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INDIGENOUS AGRICULTURAL PRACTICES OF SAURA TRIBES IN MAHENDRAGIRI MOUNTAINS, ODISHA STATE, INDIA





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M.S. Swaminathan Research Foundation



Citation:

Girigan Gopi, Prashant Parida, Kartik Charan Lenka and Israel Oliver King (2026). Indigenous Agricultural Practices of Saura tribes in Mahendragiri Mountains, Odisha state, India. MSSRF/RR/2026/64

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Design: Kannappan S, SMART TECH 2 FARMER

FOREWORD



**Dr Soumya Swaminathan,
Chairperson, MSSRF**

It gives me immense pleasure to present this important document on the Indigenous Agricultural Practices of the Saura tribes in the Mahendragiri Mountains of Odisha. This study not only highlights the ecological wisdom and cultural richness of the Saura communities but also reaffirms the enduring value of traditional agricultural knowledge in addressing contemporary challenges of climate change, biodiversity loss, and sustainable livelihoods.

Mahendragiri is a landscape where nature and culture have co-evolved over centuries. The Saura communities have demonstrated how agriculture, forests, water, and biodiversity can be managed holistically and sustainably. Their practices embody principles that modern science increasingly recognises: ecological resilience, agro-biodiversity conservation, and low-impact farming grounded in community stewardship. Mahendragiri represents a distinctive biocultural landscape whose significance as a potential GIAHS site lies in its integration of rich biodiversity with long-evolved indigenous agricultural systems. The Saura community's practices—particularly Bogodo, Bari, and Bila chasa - demonstrate sophisticated adaptations to steep hill ecology, combining mixed cropping, terrace engineering, and soil-water management. With rich floristic diversity and culturally protected sacred groves, Mahendragiri exemplifies a resilient mountain agroecosystem where traditional knowledge, ecological stewardship, and agrobiodiversity conservation continue to shape sustainable livelihoods.

I take this opportunity to express my deep appreciation to the Government of Odisha for entrusting the M.S. Swaminathan Research Foundation (MSSRF) with the responsibility of conducting this comprehensive study. Their commitment to recognising and documenting the remarkable heritage of Mahendragiri is truly commendable. I also extend heartfelt gratitude to our partner institutions - SACAL and to the Saura community members whose knowledge, insights, and lived experiences form the foundation of this work. Their collaboration has enriched this study in profound ways.

This report is a step forward in safeguarding India's agroecological heritage and ensuring that the voices and wisdom of Indigenous communities are recognised and valued. I hope it will serve as a strong foundation for future efforts, including the proposed nomination of Mahendragiri as a Globally Important Agricultural Heritage System (GIAHS).

A handwritten signature in blue ink that reads "Soumya Swaminathan". The signature is fluid and cursive, written in a professional style.

ACKNOWLEDGEMENT

We express our sincere gratitude to the Department of Agriculture and Farmers Empowerment, Government of Odisha for entrusting us with the opportunity to document and analyse the Indigenous Agricultural Practices of Mahendragiri. Their leadership and commitment to recognising and preserving unique agricultural heritage systems have been central to this study.

We gratefully acknowledge the support and collaboration of our partner organisation SACAL whose contributions strengthened both the fieldwork and analytical processes. We extend our special thanks to the Food and Agriculture Organization of the United Nations (FAO) for their valuable technical guidance and financial support, which enabled the systematic documentation of traditional knowledge and agroecological practices in the Mahendragiri landscape.

We also appreciate the cooperation of various Government Departments, including Agriculture, Horticulture, Tribal Development, Forest, Rural Development, and local administrative bodies, for providing information, facilitation, and institutional support essential for the successful completion of this study.


Our deepest appreciation goes to the Indigenous communities of Mahendragiri - the Saura and other local households - whose rich knowledge, practices, and worldviews form the foundation of this work. We sincerely thank the elders, farmers, healers, women, men, and youth who generously shared their time, experiences, concerns, and ecological wisdom with the study team. Their trust and participation have been invaluable.

We also acknowledge the many individuals - researchers, field facilitators, volunteers, CSOs and local institutions - who contributed in diverse ways to the progress and completion of this study.

To all who supported and strengthened this endeavour, we offer our heartfelt thanks.

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**“Saura Tribes:
Guardians of
Mahendragiri’s
Biocultural Heritage”**

1. SUMMARY TABLE

Name/Title of the Proposed GIAHS



Indigenous Agricultural Practices of Saura tribes in Mahendragiri Mountains, Odisha state, India

Submission Date



Requesting Agency/ Organization and contact information

Directorate of Agriculture & Food Production, Govt of Odisha in in collaboration with M.S. Swaminathan Research Foundation along with WASSAN, Ahinsha club & SACAL.
Contact Person: Director, Directorate of Agriculture & Food Production, Govt of Odisha.

Responsible Ministry and contact information

Principal Secretary, Department of Agriculture & Farmers' Empowerment, Government of Odisha
Contact Person: Principal Secretary Office, Krushi Bhaban, Odisha

Community & Livelihood



Saura tribes (PVTG), Agriculture, NTFPs

Biodiversity Status

1,348 Phats Species



Location and geographical coordinates



Location: Mahendragiri Mountains

The Mahendragiri Mountains are located in the Gajapati district of southern Odisha, forming part of the Eastern Ghats mountain range. Geographically, the Mahendragiri peak lies at approximately 18°58'28"N latitude and 84°22'05"E longitude.

Typography



Peaks, rugged slopes, watershed

Climate



Moist subtropical montane cool temps, high rainfall

Transport links between the site and the capital city or major cities



Road Connectivity

- Bhubaneswar → Mahendragiri: approx. 245 km, around 5 hours 19 minutes by road.
- Berhampur → Mahendragiri: approx. 85 km, about 2 hours 15 minutes.
- Paralakhemundi → Mahendragiri: approx. 40–50 km.



Rail Connectivity

- Nearest railway stations (Andhra Pradesh side):
 - Mandasa Road Railway Station – approx. 10 km from the hill by road.
 - Palasa Railway Station – approx. 30 km, with bus connection to Mandasa and then to the hill.
- These stations provide rail links to major cities in Odisha (Bhubaneswar, Berhampur) and Andhra Pradesh (Visakhapatnam, Srikakulam).



Air Connectivity

- Bhubaneswar Airport (Odisha): approx. 250 km away.
- Visakhapatnam Airport (Andhra Pradesh): also accessible for travellers approaching from the south.

Agroecological zones for agriculture, forestry, fisheries, and aquaculture



There are ten different agro-climatic zones in Odisha.

