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Traditional knowledge on Nicobari aloo (*Dioscorea alata* L.) among Nicobari tribal community of Car Nicobar Island, India

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Nicobarese, the dominant tribe of Andaman and Nicobar Islands, rely on coconut-based cropping systems and fishing for livelihood. The Nicobari aloo (*Dioscorea alata*) is valued staple food crop for the community. Diverse types of *Dioscorea alata* are conserved in different parts of the islands. The acquired knowledge on this food crop over the generations is vital for the sustenance. The Nicobarese live in joint family system called "*Tuhet*" which share land, coconut palms, tuber crops and livestock. Each *tuhet* cultivates different varieties of Nicobari aloo along with other crops. It was observed and documented that this tribe cultivate Nicobari aloo in traditional way even at present, as natural/organic farming practices without using fertilisers and chemicals. The community makes away of preparations of Nicobari aloo tubers for regular consumption as well as during village festivals. This paper documents the traditional knowledge of the tribe on this tuber species, varieties, cultivation and utilisation.

Keywords: *Dioscorea alata*, Farm fencing, Nicobari tribe, Nicobari Aloo, PIC numbers, Tuhet farming, Traditional Knowledge

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The Nicobar group of Islands are located in Bay of Bengal, 1200 km East of mainland India between 6º - 10º attitude and between 92º - 94ºE longitude. This group has 22 Islands of which only 12 Islands are inhabited[1]. These Islands are the home of two tribes namely Nicobarese and Shompens of Indo-Mongoloid origin. Out of these, the Nicobarese are the largest tribal group inhabiting 12 Islands with major concentration in Car Nicobar[2] and the Shompens are confined to Great Nicobar. The Nicobarese are the dominant among the tribes of whole Andaman and Nicobar Islands. Their population represent about 85% of total tribal population of Andaman and Nicobar Islands[3]. The Nicobarese are generally considered as conservative as far as food resources are concerned as they stick to their traditional food system. Coconut based cropping systems and fishing are known to be their prime sources of livelihood. The community has valuable knowledge about the natural resources of these islands and the ways to utilise them for sustenance in the fragile Island ecosystem. This knowledge might have been evolved/acquired in the tribal community through practice and has been passed on over generations[4]. The Nicobarese use tuber crops viz., Nicobari aloo (greater yam), colocasia, tannia, sweet potato and cassava as the staple food and main source of carbohydrate. *Dioscorea alata* L. (Nicobari aloo) is much valued by the tribes and diverse types of this tuber crop are being conserved in different parts and places by the community. The people make variety of food preparations regularly and during village festivals using the Nicobari aloo tubers. The Nicobar group of islands has 3 divisions namely Car Nicobar, Nancowry and Great Nicobar. In this Nicobar District, entire farming land is owned by the Nicobarese and purchase of land by other population is restricted. Car Nicobar is the district Head Quarter and has the maximum population of Nicobarese. It is a small island with a total geographical area of 126.9 sq. km and a total population of 20292 out of which 15899 are Scheduled Tribe (ST) (2001 census) comprising of 15 villages and 301 *Tuhets*. Elaborated studies on material culture of aboriginals of Andaman and

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Nicobar Islands are meager[5]. Hence, an attempt was made to document the existing traditional knowledge of the tribal community on biodiversity of greater yam, harvesting and storage of tubers, preparation for planting materials, planting/cultivation practices and farm fencing.

Materials and Methods

The study area, Car Nicobar Island, is remarkably flat except some cliffs in the Northern part and few hilly areas in the interior. The areas of flat ground consist of coralline diluvium and are surrounded by silvery beach. The Island receives average rainfall of 2750 mm per annum with temperature ranging from 22° to 32°C and 79% relative humidity. The soil type is mostly sandy to sandy loam. The Island is considered as organic by default considering the non availability of chemical fertilisers and agro chemicals. The prevailing climate of this island is congenial for the plantation crops wherein coconut occupies about 70% (9027 ha) of the total geographical area, with an annual average production of 33.38 million nuts.

