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Ethnobotany of Oyster nut (*Telfairia pedata*) in Northern Tanzania

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Abstract

Telfairia pedata (Sims) Hook is an important native climber plant commonly grown in East Africa. It bears nuts which are eaten either raw or cooked and is consumed mostly by expectant mothers, and as cooking oil. The survey was conducted between September 2019 to February 2020 in *Sambaa, Meru,* and *Pare* communities of Lushoto, Bumbuli, Arumeru and Same Districts, Northern Tanzania to assess the ethnobotany of *T. pedata* from a sample of 346 respondents using semi-structured questionnaires. Results indicate that, 21% of respondents used *T. pedata* for cooking with other staple foods while 18% claimed that the nuts are used by pregnant and lactating mothers for medicinal and breast milk stimulation and nine (9) percent indicated that the nuts are used for cultural and ritual purposes. Despite its importance, the cultivation of *T. pedata* in the study area is declining and the gap why such decline is experienced needs to be answered in further studies. Secondly, respondents within the 36-50 age groups reported the greatest diversity of uses of *T. pedata* 51% compared with those aged below 36 years old 21% signifying that the traditional knowledge known by younger aged groups may be declining. Thus, this gap of traditional knowledge between the groups should be addressed in order to improve utilization and conservation of this seriously declining yet important nut in the study area and other places of Tanzania.

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Introduction

Local societies are known to have ethnobotany knowledge that is inherited from one generation to another through word of mouth on economic, medical, ecological and cultural benefits (Hamilton, 2003) (Young, 2007) (Tamalene *et al.*, 2016). Ethnobotany assists in explaining utilization and preservation of the plants biodiversity thus maintaining local ecological systems and culture (Reid *et al.*, 2009).

Telfairia pedata (Smiths ex Sim) Hook (Fig. 1), is Cucurbitaceae family from a small genus of flowering plant which is native in Tanzania including Zanzibar Island and other countries of Africa including Uganda and northern Mozambique (I. A. Ajayi *et al.*, 2004)(Aregheore, 2012). It is also well known by its local names in regions of Kilimanjaro, Arusha, Tanga and Ruvuma as "mkweme", "ngoimee" or "ikwemee" and "makunguu", “nhahani” and so forth. It is a woody dioecious climber with coiled tendrils which bears squash like fruits containing nutritious oil seeds and grows well in well drained loamy soils (Van der Vossen & Mkamilo, 2007), Fig. 1. The plant is a facultative perennial which is grown in slightly shaded and mulched areas but not damp soils and also creeps on host trees, live hedges or staked on wooden framework (Ajibade *et al.*, 2006; Grubben, 2008; Paul & Yavitt, 2011). *T. pedata* nuts are rich in oil content, fat, protein, polyunsaturated fatty acids, monounsaturated fatty acids, minerals including magnesium, phosphorous (Akoroda, 1990b; Mwakasege *et al.*, 2021).