Mahendragiri, located in the Gajapati district of southern Odisha, is part of the Eastern Ghats, rising to 1,501 m with rugged slopes, dense forests, and rich biodiversity. Its ecosystems function as a transition zone linking peninsular Indian and Himalayan biota, making it ecologically distinctive. Mahendragiri Mountains fall under Eastern Ghats Highland Agro-climatic Zone. Within this categorisation, there are different agro-ecological zones, based on elevation, biodiversity and agriculture

01

Upland Mountain Agroecological Zone (1,000–1,500 m)



Relevant to: Millets, pulses, tubers, shifting-terrace agriculture (Bogodo chasa); conservation forestry.

Characteristics

- High elevation with rugged granite and charnockite slopes.
- Cooler temperatures, high rainfall, and cloud presence; major zone of mixed deciduous and evergreen forests.
- Supports cereal-pulse-tuber agriculture through shifting terrace systems (Bogodo chasa).
- Very high plant diversity: Over 1,300 plant species, many medicinal and endemic.

Land-use relevance

- Traditional agriculture: millets, pulses, tubers, spices; long fallow cycles for soil regeneration.
- Forestry: core zone for timber, medicinal plants, sacred groves.
- No large scale fisheries/aquaculture due to steep terrain.

02 Mid Slope Agroecological Zone (500-1,000 m)



Relevant to: Bari chasa (homegardens), agroforestry, NTFP harvesting

Characteristics

- Mixed tropical dry and moist deciduous forests, rich in fruit trees, shrubs, grasses, tubers.
- Habitat of many tribal settlements (Saora), who practise integrated food systems.
- Continuous interaction between forest and homestead agriculture.

Land-use relevance

- Home-gardens: fruit trees, tubers, vegetables, pulses.
- NTFP-based livelihoods: wild edibles, mushrooms, medicinal plants, honey.
- Forestry: sal, bamboo, evergreen patches.
- Limited fisheries in forest streams; small-scale collection only.

03 Valley & Foot Hill Agroecological Zone (0-500 m)



Relevant to: Bila chasa (terraced wet cultivation), stream fed irrigation, small fisheries potential.

Characteristics

- Gentler slopes, perennial streams from upper hills, fertile soil deposition.
- Source of Mahendratanya River, a key water body flowing through the foothills.
- Supports irrigated agriculture using bamboo and stone channels diverting spring water.

Land-use relevance

- Wet paddy cultivation (traditional landraces), followed by pulses and vegetables.
- Stream based micro fisheries: minor fishing in foothill streams; not large commercial fisheries.
- Potential for small-scale aquaculture in village ponds, though not traditionally dominant.

04 Forest & Biodiversity Conservation Zone (Cross cutting all elevations)



Relevant to: Forestry, NTFPs, watershed protection.

Characteristics

- Declared a Biodiversity Heritage Site (2022) with 1,348 plant and 388 animal species.
- Habitat for elephants, leopards, flying squirrels, birds, amphibians, and endemic reptiles.
- Includes Idongiri and Mahendra reserve forests, proposed as part of a biosphere reserve.

Land-use relevance

- **Forestry: conservation of medicinal plants, watershed protection, wildlife corridors.**
- **NTFP harvesting: resin, honey, broom grass, fruits, herbs; critical for livelihoods.**
- **No aquaculture or fisheries, except minor wild capture from forest streams.**

Topographic features



1. Mountain Peaks and Elevation Range

- The hill complex includes multiple prominent summits, with Mahendragiri peak reaching 1,501 m, while other nearby peaks rise above 1,400 m.
- These elevations create a cool, moist hill climate compared to surrounding plains.



3. Rugged Slopes and Forested Terrain

- The hills are marked by steep, rugged slopes covered by tropical deciduous and evergreen forests, creating a dramatic, wave like mountainous landscape.
- Dense vegetation and sharp gradients create limited but fertile pockets for terraced and shifting cultivation.



5. Ecological Transition Zone

- Topographically, Mahendragiri is located at a biogeographic transition - its elevation and ruggedness separate the floral and faunal elements of Peninsular India from those of the Himalayas, making it a unique ecological corridor.



7. Boundary and Cross-State Landscape

- The topography forms a natural division between Andhra Pradesh and Odisha, shaping cultural and ecological linkages across the border.
- Multiple access routes (Tumba, Burkhat, Jangalpadu) follow natural passes along the mountain ridges.



2. Geological Composition

- The range consists primarily of granite, charnockite, and khondalite rock formations, typical of the Eastern Ghats.
- These hard rock systems contribute to the steep slopes, narrow ridges and escarpments.



4. Watersheds and River Systems

- Mahendragiri serves as an important watershed, giving rise to the Mahendratanaya River, which flows down the eastern slopes toward the Bay of Bengal.
- Numerous perennial springs and small streams emerge from its hill slopes.



6. Plateau-like Hilltops and Sacred Sites

- Several peaks have flat or gently sloping summits, where ancient temples and cultural sites such as the Bhima and Arjuna peaks are located.
- These hilltops provide panoramic views of surrounding forests and valleys.

Climate type

Climate Characteristics of Mahendragiri



Cooler temperatures due to high elevation, with peak temperatures generally remaining mild. Forecasts for the 1,500 m elevation show temperatures around 15–18°C, even in typical dry periods.



High rainfall and moisture, as the hills receive significant monsoonal precipitation and often remain covered in clouds, supporting lush evergreen and moist deciduous forests.



Wind exposed slopes influenced by sea-facing aspects, with the topography allowing cool winds from the Bay of Bengal to moderate temperatures year round.



Forest dominated microclimates that maintain humidity and support high biodiversity, including unique plant and animal species adapted to the moist hill ecosystem.

Overall Climate Type



Mahendragiri can be classified as having a moist subtropical montane climate, characterized by cool temperatures, high humidity, strong monsoon influence, and dense forest cover, making it ecologically distinct within Odisha.

Approximate population



Traditional communities and/or Indigenous Peoples



Saura tribes

Main source of livelihoods



Primary Livelihood:
Agriculture



Secondary Livelihoods:
Forest resources – NTFP collection



Bogodo: Land Preparation

2. EXECUTIVE SUMMARY

This report provides the foundational evidence required for a future application to the Food and Agriculture Organization (FAO) for designating the Mahendragiri – Indigenous agricultural practices of Saura tribes (Bogodo Chasa, Bari Chasa and Bila Chasa)- as a Globally Important Agricultural Heritage System (GIAHS). The landscape exemplifies the core GIAHS principles through its long-evolved agroecological traditions, rich biodiversity, resilient subsistence systems, and deep-rooted cultural heritage.