The present study was conducted at 15 villages of Car Nicobar Island from March, 2016 under All India Coordinated Research Project on Tuber Crops funded by Indian Council of Agricultural Research to get acquainted with traditional knowledge about the Nicobari aloo and its traditional system of cultivation (Fig. 1). The team interacted with the tribes and gathered the information through key informants, group discussion, field days and also from secondary sources. The tuber parameters are also compared with the released varieties and the conserved accessions from other places of Andaman Islands. The documented information is discussed in this paper.

Results and Discussion

Nicobarese have known to cultivate, conserve, use and distribute the tubers of Nicobari aloo (*Dioscorea alata)* among themselves over several centuries as revealed through interactions. They follow the joint family system called "*Tuhet*" and each *tuhet* owns and share the land, coconut palms, tuber crops & livestock among themselves. Each *tuhet* cultivate different varieties of Nicobari aloo along with other crops (approximately 1.0-1.5 ha for each *tuhet*) mainly for the food. Nicobari aloo has been one of the staple foods among them. It was observed that they cultivate Nicobari aloo in their traditional way till now under natural farming techniques without addition of any synthetic fertilizers and chemicals. They cultivate it in their *Tuhet* garden which follows shift cultivation for sustaining productivity in natural way. They celebrate 'Bada din' and Church festival where they sell/share different agricultural produce (Nicobari aloo, banana, jackfruit, breadfruit & coconut products) and livestock produced from *tuhets*. The revenue generated through church festival is donated to the church for further development of the community. During the interaction, different diverse types of Nicobari aloo were identified and documented.

Varieties of Nicobari aloo

Six varieties/types of Nicobari aloo namely, *Achin*, *Domrit*, *Takniya Takau*, *Antounth*, *Kaniha* and *Sumlung* were documented to be cultivated by Nicobarese in the Car Nicobar (Fig. 2). These are well distinguishable by tuber morphology/shape and taste. The traditional knowledge/description on these varieties is given below as described by the tribes.

Achin

This comes in two different colours viz., light violet and creamy. Achin plants are bushy, spreading and tubers are pink fleshed. These tuber types store abundant water and are irregular in shape. This variety is very common and popular among the tribe. The uneven shape of the tubers is considered as a trade off and is not preferred as gift to guests. The tubers are generally consumed and sold during festivals to raise funds for the church. The cooked tubers are relished for their soft texture and sweet taste. The tubers of this type are considered suitable for chip making and preparation of mixed vegetables. These types are generally cultivated near seashores i.e., on sandy soils considering better growth and development. Cultivation on heavy soil decreases productivity of this type as per the perception of the people.

Domrit

This is the most valued, round shaped Nicobari aloo. Generally called as 'King' type owing to its pleasant aroma, attractive pink flesh and shiny light peel. The size of the tuber varies with soil type in the growing environment. In sandy loam soil, the tubers attain greater size and weight as compared coral sandy areas and heavy soil. Only the head of the family or special guests are served with preparations of *Domrit* type. Although it is greatly valued as gift, it has lower productivity. Nevertheless, the *Tuhet* which records maximum harvest of *Domrit* type is rated as rich among tribe as such possessor of this type gets

pride within the community. Upon boiling, the *Domrit* tubers emit unique pleasant aroma and exhibit soft texture.

Takniya Takau, Antounth* and *Kaniya

These three varieties have very few morphological differences otherwise these have similar characteristics. The tubers are round and smaller in size with white to red coloured flesh. Among these, *Takinya Takave* is considered as the best for consumption because of its firmness and mild sweet taste. *Antounth* are also called as *Thirose* by some of the tribes. The tubers are hardy and said to have shelf life of up to 18 months. These can be grown in any type of soil. The tubers are boiled, crushed and fed to infants of 6 to 12 months of age. The *Kaniha* variety is used for preparing pickles. The productivity of these varieties is comparatively higher than *Achin* and *Domrit* types. These varieties are preferred as gifts to close relatives during festivals. They are either consumed as chips or boiled tubers and in vegetable preparations. Preferably, these are boiled with coconut milk and consumed with leafy vegetables.

