till 60 days (reported by Lalbir Rai, Polma Rai and Usha Rai). Dosimetry-II: Powder dust of inner bark (one teaspoon full) mixed in a glass of mild warm water in any time of a day, taken to cure jaundice and liver diseases. It is continued till 7 days (Lalbir Rai and Usha Rai). Dosimetry-III: Red corolla of this plantare shade-dried and finally fermented to prepare "Rhododendron Wine" which is taken as energy tonic, immunity booster (during pandemic, local people were completely cured from SARS-COV-2) and body pain reliever (reported by Mr. J. K. Thami and Usha Rai). Dosimetry-IV: powder of inner bark of this plant are mixed (1 teaspoon full per day) and well-stirred in a glass of mild warm water, and taken to relieve pain due to arthritis and other parts of body (J. K. Thami and Chandrakala Rai). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 06.12.2022, S. Panda, D.K. Som, M. Elachouri & P. Roy 015 (MAC); Alubari TN Road, Darjeeling, 6800 ft, 26.02.2021, S. Panda, D. K. Som & P. Roy 00109 (MAC).

15. *Rubia manjith* Roxb. ex Fleming (Rubiaceae) [Fig. 4 (a)].

Local name: *Mojito* (Tamang); *Knowledge Provider*(*s*): Mr. Sanjit Tamang (age 36: Manebhanjang, Darjeeling) and other 6 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: freshstems and leaves in the ratio of 3:1 are boiled for 3 min. After cooling, half cup of this extract is taken to cure any type of viral fever including SARS-COV-2 (reported by Sanjit Tamang). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 06.12.2022, S. Panda, D. K. Som, M. Elachourie & P. Roy 011 (MAC).

16. *Rubus ellipticus* Sm. (Rosaceae) [Fig. 4 (b)].

Local name: *Ainselu* (Thami, Sarki, Thapa, Rai, Chhetri, Moktan). *Knowledge Provider*(*s*): Mr. J. K. Thami (age 79: Alubari TN Road, Darjeeling), Mr. Leo Chhetri (age 62: Lamaydhura, Darjeeling) and other 6 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: Young shoots [50 g per day] are chewed as raw to cure throat pain due to cold, diarrhoea, gastric problem including. acidity and to reduce vomitingtendency (reported by Mr. J. K. Thami). Dosimetry-II: extract of young shoots and roots (50 g: 25 g ratio) are mixed in a glass of mild warm water and taken daily in the morning to maintain normal blood sugar level (reported by Leo Chhetri). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 06.12.2022, S. Panda, D. K. Som, M. Elachourie & P. Roy 011 (MAC).

17. *Rumex nepalensis* Spreng. (Polygonaceae) [Fig. 4 (c)].

Local name: *Halhale* (Thami, Rai, Tamang). *Knowledge Provider(s)*: Mr. J. K. Thami (age 79: Alubari T N Road, Darjeeling), Mr. Polma Rai (age 65: Sepigaon, Darjeeling) and Mr. Kundan Tamang (age 58: Dhotrey, Darjeeling) and other 3 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: jelly-like water present at the base of leaf petiole is used as skin softner and cleaning agent like soap, also kills germs present on skin surface (reported by Kundan Tamang). Dosimetry-II: extract of roots (one teaspoon full) are mixed in a glass of mild warm water and taken daily after lunch and dinner to get relieved from indigestion and acidity (reported by Kundan Tamang). Dosimetry-III: roots are edible and eaten raw by the local poor people, especially during starvation or food

Fig. 4 — Ethnomedicinal plants of Darjeeling hills: – (a) leaves and twigs of *Rubia manjith* (Roxb. ex Fleming; (b) Flowering twig of *Rubus ellipticus* Sm. plant; (c) *Rumex nepalensis* Spreng. plant along with its leaf bases and underground tuberous roots inside soil; (d-e) *Stephania glandulifera* Miers. plant along with knowledge informant; (f-h) Fruiting twigs and seeds of *Tetradium fraxinifolium* (Hook. f.) T. G. Hartley along with knowledge informant; (i-l) Leaves and inflorescence twig of *Urtica dioica* L. along with knowledge informants; (m-o) Trichopteran insect larvae along with its aquatic habitat and clean drinking water source at Rock Valley Jungle Busty in Darjeeling hills

crisis, they survive by eating roots of this plant (reported by Kundan Tamang). *Reference specimen*: Dhotrey, Darjeeling district, 6900 ft, 04.12.2022, S. Panda, D. K. Som, M. Elachourie & P. Roy 03 (MAC).

18. *Stephania glandulifera* Miers (Menispermaceae) [Fig. 4 (d-e)].

Local name: *Tombarki/Baatule Laharo* (Thami, Tamang). *Knowledge Provider*(*s*): Mr. J. K. Thami (age 79: Alubari TN Road, Darjeeling) and Mr. Kundan Tamang (age 58: Dhotrey, Darjeeling) and other 4 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: liquid water found inside tuberous rootstocks [which is present inside soil] of this plant [one tuber per day for minimum 3 days and maximum 7 days are prescribed] is taken to cure any type of viral fever (reported by Mr. J. K. Thami). *Reference specimen*: Alubari Jungle Busty, Darjeeling district, 6400 ft, 07.12.2022, S. Panda, D. K. Som, M. Elachourie & P. Roy 21 (MAC).

