

Research paper

Skincare plants of the Naxi of NW Yunnan, China

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ABSTRACT

The Naxi of Northwest Yunnan, China use medicinal plants to treat skin conditions related to traditional lifestyles in extreme environments. However, modernization endangers both the medicinal plants used to treat skin conditions and traditional knowledge. Therefore, investigation and documentation of the medicinal plants used and associated traditional knowledge is necessary. In this study, we conducted an ethnobotanical survey in 12 Naxi communities in Northwest Yunnan. For this purpose, we used semi-structured surveys to interview 840 informants from Naxi communities. We used informant consensus factor and use frequency as quantitative indices to evaluate the importance of medicinal plant species. A total of 161 medicinal plant species belonging to 69 families were documented. The highest informant consensus factor (ICF) values were recorded for skin nourishing (ICF = 0.849), frostbite and chapped skin (ICF = 0.833). These skin treatments are highly related to the environment and lifestyle of Naxi communities. The main active compounds of plants used to treat skin conditions in Naxi communities are known to have skin-treating properties. This study reveals that the skin conditions treated by the Naxi are associated with traditional medicine culture and social economic development. In addition, this study uses ethnobotanical indices to explain how skin condition treatments are linked to the natural environment of Naxi communities.

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1. Introduction

Traditional medicinal knowledge is used by nearly 80% of the 2000 ethnic groups in the world, with each group having its own unique set of knowledge (Yang, 2000; Zhang et al., 2006; Molla et al., 2008; Giday et al., 2009; Lall and Kishore, 2014; Moteetee and Kose, 2017). These traditional systems are especially critical in developing countries, where people tend to rely on traditional

medicine for health care (Singh, 2002). In Southeast Asia and the Himalayas, indigenous people have used traditional systems of medicine, particularly herbal medicines, for centuries, utilizing the high diversity of medicinal plants (20,000 species) that occur in the region (Pei et al., 2010).

The Naxi people of southwest China have lived in the Hengduan Mountains area in the eastern Himalayas for generations. The Naxi believe in a spiritual system, the Dongba culture, that aims to maintain a close and harmonious relationship between humans and nature, as is celebrated annually in a nature worshipping ceremony called the Naxi “Sanduo” Festival. The Naxi have a semi-farming and semi-pastoral lifestyle, practice slash-and-burn cultivation, and have a fireplace culture. Their cultivation practices, beliefs, traditional medicine, and daily life are strongly connected to local plant life. For instance, branches of *Prinsepia utilis* Royle are hung over doors to protect houses from “unclean” visitors;

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similarly, green thorns are used to avoid evil spirits and to receive blessings from close relatives. Interestingly, green thorn fruit oil is also used in to treat infantile eczema, myogenic toxicity, skin burns, and scalds.

The Naxi people have long used medicinal plants (Zheng and Xing, 2009; Pei, 2007). The Naxi rely on Naxi Dongba culture to treat health conditions, primarily by consulting herbal healers, local shamans and through self-care. Naxi Dongba medicine shows a medical pluralism derived over two thousand years from Tibetan medicine, traditional Chinese medicine, and other ethnic medicines. The first ethnic herb manuscript, Southern Yunnan Herbs (1436), which includes 266 medicinal herbs, was completed 142 years earlier than the classic traditional Chinese medicine manuscripts *On Materia Medica* by Li Shizhen. The first Naxi herb manuscript, Yulong Herb (1449), is the second traditional herb manuscript in the history of Yunnan and its second revision included 379 medicinal plants (He and Ma, 2006). Since 1949, modern Western medicine has gradually taken a leading role in medical treatment in China; however, in Naxi communities, which consist of poor people in remote areas of Lijiang, Northwest Yunnan, many healers continue to use traditional knowledge and medical plants to treat villagers. Researchers have found that 13% of Naxi people rely exclusively on traditional Naxi medicine, 26% use Western medicine, and 61% use a combination of traditional Naxi and Western medicine (Yang, 2007; Hu and Pei, 2004). However, modernization has endangered traditional knowledge of medicinal plants.