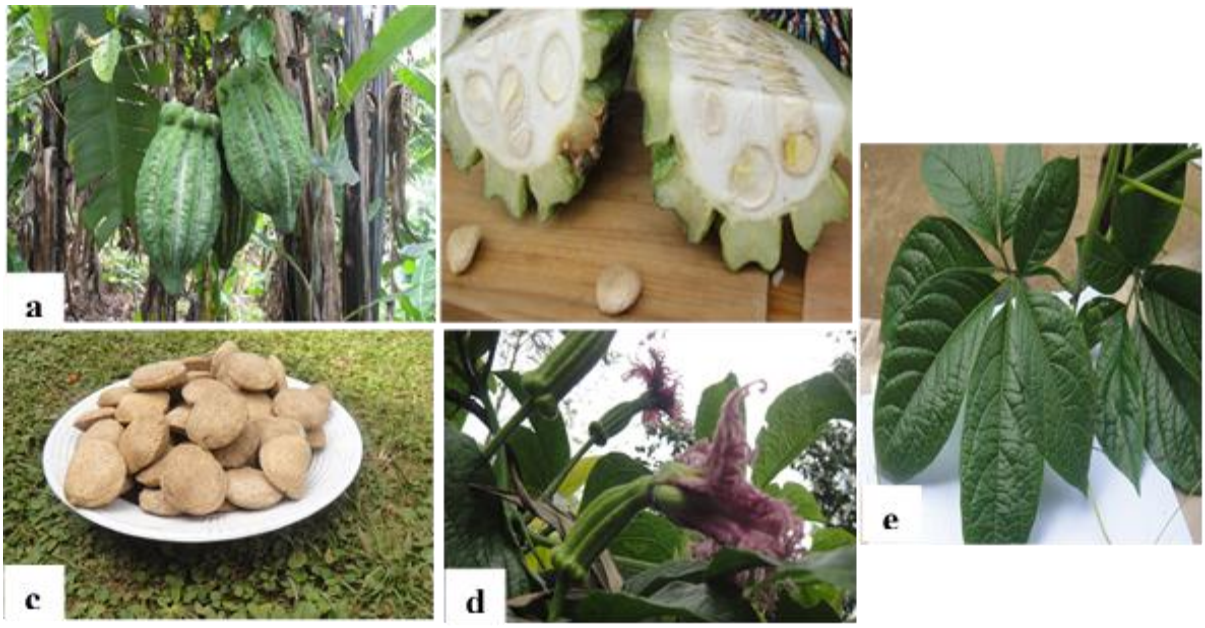

Fig. 1. (a-e) Morphology of *Telfairia pedata*. **a** Hanging mature fruits on a farm, **b** Split fruit, appr. 15 cm diameter portrayed by white hard coat which wears off after the fruit reaches full maturity, **c** Seeds, **d** Pistillate and staminate flowers and developing fruit **e** Vine with leaf petioles, tendrils, branch and cup-like appendage.

In Tanzania, ethnobotanical facets and uses of *T. pedata* have not yet been adequately documented specially in terms of local people’s livelihoods, how it used, cultivated, marketed, preserved and its conservation measures. Among local plants long used by the *Pare, Chagga, Sambaa*, and *Meru* tribes, the *T. pedata* is one which is harvested from the home gardens and agroforestry systems (trees mixed with annual crops) as a source of food, for cultural rituals and medicine. In these communities, traditional knowledge about *T. pedata* has been passed down and applied for generations (Ajayi *et al.*, 2004; Odiaka *et al.*, 2008).

Therefore, this study aims at documenting and collating knowledge on the indigenous uses of *T. pedata* nuts and its cultivation practices in order to support the consumption and utilization of the plant

in a sustainable manner, while providing benefits to the local communities through conservation of traditional knowledge. We examined the ethnobotany of *T. pedata* in northern Tanzania with the expectations that, the socio-demographic characteristic on *T. pedata* differ across the study sites; there were different ethnobotanical uses of *T. pedata* across the study area; areas where *T. pedata* were cultivated differ across study area with gender; perception of abundance of *T. pedata* differ across the study area and *T. pedata* nuts were stored in different methods across the sturdy area.

Materials and method

Study Area

We conducted a purposive sampling survey as from September 2019 to May 2020, in four districts, namely, Arumeru (Arusha region), Same (Kilimanjaro region), Lushoto (Bumbuli inclusive) and Muheza (Tanga region), of the United Republic of Tanzania, Fig. 2. Arusha region lies below the equator between latitudes 2° and 6° and longitudinally is situated between 35° and 38° East of Greenwich.

Tanga region is found in the North-East corner of Tanzania between 40° and 60° below the Equator and 37°-39°10' East of the Greenwich Meridian. Kilimanjaro region is located south of the equator 2° 25' and 4°15'S; 36°25' 30" and 38°10' 45" E, bordered to the north and east by Kenya, to the south by Tanga region, to the southwest by the Manyara Region and to the west by the Arusha Region (URT, 2013).

