Diversity assessment and ethnobotanical evaluation of the family Araceae Juss.: A quantitative ethnobotanical investigation on medicinal application and cultural practices of Aroids in the eastern Indian State of Odisha

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Research

Abstract

*Background***:** Aroids are members of the Araceae family, well known for their food, cultural, ornamental and ecological significance. The present study provides a comprehensive database regarding the diversity and ethnobotanical importance of Aroids in the Eastern Indian state of Odisha.

Methods: Ethnobotanical information was collected through semi-structured interviews and standard questionnaires with 51 potential informants, based on which quantitative indices were calculated.

Results: A total of 41 species of Aroids under 28 genera were documented, among which 30 species are herbs. This study highlighted that both the underground and aerial parts of Aroids contain multipurpose utilities. Aroids are primarily used in food, fodder, medicine (for humans & livestock), ornamentation, rituals, cultural and decoration purposes. Apart from that, Quantitative ethnobotanical values such as Use value (UV) range from 0.18 to 0.96 and Relative frequency of citation (RFC) value from 0.1 to 0.88. *Colocasia esculenta* (L.) Schott shows both high UV and RFC values. The Family use value (FUV) of Araceae is 0.39, whereas it is 0.62 when considering the Aroids used as food. Similarly, plant part value (PPV) suggests that leaves and underground parts possess high PPV in 2 and 3 species, respectively. *Alocasia macrorrhizos* (L.) G.Don*,* with a score of 21 and human medicinal purpose use with a score of 36, secured the principal rank among plant and different use categories based on Direct matrix ranking (DMR). Jaccard similarity index (J) value ranges from 4.92 to 37.42 and suggests that the findings of the present study are more similar to the study conducted in Andhra Pradesh.

Conclusion: The findings of the present study contribute to a better understanding of the Aroid flora of Odisha and highlight the importance of the Arum family in sustaining livelihoods. These data will be helpful for species protection and habitat conservation. Further studies regarding scientific validation of obtained traditional knowledge by screening of bioactive compounds and detection of the pharmacological potency are necessary to bridge ancient community practice with evidence-based science.

Keywords: Araceae, Aroids, Conservation, Diversity, Eastern Ghats, Ethnobotany, Food security, Odisha, India

Background

The family Araceae (Arum family) belongs to the order Alismatales well known for its food, medicinal, cultural, ornamental and aesthetic significance. The members of the family are commonly known as Aroids (Das *et al.* 2014). The family comprises about 146 genera and 3645 known species worldwide with a high degree of endemism (Sinha & Borkataky 2025). The Araceae family contains 8 subfamilies, which are primitive angiospermic plants (Croat & Ortiz 2020). In India, the family is represented by 140 species under 25 genera (Islam *et al.* 2017). The detailed taxonomic study of the family Araceae in Odisha by Saxena and Brahmam (1994-96) documented 23 species under 18 genera.

The Aroids possess amazing diversity in habit and size, ranging from free-floating aquatic plants to massive leaf-bearing herbaceous species. These plants may be terrestrial or caulescent, generally possessing a corm, tuber or rhizome (Croat 2019). They are found in different types of natural habitats such as ponds, lakes, swamps, rivers and rice fields. The tuber or rhizome of some Aroid species contains raphides or crystalloid calcium oxalate (Das *et al.* 2014).

The family Araceae is well known as it possesses a lot of importance. Aroids such as *Cyrtosperma merkusii* (Hassk.) Schott, *Xanthosoma sagittifolium* (L.) Schott, *Amorphophallus paoenifolius* (Dennst.) Nicolson and *Colocasia esculenta* (L.) Schott are used as food (Chandra 1984) and are rich in carbohydrates. In Indonesia, 20 species and 13 varieties of Aroids are cultivated in different types of agro-ecosystems (Mutaqin *et al.* 2018). Similarly, taro is used as a staple food in most of the subtropical regions and developing countries (Vaneker & Slaats 2012). Ornamental Aroids are attractive due to their vegetation pattern, colour, texture, as well as the nature of their spathe. Some living Aroid specimens are grown as indoor plants for decoration as they are aesthetically pleasing (Chen *et al*. 2005). In ancient culture, many Aroids have been used as herbal medicines for the treatment of wounds, skin diseases, sting healing and insect bites (Bown 2000). Apart from that, Aroids possess specific properties such as antibacterial, antifungal, anti- inflammatory, and anticancer properties. Due to the presence of anticancer properties, they are used for the treatment of breast and stomach cancers (Bown 2000). Aroids are valuable sources for the glycosidase inhibitors, with anti-diabetic, antiviral and anti-metastatic properties (Asano *et al.* 1997). Besides the economic and medicinal values, the Araceae members also have ecological significance. Several Aroids growing as indoor plants are helpful for the purification of air polluted by formaldehyde (Zhou *et al.* 2011). However, despite their lot of ecological and economic significance, many species of this family are considered underutilised and neglected crops (Sinha & Borkataky 2025).

It is well known that plants have been associated with the culture of human beings since ancient times. People of a particular region and culture depend upon the plants for sustaining life on the earth. Due to climate change and unfavourable environmental conditions, the potential of the underutilised plants is important, as it affects local food security greatly. Several taxonomic and ethnobotanical studies on Aroids were previously conducted in the adjoining regions of Odisha. In the Baksa district of Assam state, a total of 28 Aroid species were documented, including both cultivated and wild members. Among these documented plants, 21 species are used in traditional medicine, followed by 18 species consumed as food by the Bodo community of this region (Basumatary *et al.* 2025). Another study conducted by Sinha & Borkataky (2025) in Upper Assam documented 46 species of Aroids belonging to 19 genera (categorised as cultivated, wild and ornamental plants), highlighting the diverse ethnobotanical usage, including treatment of ailments as well as famine food during environmental challenges. Apart from that, the study of Rapak (2025) on the Aroids of the Indian state Andhra Pradesh provides information regarding the diversity of 56 Aroid species in the state. Similarly, Samanta (2020) described about 38 species representing the 14 genera under the family Araceae in the Flora of West Bengal. The comprehensive taxonomic study of the family Araceae in Odisha (formerly known as Orissa) by Saxena and Brahmam (1994-96) documented 23 species under 18 genera. Subsequently, a study by Mishra *et al.* (1999) provided information regarding *Arisaema tylophorum* C.E.C. Fisch., whereas Panda (2002) and Panda *et al.* (2005) highlighted the presence of 3 species of *Typhonium* Schott as a new distributional record to the flora of Orissa. Swamy & Rasingam (2022) reported on the extended distribution of the endemic and threatened species *Amorphophallus mysorensis* E.Barnes & C.E.C. Fisch. (Araceae) from the Mahendragiri region of Odisha. Similarly, Mohanty et al. (2025) reported *Xanthosoma robustum* Schott as a new distributional record to Eastern India from Jajpur district of Odisha. These data indicate that further diversity assessment of Aroids is necessary in Odisha.

The Indian state of Odisha is famous for its biodiversity and cultural heritage. The people of this state primarily depend upon agriculture. Most of the population lives in rural areas and prefers to apply their indigenous knowledge in their daily life to fulfil the basic requirements. Although several taxonomic and ethnobotanical studies were previously conducted in the state, the complete account of diversity and ethnobotanical utility of Aroids in Odisha remained insufficient. The present study aims to prepare a comprehensive database on the diversity of Aroids in Odisha, followed by an investigation into their ethnobotanical usage. Assessment of Aroid diversity highlighted the variety and variability among the family Araceae in the state, which will be helpful to policymakers and conservation biologists for species protection and habitat conservation. Likewise, ethnobotanical investigation elaborates the hidden potency of Aroids, based on which the quantitative indices such as UV, RFC, PPV, FUV, and DMR were calculated. This obtained ethnobotanical information with special reference to cultural and medicinal applications justifies the vast indigenous knowledge of Odisha and will be helpful in the sustainable utilisation and conservation of Aroids of Odisha.

Although this study emphasises ethnobotanical utilisation with special reference to cultural and medicinal properties, it lacks scientific validation. The traditional knowledge based on medicinal applications of the family Araceae by indigenous communities described along with its extraction technique & mode of application can contribute to drug discovery by phytochemical analysis followed by suitable pharmacognostical evaluation. Further studies in the upcoming days regarding the estimation of carbohydrates, proteins and vitamins as nutritional properties, as well as the determination of antimicrobial, antioxidant, anticancer, and anti-inflammatory activities of edible aroids, are necessary to bridge ancient community practice with evidence-based science.

Materials and Methods

Study area

The Indian state of Odisha is the 8th largest state of the country, with an area of 1,55,707 square kilometres. Among these, 37% of the state's geographical area is covered by forest. It is situated between 17°48′ to 22°34′ N latitude and 81°24′ to 87°29′ E longitude, on the eastern coast of the Indian Peninsula and falls in the northern limit of the Eastern Ghats region (Reddy et al. 2013). The state consists of 30 districts and 314 blocks with approximately 4.2 Cr of total population. Out of the total population, 83.31%of people live in rural areas, whereas 16.69% live in urban areas (Census 2011). The present study covers Mayurbhanj, Balasore, Kendrapada, Bhadrak, Jajpur, Khorda, Cuttack, Puri, Gajapati, Ganjam, Nayagarh, Balangir and Koraput districts of Odisha (Fig. 1).