Sumlung

Preparations using this type of tubers are considered as elite food and served to mostly head of families and special guests. The other names for this

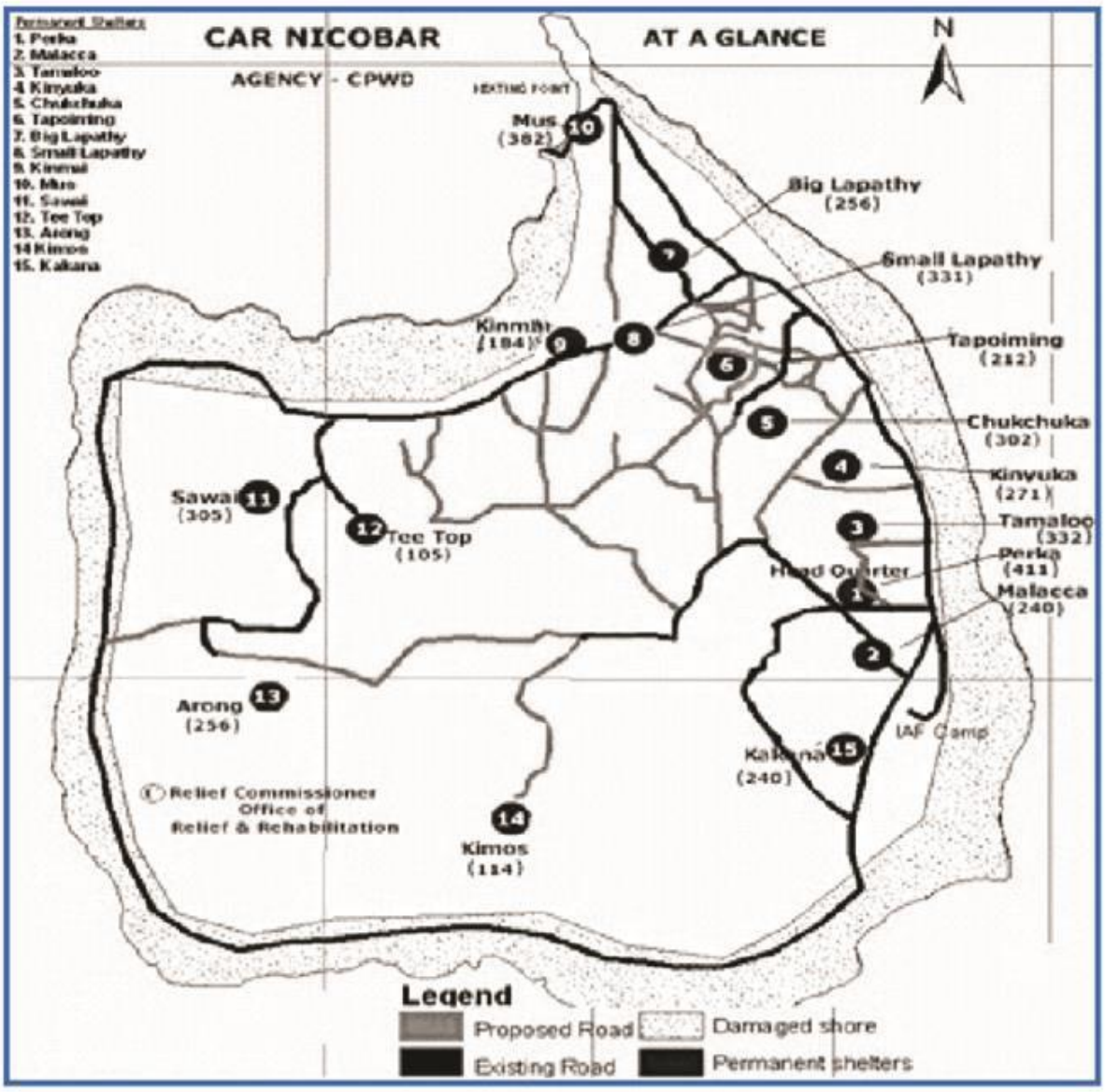

Fig. 1— Map showing the study area

Fig. 2 —Diverse types of Nicobari Aloo

type are *Talichong* or *submarine*. The tubers are sweet and have smooth texture. The tubers are cylindrical and grow vertically deep in soils and hence are cultivated in deep soils. For ease of harvesting and limiting the length of the tuber, the Nicobari use a unique ITK. During sowing time, they keep rock / wooden plank or coconut shell at a depth of 2 – 2½ feet deep in the pit and then soil is filled 3/4th of the pit and then piece of tuber is kept and filled with soil. This technique restricts the length of the tuber and increases its size. This variety is not a preferred gift during festivals and used for self/community consumption. The productivity of the type is considered as good and can be cultivated on any type of soil.