Over the past thirty years, ethnobotanists have studied medicinal plants (Guo, 1989; Wang, 1999; Zhang et al., 2015; Pei et al., 2009), Naxi edible plants (Guan, 2016; Geng, 2015; Zhang et al., 2013; Yang et al., 2014), and home-garden plants. In addition, some researchers have investigated Naxi medicinal plants with traditional Han usages, which has been separated by the Naxi Dongba system of pharmacognosy (Yang et al., 2014; Heinrich et al., 2009). Ethnobotanists have also noted that the Naxi use plants to treat skin conditions. The Naxi live in cold and dry climates with intense ultraviolet solar radiation. Furthermore, their traditional lifestyle exposes the Naxi to common skin conditions such as sunburns, fire burns, cuts, and scalds. The plants the Naxi use to treat these skin conditions and the related indigenous knowledge have not been reported by ethnobotanical research. Consequently, the diversity of medicinal plants the Naxi use to treat skin conditions and the traditional knowledge associated with these ethnomedicines are in danger of disappearing. In this study, we documented the plant species and related traditional knowledge that the Naxi of Northwest Yunnan use to treat skin conditions.

2. Materials and methods

2.1. Study area

This study was conducted in Yulong Naxi Autonomous County (99°23'–100°32'-E, 26°34'–27°46' N) and in Shangri-La County, Northwest Yunnan, China (99°21'–100°19' E, 26°52'–28°52' N). Northwest Yunnan is situated within the Three Parallel Rivers Region, which has well-documented biological and cultural diversity. The region ranges in elevation from 1300 m to 5596 m, and has a low latitude plateau South Asian monsoon climate that is windy and cool during spring and summer, while cold and dry with strong sunshine and intense ultraviolet radiation during autumn and winter. The average temperature of Northwest Yunnan is 13.4 °C with annual precipitation of 800.6 mm. The dominant vegetation types of the region include coniferous forest, evergreen broad-leaved forest, shrub, and meadow. Naxi villages are generally situated at elevations from 2300 m to 2600 m. This elevational range is accompanied by variation in climate, habitats, soils, and ecotypes

that provides diverse conditions for medicinal plants. To survey this variation, we selected twelve Naxi communities in Yulong Naxi Autonomous County and one Naxi community in Shangri-La County (Baishuitai township) as study sites (Fig. 1).

2.2. Data collection

Field studies were conducted at regular intervals in different seasons between 2010 and 2015. A snowball sampling method was used to select 840 informants (72 Naxi doctors; 768 Naxi villagers). Naxi village informants included farmers, healers, and indigenous people who had knowledge of medicinal plants. Semi-structured interviews with informants included the following questions: (1) Which plants do you use to cure skin conditions? (2) Which parts of the plants do you use? (3) What kind of process for preparation have you used for medicinal plants? (4) What kind of causes and symptoms of skin disease have they treated? (5) How many patients have you treated per month or year? Prior to this study, locals were contacted and informed of the purpose of the study and investigations were conducted with their consent.

We selected forty-two Naxi home gardens (again by snowball sampling) to document plants mentioned by informants. All medicinal plants recorded for the treatment of skin conditions were photographed in the field. We tabulated recorded information about the plants, including voucher specimen code, scientific name, local name, family name, life form, used parts, preparation method, and use frequency (Table S1). We collected 1–2 voucher specimens and 3–5 plant pictures for each species. Each sample specimen included leaves, stems, flowers and fruits, when available, and specimens were identified. For small herbaceous plants, whole plants were collected as specimens and deposited in the Key Laboratory of Economic Plants and Biotechnology, Kunming Institute of Botany, Chinese Academy of Sciences.

2.3. Data analysis

Two quantitative indicators, informant consensus factor (*ICF*) and use frequency (*f*), were used to evaluate the skincare plants and related traditional knowledge in Naxi community, Northwest Yunnan, China.

Informant consensus factor (*ICF*) was employed to determine the homogeneity in the information given by the informants. *ICF* values will be low (near 0) if one or several plant species are widely used to treat various skin conditions or when informants do not exchange information about plant species used to treat skin disease. Values will be high (near 1) if the plant species is widely used to treat various skin conditions or the information about the plant species used to treat skin disease is actively exchanged between informants. *ICF* was calculated by the following formula (Gazzaneo et al., 2005):

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

where *Nur* represents the total number of plant species used for all informants to treat a specific skin disease, and *Nt* refers to the number of plant species simultaneously utilized by all informants for treating a certain skin disease.