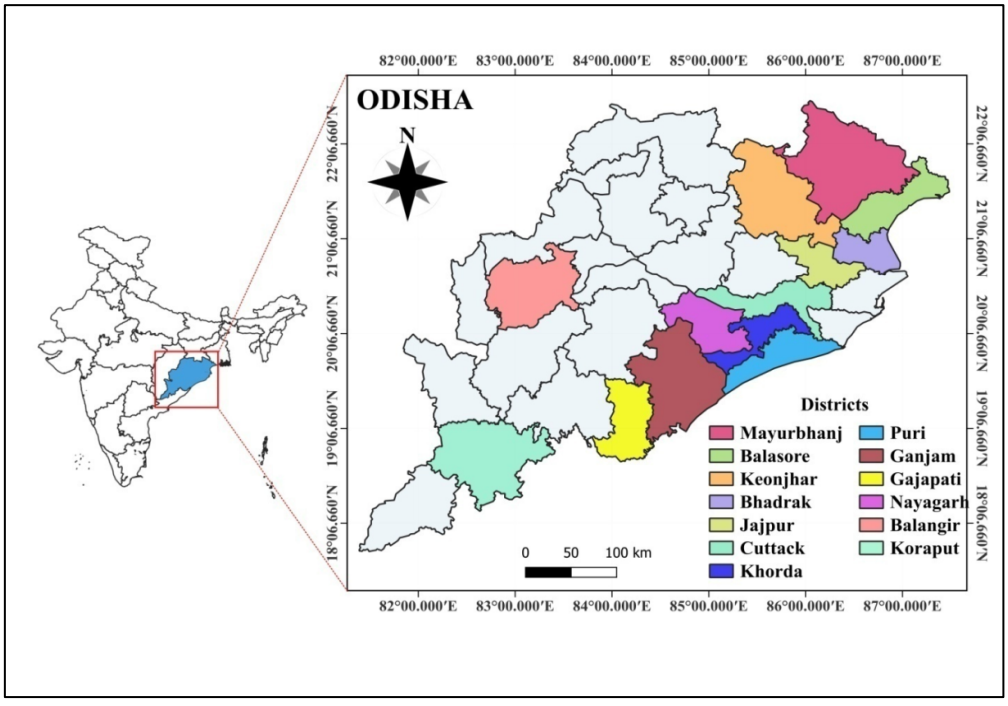

Figure 1. Map of Odisha, India, showing the study area

Methodology

Demographic feature of informants

The investigation process involved 51 informants, among which 31 were males, and 20 were females of different age groups ranging from 23 to 98 years (Table 1). The informants, villages and districts were purposefully selected with respect to the aim and objectives of the present study. The informants belonged to different ethnic communities such as Brahmin (who refer to traditional medicinal practices or healing traditions described in Vedic literature to treat disease), Chasaa (Primarily involved in agriculture), Kudumi, Niari, Karana, Kaibarta, Sundhi, etc. Apart from that, the indigenous communities such as Santala, Ho, Vumija, Gonda, Bathudi, Mankidia, Munda and Sabara were also involved in this study to share their expertise on plant-based practices. The highest number of informants were from the Mayurbhanj district, followed by Keonjhar, Koraput, Balangir, Bhadrak, and Balasore, whereas the lowest number of informants belonged to Cuttack, Khorda and Ganjam districts (Fig. 2). The Santali community represents the dominant ethnic group involved in the present investigation, whereas the Sundhi and Niari communities contributed a little. Among the total informants, 13.72 % of informants were illiterate, whereas 21.56 % of qualified at graduation and above. All the informants were able to speak Odia; however, a few informants preferred to use the Santali language. The informants provided detailed ethnobotanical usage of Aroids through their traditional knowledge and experience, indicating their expertise in this field. Data regarding the names of the informants, their villages, as well as addresses remain confidential. Only the overall idea about the gender, age group, qualification details and involvement of communities was described to highlight the primary source of indigenous knowledge in Odisha, as this requires specific attention from a conservation point of view.

Table 1. Demographic features of informants

Variable	Category	Total	Percentage
Gender	Male	31	60.78
	Female	20	39.22
Age Group	25-35	10	19.60
	36-50	13	25.49
	50-65	09	17.64
	66-80	11	21.56
	Above 80	08	15.68
Qualification	Illiterate	07	13.72
	Primary	13	25.49
	Secondary	11	21.56
	Higher Secondary	09	17.64
	Graduation and above	11	21.56

Institutional Ethical Clearance

The Subject Research Committee (SRC) of the Department of Botany, Fakir Mohan University has recommended conducting ethnobotanical data collection, as an ethnobotanical study of Aroids of Odisha is an objective of the PhD research work (Letter No. Exam/Ph.D/BO/12/2025/2457/FMU).

Ethnobotanical survey and data collection

Frequent field studies were conducted in different locations of Odisha to document ethnobotanical information linked with the Family Araceae in the study area (Fig. 3).

Selection of informants

In this study, the primary informants were selected based on their experience in traditional knowledge practices. The snowball method described by Jan et al. (2022) was applied to select potential informants, which is a referral-based technique where initial participants recruit others from their network who may not be easily accessible through random sampling.

Consent for participation

During this discussion with local people, the aim and objective of the study were explained to the informants. Oral informed consent was taken from each informant before disclosing their indigenous knowledge. Special efforts were made to discuss with individuals of different age groups, sexes, cultures, social statuses and ethnicities to document the unexplored traditional knowledge.

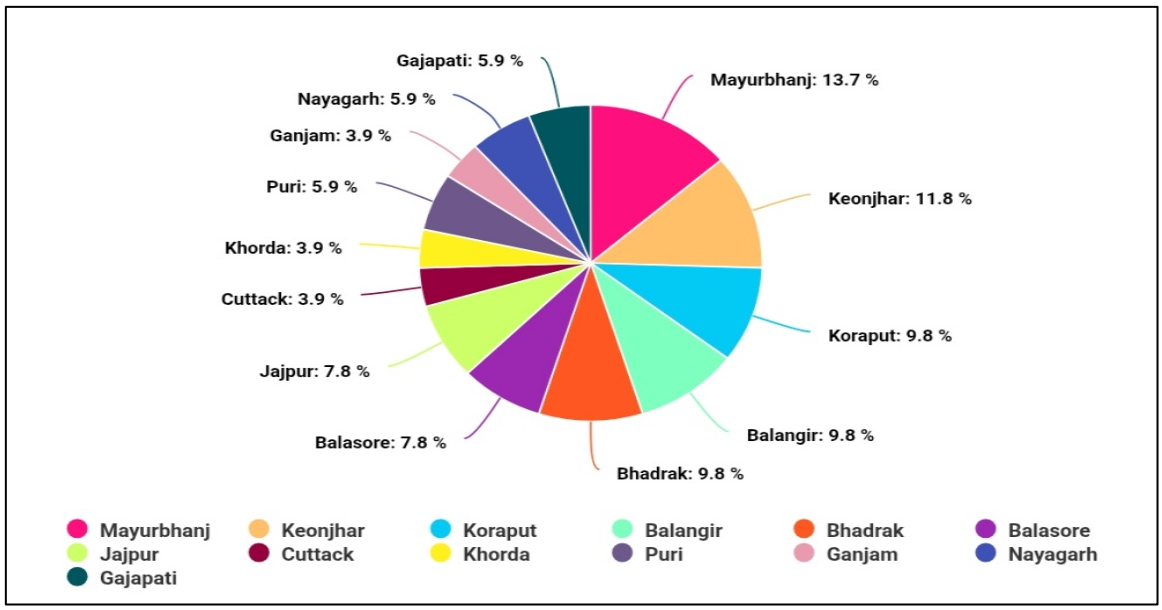

Figure 2. Pie chart representing the district-wise distribution of informants

Sampling strategy

The ethnobotanical evaluation was conducted by documenting the information through a semi-structured interview (Fig. 4) and standard questionnaires in group discussions (Martin 1995). The discussions were conducted in the places where villagers gather for social interactions. Group discussions were arranged community-specifically. The number of members present in each group varied from one community to another depending upon the number of families belonging to that community in a particular region. During the group discussion with local people, the community members identified knowledgeable individuals who were selected as key informants based on their recognised expertise in traditional plant usage. To collect information regarding the medicinal usage, special interviews were conducted with Vaidyas and local healers. During the investigation, the plant material was presented to informants or the plant name they had used previously (Martin 1995). To confirm the accuracy, authenticity and to maintain uniformity of obtained information as well as to avoid referral bias, multiple interviews were conducted among different demographic groups.

Collection of Ethnobotanical information

Collection of information focused on vernacular names, useful parts and purposes of use, processes of preparation and modes of application. The information collected in the local vernacular language was later translated into the English language. Some informants preferred the Santali language for providing information. Considering the specific situation, translation was performed by a competent bilingual individual to improve confidence in the accuracy of the translated information.

Cultivation and Commercial Value of Aroids

To collect information regarding the commercial value of Aroids in Odisha, frequent studies were conducted in the local markets situated in different parts of the study area. A total of 35 informants (21 males and 14 females) were investigated with prior oral informed consent for collection of information regarding the cultivation and commercial value of Aroids. These informants belonged to a diverse age group ranging from 30-82 years, of whom most of the informants were farmers (17), followed by 10 sellers and 8 suppliers. In this study, various weekly markets (known as Village hata) such as Kuliana hata, Singada hata, Thakurmunda hata, Biraja-Agneshwar hata, Bhandaripokhari hata, Thakurtota hata, as well as daily vegetable markets like Chatrabazar market and Lodhachua market were considered as the major study sites. During the investigation, the cultivation time, harvesting period, variation of price in different seasons and net profits, etc information was recorded through semi-structured interviews. All the informants belonged to distinct categories as there was no overlap between their occupations. Informants belonging to the farmer category contributed to cultivation-related information like cultivation period, propagule requirements, price of propagule, labour cost, net yield and selling price. Similarly, marketing information such as selling price of edible parts of Aroid was collected from all these 35 informants.