Located in the Gajapati district of southern Odisha, Mahendragiri rises to 1,501 metres and forms a striking component of the Eastern Ghats. Its dense forests host exceptional biological diversity, including hundreds of medicinal plants and endemic species—attributes that position it as a vital ecological corridor and gene pool of the region.

Saura Communities and Their Cultural Landscape

The Mahendragiri Mountains are home to the Saura (Saora) tribes, a Particularly Vulnerable Tribal Group (PVTG) known for their profound ecological ethics, unique agricultural traditions, spiritual worldview, and heritage of living harmoniously with forests and mountains. Their cultural traditions—ranging from ancestral spirit worship, sacred groves, ritual art forms, and community guided decision-making - reflect a sophisticated system of values grounded in reciprocity, ecological balance, and collective identity.

Saura healers preserve extensive ethnobotanical knowledge, preparing herbal medicines from different species of medicinal plants. Their cultural landscape, shaped over centuries, represents a living biocultural system where agriculture, culinary traditions, livelihoods, spirituality, and ecological stewardship remain deeply interconnected.

Agriculture, Food Systems and Livelihoods

Agriculture forms the backbone of Saura subsistence, complemented by rich forest-based livelihoods. They follow unique traditional practices based on crop genetic resources, evolved in this agro-ecology over a long period of time. Their farming



system is mountain-adapted, biodiverse, low input, and ecologically sustainable, relying on a mosaic of land use practices. There three different landuse models observed – Bogodo chasa – age old land use system where forests are cleared through burning for cultivating food crops like paddy, pulses, millets, vegetables under shifting cultivation practices; Bari Chasa – rainfed permanent cultivation around homesteads for growing tree crops and food crops like pulses, vegetables, millets etc; Bila Chasa – wet terraced paddy cultivation.

Bogodo Chasa (Shifting–Terrace System)

Bogodo Chasa is a unique semi permanent traditional terraced farming system adapted to steep slopes. Saura farmers build small stone-bunded terraces to conserve soil and moisture, enabling mixed cropping of millets, pulses, tubers, spices and paddy. Bogoda Chasa exhibits traditional engineering and agricultural knowledge of Saura tribes – as they follow contour methods to minimize damage like landslides – and retain soil moisture and soil fertility for cultivating preferred crops. Fields are cultivated for about three years and left fallow for 10–15 years for natural regeneration, ensuring long-term ecological balance. A complex mix of traditional ecological knowledge, inherited customary rules, collective decision making and action facilitate this difficult terrain cultivable for diverse crops, and protecting crops from wild animals and climate vagaries. Bogodo Chasa plays vital role in ensuring food security of hill dwellers.

Bari Chasa Homestead Gardens

The land adjacent to human settlement is also used for cultivating crops for household needs. Homestead gardens are enriched with perennial trees, diverse tubers, pulses, vegetables and fruits. Saura tribes have developed unique practices for retaining soil moisture, soil fertility and plant protection. Bari Chasa plays critical role in nutrition security, year round food supply, and traditional culinary diversity.



Steep slopes
Terrace farming



Ecological
Balance



Pulses



Tubers



Bamboo or
stone channels



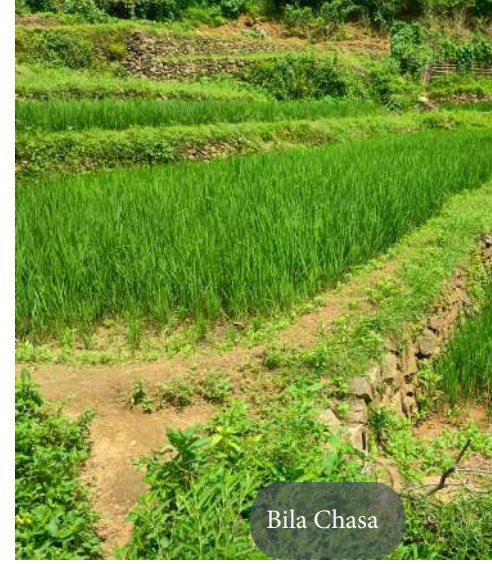
Engineered
terraces



Bogodo Chasa



Bari Chasa



Bila Chasa

Bila Chasa

Terraced Wet Cultivation

Historically engineered terraces irrigated by bamboo or stone channels diverting perennial springs. These terraces support landraces of paddy, followed by pulses and vegetables through sequential cropping. Soil health is maintained entirely through leaf litter, mulching and organic recycling, with no chemical inputs. Bila Chasa conserve diverse varieties of paddy and pulses.



Seed Collection

NTFP-based Livelihoods

Forests are critical source of food, nutrition and income for forest dwellers across India. Saura households depend heavily on diverse wild edibles species, tubers, mushrooms and small fauna for the food security. Forests are important source of food during lean periods and when agriculture fails.

They also collect commercially important Non-timber Forest Produces and medicinal plants for ensuring cash income.

Collectively, these systems create a resilient agro landscape where agrobiodiversity, ecological stewardship and cultural continuity reinforce one another.

Traditional Ecological Knowledge

The Saura community for generations of interaction with multiple landscapes, have generated rich array of knowledge that helped them to cultivate multiple crops and maintain genetic diversity of crops and livestock well adapted to the harsh environment of the undulating hill ecosystems. Traditional ecological knowledge and value systems have helped them to live in harmony with the nature and follow sustainable harvest of forest resources.

Challenges and Threats

Mahendragiri faces growing and compounding threats that jeopardize both its ecosystems and its unique agricultural systems:



Wild Yam Curry for Consumption



- Weather vagaries, landslides and extreme climate events are posing challenges to crop production
- Changing aspirations of youths, lack of sufficient support for agriculture, lack of agriculture based value addition infrastructures, deviating youths from agriculture



- Migration of men for better employment opportunities – creating an image that farming is less remunerative
- Conflict with forest department on the tenure of Bogodo land is another concern



- Unregulated construction and infrastructure development and fragmented habitats, disturb wildlife and accelerate deforestation in this ecologically fragile mountain system.
- Climate shocks, especially recurrent cyclones, have caused landslides, destroyed orchards, eroded hill slopes, and decreased the resilience of traditional rainfed farming.



- Deforestation, illegal extraction of medicinal plants, overuse of forest resources, and unmanaged pilgrimage pressures further degrade fragile ecosystems.
- The combined impacts endanger centuries-old Indigenous land-use systems, including sacred groves, agroecological knowledge, seed diversity, and the Saura community's intergenerational stewardship traditions.