To quantify the use frequency of a species (Lozada, 2001), the following formula was adopted:

$$f = \frac{N_m}{N_i}$$

where *f* represents the use frequency, *N_m* is the frequency of certain species mentioned by informants or certain used parts, families,

habitats and skin-treating efficacy (shown in Table 1). The value N_i represents the total number of informants, used parts, families, habitats and skin treatments (shown in Table S1). The higher the value of f is, the more frequently it is used by Naxi.

We conducted a literature review to identify the main active ingredients of plants that informants reported as high frequency or high efficacy.

3. Results

3.1. The plant diversity of Naxi skin-treating

Plants used by the Naxi to treat skin conditions are highly diverse. Specifically, informants identified a total of 161 plant species belonging to 69 families that are used to treat different skin conditions (Table 1). The majority of species used to treat skin conditions are herbs (63%), although trees (21%) and shrubs (13%) are also commonly used. The ten most common families of plants used by the Naxi to treat skin conditions are Compositae (9.9%), Ranunculaceae (8.1%), Umbelliferae (5.6%), Labiatae (5.0%), Polygonaceae (4.3%), Liliaceae (3.7%), Rosaceae (3.7%), Leguminosae (2.5%), Urticaceae (2.5%) and Araceae (1.9%) (Fig. 2).

The most common part of the plant used to treat skin conditions was the whole plant (35%) (Fig. 3). However, the root (30%), leaves (9%), stems (7%), seed (6%), flower (4%), fruits (3%), bark (3%), rhizomes (2%) and branches (1%) are also used. Most of the 161 plants documented are found in home gardens (23%), followed by the grassland (21%), cropland (20%), shrub (18%), woodland (10%), and valley (8%). These sources and gathering places for skincare plants appear to be highly related to local production activities. For example, our finding that large proportions of plants are collected in grasslands and croplands is consistent with the primary activity of many Naxi communities: farming and foraging. Similarly, Naxi communities have traditionally grown medicinal plants near their homes to collect plants in times of need. This tradition is consistent with our finding that most skincare plants are collected in the home garden. In addition, many herbal healers used to cultivate the rare medical plants in their home garden.

3.2. Traditional preparation of Naxi skin treatments

For thousands of years, the Naxi have accumulated ethnobotanical knowledge on skincare. Traditional preparations of skincare plants are closely related to the major therapeutic effects of the plants. For example, plants that contain poisons, such as *Coriaria nepalensis* or the plants of Euphorbiaceae, are generally detoxified through a mixture of rice wine, brown sugar, egg whites, and honey. Tools that are used to prepare skin treatments (stone, knife, clay pot, iron pot, porcelain cylinder) have largely been made from natural surroundings and/or from tools used in daily life. Naxi traditional herb preparation mainly includes fresh extraction, pulverization, decoction, boiling, and soaking in traditional home-made wine and seed oil. We found that Naxi preparation of

skincare plants consists of three types of treatments, taken either externally or orally.

Plant extracts are boiled for both oral and external treatments. For example, plant extracts of *Pinellia ternata*, *Arisaema erubescens*, and *Euphorbia jolkinii* are boiled to treat frostbite. Extracts of *Lithospermum erythrorhizon* and a mixture of purple starch with *Taxus yunnanensis* are used for myogenic detoxification. Moreover, the boiled extracts of some toxic plant species (*A. erubescens*, *Senecio scandens*, and *E. jolkinii*), for which exposure to the lips and eyes should be avoided, are used to treat skin allergies. Water boiled with *Cnidium monnieri*, *Sophora flavescens*, *Xanthium sibiricum*, *Senecio chrysanthemoides* and the leaves of *Rhododendron* are used externally for itchy skin and eczema. External application of boiled extracts of *Clematis napaulensis* and *E. jolkinii* are used to treat psoriasis. Skin health is also treated with medicinal baths or oral consumption of *Mirabilis jalapa*, *Salvia miltiorrhiza*, *Angelica sinensis*, and *Ligusticum chuanxiang*.