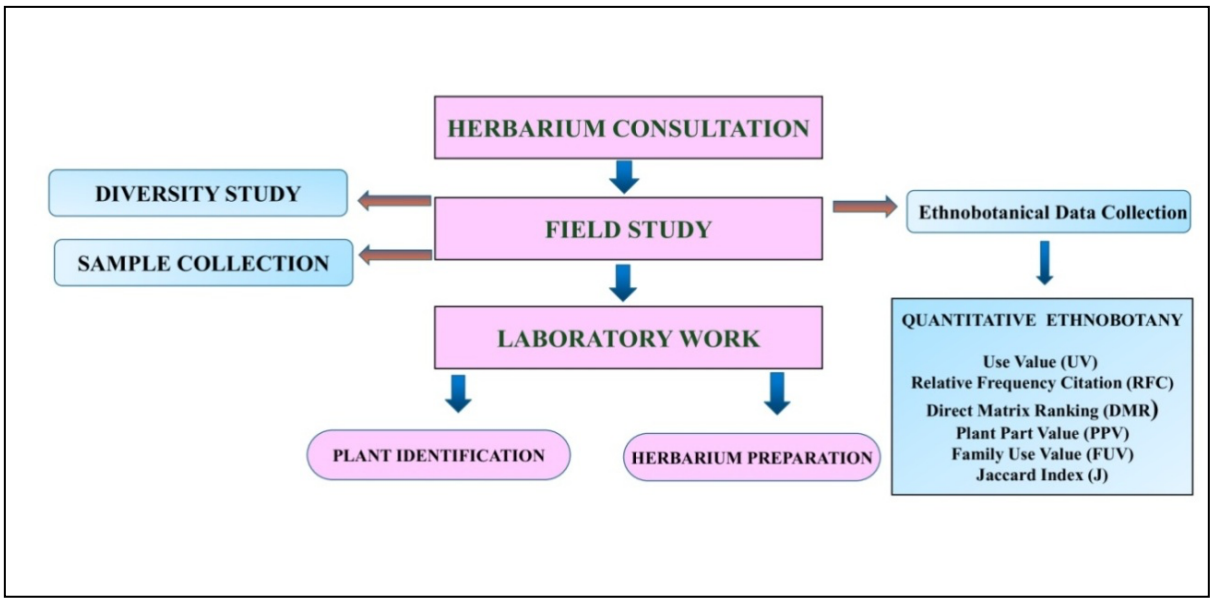

Figure 3. Flow chart representing the methodology of the present study

Figure 4. Photo plate representing collection of ethnobotanical information

Plant specimen Collection and Identification

Frequent field visits were carried out from June 2025 to January 2026 to collect the plant samples. The plant specimens were collected during their flowering or fruiting stages for detailed enumeration and proper identification. The collected specimens were tagged and assigned a unique field notebook number for preparation of the herbarium and information regarding the distribution of the taxon. The identification of most of the taxa up to the family level was done on the spot. After critical observation under a stereo microscope followed by detailed description and proper enumeration of all vegetative and reproductive characteristics, the identity of the taxon was determined with the help of dichotomous botanical keys, taxonomic revisions as well as the available literature and flora (Hooker 1872-1897, Gamble 1884-1885, Haines 1921–1925, Mooney 1950, Saxena & Brahmam 1994–1996, Goncalves 2011, Sharief *et al.* 2024, Mohanty *et al*. 2025). Apart from that, online databases such as World Flora Online (WFO), Herbarium of Indian Institute of Science (IISc), India Biodiversity portal and Tropicos were also referred to ensure smooth identification. After the accurate identification of the taxon, the databases available online, including Plants of the World Online (POWO) and International Plant Names Index (IPNI), were employed to validate the updated nomenclature. The herbaria were prepared following the standard protocol and deposited in the Herbarium of the P.G. Department of Environmental Science, Fakir Mohan University, for future reference.

Species Accumulation and Sampling Adequacy

Knowledge saturation and sampling adequacy were achieved through the species accumulation curve (Fig. 5) (Gotelli & Colwell 2001). This curve indicated that the sampling effort is sufficient to capture the majority of Aroid diversity in the study area.

Sample size and representativeness

The study covers 13 out of 30 districts of Odisha, in which 51 informants were interviewed. The sample is considered sufficient for data analysis, as the selected districts are renowned for their vast ethnobotanical knowledge, that proved from the previous ethnobotanical studies. The informants, villages and districts were selected purposively for documenting only the traditional knowledge associated with Aroids. After interviews with 51 informants, it was noticed that the full range of traditional knowledge present in the community was captured as the species accumulation curve became asymptotic. The obtained species accumulation curve flattens out and becomes a horizontal line and provides a stable value. The total number of observed species stays completely flattened at 41 species (Fig. 5). Knowledge saturation was achieved as an intensive survey of ethnobotanical informants, beyond which no further informants were recorded with new Aroid species.

Quantitative Ethnobotanical data analysis

The collected ethnobotanical information was represented in numerical values such as the total number of usages reported for individual plants, the total number of informants citing the use of plants, the total number of species documented in the study, etc. Those quantitative ethnobotanical indices, e.g. Use value (UV), Relative frequency of citation (RFC), direct matrix ranking (DMR), Family Use Value (FUV), Plant part value (PPV) and Jaccard similarity Index (J), were analysed referring to the formula described in Table 2.

Table 2. Formula for calculation of quantitative ethnobotanical indices

	Short form	**Formula**	**Remark**	**Reference**
Use Value	UV	UV = Σ Ui / N	'Ui' represents the total number of usage reports provided by each informant, and 'N' represents the total number of informants involved in the inquiry.	Phillips &Gentry (1993)
Relative Frequency of Citation	RFC	RFC = FC/N	Where 'FC' represents the Number of informants who reported the plant's use and 'N' represents the total number of informants investigated. The value of RFC ranges from 0 to 1.	Kayani *et al.*(2014)
Family Use Value	FUV	FUV= ΣUV/N	'ΣUV' represents the summation of the total use value from all species of a particular family, and 'N' represents the overall count of species that belong to that family. In this study, the FUV is calculated on different categories on the basis of type of use.	Phillips &Gentry (1993)
Plant Part Value	PPV	PPV= RUPP/RU	Where 'RUPP' denotes the total number of reported uses for each plant part and 'RU' denotes the total reported usage of a given plant. The value of PPV ranges from 0-1. The obtained value of 0 indicates the plant part is generally not used by the local community, whereas 1 indicates that this plant part is only a useful part of this plant.	Siraj & Khan (2021)
Direct Matrix Ranking	DMR	Scores secured by each plant were aggregated to obtain a total score (cumulative score), which was ranked.	For this purpose, a group of 15 informants were selected based on their expertise in ethnobotanical practice. The informants were instructed to mark the use value to each species with a scale ranging from 0-5, where '0' has no value and '5' represents best. The average score for individual species for specific use categories was presented in the table to obtain the DMR.	Martin (1995)
Jaccard Similarity Index	J	J (A, B) = [(A∩B)/ (AUB)]×100	The number of species common in both the studies divided by the number present in either or both, multiplied by 100	Shah *et al*. (2021)

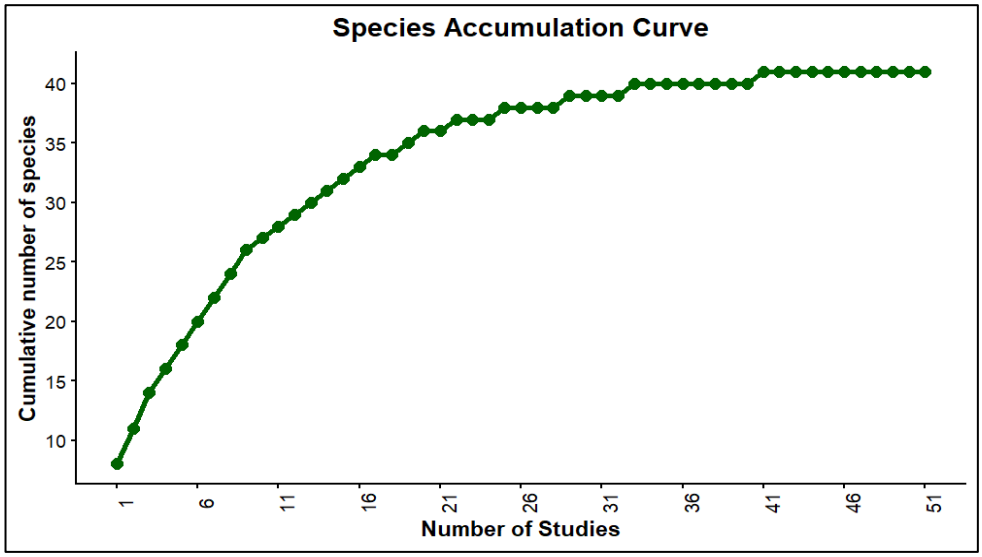

Figure 5. Species accumulation curve representing knowledge saturation

Results

Diversity of Aroids in Odisha

The assessment of diversity in Odisha documented a total of 41 species of Aroids belonging to 28 genera (Table 3, Fig. 6) in the study area, highlighting significant taxonomic and morphological diversity. Among the documented genera, 3 genera are represented by 3 species in each, 7 genera with 2 species in each and 18 genera are monotypic (represented by a single species) in the present study. The genera represented by 3 species in each are *Amorphophallus* Blume ex Decne, *Rhaphidophora* Hassk. and *Syngonium* Schott. Among the documented taxa, 30 species grow naturally in different regions of Odisha, whereas 11 species also occur in natural habitats, but are considered cultivated as they were previously introduced due to their ornamental properties. The updated nomenclature of each taxon, followed by its local name, growth habit, useful part, purpose of use, ethnobotanical usage as well as ΣUI (total number of usage), FC (number of informants who reported the plant's use), UV (Use value) and RFC (Relative frequency of citation) were described in detail in Table 3.

Habit & Habitat

Among the documented species, herbs represent the dominant growth habit with 30 species (73.17%), whereas climbers contribute 26.83 % of the diversity with 11 species (Table 3). Similarly, most of the genera are terrestrial plants, and a few prefer marshy habitats. The genera include *Pistia* L., *Wolffia* Horkel ex Schleid, *Spirodela* Schleid. and *Lemna* L. prefer a complete aquatic habitat.

Part used and purpose of Use

During the ethnobotanical investigation, it was observed that different plant parts such as leaves, flowers, fruits, bulbils and underground parts including corms, tubers, and stolons are used for different ethnobotanical practices, e.g. food, fodder, medicine, ritual, ornamentation and decoration purposes. Among the reported usages in Odisha, the Aroids are mainly used for food, medicinal and ornamental purposes. While considering the plant parts, the whole plant of 23 species, followed by the underground parts, leaves, roots and fruits of 13, 16, 5 and 3 species, respectively, are documented as major useful plant parts. Apart from this, the latex, a secretory product of *Xanthosoma sagittifolium* (L.) Schott plant is also useful for its medicinal applications. The plant species *Aglaonema commutatum* Schott, *Anthurium crystallinum* Linden & Andre, *Anthurium andraeanum* Linden ex Andre, *Dieffenbachia seguine* (Jacq.) Schott, *Epipremnum aureum* (Linden & Andre) G.S.Bunting, *Epipremnum pinnatum* (L.) Engl., *Homalomena lindenii* (Rodigas) Ridl., *Monstera deliciosa* Liebm and all 3 reported species of the genus *Syngonium* Schott are widely grown as ornamental plants due to their attractiveness. Besides their ornamental properties, *Aglaonema nitidum* (Jack) Kunth, *Epipremnum aureum* (Linden & Andre) G.S. Bunting and *Syngonium angustatum* Schott are considered Vastu plants. The Aroid species *Xanthosoma robustum* Schott possesses ecological significance as it is grown in hilly areas to check soil erosion.