Other types

In addition to the above, Nicobari people use *Lech Long* type which has two variants viz., Sweet and Bitter types. These are commonly used as vegetables. These types produce both aerial and underground tubers. Bitter types are used as remedy for bowel ailments. Apart from *Lech Long*, they also consume wild tubers collected from the forest. There are two types of wild *Dioscorea* tubers i.e., *Tavingo* and *Tokufioso* available in Car Nicobar Island which are used for consumption.

Tavingo is also known as magical aloo as it is a common belief among Nicobarese that no one can find the tuber plant if they go with the intention to search and collect the same. There is high chance that the searcher(s) may lose their way out of the forest due to disorientation and confusion. This tuber is available in the wild round the year but during the month of April-May it may be found with much higher probability. This tuber is protected in the wild due to these magical effect or beliefs. These types produce very lengthy, pink fleshed tubers with more hairs (hairy roots) on the tubers. It can be boiled or roasted and eaten. The texture is somewhat hardy in nature and tubers give acridity. These types are not cultivated but collected from the forest in wild form.

In case of *Tokufioso* tuber, the nature has provided abundant sharp thorn bunches near to the root zone of the plant just above the tubers which protects it in the wild from swine. At the time of collection, at first thorns must be carefully removed to get access to the tubers under it. These types of tubers can be mainly collected during dry season. They are like *Domrit* type in shape with white flesh. They are consumed after boiling and taste is considered as good.

Fig. 3 —Traditional *Tuhet* garden comprising array of crops

Cultivation techniques followed

Land preparation

Nicobarese tribes live in joint family system (*Tuhet*, Fig. 3)[6]. Each joint family consists of 85-95 tribal farmers of 20-25 families. The *Tuhet* head first decides the location of *Tuhet* garden and nominates family members for the purpose. A wide range of crops including several fruits, number of vegetables, tuber crops, herbs and medicinal plants are grown in *tuhet* system along with coconuts on borders. They first clear the jungle and fencing is done in traditional way. Big trees in the garden are just pruned and stumps are left whereas the bushes and grasses are cleaned and uprooted. The dried branches are allowed *in-situ* as a pandal for growing of Nicobari aloo vines and the dried leaves supply the nutrients to the crops.

For land preparation, they use crowbars (sabbals) and wooden logs (Fig. 4). They loosen the soil and remove the coral stones by employing this method. Here the wooden log is kept adjacent to the area which is to be loosened. Then sabbals are inserted by four or five persons at the points where the soil has to be loosened and force is applied by hands on the upper side of sabbals which is slanted over the log. Once the stone and soil is loosened, they remove the stone by hands and it is kept safely for strengthening the coral fence. Thereafter, the loosened soil is crushed, stones and gravels are cleaned and soil is spread uniformly by hand.

Fencing

Traditionally the Nicobarese construct two different types of fences in their *Tuhet* gardens.

Farm fencing with coral rocks

In Nicobar, bricks or stones are to be imported from outside to erect a wall. To protect their farms, the tribals have devised a cost-effective way of fencing the farms. They use dead coral by arranging them in a self-locking system supported by wooden planks and bamboos for fencing (Fig. 5). This type of fence is strong enough to protect from animals and has much longevity. Easily available dead corals can be used for important activity-protection from wild animals and pigs. Huge expenditure is avoided by using the material for erecting walls and fencing. Also the cost incurred in transportation of building material from other islands to Car Nicobar is avoided by this type of fence.

Fig. 4 —Land preparation and planting technique

Fig. 5 —Traditional coral rock fence

Wooden fencing

The *Tuhet* gardens are also fenced by wooden logs which are tightly tied with 5 to 6 feet polls in a zig-zag manner (Fig. 6). The wooden logs are axed into four equal size pieces and normally used for making a fence. The design is unique, strong and provides safety from stray animals and pigs entering into the garden. The knowledge about this fence design is vital in safeguarding the food crops from the free-range pigs and stray animals.