Without targeted, community-centered conservation, Mahendragiri risks irreversible loss of its ecological balance, cultural identity, and adaptive agricultural heritage.



Wild Bittergourd



Bogodo: Mixed Cropping

Mahendragiri's Uniqueness as a GIAHS Site

Mahendragiri stands out as an exemplary landscape for GIAHS recognition due to its:



1. Outstanding agrobiodiversity, agro-ecosystems and indigenous agricultural practices
2. Bogodo chasa – is a unique semi-permanent terraced mixed cropping system, exhibiting traditional engineering and agro-ecological knowledge



3. Unique genetic resources adapted to hill systems and inherited traditional farming wisdom
4. Rich biodiversity –including endemic species and rich medicinal flora.
5. Living indigenous knowledge systems, embedded in sustainable hill agriculture and forest management.



6. Sacred landscapes, culturally anchored in millennia-old traditions, mythology and spiritual association.



7. Integrated agroecological systems, adapted to steep terrain, variable rainfall and forest ecosystems without external inputs.



8. Resilient socio-ecological heritage, shaped by the Saura tribes' deep relationship with land, forests and water.

By embodying the synergy between biodiversity, traditional knowledge, adaptive agriculture and cultural identity, Mahendragiri represents a globally significant mountain-people heritage system worthy of international recognition.



Bogodo: Ritual

3. Significance of Mahendragiri as a GIAHS site

This application deals with the unique indigenous agricultural practices followed by the Saura tribes, inhabiting on Mahendragiri Mountains in Odisha state, India. They have classified their production landscapes based on its location, resource availability and functional significance. The land use systems like – Bogodo, Bari and Bila Chasa – vary in terms of their functional significance but support diversity of crops and landraces, with unique traits including biotic and abiotic resistance, nutritional qualities, varying periods of maturity and harvesting – play a vital role in ensuring food, nutrition and livelihoods of the Saura tribes. The agricultural landscapes are part and parcel of natural forest ecosystems and benefit multiple ecosystem

services – including provision of food, building ecological resilience, ensuring services including pest & disease resistance, pollination and nutrient cycling.

Terraced Bogodo cultivation is a unique indigenous farming system taking place inside the forest, exhibit the traditional engineering skills of constructing terrace according to contours, minimizes soil erosion, retaining soil moisture, restricting the entry of wild animals. The materials like stones and bamboos are used for constructing terraces. Using locally available stones and bamboo creates uniquely resilient terraces that blend with the landscape, strengthen ecological stability, and ensure the structures endure for generations.

Agricultural practices embedded with traditional wisdom, unique genetic resources having valuable genetic traits, managing wildlife conflicts and adaptive agricultural practices – etc have greater significance in the current context. Agriculture in harmony with the nature, pinpoints the fact that agriculture and forestry can go hand in hand.

This unique production landscapes and indigenous agricultural practices are distinct from modern commercial agricultural systems. These agro-ecosystems nurture valuable genetic diversity, providing platform for practicing and innovating traditional agricultural wisdom, showcasing traditional engineering skills, and facilitating in situ on farm conservation of crop and animal genetic resources valuable to the sustainability of agriculture.

3.1. Site Description

Mahendragiri Mountains, located in Gajapati district of Odisha (18°58'–19°04' N; 84°20'–84°34' E), form part of the Eastern Ghats with an altitude varies from 200 m to 1,501 m, creating diverse microclimates and vegetation zones. This place holds a historical significance and are connected with the Ramayana and Mahabharata (Indian epics) and host sacred groves and shrines dedicated to Shiva and Parashurama, making them a center for pilgrimage and tribal rituals. The region is a biodiversity hotspot with about 1,300–1,400 flowering plant species, including *Shorea robusta*, *Madhuca longifolia*, *Terminalia arjuna*, and bamboo (*Dendrocalamus strictus*), alongside over 300



Saura Woman Harvesting Pigeon pea

medicinal plants such as *Tinospora cordifolia* and *Curcuma longa*. Faunal diversity includes leopard (*Panthera pardus*), Indian giant squirrel, wild boar, sloth bear, Indian peafowl, grey hornbill, king cobra, and numerous pollinators like bees and butterflies. Non-Timber Forest Products (NTFPs)—Mahua flowers, Kendu leaves, bamboo, honey, and wild tubers—support tribal livelihoods. Traditional Bogodo shifting cultivation integrates millets, pulses, tubers, and spices, while livestock rearing (goats, cattle, poultry) provides food and financial security. The Saura tribe dominates the cultural landscape with unique art, oral traditions, and rituals linked to agriculture and forest resources. Mahendragiri’s ecological role as a watershed and carbon sink underscores its regional environmental significance.