Ethnobotanical Usage

The underground parts such as corm, tuber and stolon (Fig. 6), as well as the aerial parts including leaves and petiole, are consumed as food for their nutritional properties as well as used in the preparation of useful traditional medicines. Among the 41 documented species, 8 species were used as food and 27 species were used for their medicinal properties. The leaves

of Aroids are used as leafy green vegetables, whereas petioles of *Amorphophallus paeoniifolius* (Dennst.) Nicolson and *Colocasia esculenta* (L.) Schott are used in the preparation of delicious curry. Farmers grow Aroids (Fig. 7) for their edible underground parts, which are consumed either boiled or in a roasted form. *Alocasia fornicata* (Kunth) Schott*, Alocasia macrorrhizos* (L.) G.Don*, Lasia spinosa* (L.) Thwaites*, Theriophonum minutum* (Willd.) Baill. and *Typhonium trilobatum* (L.) Schott are consumed as wild edible plants by the tribal communities. Aroids play a crucial role in traditional medicine and are primarily used for the treatment of rheumatologic, haematological, gastrointestinal and skin disorders. The paste prepared from the underground parts of *Alocasia fornicata* (Kunth) Schott, *Sauromatum venosum* (Aiton) Kunth and *Xanthosoma sagittifolium* (L.) Schott are reported to be used in the treatment of bone fracture by dermal mode of application, but the process of paste preparation is separate for each species. Goat milk and egg albumin were mixed with dried powder obtained from the tuber of *Alocasia fornicata* (Kunth) Schott, whereas latex of Banyan tree was used as an ingredient in the case of *Sauromatum venosum* (Aiton) Kunth for the treatment of bone fractures. The people of Odisha worship two members of the Araceae family, i.e *Alocasia macrorrhizos* (L.) G.Don in Ganesh Chaturthi, Biswakarma Puja and Navaratri, whereas *Colocasia esculenta* (L.) Schott in Navaratri (During Goddess Durga puja) festivals. Besides these ritual values, tribal people worship *Englerarum montanum* (Roxb.) P.C Boyce, K.Z Hein & A.Hay to ward off spirit attacks and especially worship on Saturdays for resolving family disputes. For ornamental purposes, members of this family are grown in different public places, specifically gardens, parks, offices, and homes, for aesthetic value. Due to their unique pattern of inflorescence, variation in spadix and spathe arrangement, spathe colour and leaf shape, they attract humans for recreation. The leaves of Aroids are used for decoration purposes in different festivals and functions (Fig. 7). The large-sized leaves of *Alocasia macrorrhizos* (L.) G.Don are used in the decoration of walls, stages, tables, etc in different events. The leaves of *Colocasia esculenta* (L.) Schott and *Alocasia macrorrhizos* (L.) G.Don are used as natural plates to carry food products, as reported in this study. The detailed ethnobotanical usage of members of the Arum family is described in Table 3, based on which quantitative values were derived referring to the standard formula.

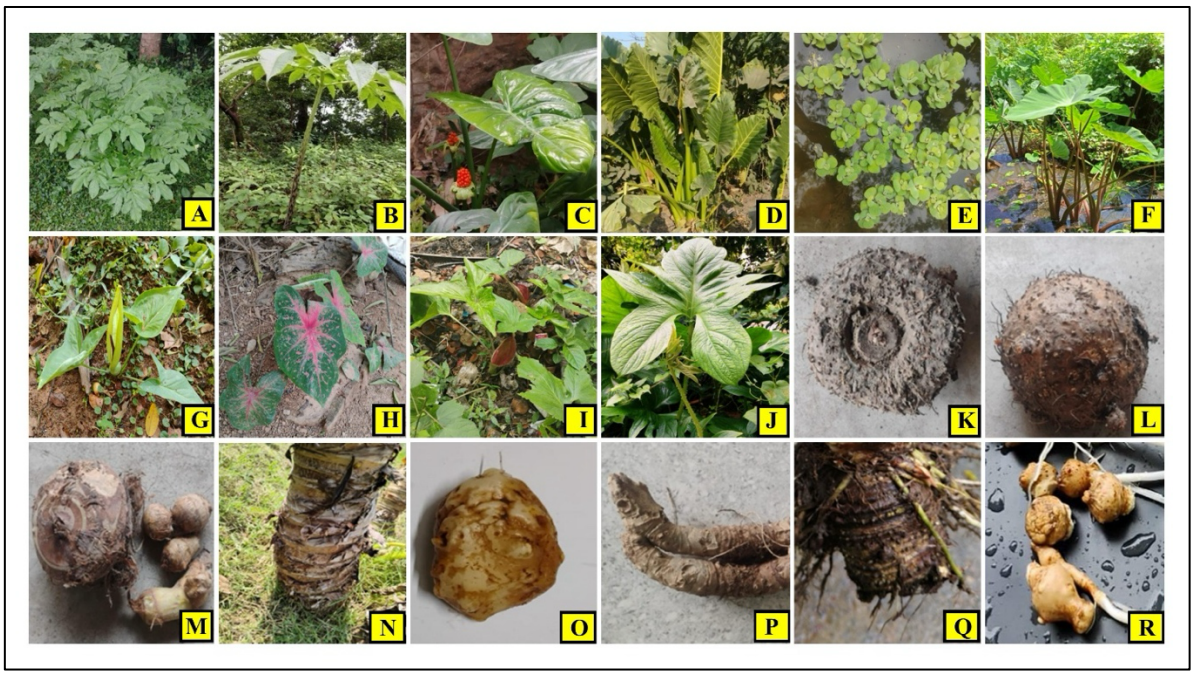

Figure 6. Photo plate representing Aroid species (A: *Amorphophallus paeoniifolius* (Dennst.) Nicolson, B: *Amorphophallus bulbifer* (Schott) Blume, C: *Alocasia fornicata* (Kunth) Schott, D: *Alocasia macrorrhizos* (L.) G.Don, E: *Pistia stratiotes* L., F: *Colocasia esculenta* (L.) Schott, G: *Theriophonum minutum* (Willd.) Baill., H: *Caladium bicolor* (Aiton) Vent, I: *Typhonium trilobatum* (L.) Schott, J: *Lasia spinosa* (L.) Thwaites, K: edible part of *Amorphophallus paeoniifolius* (Dennst.) Nicolson, L: useful part of *Amorphophallus bulbifer* (Schott) Blume, M: edible part of *Colocasia esculenta* (L.) Schott, N: useful part of *Alocasia macrorrhizos* (L.) G.Don, O: useful part of *Typhonium trilobatum* (L.) Schott, P: useful part of *Alocasia fornicata* (Kunth) Schott, Q: edible part of *Xanthosoma sagittifolium* (L.) Schott, R: useful part of *Theriophonum minutum* (Willd.) Baill).

Table 3. Ethnobotanical Usage, UV and RFC of Family Araceae in Odisha

Name of Species	Local name	Habit	Part Use	Purpose of use	Ethnobotanical usage	ΣUI	FC	UV	RFC
Aglaonema commutatum Schott	Tipira	Herb	Whole plant	Ornamental	The plant is grown as an indoor plant due to its attractiveness.	11	11	0.22	0.22
Aglaonema nitidum (Jack) Kunth		Herb	Whole plant, fruit	Ornamental, cosmetic	The plant is placed in the front door of the home or business sector to be considered as a Vastu plant. The fruit is connected with a string to make a garland used by females to decorate the plait.	14	7	0.27	0.14
Alocasia fornicata (Kunth) Schott	Bana saru	Herb	Corm, Fruit	Medicinal, food	The powder prepared from the dried corm mixed with egg albumin and goat milk is applied on the dermal region of the affected area for treatment of bone fracture. The fresh corms are boiled along bamboo leaves, and the decoction is used for treatment of cracked feet. Fruit is mixed with oil of *Madhuca indica* and boiled over a low flame. The obtained product is applied on the toe for treatment of asthma. The corm is sometimes consumed after special treatment.	29	17	0.57	0.33
Alocasia macrorrhizos (L.) G.Don	Mana	Herb	Leaves, corms, whole plant	Medicinal, food, fodder, ritual, decoration, cultural	The corms are used as food in tribal communities. It is fried with cow ghee and consumed for the treatment of internal ulcers. Used as fodder by pigs. Leaves are used in Biswakarma puja festival, whereas the whole plant is worshipped in Ganesh chaturthi and Navaratri festival. Leaves are used for decorative purposes in different social functions as well as used as a natural plate.	36	23	0.71	0.45
Amorphophallus bulbifer (Schott) Blume	Bana Ola	Herb	Corm, Bulbil, Leaves	Medicine	Fresh corm is pieced into small tablet size structure and placed inside the mesocarp of ripe banana to consume for the treatment of haemorrhoids and piles. Corms are used to treat joint pain and inflammation. The bulbils are used as an antidote against animal bites. Leaves are used in the treatment of veterinary diseases.	32	18	0.63	0.35
Amorphophallus margaritifer (Roxb.) Kunth	Jhumpa gudi	Herb	Leaves, root	Medicine	Leaf infusions are used to relieve joint pain due to ageing and continuous labour. Root powder is used to check skin disease.	19	11	0.37	0.22
Amorphophallus paeoniifolius (Dennst.) Nicolson	Olua, ola, Olu kenda	Herb	Corm, petiole	Food, medicine	The corms are edible; boiled corms have potency to cure piles and other anorectal diseases. The petioles are used for preparation of delicious curry. The boiled corm is used to prepare a chutney and consumed on the first day of Odia month Kartika (celebrated as Garvana Sankranti) as a traditional practice of Odia farmer communities.	41	28	0.80	0.55
Anthurium crystallinum Linden & Andre	Panapatri	Herb	Whole plant	Ornamental	The plant is grown as an ornamental plant.	10	7	0.20	0.14
Anthurium andraeanum Linden ex Andre		Herb	Whole plant	Ornamental, cultural	Plant is grown as an ornamental plant. It is believed that the heart-shaped inflorescence brings positive vibes towards family.	22	16	0.43	0.31
Arisaema tortuosum (Wall.) Schott	Bhaibabimula	Herb	Tuber	Medicine	Tuber is used for the treatment of skin disease and snakebite (mode of application not reported). Juice or powder of the underground part is applied on the wounds of livestock to prevent parasite infection. Paste	27	19	0.53	0.37