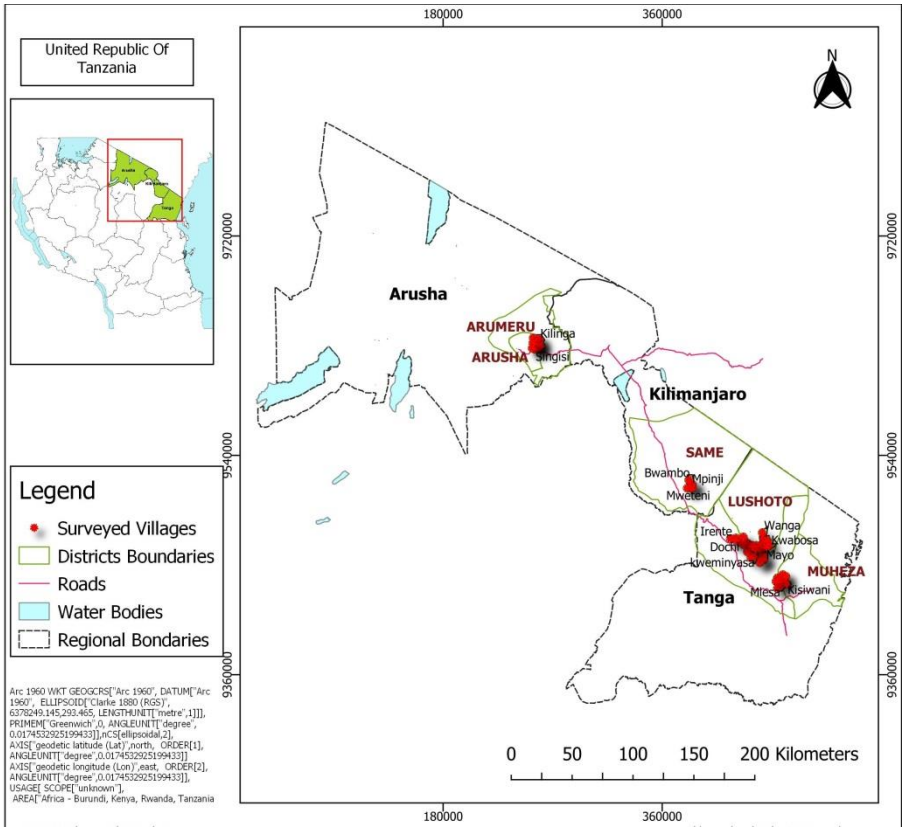

Fig. 2. Map of Northern Tanzania showing survey locations, districts of Lushoto (Bumbuli inclusive), Muheza, Arumeru and Same.

Methods of data collection

The surveys were randomly and purposely selected and surveyed in fifty seven (57) villages where *T. pedata* were found based on vicinity, availability, cultural relevance and accessibility of the plants based on literature, unpublished reports and recorded conversations. A total of 346 *T. pedata* growers (female and male) were purposely selected and

surveyed. Semi structured questionnaires were used to collect information on farming systems, socio-economic factors, source of seed, cultural practices representing different age and gender groups, utilization, postharvest handling and storage, and associated constraints in production of *T. pedata*. Participatory research appraisal and techniques including individual interviews, direct observation and field visits using questionnaire were used using techniques proposed by (Adjatin *et al*., 2012; Dansi *et al*., 2012). Along with the associated trees within the respondent's farmlands, the data collected included local names (Kiswahili and ethnic names) of *T. pedata* plant. In addition, known uses and parts of plant used, their abundance, that is, if they were perceived to be stable or declining, the reasons for perceived changes if known and types of host tree species in the area were recorded. The respondents' demographic data were also collected from key informants and through focus groups discussions. The informants were grouped according to their age, time lived in the area (more than 20 years) as well as gender, educational attainment, and marital status. The respondents were divided between sexes and represented three age groups: 18-35 years, 36-50 years and older than 50 years. The respondents were selected through the snowball sampling technique based on procedures described by (N'Danikou *et al*., 2015; Adigoun-Akotegnon *et al*., 2019). The questionnaire used during the interviews was first run as a pilot before the final questionnaire was administered. During the surveys, the questionnaires were conducted with the help of Agricultural Extension Officers and translators who were recruited in each study area.

Data analysis

Data from the field survey were coded, organized and analyzed both qualitatively and quantitatively using Statistical Package for Social Sciences (IBM SPSS ver. 20.0). The analysis consisted of descriptive statistics (response frequencies, means and percentages) and inferential statistics (T-test and Chi-square (X^2) and the results were presented in form of graphs and tables constructed with Excel software (Microsoft office 2016). Summaries and tables at different levels (villages and ethnic areas) were used.

Results and discussions

Socio-demographic characteristics of respondents

In this study, 346 people from the four sites were interviewed. The respondents were separated by sex and represented in three age groups: 18-35 years, 36-50 years and older than 50 years. Among these 346 respondents, more than half 83% were female and 17% were male. An analysis of results obtained from this study reveals that the majority of the respondents, more than half 51% ranged between the ages of 36-50 years. While the youths (between 18-35 years old) represented about 21%; and the older generation (above 50 years old), represented about 28%, Fig. 3.