200-1,501 m

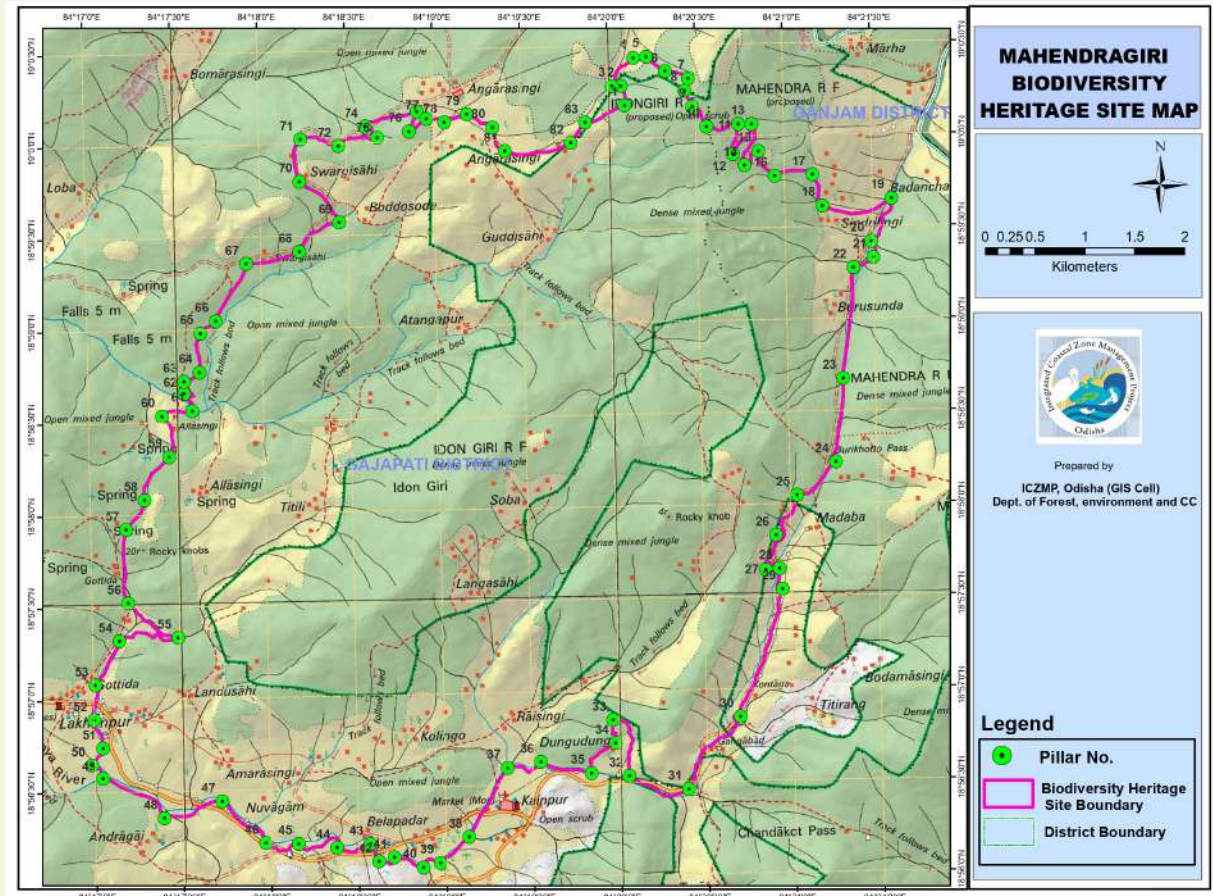
Above Sea Level



1,300-1,400

Flowering Plant Species

Fig.1. Map of Mahendragiri



3.2. Indigenous agricultural landscapes and practices followed by the Saura tribes in Mahendragiri, Odisha

The Saura tribes inhabiting on the hills follow unique agricultural practices in harmony with wilderness, rich biodiversity, undulating terrain and waterscapes. The agricultural landscape is covered by natural forest, making it unique and distinct from other parts of the State. The Saura tribes make use of three distinct agro-ecosystems, locally called Bogodo Chasa, Bari Chasa and Bila Chasa.



Millet Rice

3.2.1 Bogodo Chasa

Bogodo Chasa is a semi-permanent land use system, where forest patches are cleared by burning, and terraces are built using local resources, and on the basis of contours, facilitating water retention and soil management for raising crops like millets, pulses, oilseeds, tubers, and spices are cultivated together to optimize soil fertility and minimize pest risks. Bari Chasa, practiced in homestead gardens, focuses on perennial crops, vegetables, and spices, providing year-round nutrition and household needs. Bari Chasa (homestead gardens) relies on proximity to household water sources, such as stored rainwater or small bamboo channels directing water from nearby springs. Bila Chasa is

a settled agricultural system giving emphasis for producing staple rice and other crops on a rotation basis. This method utilizes moist lower slopes and valley edges for sequential cropping—starting with indigenous paddy followed by pulses and vegetables



This section elaborates the indigenous agricultural systems followed by indigenous communities in Mahendragiri

3.2.1.1 Bogodo cultivation by Saura tribes in Mahendragiri

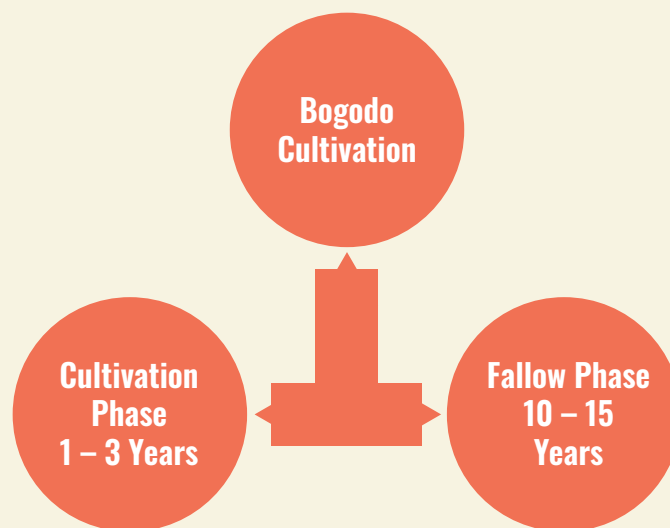
Bogodo cultivation is a semi-

permanent rainfed agricultural system developed by Saura tribal communities over generations and evolved to suit hilly and sloping terrains. Bogodo cultivation differ from conventional slash and burn cultivation practiced by the tribal communities elsewhere India. In Bogodo cultivation, Saura farmers construct small terraced plots on hill slopes, stabilized by bunds of soil and stones. These terraces retain moisture, reduce soil erosion, and allow the cultivation of diverse crops, often in mixed and intercropped patterns, to ensure food, fodder, and livelihood security under uncertain climatic conditions.

Unlike shifting cultivation, Bogodo

involves stabilizing hill slopes by constructing small terraced plots, ensuring better soil and water management. By stabilizing hillslopes by constructing terraced plots, they use the same patch for raising crops for maximum upto six years (in rare cases) or minimum three years and leave the place uncultivated/fallow until the land regains its soil fertility and vegetation cover. In the past, they usually use Bogodo patch for 1 -3 years for cultivation and leave the patch fallow for generating soil fertility for 15 years. Due to population pressure and lack of availability suitable land for Bogodo cultivation, at present they revisit the uncultivated Bogodo patch in 6 to 7 years.

Bogodo cultivation cycle in Mahendragiri



They cultivate 10 to 20 crops simultaneously in a same plot, and harvest them for their food security. These crops are integral part of their culinary practice, culture and traditions. They conserve landraces suitable to hilly and sloping terrains and able to provide a consistent yield in harsh environment.

3.2.1.2. Sequential Steps in Bogodo cultivation

1. Preliminary Survey

Elder farmers walk through the forest to locate potential plots (based on the ideal location and customary rights over the identified land). They select patches inherited from their forefathers (customary rules) and the land used for agricultural purpose in the past. This helps to avoid intrusion of other areas and to avoid conflicts with Forest Department.

2. Soil Testing by Experience

Soil is checked for texture, colour, smell, soil depth and moisture—sticky soils indicate fertility. Soil fertility (in terms of colour and texture), soil depth and moisture retaining capacity are critical factors for selecting a land patch for Bogodo cultivation, as it is completely rainfed and no external inputs are applied.