					prepared from the tuber is applied on the joint area of the muscle to check joint pain and rheumatism. Tuber collected on Tuesday is bound with a red spun cord and bound on the right arm to stimulate the sex power of males and on the left arm to check the irregular menstrual cycle in females. Used to promote the regeneration of broken horn of ox by external application. Cautionary Note: Although this plant is used for the treatment of several diseases, it is a poisonous plant. Reported medicinal usages represent documented traditional practice, do not constitute clinical endorsement, are biomedically invalidated, and some are potentially risky. Hence, scientific validation should be necessary before the use of this primary information, which was collected from the traditional healers.				
Caladium bicolor (Aiton) Vent	Nali Saru, Rangi Saru	Herb	Leaves, whole plant	Medicinal, ornamental	Fresh leaves are crushed to destroy the infectious organisms on the sores of livestock. Used for the treatment of Foot and Mouth Disease (Phatua) in cattle. Leaf extract is used to check diarrhoea. The plant is grown as an ornamental plant due to its colourful leaves.	33	24	0.65	0.48
Colocasia esculenta (L.) Schott	Saru	Herb	Leaves, corm, Whole plant	Food, medicinal, ritual	The corm is used as a staple food, to promote digestion, to check diabetes, as a supplement to potato; it is consumed in the diet to check rheumatism. The leaf is cut into small pieces and wrapped with Sal leaf, followed by roasting, and the obtained product is mixed with Garlic to increase immune power during the rainy season. The petiole is used in the preparation of curry along with small fishes. Leaf juice is applied on infected areas to cure eczema and wounds to check bleeding. The steam produced by boiling leaves along with water is inhaled to check Asthma. The sap produced from the petiole is applied on the forehead to check migraine. The leaf is used as a natural plate to carry flowers and food items. The plant is worshipped during the Navaratri festival.	49	45	0.96	0.88
Cryptocoryne ciliata (Roxb.) Schott	Keria	Herb	Leaves	Medicine, fodder, ornamental	The leaf juice is applied to repel leeches and check bleeding; The juice is also applied to relieve pain in case of a honey bee attack. The leaves are used as fodder for ducks. The whole plant is grown as an ornamental plant.	18	11	0.35	0.22
Cryptocoryne retrospiralis (Roxb.) Kunth	Kerker, Mala	Herb	Tuber, leaves	Medicine	The paste prepared from fresh tuber is applied on the burn wound for speedy recovery. The leaves are crushed and inhaled to check vomiting.	13	12	0.25	0.24
Dieffenbachia seguine (Jacq.) Schott		Herb	Whole plant	Ornamental	The plant is grown as an ornamental plant for decorative purposes.	22	10	0.43	0.20
Epipremnum aureum (Linden & Andre) G.S.Bunting	Money Plant	Climber	Whole plant	Ornamental, cultural	It is believed that keeping this plant in the home or workplace brings prosperity, financial growth and positive vibes. It is considered that the plant is capable of eradicating the Vastu problem at home. The plant is also grown as an ornamental plant due to its variegated leaves.	31	18	0.61	0.35
Epipremnum pinnatum (L.) Engl.	Money plant	Climber	Whole plant	Ornamental	The plant is used for its ornamental properties due to its unique leaf structure.	10	9	0.20	0.18

Englerarum montanum (Roxb.) P.C Boyce, K.Z Hein & A.Hay	Mankada Saru	Herb	Whole plant	Ritual	The plant is worshipped on Saturday to resolve family disputes. The plant is worshipped by tribal communities in order to avoid spirit attack.	16	14	0.31	0.27
Homalomena lindenii (Rodigas) Ridl.		Herb	Whole plant	Ornamental, aesthetic	The plant is grown for its ornamental properties. It is believed that the plant represents harmony in the workplace.	11	11	0.22	0.22
Lasia spinosa (L.) Thwaites	Kanta Saru	Herb	Leaf, flower, corm	Medicinal, food	Young leaves are consumed as leafy vegetables or cooked to prepare curry. The juice prepared from the leaf, corm or flower is used to cure different types of diseases in livestock. The decoction of the leaf is mixed with water and used in a bath to cure measles and chicken pox.	26	17	0.51	0.33
Lemna perpusilla Torr.	Kenduli	Herb	Whole plant	Medicine, Fodder	The plant is used as fodder in local poultry farms. The decoction is used for washing the area affected by Eczema.	12	10	0.24	0.20
Monstera deliciosa Liebm		Climber	Whole plant, root	Ornamental, art craft	The plant is grown as an ornamental plant due to its attractiveness. The aerial roots are used in the preparation of baskets.	15	11	0.29	0.22
Pistia stratiotes L.	Bilati dala	Herb	Leaves, root	Medicinal, fodder	The leaf juice mixed with Kusuma oil and applied on the affected area for treatment of eczema and leprosy. The root is ground with peppermint and used as a poultice. Leaves are used as fodder for ducks, hens, and pigs.	27	14	0.52	0.27
Pothos scandens L.	Aradi	Climber	Leaves	Medicinal	The leaves are crushed with camphor and inhaled to cure asthma and clear the nasal chamber due to excess cold. Saliva applied on the dorsal leaf is placed on the pimple to avoid pain and dark spots on the skin.	13	11	0.25	0.22
Remusatia vivipara (Roxb.) Schott	Bana saru	Herb	Leaves, tuber	medicinal	The leaves are used for the treatment of conception in pregnancy (mode of application not reported). The tuber is poisonous but used for the treatment of swelling on the external part of the body with pus. Cautionary Note: Although this plant is used for the treatment of several diseases, it is a poisonous plant. Reported medicinal usages represent documented traditional practice, do not constitute clinical endorsement, are biomedically invalidated, and some are potentially risky. Hence, scientific validation should be necessary before the use of this primary information, which was collected from the informants.	20	16	0.39	0.31
Rhaphidophora decursiva (Roxb.) Schott		Climber	Whole plant	Ornamental	The plant is grown as an ornamental plant.	18	11	0.35	0.22
Rhaphidophora glauca (Wall.) Schott		Climber	Leaf, whole plant	Medicinal, ornamental	Ash produced by burning dried leaves is used for the treatment of ringworms. The plant is grown as an ornamental plant.	21	16	0.41	0.31
Rhaphidophora hookeri Schott		Climber	Whole plant	Ornamental	The plant is grown as an ornamental plant	09	09	0.18	0.18
Sauromatum venosum (Aiton) Kunth	Nukhuri	Herb	Tuber	Medicinal	The powder prepared from dried tuber is mixed with latex of the Banyan tree and applied on the dermal area to cure bone fracture. The fresh tuber is crushed, and the paste is applied in the spinal cord region to check	23	18	0.45	0.35

					spondylitis. The tuber is used to check menstrual irregularity by keeping the tuber in the hair bun.				
Scindapsus officinalis (Roxb.) Schott		Climber	Fruits, root	Medicinal	The fruits of the plant are used for the treatment of joint pain, rheumatism and accumulation of fluid in the joint area. It is also used for the treatment of paralysis. The root of the plant is used for the treatment of fungal infection.	17	12	0.33	0.24
Spathiphyllum wallisii Regel		Herb	Whole plant	Ornamental, aesthetic	Due to the unique leaf and flower morphology, it is grown as an indoor ornamental plant in homes and offices. People believe that the white colour flower is the symbol of peace, positive energy, and prosperity.	24	19	0.47	0.37
Spirodela polyrhiza (L.) Schleid	Bataka dala	Herb	Whole plant	Fodder, Medicine	The plant is used as fodder for hens, ducks, and swans. The whole plant is crushed and applied to the burn wound for easy recovery and skin regeneration.	17	9	0.33	0.18
Syngonium angustatum Schott		Climber	Whole plant	Ornamental, cultural	The plant is grown as an ornamental plant at the entry gate of the home. Sometimes the plant is considered a Vastu plant.	11	09	0.22	0.18
Syngonium macrophyllum Engl.		Climber	Whole plant	Ornamental	The plant is used as an ornamental plant in different public places.	10	10	0.20	0.20
Syngonium podophyllum Schott		Climber	Whole plants, leaf sap	Ornamental, medicinal	The foliage, flowers and the shape of the entire plant provide aesthetic value, due to which it is grown as an ornamental plant at the entry gate of the home, office and garden. Leaf sap is used for the treatment of red spots caused by mosquito bites.	13	07	0.25	0.13
Theriophonum minutum (Willd.) Baill.	Saru patri	Herb	Tuber, leaves	Food, medicine	The tuber is used as food after a specialised treatment. Leaves are crushed, and the juice is used as a louse repellent. The leaves are consumed as mixed leafy vegetables.	19	12	0.37	0.24
Typhonium roxburghii Schott		Herb	Corm	Medicinal	The corm is used for the treatment of diarrhoea and dysentery.	09	08	0.18	0.16
Typhonium trilobatum (L.) Schott	Trisakha	Herb	Tuber, leaves	Food, medicine	Consumed as wild leafy vegetables; the dried powder is mixed with mustard oil and applied on feet to cure Asthma. The tuber is crushed along with a leaf of *Andrographis paniculata* and the paste is applied on the knee and shoulder for relief from muscle cramps.	20	15	0.39	0.29
Wolffia globose (Roxb.) Hartog & Plas	Kenduli	Herb	Whole plant	Fodder, medicine	The whole plant is used as fodder for hens, ducks, and swans. The juice obtained from crushed plants is used as an ear drop against earaches.	21	13	0.41	0.25
Xanthosoma robustum Schott	Astamuli	Herb	Leaf latex, whole plant	Medicine, ecological	Milky latex is used for the treatment of cracked feet, Athlete's foot and eczema. The plant is grown in the nearby home to check soil erosion in hilly areas.	12	5	0.24	0.10
Xanthosoma sagittifolium (L.) Schott	Guarkhi	Herb	Corm, root	Food, medicinal	The corm is used as a staple food by different tribal communities. The corm is used for the treatment of bone weakness. Roots are used for the treatment of haematological disorders.	34	19	0.67	0.37

Figure 7. Photo plate representing Aroids ethnobotanical usage, cultivation process and commercialisation (A: Leaf of *Alocasia macrorrhizos* (L.) G.Don used in rituals, B: Leaf of Aroids used as natural plate, C & D: Leaf of *Alocasia macrorrhizos* (L.) G.Don used in decoration, E: Preparation of medicine by using Aroids, F: Cultivation of *Amorphophallus paeoniifolius* (Dennst.) Nicolson, G: Cultivation of *Colocasia esculenta* (L.) Schott, H: Harvested stolon of *Colocasia esculenta* (L.) Schott, I & J: Selling of harvested stolon in local market.

Quantitative Data Analysis

Use Value

The Use Value (UV) scores of Aroids ranged from 0.18 to 0.96 (Table 3, Fig. 8). The highest Use Value was recorded in *Colocasia esculenta* (L.) Schott (0.96), whereas two plant species, i.e. *Raphidophora hookeri* Schott and *Typhonium roxburgii* Schott, ranked the lowest use value (0.18). This Use value indicates that *Colocasia esculenta* (L.) Schott is the most useful species in the study area in comparison to others. This high use value reflects that the Taro plant possesses multiple utilities, including being used as a staple food, curing rheumatism, increasing immune power, curing asthma, checking migraine, used in rituals, as well as leaves used as natural plates. Although Aroids are associated with the culture of the Odia community from multiple points of view, their food and medicinal properties act as a key factor behind their high use values.