Planting

The planting of Nicobari aloo is done during the months of May - July. The tubers are cut into pieces weighing approximately 70-100 g/piece and kept in soil at a depth of 15 cm. For making planting pits, the tribes use a farm implement called as 'Sannap'. Two persons are required to operate this 'Sannap'. Similarly, they also use an implement called as 'Salib' for loosening of the soil by upward and downward motion. At the time of planting, care is taken to keep the sprouting portion of tuber in the pit facing east direction (Fig. 7). Application of ash on the cut surface of planting material as well as in the pit at the time of planting suffocates the eggs and larvae of insects and prevents the contact of adult insect pests on the leaves[3]. A single green leaflet of coconut is vertically placed at the planting pit as a mark of identification of planting site. This technique helps them to identify the pit where the tuber is planted as an inter crop in the field. Thereafter, dried shrubs branches/ bushes are kept around the marked area so that after germination, the creeper could climb on them and spread the growth luxuriously.

When bigger sized tubers are cut into smaller bits for planting, the leftover portions of tuber flesh are just heated or boiled and eaten without adding salt and spice. They believe that, if salt and spice are used to cook the leftover or remaining parts of tubers, the planted bits of tubers will not sprout. As per their belief, they also heap all the garden waste in a single place to facilitate easy sprouting of the tubers.

Harvest and Post- harvest handling

Nicobari aloo is harvested after six to seven months of planting which coincides with their festive season

Fig. 6 —Traditional unique wooden fence

Fig. 7 —Planting material – cut pieces of tuber

i.e., November to January. The maturity is determined by yellowing of leaves or drying–up of leaves. The Nicobarese employ four methods of storage of Nicobari aloo after harvesting (Fig. 8).

a) Heap method

In this method, the tubers are kept heaped in a dark room. This method is used for storing the tuber for relatively shorter period.

b) Hanging

The tubers are hanged on ropes or wooden roof column mainly in their kitchen and veranda**.** This method has been believed to provide maximum shelf life to the tubers. It also delays germination during the storage.

c) Bamboo bin

In this method**,** the tubers are kept in cylindrical bamboo bins (one meter height and half meter diameter) designed in such way that, the air can easily pass through the walls of the bin made up of vertical pieces of bamboo tied with spacing of 2-3 cm. By this method, the tubers can be stored effectively for about 6 months. This structure reduces the termite attack and also enhances the storage life of tubers.

d) Iron net bin

In this method**,** the tubers are kept in cylindrical bins as mentioned above which are made up of iron wire net. Through this method also, the tubers could be stored effectively for about 6 months. In addition, old fishing nets are also used for storage and transportation of Nicobari aloo. The same was also reported earlier by Anon[7].

Preparations of Nicobari Aloo

Nicobarese make number of food preparations from Nicobari aloo viz., simple boiled tubers, boiled with coconut milk, chips fried in oil, curry with or without vegetables and chutni. They also use it as vegetable by frying it and as a component in mixed vegetable preparations[8]. The nutritive value of tuber crops varies and their utilisation is region specific[9]. The community have also participated in the National tuber crops food festival held at ICAR- Central Tuber Crops Research Institute during 2015 and displayed their ethnic Nicobari aloo dishes (Fig. 9).

Characterisation and evaluation of greater yam germplasm collections

Efforts made at ICAR-Central Island Agricultural Research Institute (ICAR-CIARI), Port Blair has

Fig. 8 —Methods of storage [heap (a), hanging (b), bamboo bin (c) and iron net bin (d)]

resulted in collection of diverse types of greater yam from Nicobar and other areas for conservation and evaluation. Twenty six greater yam collections (local) including 16 collections from Nicobar district and other parts of the Islands were characterised and evaluated for a period of 2 years from 2016 to 2018 at Horticultural Research Farm, Sipighat under ICAR-CIARI along with a check variety CARI-DA-1 (Yamni). The result revealed that, the accessions viz., CARI-DA-1, TAM-3, DA-3, DA-2 and RKP-4 are promising with yield more than 25 t/ha. (Table. 1). Among the Nicobar collections Tam-3 recorded the highest yield (33.6 t/ha) while *Domrit* was observed to be the very shy yielder.