3. Vegetation Observation

Indicator plants and forest regeneration stages are assessed. Presence of certain plant species indicate soil fertility, soil moisture. Such traditional wisdom are inherited from their forefathers

4. Observing water sources and natural drainage - natural springs and other sources indicate the water availability and moisture retaining capacity of soil. They ideally choose a location closer to waterbodies or surface flow.

5. Ritual Permission

Offering made to Dharani Penu (Earth deity) before clearing. They avoid lands with frequent presence of wild



Bogodo: Terrace Preparation

animals.

6. Clearing and Marking

Selective trees retained for shade and soil stability; terraces marked using stakes. Burning vegetation and settling ashes

7. Constructing terraces for soil conservation, retaining water or soil moisture, and deterring the entry of wild animals. They construct terraces using bamboos and stones, and apply contour methods to minimise soil erosion and facilitate water retention as required

8. Raising crops - based on the specific features of land patches, soil moisture and fertility of soil, they select suitable crops. Lower areas, where soil moisture is more and its retention capacity is also high, select for upland paddy. Millets and pulses are cultivated in higher elevations of the Bogodo, as they can withstand drought situation.



3.2.1.3. Criteria for Selecting Land for Bogodo Cultivation

The selection of a suitable land parcel is crucial for the success of Bogodo farming. They adopt a set of criteria for the selection of land for Bogodo cultivation.

Tribes rely on indigenous ecological indicators, combining traditional wisdom, experience, and observation of natural signs to decide where to cultivate. They pass on traditional ecological knowledge of identifying land for Bogodo cultivation from generations to generations. The selection of Bogodo patch is a collective effort. The process of identifying and selecting land for Bogodo cultivation follows community-based decision-making, guided by elders and experienced farmers.

The main criteria include topography, soil fertility, water availability, vegetation indicators, and ease of access.

Topographical Criteria

Slope of the land: Slope of the land is an important criterion for selecting the patch for clearing for Bogodo cultivation. They prefer moderate slope (ranging from 10° to 30°). Gentle to moderate slopes are preferred for constructing terraces. According to the Sauras, steep slopes are avoided due to higher risks of soil erosion, managing water, and retaining soil fertility.

Direction of the slope is another factor governing the selection of land for Bogodo cultivation. They

prefer 'east' or 'north' facing slopes, because they receive adequate sunlight and help to retain soil moisture. They believe that south facing slopes are drier and less productive.

Wind direction and speed: They consider wind direction to select a patch for Bogodo cultivation and clearing of land for cultivation. This helps to control accidental spread of fire during slash and burn clearance of the land.

They also consider minimum disturbances from wind to retain ash on the patch itself for ensuring soil fertility. Wind direction influences where ash settles, so patches are chosen to ensure ash remains on the cleared land rather than blowing away. The slopes and wind direction are critical to avoid wind stress on young plants.

Proximity to settlements: Another important factor that determines the selection of land for Bogodo cultivation is its proximity with their settlements. Patches close to the settlement or accessible footpaths are chosen for ease of daily supervision and transport of produce.

Soil factors

Soil is considered as the most important input by Saura tribal communities. Soil fertility, its capacity to retain moisture and depth of soil are critical factors that determine the crop productivity and they influence how long they can use the patch for cultivation or leave as fallow.

Soil Colour and Texture: Dark brown or black loamy soils preferred for





Sesame Field in Bogodo

selecting the patches for cultivation. They believe that soil colour – dark brown and black – indicates the soil fertility and moisture retaining capacity, while gravelly soils are avoided because they dry quickly and they contain low nutrient. Nutrients and moisture retaining capacity of soils determine the yield and suitability to multiple crops.

Soil Depth and Structure: Soil layer and colour of the soil determine the extent of water/ moisture retention capacity of the selected patch for Bogodo cultivation. Land with one feet soil layer or more is ideal for Bogodo cultivation according to Sauras. Farmers test this by inserting a digging stick or by observing root growth of local vegetation.

Moisture and Drainage: They cultivate rainfed crops that survive in minimum moisture. Waterlogged areas are avoided, at the same time retention of moisture is vital for the

survival of the crops. Bogodo fields require balanced moisture; neither waterlogged nor too dry. They recognize the soil moisture retaining capacity based on soil colour, texture, depth of soil layer and presence of indicator species like Colocasia and Flemingia.

Presence of earthworms and Organic Matters: Saura considers the presence of earthworms as an indicator of soil nutrients. High earthworm activity and decomposing leaf litter signal healthy and fertile soil.

Water sources and Drainage

Saura select patch of land on the basis of water availability and drainage support. The crops under Bogodo never perform well under waterlogged situation, at the same time soil moisture is inevitable for a good yield. This indicates the importance of water management in Bogodo field.

Water source: Saura select Bogodo



patches near springs (jhola), seasonal streams or near rainfed gullies – to ensure water for irrigation or retaining moisture in the field. They construct temporary bamboo channels or earthen canals to direct water flow to Bogodo patches for irrigation.

Drainage pattern of the land: They observe the drainage pattern of the patch, as the crops never perform under waterlogged conditions. They choose patch with gentle slope, allowing gentle runoff restricting soil washout. They observe surface water flows (runoffs) during Monsoon to identify natural drainage patterns. They also make gentle slopes to facilitate drainage when other criteria are met.

Moisture retention potential of the patch: Moisture retention potential is vital for crop performance under Bogodo cultivation. Within the selected patches, they categorise

land according to its potential to retain moisture. Valleys or lower hill slopes with good moisture-holding soil are considered more productive for paddy (a unique paddy landrace) and vegetables.

Flora and identification of water retention capacity of Bogodo patch:

Saura tribes hold unique knowledge about the forest ecosystems, lands suitable for Bogodo farming, soil features, water holding capacity of soil, and drainage pattern of the land etc, flora and fauna. Over time, they have generated traditional wisdom that indicates the relationship between presence of certain plant species and water holding capacity of soil. According to Saura tribal communities, presence of species like *Colocasia esculenta* and *Clerodendrum infortunatum* indicate the presence of soil nutrients or water retention capacity of soil.