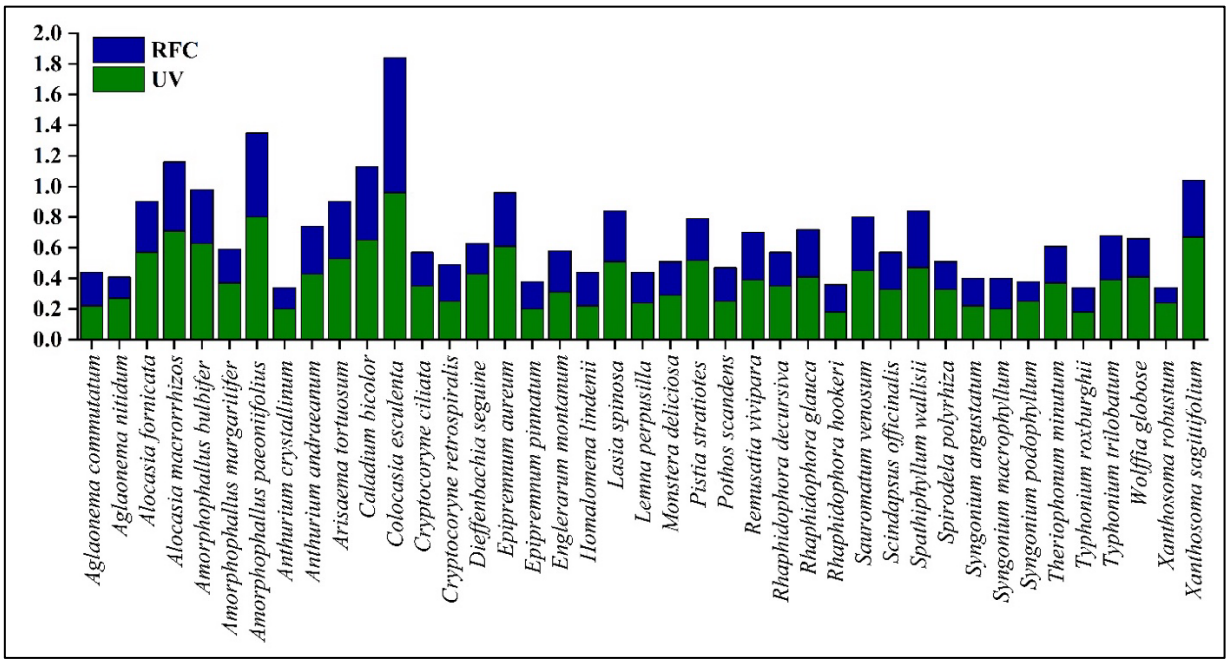

Figure 8. Graph representing use value and Relative frequency of citation of documented Aroid species.

Relative Frequency of Citation

The findings of the present study revealed that the Relative Frequency of Citation (RFC) of members of the Araceae family ranged from 0.1 to 0.88 (Table 3, Fig. 8). The results revealed that *Colocasia esculenta* (L.) Schott had the highest RFC (0.88), ranked highest, with the plant cited by the highest number of informants, followed by *Amorphophallus paeoniifolius* (Dennst.) Nicolson (0.55) and *Caladium bicolor* (Aiton) Vent (0.48). The lowest RFC was recorded in the case of *Xanthosoma robustum* Schott (0.1). This RFC elaborates the local importance and cultural significance of Aroids. In the present study, *Colocasia esculenta* (L.) Schott was mentioned by the maximum informants, which possesses a high RFC.

Family Use Value

The family use value of the Araceae family is 0.39 when considering all types of usage, notably food, medicine, fodder, ornamental and ritual usage; but in consideration with only food values, the obtained family use value with reference to Aroid use as food is 0.62.

Plant Part Value

Different plant parts of Aroids are used by the people of Odisha to fulfil their basic requirements of daily life. In this context, the present study attempts to calculate the plant part value of plant species under the Arum family. The obtained quantitative analysis results indicated that the value of plant parts ranges from 0 to 1 (Table 4, Fig. 9). A value of "0" indicates that the plant part is generally not used by the local community, whereas "1" indicates that this plant part is a useful part of this plant. The plant parts, including leaves, underground part (corm, tuber), whole plant and other parts (flower, fruit, root, bulbil), are useful in 24, 14, 23 and 9 species, respectively. In the case of leaves, the highest PPV was 1 and recorded in 2 plant species, *Cryptocoryne ciliata* (Roxb.) Schott and *Pothos scandens* L., followed by *Amorphophallus margaritifer* (Roxb.) Kunth (0.74) and *Typhonium trilobatum* (L.) Schott (0.7). Likewise, the underground parts of *Arisaema tortuosum* (Wall.) Schott*, Sauromatum venosum* (Aiton) Kunth and *Typhonium roxburghii* Schott secured the first rank with a score of 1, followed by *Xanthosoma sagittifolium* (L.) Schott (0.79) and *Colocasia esculenta* (L.) Schott (0.78). Among the other plant parts (root, bulbils, flower and fruits), root obtained the principal rank with a score of 0.44. Detailed information about the reported usage of plant parts and plant part value is represented in Table 4.

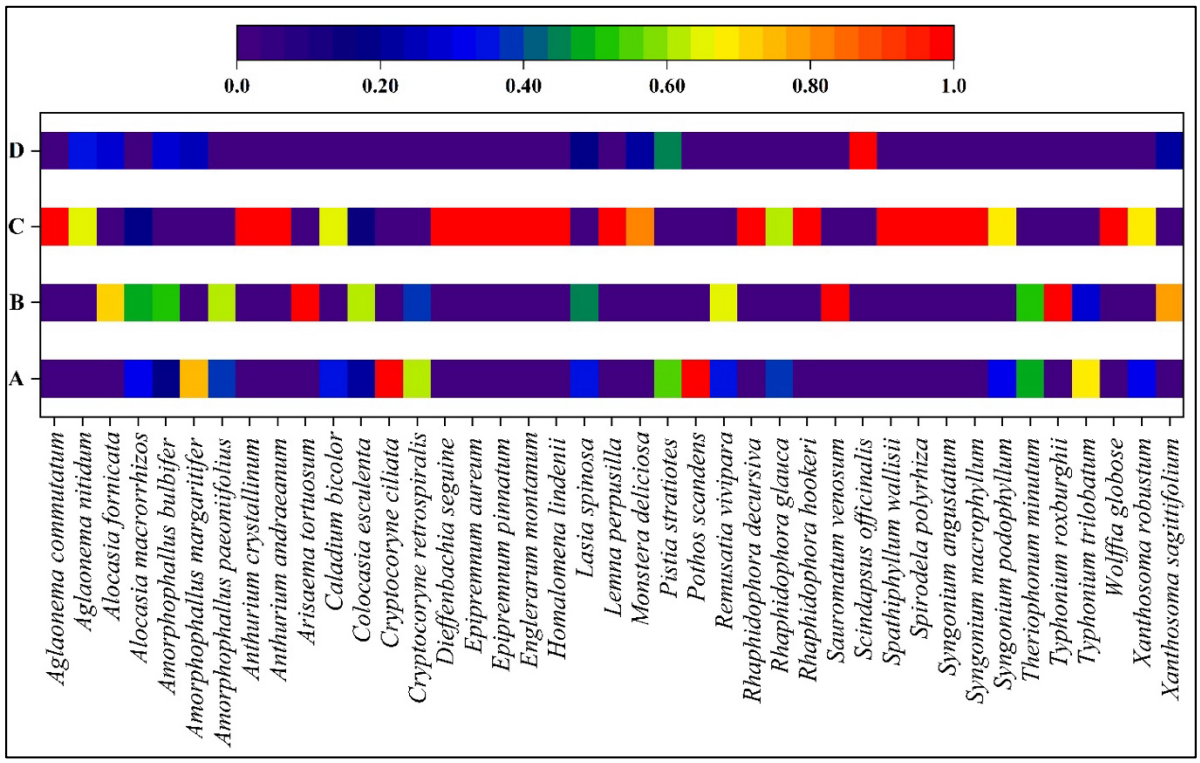

Figure 9. Heat map representing the Plant part value of documented Aroid species (A: PPV of Leaf/petiole, B: PPV of Corm/tuber, C: PPV of Whole Plant, D: PPV of other parts).