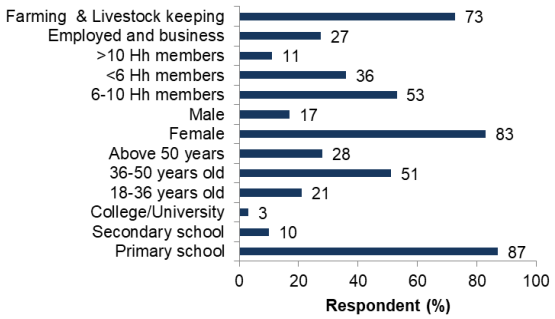

Fig. 3. Socio-demographic characteristics of respondents (N = 346) across the region that were interviewed from September 2019 to March 2020. Whereas >10 Hh (Household) members means having more than 10 family members; <6 Hh members means having less than 6 family members; in Tanzania, college/university is the highest level of education after attending ordinary/advanced secondary school and primary school is minimum level of education (7 years in school).

The results depicted in Fig. 3, reveals that women 83% consume or utilize *T. pedata* more than men 17% counterparts since women are the producers of meals, food and custodians of knowledge compared to men and it is taken as a simple job in nature for women (Ashagidigbi *et al*., 2018). Also, the majority of respondent's falls within age range of 36 to 50 years which indicated that they were in a productive and economically viable stage of life.

Moreover, many of respondents had formal education which revealed that a good proportion of rural people are literate, this also coincides with findings of (Akujuobi *et al.*, 2010) that even *T. occidentalis* is grown by literate. This could be worthy enough to facilitate the introduction of agricultural innovations and technologies more quickly and smoothly. In terms of marital status, generally, it appears that the majority of growers in the study area were married couples hence they were likely to be more involved in the production of *T. pedata* which could also give an indication that the spouses were working together in carrying out domestic and farm chores. And also, more sensitization should be given to the males as they appeared to be low in order for them to increase the consumption and more understanding on its benefits for the betterment of the society.

Ethnobotanical uses of T. pedata crop

Telfairia pedata grow in closest proximity to the respondents' place of residence and an average of ten uses for economic, ecological, health and cultural reasons were recorded for each respondent. Table 1 below, shows that its' the major uses were related to cooking it with staple foods 21% (of use records), followed by pregnant and lactating mothers 16% inorder to stimulate milk production and to regain strength after child birth and breastfeeding. Even the *Sambaa* and *Pare* communities' use thick paste of pounded *T. pedata* nuts for skin protection as this has long been exploited for cosmetics, aromatherapy and massage for girls and lactating mothers. The nut oil is also used to increase milk flow by using it for breast massage (Ajayi *et al.*, 2004). It was also recorded that *T. pedata* were also commonly used as snacks 15% and other uses such as candle and soap production 48%.

Table 1. Ethnobotanical uses of *T. pedata*.

Uses	Frequency	Percent of responses
Cooking	324	21
Lactations	281	18
Snacks	249	16
Conservation	234	15
Medicine/herbs	200	13
Culture	131	9
Ornamental	116	8
Total	1535	100

Source: Field survey, 2020

Furthermore, *T. pedata* contribute significantly to the socio-economic status of these communities. Although, currently the nuts are mostly consumed by children, youths, adults and elders, they have the potential to increase the income of local people through the sale of the seeds and the production of oil for food, cosmetic purposes and industries (Okoli & Nyananyo, 1988; Mwakasege *et al.*, 2021). They are primarily grown to be used as spice to foods, and used by pregnant and lactating mothers and as a substitute for cooking oil. They also have a secondary function as panacea (panacea of witchcraft, couth, and friendship oaths), (Ajayi *et al.*, 2004; Furusawa *et al.*, 2014) suggested that behaviors, such as giving respect to forest reserves and the semi-domestication of some species can contribute to the effort of preserving local biodiversity especially local endemic species. The extensive knowledge of rural farmers have on the use of *T. pedata* nuts could motivate the cultivation of this crop if they are mentored and encouraged to do so. Thus, there exists an opportunity to increase production, post-harvesting and marketing opportunities.