Seed oils and fresh extracts are also used to treat skin conditions in Naxi communities. The root of *L. erythrorhizon* soaked in the seed oil of *P. utilis* is used as an anti-aging skincare oil, as well as to treat tetanus, heat rash, acne, and unfallen umbilical cord. Similarly, the dried seed of *M. jalapa* is used for moistening skin and spot-fading. The Naxi dissolve powders of *L. erythrorhizon* and *Sanguisorba officinalis* in sesame oil to treat scalding and eczema. Extractions of the fresh liquid from the root of *Cirsium japonicum* is used to treat burns. Application of smashed *Bidens pilosa* is used to treat mosquito bites. Leaf extracts of *S. chrysanthemoides* and *Reynoutria japonica* are prepared by rubbing the leaves directly on the skin to treat itching, skin tinea, eczema, and rubella. Fresh leaves of *Rumex nepalensis* are kneaded to prepare Makino's extract, which is used to treat festering skin.

Alcoholic extracts of herbal plants are used externally to treat herpes and zoster, wounds, and snake bites. Ten species of frequently used plants in these preparations include *Dipsacus asperoides*, *Reynoutria japonica*, *Corydalis raddeana*, *Oxalis corniculata*, *Melastoma candidum*, *Scutellaria baicalensis*, *Scutellaria likiangensis*, *Tofieldia thibetica*, *Gynura segetum*, *Fagopyrum tataricum*, as well as powders of *Paris polyphylla* and *Ranunculus ternatus*. Plant seed oils are also mixed with honey and fresh egg whites and then applied to the surface of skin where wounds are cracking due to the dry environment. Prepared ointments are used to maintain smooth, moist skin.

3.3. Naxi herbal skincare functions

Naxi ethnomedicines are used for seven common skin conditions and/or treatments: nourishing, cosmetic, frostbite and chapped skin, myogenic toxicity, laceration, burns, and skin irritation or inflammation. These skin conditions and treatments are related to the culture and living environments of the Naxi people. The ICF values obtained from the reported categories indicate the degrees of shared knowledge for the skin conditions treatments (Table 1).

3.4. Active ingredients of Naxi skincare plants

Our literature review of the most frequently used and efficacious Naxi skincare plants revealed numerous active compounds (Fig. S1). The *Senecio scandens*, which is used by the Naxi to treat skin condition of allergies, has the following active ingredients: Hyperoside, Chlorogenic acid, Rutin and Quercetin dihydrate. These compounds are known to act as anti-oxidants, and have been shown to have anti-viral, anti-bacterial, anti-inflammatory, and anti-tumor effects. Informants from the Naxi community reported that *Bletilla striata* is one of their main products. This plant, which is cultivated in Naxi home gardens, has a wide diversity of recorded

Table 1
Informant consensus factor of skin-treating plants used by Naxi people.

Skin treating efficacy	N_t	N_{ur}	ICF
Nourishing	19	120	0.849
Frostbite, chapped skin	7	37	0.833
Myogenic detoxification	15	75	0.811
Skin laceration	12	45	0.750
Cosmetology	23	87	0.744
Burns and scalds	20	71	0.729
Skin inflammation and others	73	178	0.597

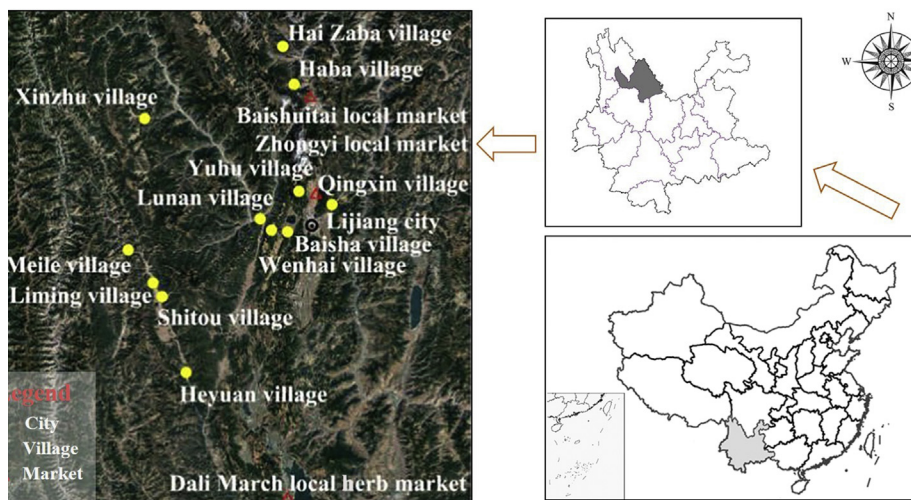


Fig. 1. Location of study sites.