Table 1. Plant Species and Soil Fertility Indicators

| Indicator Species | What it signifies | Decision for cultivation |
|--|---------------------------|---|
| <i>Flemingia semialata</i> | Moist, fertile soil | Suitable for cereals and millets |
| <i>Lantana camara</i> , <i>Imperata cylindrica</i> | Degraded, dry soil | Avoid cultivation |
| <i>Butea monosperma</i> (Palash) | Moderately fertile upland | Can support mixed cropping |
| <i>Clerodendrum infortunatum</i> | Deep, humus-rich soil | Preferred for Bogodo terraces |
| <i>Colocasia esculenta</i> (wild) | High soil moisture | Suitable for vegetable-based Bogodo and paddy cultivation |

These bioindicators have special significance in selecting or not selecting a patch for Bogodo cultivation. They provide an insight about the health of the ecosystem. Abundant presence of these species in the fallow land indicates its regenerative capacity abandoned Bogodo land back to Bogodo cultivation.

Social and cultural factors selecting a land for Bogodo cultivation

Customary rights over land: The Saura tribes live in harmony with the forest and never clear forest land not belonging to them. They claim ownership over the land that they believed to be possessed by their forefathers. They claim customary tenure over ancestral land or clan territory. The decisions on clearing of land are taken collectively by the village council to avoid disputes. They will never clear/ burn forest that do not belong to the community. The village council is responsible for settling disputes, finalising the decisions on land and selecting land for Bogodo cultivation among Saura tribes. They are also keen to conserve the forest, as a healthy forest is inevitable for Bogodo cultivation, collection of NTFPs and ensuring soil nutrients and water retention.

Rituals for Bogodo land selection: They observe certain rituals before clearing land for Bogodo cultivation to seek permission from forest and earth spirits (Dharani Penu). This indicates their bond with forest.

They also observe bird calls and animal movements in the selected land for clearance. If omens (bird calls, animal movements) are unfavorable, the plot may be abandoned.

History of land use: Land previously used for Bogodo cultivation and left fallow over 5 to 7 years is preferred for cultivation if it regains soil fertility and meet other requirements. Recently used land is avoided to allow natural regeneration.

Other Factors that govern the choice of Bogodo land

Bogodo terrace construction require stone and soil materials. In order to avoid transporting of these materials, they select land where such required materials are easily available. They avoid land with excessive rocky or hard soils.

They also prefer forest edges that help to access firewood, fodder and forest produces conveniently. They avoid forest areas with frequent animal presence. Elephants, wild bore and deer are frequently raiding crops.



Bogodo Upland Paddy

3.2.1.4. Bogodo cultivation

They cultivate 10 to 20 crops at a time under Bogodo cultivation. These crops are integral part of their culture and culinary traditions. Within Bogodo patches, they further classify the land, based on soil texture, soil depth, water holding capacity, drainage and elevation. They cultivate different crops in each type of land.

Bogodo is a mixed cropping system, where same piece of land is used for cultivating multiple crops at a time. They have been following mixed cropping pattern for generations. Mixed cropping pattern reduces the risk of crop loss due to pest or disease attack. This system ensures consistent supply of diverse food groups, essential for a dietary diversity and nutritional security of tribal people in remote areas.

Table 2. Crop cultivated in different types/slopes of Bogodo patches

| Type of Bogodo land | Soil and water conditions | Crops grown |
|---------------------------|---------------------------|---|
| Upper slope (upland) | Light, well-drained | Millets + pigeon pea + niger + cowpea |
| Mid-slope (medium land) | Moderate moisture | Foxtail millet + horse gram + sesame + ridge gourd |
| Lower slope (valley edge) | Moist, fertile | Paddy + Colocasia + beans + cucurbits + other vegetables |
| Bund edges and corners | | Castor + pumpkin + turmeric + banana + ginger + chili + fruit trees |

These combinations ensure spatial complementarity (root depth and canopy variation) and nutrient recycling, reflecting traditional ecological design.

Bogodo cultivation practices

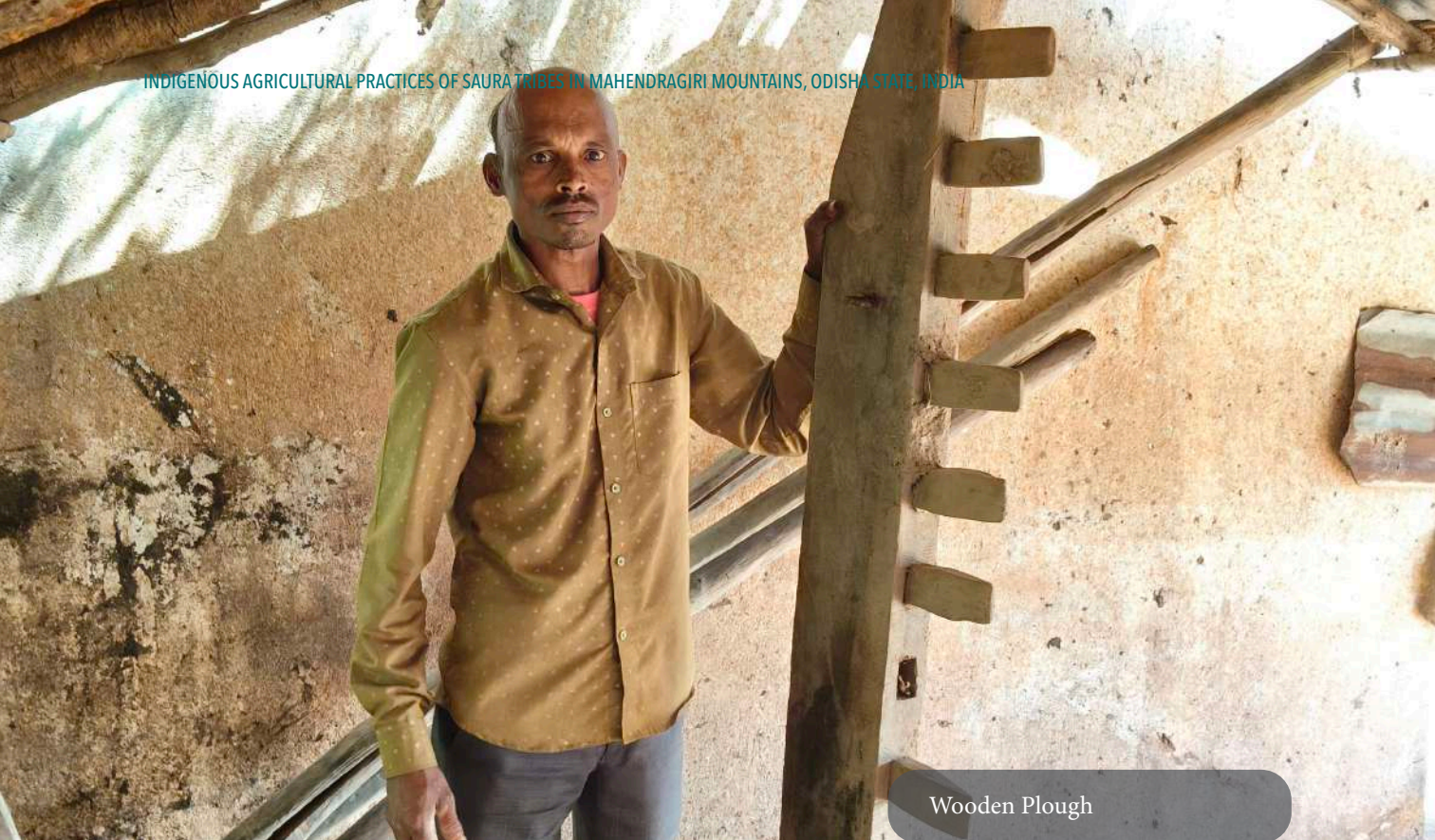
Saura tribes follow traditional practices that are suitable for terrace cultivation surrounded by hills with thick vegetation. They never rely on external inputs or chemical fertilizers. Soil fertility is maintained through burning vegetation, which add ash as a natural nutrient source. When they feel soil fertility is below a particular level, they leave the land fallow and allow natural vegetation to grow. Litters and humus deposits make the land fertile in 5 to 7 years. Leaf litter, humus carried by rain water from the hilltops and decomposed biomass