Fig. 9 —Different Nicobari aloo dishes

Table1 —Evaluation of greater yam germplasm under Island ecosystem

Sl No	Accession	Vine length (m)	Vine colour	Leaf petiole colour	Tuber length (cm)	Tuber diameter (cm)	Tuber weight (g)	Estimated Yield (t/ha)
1	SG-1	10.6	Purple	Purple	30.8	16.4	523.2	9.4
2	RKP-1	14.8	Green	Purple	19.9	24.8	920.3	21.7
3	RKP-2	14.5	Green with purple hair	Pink	16.9	25.1	853.6	14.4
4	RKP-3	8.9	Green	Pink	15.0	25.5	1225.3	16.4
5	RKP-4	7.1	Green	Pink	19.9	25.3	1052.5	27.5
6	DA-2	14.8	Green	Green	21.9	19.1	344.9	25.2
7	DA-3	11.5	Green	Green	41.0	46.0	1631.8	31.1
8*	Achin	13.9	Green	Purple	16.7	24.2	705.4	7.7
9*	Bolta	9.6	Green	Pink	12.9	29.7	726.5	8.3
10*	Domrit	7.2	Green	Pink	4.6	13.4	83.3	1. 3
11*	Takanya Takavu	10.1	Green	Green	9.8	23.3	355.2	4.1
12*	Domrit pink	5.2	Green	Pink	13.7	13.9	184.0	6.8
13	HB-1	11.4	Green	Green	10.8	24.9	510.6	4.6
14	HB-2	8.2	Green	Green	13.3	26.3	606.1	5.9
15*	TAM-1	10.6	Green	Green	8.8	26.2	333.2	6.2
16*	TAM-2	3.8	Green	Green	4.6	17.1	100.2	3.2
17*	TAM-3	6.2	Green	Green	11.1	29.0	586.7	33.6
18*	Nic Da-1	9.3	Green	Green	6.4	23.7	291.3	7.2
19*	Nic Da-2	4.7	Green	Pink	10.4	17.5	291.2	6.8
20*	Nic Da-3	5.6	Green	Green	9.9	21.6	263.1	6.1
21*	Nic Da-4	6.4	Green	Pink	12.4	22.8	429.8	9.8
22*	Nic Da-5	6.5	Green	Green	5.6	22.5	217.6	7.4
23*	Nic Da-6	5.1	Green	Green	5.1	19.6	175.2	7.3
24*	CDA-1	5.2	Green	Green	9.8	27.6	588.6	14.2
25*	TDA-1	5.8	Green	Green	4.5	25.9	449.4	9.2
26	HL-1	11.2	Green	Pink	9.3	28.1	501.1	7.9
27	CARI DA-1 (Yamni)	14.9	Green	Green	32.5	21.3	1201.0	38.5

*Collections from Nicobar district
**Accessions yielding > 25 t/ha – CARI-DA1, TAM-3, DA-3, DA-2 and RKP-4

Conclusion

Indigenous traditional knowledge is the nature's gift for sustaining the livelihood and also food security at any given place. The ITK on Nicobari aloo and its traditional cultivation techniques possessed by the Nicobari people are unique and capable of efficient conservation and utilisation *in situ*. The indigenous and unique Nicobari aloo conserved by the Tribals have been recognised by the Protection of Plant Varieties and Farmers Rights Authority (PPV & FRA), GOI, New Delhi by awarding prestigious Plant Genome Saviour Community Award 2014-15. The traditional knowledge on the Nicobar aloo and the diverse types could be very well disseminated to other tropical island ecosystems to ensure the food and nutritional security. The Nicobari aloo based products and preparations have potential to be popularised as other value added products and it may attract the tourists who visit Andaman Islands enhancing the income of tribal communities. The traditional varieties have potential to be used in improvement programmes for evolving bio-fortified varieties supporting nutritional security among the tribal community.

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Conflict of Interest

The authors declare no conflict of interest in the financial/subject matter or materials discussed in the paper.

Authors' Contributions

VD conceived, designed and conduct the research. SKP, ZG, SKS and LBS contributed to the data collection and documentation from tribal farmers of Car Nicobar. JG and SS conserved the germplasms and suggested valuable comments. BAJ contributed in preparing manuscript *in-situ* and *ex-situ* characterization of the germplasms. IJ guided in preparation of manuscript, reviewed and edited the manuscript and suggested critical comments. All authors read and approved the manuscript.

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