Table 4. Plant part value of Family Araceae

Name of Species	Voucher Number	ΣUI	RUPP of Leaf/ petiole	RUPP of Corm/ tuber	RUPP OF Whole Plant	RUPP of Other part	PPV of Leaf/ petiole	PPV Corm/tuber	PPV of Whole Plant	PPV of Other part
Aglaonema commutatum Schott	ENVFMU-1724	11	0	0	11	0	0	0	1	0
Aglaonema nitidum (Jack) Kunth	ENVFMU-1735	14	0	0	09	05	0	0	0.64	0.36
Alocasia fornicata (Kunth) Schott	ENVFMU-1711	29	0	21	0	08	0	0.72	0	0.28
Alocasia macrorrhizos (L.) G.Don	ENVFMU-1733	36	12	17	07	0	0.33	0.47	0.19	0
Amorphophallus bulbifer (Schott) Blume	ENVFMU-1708	32	6	17	0	09	0.19	0.53	0	0.28
Amorphophallus margaritifer (Roxb.) Kunth	ENVFMU-1725	19	14	0	0	05	0.74	0	0	0.26
Amorphophallus paeoniifolius (Dennst.) Nicolson	ENVFMU-1713	41	16	25	0	0	0.39	0.61	0	0
Anthurium crystallinum Linden & Andre	ENVFMU-1706	10	0	0	10	0	0	0	1	0
Anthurium andraeanum Linden ex Andre	ENVFMU- 1730	22	0	0	22	0	0	0	1	0
Arisaema tortuosum (Wall.) Schott	ENVFMU-1736	27	0	27	0	0	0	1	0	0
Caladium bicolor (Aiton) Vent	ENVFMU-1721	33	12	0	21	0	0.36	0	0.64	0
Colocasia esculenta (L.) Schott	ENVFMU-1712	49	11	31	07	0	0.22	0.63	0.14	0
Cryptocoryne ciliata (Roxb.) Schott	ENVFMU-1731	18	18	0	0	0	1	0	0	0
Cryptocoryne retrospiralis (Roxb.) Kunth	ENVFMU-1722	13	8	5	0	0	0.62	0.38	0	0
Dieffenbachia seguine (Jacq.) Schott	ENVFMU-1742	22	0	0	22	0	0	0	1	0
Epipremnum aureum (Linden & Andre) G.S.Bunting	ENVFMU-1737	31	0	0	31	0	0	0	1	0
Epipremnum pinnatum (L.) Engl.	ENVFMU-1705	10	0	0	10	0	0	0	1	0
Englerarum montanum (Roxb.) P.C Boyce, K.Z Hein & A.Hay	ENVFMU-1718	16	0	0	16	0	0	0	1	0
Homalomena lindenii (Rodigas) Ridl.	ENVFMU-1703	11	0	0	11	0	0	0	1	0
Lasia spinosa (L.) Thwaites	ENVFMU-1702	26	9	12	0	5	0.35	0.46	0	0.19
Lemna perpusilla Torr.	ENVFMU-1720	12	0	0	12	0	0	0	1	0
Monstera deliciosa Liebm	ENVFMU-1723	15	0	0	12	3	0	0	0.8	0.2
Pistia stratiotes L.	ENVFMU-1701	27	15	0	0	12	0.56	0	0	0.44
Pothos scandens L.	ENVFMU-1739	13	13	0	0	0	1	0	0	0
Remusatia vivipara (Roxb.) Schott	ENVFMU-1704	20	7	13	0	0	0.35	0.65	0	0
Rhaphidophora decursiva (Roxb.) Schott	ENVFMU-1734	18	0	0	18	0	0	0	1	0
Rhaphidophora glauca (Wall.) Schott	ENVFMU-1727	21	8	0	13	0	0.38	0	0.62	0
Rhaphidophora hookeri Schott	ENVFMU-1740	09	0	0	9	0	0	0	1	0
Sauromatum venosum (Aiton) Kunth	ENVFMU-1709	23	0	23	0	0	0	1	0	0
Scindapsus officinalis (Roxb.) Schott	ENVFMU-1716	17	0	0	0	17	0	0	0	1
Spathiphyllum wallisii Regel	ENVFMU-1741	24	0	0	24	0	0	0	1	0
Spirodela polyrhiza (L.) Schleid	ENVFMU-1732	17	0	0	17	0	0	0	1	0
Syngonium angustatum Schott	ENVFMU-1726	11	0	0	11	0	0	0	1	0

Syngonium macrophyllum Engl.	ENVFMU-1715	10	0	0	10	0	0	0	1	0
Syngonium podophyllum Schott	ENVFMU-1728	13	4	0	9	0	0.31	0	0.69	0
Theriophonum minutum (Willd.) Baill.	ENVFMU-1707	19	9	10	0	0	0.47	0.53	0	0
Typhonium roxburghii Schott	ENVFMU-1738	09	0	9	0	0	0	1	0	0
Typhonium trilobatum (L.) Schott	ENVFMU-1717	20	14	6	0	0	0.7	0.3	0	0
Wolffia globosa (Roxb.) Hartog & Plas	ENVFMU-1710	21	0	0	21	0	0	0	1	0
Xanthosoma robustum Schott	ENVFMU-1714	12	4	0	8	0	0.33	0	0.67	0
Xanthosoma sagittifolium (L.) Schott	ENVFMU-1729	34	0	27	0	7	0	0.79	0	0.21

Direct Matrix Ranking

The Direct Matrix Ranking (DMR) values obtained through cumulative score show the ethnobotanical importance of different categories of usage, specifically food, medicine, ritual value and aesthetic value, across 5 use categories (Table 5). The obtained result showcases that *Alocasia macrorrhizos* (L.) G.Don secured the 1st rank with a score of 21, followed by *Colocasia esculenta* (15) and *Lasia spinosa* (11). The obtained result states that the highest value of *Alocasia macrorrhizos*(L.) G.Don is due to its application in food, fodder, human medicine, animal medicine, as well as cultural and aesthetic significance. Among the diverse use categories, medicinal use of Aroids for the treatment of humans secured the highest score (36), followed by their use as food (27). Among the Aroids, *Amorphophallus paeoniifolius* (Dennst.) Nicolson and *Colocasia esculenta* (L.) Schott secured the highest score for food use, followed by *Theriophonum minutum* (Willd.) Baill. and *Xanthosoma sagittifolium* (L.) Schott. Among these 10 species, 9 species are directly used in human medicine, with *Alocasia macrorrhizos* (L.) G.Don and *Amorphophallus paeoniifolius* (Dennst.) Nicolson at the top position. Similarly, *Lasia spinosa* (L.) Thwaites gains the maximum score, followed by *Arisaema tortuosum* (Wall.) Schott and *Alocasia macrorrhizos* (L.) G.Don for the treatment of livestock disease.

Table 5. Direct matrix ranking of selected Aroids

Plant Name	**Ethnobotanical Uses**					**Total score**	**Rank**
	A	**B**	**C**	**D**	**E**		
Alocasia fornicata (Kunth) Schott	1	1	4	2	2	10	4th
Alocasia macrorrhizos (L.) G.Don	3	4	5	4	5	21	1st
Amorphophallus bulbifer (Schott) Blume	0	0	4	2	0	06	7th
Amorphophallus paeoniifolius (Dennst.) Nicolson	5	0	5	0	1	11	3rd
Arisaema tortuosum (Wall.) Schott	0	0	4	4	0	08	6th
Colocasia esculenta (L.) Schott	5	2	3	1	5	15	2nd
Lasia spinosa (L.) Thwaites	2	0	4	5	0	11	3rd
Theriophonum minutum (Willd.) Baill.	4	1	3	0	0	08	6th
Typhonium trilobatum (L.) Schott	3	0	4	2	0	09	5th
Xanthosoma sagittifolium (L.) Schott	4	0	0	4	2	10	4th
Total Score	27	08	36	24	15		
Rank	2nd	5th	1st	3rd	4th		

A: Food, B: Fodder, C: Human medicine, D: Livestock medicine, E: Other (Ritual, cultural, ornamental, etc)

Jaccard Similarity Index

The calculated Jaccard Similarity Index value of the previously conducted 6 studies from different parts of the globe in comparison with the present study is represented in Table 6. The obtained Jaccard Similarity Index value ranges from 4.92 to 37.42. The findings of the present investigation are much more similar to the study of Rapaka (2025) in Andhra Pradesh State of India, whereas lower similarities (4.92) were observed in the research conducted at Maliau Basin, Malaysia by Sulaiman & Shunmugam (2010). The findings are most similar to the study carried out in the Andhra Pradesh region, as a maximum of 25 species are common to both Odisha and Andhra Pradesh in comparison to others. Similarly, the ethnobotanical study of Sinha & Borkataky (2025) in the Upper Assam region, in comparison with the present study, documented 21 common taxa to both regions and secured the 2nd highest Jaccard Similarity Index value.

Table 6. Jaccard index percentage of the present study in comparison with other areas.

Area of Study	Year of study	Total plant species recorded	Common plant species in both studies	Dissimilar plant species	Jaccard Index (%)	Reference
Maliau Basin, Malaysia	2010	23	03	20	4.92	Sulaiman & Shunmugam, 2010
Nazir Sub division of Assam	2014	26	14	12	26.42	Das *et al.* (2014)
Hau River, Vietnam	2015	27	15	12	28.30	Truyen *et al.* (2015)
Upper Assam	2025	46	21	25	31.81	Sinha and Borkataky (2025)
Kalasin Province, Thailand	2025	51	17	34	22.67	Hein *et al.* (2025)
Andhra Pradesh	2025	56	25	31	34.72	Rapaka (2025)

Cultivation Cost and Commercialisation of Aroids

Cultivation Process

Aroid species, particularly *Colocasia esculenta* (L.) Schott, *Amorphophallus paeoniifolius* (Dennst.) Nicolson and *Xanthosoma sagittifolium* (L.) Schott are widely cultivated for their edible underground parts (Fig. 7). The cultivation of *Colocasia esculenta* (L.) Schott and *Amorphophallus paeoniifolius* (Dennst.) Nicolson is done in all parts of the study area, whereas cultivation of *Xanthosoma sagittifolium* (L.) Schott is restricted to Northern Odisha. April to June is the suitable period for initiating cultivation, while harvesting is done in November and December. Fertile, well-drained, and moisture-retentive soils favour the growth of these plants. Additionally, farmers provided ash, dried cow dung and rotten paddy straw as the sources of organic matter to facilitate better yield. The cultivation process requires expenditure of heavy labour along with proper management. Among different steps of cultivation, the harvesting process required maximum expenditure of money.

Cultivation Cost

Local farmers conserve the propagative material (germplasm) such as stolon and corm, which are necessary for cultivation in the next growing season, and are available in the local market at a low cost (maximum 40 INR per Kg). To cultivate one acre (100 decimal) of land, approximately 50-60 kg of propagules are required (with a cost of minimum 2000 to maximum 2400 INR), followed by labour cost (minimum 7000 to maximum 10000 INR). Apart from that, the post-harvesting process requires expenditure of approximately minimum 2500 to maximum 3000 rupees. The total expenditure for these crops is approximately ranging from a minimum of 11,500 to a maximum of 15,400 INR, depending on the harvesting process.

Commercialisation and economic profits

The edible underground parts of these three species are sold in the local market (known as Hata). The underground part of *Colocasia esculenta* (L.) Schott is sold at the highest price (varies from 40-70 rupees per Kg) in comparison to others. The detailed analysis of the cultivation of Aroids such as *Colocasia esculenta* (L.) Schott and *Xanthosoma sagittifolium* (L.) Schott reveals unique economic profits. The *Colocasia esculenta* (L.) Schott yields 15 to 18 quintals (average 16.5 quintals) per acre at a market price of minimum 40 to maximum 70 INR (average Rs 55 per Kg.), as a result generating an average 77,300 INR net income per acre (Table 7). This offers favourable returns to farmers.

Table 7. Table representing total expenses and net profit in cultivation of *Colocasia esculenta* (L.) Schott in one acre of land.