The nuts are used in various traditional dishes such as cooked banana plantain, to thicken traditional soup, cooked beans, green vegetables, mixed maize and beans (*makande*), Fig. 4e and special meals for lactating mothers including *kibibi* from the *Sambaa* tribe (Fig. 4c) where it is pounded like peanuts (*Arachis hypogaea* L.). But the nuts can also be eaten either fresh or roasted for confectionery purposes and for snacks (Ajayi *et al.*, 2004), Fig. 4 a, b & d. Various studies have indicated that consuming the nuts reduces degenerative diseases such as, diabetes, stomach problems, and rheumatism (Okoli & Nyananyo, 1988). It is also used for variety of other purposes for traditional rituals, cosmetics for skin (aroma-therapy) and hair (Akpabio *et al.*, 2008; Aregheore, 2012). Therefore, its contribution to human health and livelihood diversification is significant (Fasuyi 2007; Mwakasege *et al.*, 2021). Nevertheless, it is important to understand that, there are extraordinarily strong traditions attached to tribes both in the rural and urban geographical areas. One example that stands out as a common practice for

pregnant women is to have a large storage of *T. pedata* nuts prior to delivery because it is part of the traditional food for breastfeeding mothers and weaned infants in parts of East Africa (Ajayi *et al.*, 2007).

Fig. 4 (a-e). Photos of different uses of *T. pedata* a) Raw nuts b) nuts coated with chocolate (c) pounded nuts known as *kibibi* (d) pastries with nuts (e) flour.

Areas of cultivation and by gender

Of the 346 respondents, the majority of farmers, 89% cultivated the plant on their own farm or family inherited farm lands and 11% elsewhere i.e. on neighbors' or relatives' land, Fig. 5a. The most common planting procedure 100% was direct seeding to the farm lands close to tall trees 94% or close to wired fences or live fences were six (6) percent. Moreover, the results show that *T. pedata* plants were mostly cultivated by female 83% compared to male 17%, (Fig. 5b). There was a significant difference between female and male respondents in terms of frequency of cultivating of *T. pedata* seeds (χ^2=431, df= 9, p<0.001), as most of those who frequently used and engaged in farming were female. All growers that were studied planted *T. pedata* by sowing them in their fields, and (Loaiza *et al.*, 2016) has stated that, direct seeding is a simple, cost efficient alternative to germination in a nursery.

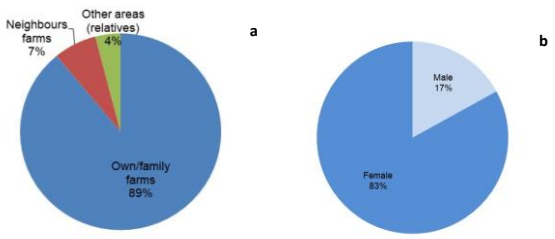

Fig. 5. a) Areas where *T. pedata* are cultivated b) Cultivation by gender (N=346).

Perceptions of abundance of T. pedata nuts

Overall, more than half of the respondents 54% perceived that *T. pedata* were declining within a scope of the last 10 years, 32% reported that their availability have not changed (have remained the same) and 14% of respondents had no idea whether the abundance of *T. pedata* plant was changing or not, Fig. 6. The respondents who perceived a decrease in *T. pedata* abundance, said that the decline was due to the absence of large native trees in response to agricultural activities, change of weather patterns, the presence of pests and small animals (rodents and squirrels) that tend to eat the seeds and bury them underground for their future consumption. Eventhough, the humans' interest was to manage the trees that the *T. pedata* grew on was for timber purposes (Chaturvedi *et al.*, 2016).

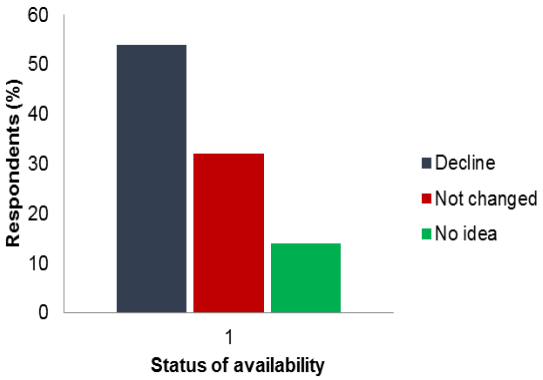

Fig. 6. Status of availability of *T. pedata* in the study area (N=346).