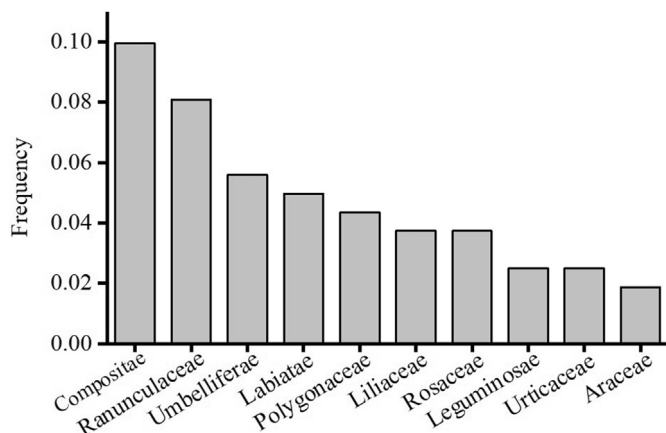


Fig. 2. Ten most common plant families used by Naxi to treat skin conditions.

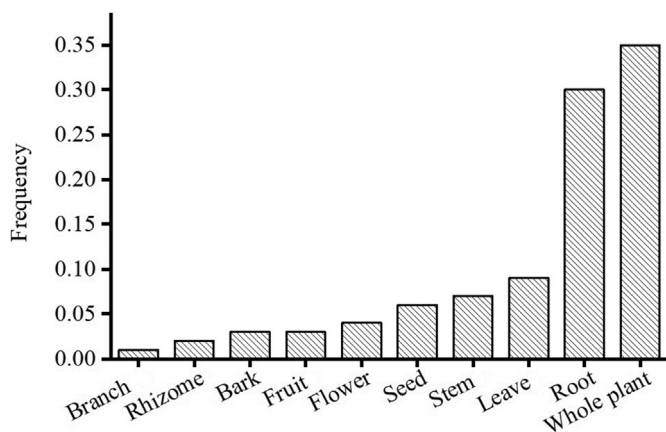


Fig. 3. Parts of plants used by Naxi to treat skin conditions.

medical uses. The Naxi use these plants as an astringent lotion and to reduce muscle swelling. Previous studies have identified the active ingredients of *B. striata* as Militarine, Coelonin and Batatasin III (Chen et al., 2019; Liu et al., 2020; Qin et al., 2020). *P. utilis* and *L. erythrorhizon* are used by the Naxi as anti-aging oils and to treat

tetanus, heat rash, acne, and an unfallen umbilical cord; however, these plants also have a rich history in modern medicine. The active ingredients of *M. jalapa* and *P. utilis* include linoleic acid, oleic acid, palmitic acid. The active ingredient of *L. erythrorhizon* is β , β -dimethylacrylalkannin. These compounds have a wide range of recorded medical usages and applications. The Naxi traditionally use the juice from the root of *C. japonicum* to treat burns and scalding. The active ingredients in these roots include linarin and pectolarin, which traditional usage suggests possess antibacterial, anti-aging, anti-fatigue, hemostasis, coagulation properties.

4. Discussion

The Naxi live in Yunnan Province in the southern Hengduan Mountains of the Himalayas, which is one of the most important habitats for medicinal plants in China. Naxi communities use a diversity of medicinal plants to treat many ailments, including skin conditions. In this study, we have documented significant plant diversity used to treat skin conditions in Naxi communities. Over half of the plants identified as Naxi skincare plants are herbaceous. Herbaceous plants may be used more than other types of plants (e.g., woody plants) because they are easy to collect, present in high abundance, and are highly effective. This would be consistent with previous ethnobotanical studies that found weedy and herbaceous plants constitute the majority of plants collected for food, medicine, and other purposes often (Ju et al., 2013). The sources and gathering places for skincare plants appear to be highly related to local production activities. For instance, our finding that large proportions of plants are collected in grasslands and croplands is consistent with the primary activity of many Naxi communities: farming and foraging. Similarly, Naxi communities have traditionally grown medicinal plants near their homes to collect plants in times of need. Many herbal healers cultivate rare medical plants in their home garden. This tradition is consistent with our finding that most Naxi skincare plants are collected in the home garden.