19. *Tetradium fraxinifolium* (Hook. f.) T. G. Hartley (Rutaceae). Syn. *Euodia fraxinifolia* (D. Don) Hook. f. (Fig. 4 (f-h)).

Local name: *Khanakpa/Khanukpa* (Rai community). *Knowledge Provider*(*s*): Mr. Polma Rai (age 65: Sepigaon, Darjeeling). *Mode of use and dosimetry*: Dosimetry-I: Seeds are eaten raw or 8 to 10 seeds are made into powder which is then mixed in a glass of mild hot water and taken in the morning after food for 7 days to cure any type of viral fever including. SARS-COV-2. Seeds are also taken asimmunity booster and relieving headache (reported by Polma Rai). *Reference specimen*: Sepigaon, Darjeeling district, 6000 ft, 06.12.2022, S. Panda, D.K. Som, M. Elachourie & P. Roy 0023 (MAC).

20. *Urtica dioica* L. (Urticaceae) A calcium-rich plant [Fig. 4 (i-l)].

Local name: *Sishnu* (Thami, Rai, Tamang). *Knowledge Provider*(*s*): Mr. J. K. Thami (age 79: Alubari T N Road, Darjeeling), Mr. Kundan Tamang (age 58: Dhotrey, Darjeeling), Mr Fendu Tamang (age 40: Dhotrey), Mr Nima Tamang (age 32: Dhotrey) and other 3 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: inflorescence, twigs and tender leaves after cleaning [500 g] are boiled in water for 5 to 10 min, then mixed with 25 g ghee and stirred for 2 min. This soup is then taken to relieve any type gastric problems, acidity and lowering high blood pressure. This is also a good source of calcium (reported by Mr Fendu Tamang). Dosimetry-II: During starvation, local people used to take this plant tender leaves & twigs boiled with rice and taken for their survival. It provides Ca and other minerals, and also relieve from gastric problem (reported by Nima Tamang). Dosimetry-III: soup is prepared with tender leaves and inflorescence twigs like Dosimetry-I, for lowering high blood pressure and relieving from gastric problem (reported by J.K. Thami). Dosimetry-IV: root extract used as bandage to cure bone fracture pain as well as join broken bones (15 days time required) (reported by Mr. J. K. Thami). *Reference specimen*: Dhotrey, Darjeeling district, 6900 ft, 04.12.2022, S. Panda, D.K. Som, M. Elachourie & P. Roy 05 (MAC); Alubari TN Road, Darjeeling, 6600 ft, 07.12.2022, S. Panda, D.K. Som, M. Elachourie & P. Roy 031 (MAC).

One insect taxon

21. Trichopteran aquatic insect (Caddishflies)—larvae of Trichoptera identified by Dr. Dirk Mattern of Erfurt Natukunde Museum, Germany [Fig. 4 (m-o)].

Local name: *Dhungre kira* (Thami community). *Knowledge Provider*(*s*): Mr. J. K. Thami (age 79: Alubari T N Road, Darjeeling) and other 3 Gorkha Nepalese in Darjeeling Hills. *Mode of use and dosimetry*: Dosimetry-I: this Trichopteran larvae indicate potable clean and healthy energetic drinking water source in streams and jhoras as biological indicator in and around Rock Valley Jungle Busty, Darjeeling Himalaya, India (reported Mr. J. K. Thami). *Reference specimen*: 6 km down Alubari TN Road, Jungle Busty village, Darjeeling district, 5200 ft, 27.04.2016, S. Panda & D S Mahanty 7 (MAC).

Conclusion

Mostly innovative and novel local uses of different plant parts including doses of 20 species of wild plants and one insect taxon by ten Gorkha communities of Darjeeling hills are documented in respect to instant remedies against viral fever, immunity booster, piles, skin irritation, diarrhoea, jaundice, gastric problems including chronic acidity and gas, arthritis, pyorrhea or toothache, snakebite polyherbal formulations, urinary problem including kidney disorder, energy tonic, earache, body pain reliever, cold and cough, labour pain reliever and vomiting. Most of these validated authentic information are not recorded earlier, when reported[3,5,7,11-12,19], their dosimetry and plant parts are different.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at https://nopr.niscpr.res.in/jinfo/ijtk/IJTK_23(03)(2024)279-290_SupplData.pdf

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Declaration

We declare that pictures of local Gorkha Nepalese people were used here after their permission. We took PIC (Prior Informed Consent) during interviews**.**

Conflict of Interest

All authors declare no conflict of interest.

Author Contributions

SP contributed in respect to field survey, oral interviews and data documentation including manuscript preparation. ME contributed in respect to one field survey, ethnobotanical methodology and oral interview. DKS and PR contributed in respect to several field surveys, oral interviews and data collection. DSM contributed in respect to two field surveys, oral interview and photography.

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