Expenses and income (for 1 acre of land)		Unit	Minimum	Maximum	Average
Cultivation input	Propagule requirement (50-60 Kg) cost (INR 40 per Kg.)	INR (Indian rupees)	2,000	2,400	2,200
	Labor cost	INR	7,000	10,000	8,500
	Post-harvesting management	INR	2,500	3,000	2,750
	Total expenses	INR	11,500	15,400	13,450

Yield	Net yield	Quintal	15	18	16.5
	Selling price per kg	INR	40	70	55
	Gross income	INR	60,000	1,26,000	90,750
Profit	Net income	INR	48,500	1,10,600	77,300

Discussion

These research results showcase the rich species diversity of Aroids in Odisha and provide a detailed idea regarding the diversity of 41 species of the Araceae family in the state. Aroid species are used by local people for different purposes. Similarly, obtained ethnobotanical information reflects the diverse utility of members of the Arum family to fulfil the basic requirements in daily life; as a result, it supports livelihood in various ways. Saxena and Brahmam (1994-96) documented 23 species under 18 genera from the entire state. However, the present study documented 41 species from 13 districts of Odisha. A comprehensive study is necessary to study the diversity of the Arum family in the entire state of Odisha, which may contribute to adding more species to the Aroids flora of Odisha.

The assessment of Aroid diversity in Odisha is well comparable with recent studies conducted in the neighbouring state Andhra Pradesh and other regions of India. In this investigation, 41 species under 28 genera were documented, whereas in Andhra Pradesh, a total of 56 species were documented under 28 genera by Rapaka (2025). However, among the 56 species documented in their study, some species are synonymous with others, whereas this study avoids the use of synonyms, as updated nomenclature of taxa was provided, referring to the Plant of the World Online (POWO 2026). Notably, in the Indian state Assam, a diversity study of the Araceae family in Nazir subdivision by Das *et al.* (2014) listed 26 species under 17 genera. Similarly, the study conducted by Sinha & Borkataky (2025) in the Upper Assam region of India documented 46 species of Aroids belonging to 19 genera. The comprehensive analysis of the results of this study on Aroids in comparison with the different locations of India increases the wealth of monocotyledonous flora of India. The variation observed in the number of species in these studies may be due to differences in sampling techniques, study methodology, habitat diversity, taxonomic scope, variations in geographical locations, and topographical factors of the study area. While comparing the results of the present study with the findings of research conducted outside India, it was observed that a total of 51 species under 24 genera were documented by Hein *et al.* (2025) in Kalasin Province of Thailand, whereas 18 species were recorded in the study of Truyen *et al.* (2015) in Hau River of Vietnam. This deviation in the number of species may be due to the difference in the timing of the studies, as the study in Thailand was conducted 10 years after the study conducted in Vietnam. Apart from that variation in the geographical area, climatic as well as edaphic factors of both regions may act as a key factor behind the variation in species number.

While discussing the ethnobotanical utility of Aroids documented in the present study with the previously conducted research, the present study focused on both qualitative and quantitative ethnobotanical usage of Aroids. The study by Sinha & Borkataky (2025) used a random sampling method to document the ethnobotanical study, whereas this study followed the snowball method to select informants, which is a purposeful sampling method. Hein *et al.* (2025) applied structured interviews, and Basumatary *et al.* (2025) used both structured and semi-structured interviews to collect the ethnobotanical information. In the present study, the ethnobotanical investigation was performed through semi-structured interviews.

The study of Truyen *et al.* (2015) describes the five use values including food, medicine, ornamental, waste water purification and feeding. Interestingly, the broad area of the present investigation described the additional uses, notably ritual, cultural and aesthetic values. The aroids are widely used for ornamentation in Vietnam, whereas in Odisha they are mainly used for food and medicine. Similarly, Sinha & Borkataky (2025) described the use of Aroids for decorative purposes, which is also noticed in the present study, as leaves of *Alocasia macrorrhizos* (L.) G.Don and *Caladium bicolor* (Aiton) Vent. are used for decoration. Apart from that, the study of Das *et al.* (2014) described that 8 species are used for vegetable and delicacy purposes; interestingly, in our observation, also 8 edible Aroids are documented, among which 4 species are common in both studies. Hence, further studies based on phytochemical analysis, detection of pharmacological properties, and analysis of antimicrobial properties will be necessary to explore the multiple potencies of Aroids.

Apart from this, during the field study, it was observed that the underground parts of some Aroid species are consumed by local people as staple food, for which the indigenous people prefer cultivating some wild species of the Araceae family. This sustainable cultivation technique may be helpful for the domestication of wild Aroids in future. The cultivation and commercialisation of widely used Araceae members, particularly *Colocasia esculenta* (L.) Schott and *Xanthosoma sagittifolium* (L.) Schott, play a crucial role in empowering livelihoods. The data generated in the present study regarding the

estimated cultivation cost, propagule requirements, yield and net income in the cultivation of Aroids in Odisha were obtained through field observations followed by interviews with farmers, suppliers and sellers. This cultivation process offers favourable returns to the farmers through multiple steps of marketing. Once the underground parts mature and the plant dies, these parts, such as corms, tubers and stolons, are harvested by farmers. After harvesting, the farmer sells the products in the local market, followed by the purchaser selling these products again in other large-scale markets for their profit. Hence, it reveals the distinct economic profit of both the farmer and the seller, as a result promoting their economic development.

Aroids are highly contributed to the cultural aspects in Odisha. The present study reveals that *Alocasia macrorrhizos* (L.) G.Don, *Colocasia esculenta* (L.) Schott and *Engleraum montanum* (Roxb.) P.C. Boyce, K.Z.Hein & A.Hay are worshipped by the people of Odisha in different rituals, indicating biodiversity conservation through social approaches. The use of *Aglaonema nitidum* (Jack) Kunth, *Epipremnum aureum* (Linden & Andre) G.S. Bunting and *Syngonium angustatum* Schott as Vastu plants indicates the symbol of growth and prosperity. Similarly, the use of leaves of *Alocasia macrorrhizos* (L.) G.Don in the decoration and preparation of leaf plates by the local community shows plant-based remedies against the use of plastic to protect the environment. Apart from that, not only the underground parts but also the use of leaves and petioles of Aroids in the preparation of delicious curry highlights the cultural significance of Aroids in Odisha.

In this study, the involvement of indigenous and tribal communities plays a vital role by sharing their expertise. According to the Nagoya Protocol, prior informed consent was taken from the informants. Community leaders or representatives were fully informed about the aim and objectives of the study before the interview. They agreed to share their expertise for the benefit of human society. All informants allowed the authors to publish this research data regarding the obtained traditional knowledge. Foreign Nationals, companies or entities seeking to use this traditional knowledge must obtain prior approval from the National Biodiversity Authority (NBA). Under the Biological Diversity Act, this process prevents biopiracy and ensures the Fair and Equitable Sharing of Benefits with local communities.

Although the findings of the present study contribute to a better understanding of the Aroid flora of Odisha and highlight the importance of the Arum family in sustaining livelihoods, this study has some limitations such as small sample size, snowball bias and lack of scientific validation. Similarly, in the present investigation, some informants provided different statements on Aroids regarding Vastu, prosperity, positive energy and protection from spirits; however, such ethnobotanical information is a cultural belief reported by the informants rather than the objective characteristics of Aroids. Apart from that, although the plants, specifically *Arisaema tortuosum* (Wall.) Schott and *Remusatia vivipara* (Roxb.) Schott, were used for the treatment of several diseases, these two plants are poisonous. As the reported medicinal usages represent documented traditional practices, they do not constitute clinical endorsement, lack biomedical validation, and some usages are potentially risky. Hence, scientific validation should be necessary before the use of this primary information, which was collected from the informants. Further studies on phytochemical analysis, detection of pharmacognosical activities as well as estimation of nutritional properties (Carbohydrate, protein, vitamin, fats) will be necessary to claim the obtained indigenous knowledge, which will be beneficial for human beings.

Possible future conservation approaches

According to Sahoo *et al.* (1999), *Alocasia Montana* (Roxb.) Schott (presently known as *Engleraum montanum* (Roxb.) P.C. Boyce, K.Z.Hein & A.Hay), *Cryptocoryne ciliata* (Roxb.) Schott and *Rhaphidophora decursiva* (Roxb.) Schott were listed as endangered plants, whereas *Rhaphidophora hookeri* Schott was listed as a rare plant species in Odisha, which are also documented in the current study. In the present scenario, deforestation, urbanisation, industrialisation, and climate change are the major concerns behind the loss of species diversity. Hence, a detailed threat assessment for Aroids of Odisha by referring to the standard protocol of IUCN is necessary for identifying the key species. Immediate action is needed to conserve this species through in-situ and ex-situ conservation. Biotechnological applications such as mass propagation, tissue culture, and somatic embryogenesis can be applied, which may contribute to the large-scale production of Aroids in Odisha.

Conclusion

The present study highlighted the traditional knowledge associated with 41 species of the Araceae family belonging to 28 genera in the eastern Indian state of Odisha. The whole plant, its different parts such as its Corms, tubers, leaves, roots, flowers, as well as secretory product (latex), are involved in different ethnobotanical practices. The leaves and Corms are mainly transformed into useful traditional medicines by local healers for the treatment of gastrointestinal, anorectal, rheumatologic and skin disorders. Besides these medicinal utilities, due to the edible underground parts in some species, Aroids play crucial roles from both economic and commercial points of view. These plants are also utilised for their cultural, ecological, aesthetic and ornamental significances, indicating the multipurpose application of the Arum family in daily life. In

the present study, only 13 of the 30 districts of Odisha were covered. Diversity assessment of Aroids may provide information regarding more species diversity and new distributional records of Aroids to the state if the entire Odisha were covered. Instead of valuable information, the study possesses key gaps regarding scientific validation of obtained ethnobotanical information. Further studies regarding screening of bioactive compounds, analysis of nutritional quantity (estimation of carbohydrates, proteins and vitamin contents), detection of pharmacological properties, antioxidant efficiencies and antimicrobial activities are necessary to validate the obtained information, which plays a crucial role in the sustainable utilisation of Aroids. The information regarding the diversity of species will be helpful for conservation biologists and policymakers in habitat conservation and species protection. Apart from that, this work can be used as an information source to conserve the genetic resources of the family Araceae.

Declarations

Ethics approval and consent to participate: The Subject Research Committee (SRC) of Botany, Fakir Mohan University, Odisha has recommended conducting the ethnobotanical study of Aroids as an objective of the Ph.D. research (Letter No. Exam/Ph.D/BO/12/2025/2457/FMU). Apart from that, before the collection of ethnobotanical information from informants, oral informed consent was obtained from each informant.

Consent for publication: All informants shown in images agreed to have their image taken and published.

Availability of data and material: Not applicable

Competing interests: The authors have no relevant financial or non-financial interests to disclose.

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