T. pedata can be used as agroforestry multipurpose plant species grown together with other crops to reduce carbon in the air and the kernel can be used as source of fuel to enhance ignition for kitchen cooking needs. Fortunately, the production of *Telfairia* specie is throughout the year (Odiaka *et al.*, 2008). In addition, oysternut species are also functioned as soil stabilization and bioremediation (Obute *et al.*, 2001; Wegwu *et al.*, 2002). Local ecological knowledge of the communities found in the study area related to *T. pedata* along with the trees they grow on, for biodiversity conservation which could positively affect local biodiversity.

Storage of Telfairia pedata nuts

In many parts of Africa, certain crops are produced throughout the year, while the major food crops such as cereals, grains and tubers, including potatoes, are normally seasonal crops (Adjatin *et al*., 2012). The *T. pedata* nuts are harvested, washed and sun-dried then stored in various materials in homesteads where the storage materials include gourds, sacks, sisal bags, buckets, tins and pots and no chemical treatment was reported to be used. Therefore the principal aim of any storage system must be to maintain the crop in prime condition for as long time as possible.

Consequently the seeds produced during the harvest period may in some cases only last for few weeks, therefore, they require to be stored for gradual consumption until the next harvest. The conservation of *T. pedata* is based on indigenous knowledge since most of seeds are stored in local and traditional storage methods including wooden earthen ware containers, metal cans, sacks, buckets and perforated bags without any pesticides added to the stored nuts. The storage and handling methods should minimize losses and must also be appropriate in relation to other factors, such as its availability, labour, machinery and building costs and economies of scale (Chukwurah *et al*., 2015).

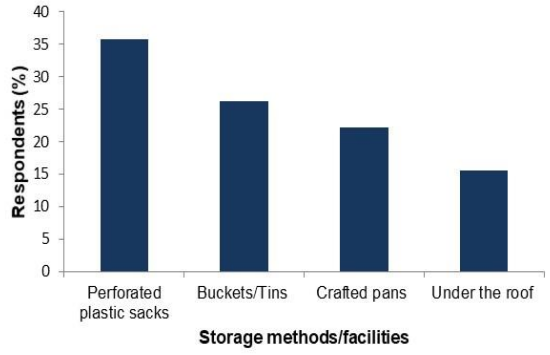

Fig. 7. Storage methods and facilities of *T. pedata* seeds in the study area.

Since the seeds are recalcitrant (Akoroda, 1990a), the majority of respondents 36% used perforated plastic sacks to store the nuts whereas, putting them into plastic buckets or metal tins (usually 20 kg capacity) were 26%, the use of traditional crafted pans were 22% and placing them under the roof to dry was 16% were the mostly preferred and used storage facilities through the study area. This could have been the case as they were more available, easy to use and cheap to purchase compared to other facilities such as jute bags, Fig. 7. Respondents reported that, the mentioned storage methods and facilities could keep the seeds viable up to one year.

Therefore, the development of appropriate techniques and tools for efficient storage facilities and methods will boost the potential of the crop hence provide food security and guarantee of economic gain for small scale farmers and entrepreneurs. (Igbozulike, 2015), further explained that the prevailing traditional postharvest methods and operations if not tackled well can lead to great loss in *T. occidentalis* and similar crops including *T. pedata* in food production chain and storage.

Conclusion

Based on the study results, we conclude that in the *Sambaa, Meru and Pare* communities, *T. pedata* plants are multifunctional in the maintenance of their health, economy, ecology, and culture. Based on this discussion, it is recommended that rural farmers should be encouraged to be actively involved in the cultivations and utilization of the *T. pedata* within and beyond the study areas. The transfer of traditional knowledge to younger generations is low, a fact which highlights not only the need for such knowledge to be documented but also the need for training and seminars on cultivation and utilization of the plant. The emphasis on technology transfer using extension workers and other stakeholders from private and public agencies should also be strongly encouraged. This will eventually ensure sustainable production of *T. pedata* plants as it has the potential to contribute to the wellbeing and income generation for the rural farmers and also to contribute to global food security and conservation. Therefore, all necessary efforts must be used to protect the plants through *ex situ* conservation, given that the plant populations are perceived to be declining due to native trees being harvested for agricultural and expansion of villages' activities. The transfer of

indigenous knowledge to younger generations is also at risk hence there is a need for the knowledge to be maintained through education and documentation for sustainable conservation and local community empowerment. The mentoring of young adults and the availability of financial incentives is crucial.

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Disclosure statement

The authors declare that they have no conflict of interest.

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