The medicinal plants used by the Naxi to treat skin conditions are directly related to the Naxi environment and lifestyle. The Naxi ethnic group mostly lives in Lijiang City, at a high elevation, where ultraviolet radiation from the sun is strong, and the annual average rainfall is less than 1000 mm. To cope with these environmental conditions, the Naxi people have accumulated ethnobotanical

knowledge to treat sunburn and cracked skin. Most Naxi homes build fires for heat and cooking, which frequently causes burns and scalding. Furthermore, the Naxi lifestyle of semi-herding and semi-farming leads to injury by tools and animals (dogs and snakes) during farming activities. The Naxi use knives, hoes, and trowels to sow or harvest crops; they also travel to the mountains to collect firewood and fodder for fertilizer. Occasionally, these activities lead to injuries, which the Naxi have learned to treat with medicinal plants.

The Naxi also use plants as for cosmetic and pediatric purposes. In recent years, skincare for beauty has become popular in Naxi communities. The Lijiang people's Hospital has a special dermatology and cosmetology department and Yulong County Hospital has a traditional Chinese department for skin disease treatment. Also, there are three traditional herbal clinics in downtown Lijiang dedicated to female beauty. The Naxi use plants to treat common pediatric skin conditions such as measles and eczema. This is especially important because the measles vaccine is unavailable in many Naxi communities and all children in the Naxi villages experience measles at least once. These treatments may be of considerable value for future studies.

The *ICF* values of some plants used by the Naxi to treat skin conditions were relatively high. These plants have widespread applications in Naxi communities. The plant used with the greatest frequency by the Naxi is *Foeniculum vulgare*, the root of which is used to treat purpura and allergic dermatitis. *F. vulgare* is also a good medicinal and food homologous plant. Studies have shown that fennel extract has a variety of pharmacological effects, such as anti-aging, anti-allergy, anti-inflammatory, anti-bacterial, and antiviral. The health benefits of this plant may be credited to the presence of the various phytochemicals, including volatile compounds such as flavonoids, phenolic compounds, fatty acids, and amino acids (Badgujar et al., 2014; Anwar et al., 2009). These volatile compounds often have significant pharmacological activity against skin conditions and potential development value (Balick and Lee, 2003; Balick, 2006; Efferth, 2009). Many of the Naxi skincare plants used most frequently belong to the plant family Compositae, which have sesquiterpene lactones with various biological activities (Wang, 2012). For example, *S. scandens* is frequently used in Naxi communities to treat sores, carbuncle, abscess, and eczema. Similarly, studies have shown that *Jiuliguang* whole grass contains a large amount of flavoxanthin, chrysoanthemoxanthin, and a small amount of senecionine, seneciphylline, hydroquinone, p-hydroxyphenylacetic acid, vanillic acid, salicylic acid and pyromucic acid, which may have numerous pharmacological effects, including anti-bacterial, anti-inflammatory, anti-oxidative, anti-viral, anti-cancer properties (Feng et al., 2014; Xu et al., 2014). Additional plants that have high *ICF* values and are related traditional knowledge in Naxi communities should be researched further.

Traditional medicine continues to be a valuable source of remedies that have been implemented by millions of people around the world to improve their health. The ethnobotanical knowledge of the Naxi arose from long-term interaction with their surrounding environment and is highly valuable to both further cultural understanding and the development of new skincare products. Research into the ethnomedicines of the Naxi may protect plant diversity and traditional knowledge. In addition, traditional applications of plants provide clues to improve screening for functional substances and active compounds.

Author contributions

Yanqiang Zhao and Zexing Yang conceived the study and conducted field investigation and data collation, Manfred Shao Wu

Meng, Dayuan Xue and Lu Gao analyzed the data and revised the paper. Bayi Lang and Lixin Yang wrote the paper. All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pld.2020.12.005>.

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