enrich soil.

They are least bothered about plant protection. Mixed cropping and natural forest ecology help in minimising pest attack. Pest and disease resistant landraces of crops like millets, pulses, maize paddy, tubers and vegetables are used. No farmers use synthetic pesticides for pest control under Bogodo cultivation.

No specific practices followed for irrigating the crops. Bogodo fields depend entirely on monsoon rainfall. They conserve water moisture through mulching and natural slope





Wooden Plough

management. The Bogodo land is chosen to be located adjacent to small springs, sometimes redirected towards Bogodo fields. Using their experience, they prepare contour lines and terraces to reduce runoff.

Farm implements

Farmers use locally made simple and traditional implements, often made out of wood and iron for agricultural purpose. Khunti (digging stick) is used for loosening soil. Hand hoes (Gubuda) made from iron is used for planting and weeding. Wooden ploughs are used in some areas for levelling the land. Axes and sickles are used for clearing the vegetation.

Seeds and seed system

The Saura tribes in Mahendragiri prefer landraces of crops like finger millets, little millets, horse gram, pigeon pea, paddy, tuber crops and vegetables. They are keen

to conserve the seeds of these landraces. Seeds are saved from previous harvests and exchanged within the community. No external seeds or modern varieties are found in Mahendragiri. Farmers are of the opinion that the unique varieties maintained by Saura tribes in Mahendragiri are suitable for Bogodo cultivation, as they resist pest, diseases and tolerate drought situations. Most of these crops and varieties are highly tolerant to harsh environment and climate change.

They adopt mixed cropping methods and rely on age old traditional practices.



Table 3. Crops cultivated by Saura tribes under Bogoda practice

| Crops | Local Name | Sowing time | Harvest time |
|------------------------|---------------------|-------------|---------------------|
| Red Husk Paddy | Kundo Dhano | June | Sept - October |
| Finger Millet | Mandia | June-July | Sept - October |
| Foxtail Millet | Kangu | June-July | Nov - December |
| Sorghum | Jonha | June-July | Sept - October |
| Little Millet | Suaan | June-July | Nov - December |
| Pearl Millet | Ghantia | June-July | November |
| Barnyard Millet | Bilo Suaan | June-July | Nov - December |
| Ganga (Type of Millet) | Ganga | June-July | Nov - December |
| Red Gram | Kandulo | June-July | Nov - December |
| Long Bean | Burbudi, Dongorrani | June-July | January |
| Cowpea | Jhudungo | June-July | November - December |
| Flat Bean | Jhota | June-July | December |
| Wood yam | Katho konda | Wild form | November - December |
| Brinjal | Baegono | June-July | December - January |
| Lady Finger | Bhendi | June-July | November - December |
| Cucumber | Kakudi | June-July | November - December |
| Chilli | Dhani Lonka | June-July | November - December |
| Young Bamboo Shoot | Korodi | Wild form | July - August |

Addressing wild animal attack

Crop protection from wild animals – practices followed by Saura tribes in Mahendragiri

Protection of crop from wild animals is a concern of every tribal farmer who practices Bogodo cultivation in Mahendragiri. The Sauras have been following Bogodo for generations, and protecting their crops from wild animals. They have developed traditional practices based on their traditional wisdom, animal behaviour and their views and commitments towards the values that respect the principles of mutual coexistence and harmony with nature.

The Bogodo land is surrounded by thick forest and face crop loss due to wild animal attack. The Saura tribe in Mahendragiri adopt multiple traditional methods to protect crops from wild animals. Protection of crops from wild animals is considered as a collective responsibility of farmers. These practices are deeply rooted in their cultural and ecological knowledge, practised over generations.

Fences/ physical barriers: Saura tribes protect their field by building fences using locally available resources including stones, logs, and thorny bushes the fields to deter wild boars, deer and other animals. They also plant thorny species like *Euphorbia neriifolia* (Indian spurge



Monitoring of Bogodo Cultivation

tree), locally known as Thor, *Bambusa arundinacea* (Thorny bamboo) and *Vachellia nilotica*, locally known as Babul, along field boundaries to acts as a natural barrier. These plants form dense, prickly barriers that prevent access by wild animals

Watch towers and rotational night guarding: Traditionally they construct bamboo or wooden platforms in fields to keep watch during night hours. The community members take turns guarding fields, often using fire torches or drums to scare animals. This indicates the collective responsibility and rotating it among the physically active people. Usually men are involved in night guarding of the crop field. Loud sounds from drums, and sudden lights are used to frighten elephants, wild boars and other animals.

Traditional fire lines around field boundaries: Controlled burning of dry leaves around field serves as a barrier



and discourages the entry of animals into crop field.

Crop selection and layout: Under Bogodo practice, the Saura tribes cultivate many crops at a time. This not only reduce the climate risks, but also help them reduce the wild animal attraction to crops. Combining cereals, pulses, and tubers reduces risk since animals rarely damage all crops at once. They opined that wild animals avoid certain crops or presence of certain crops. They plant less palatable crops (like chili, castor, or bitter gourd) on the outer boundary to discourage animals. According to the Saura tribes, planting chili on borders serves as a strong deterrent for wild animals including wild boars.

Indigenous repellents: Traditionally the Saura tribes use neem leaves, cow dung slurry, and ash around the fields to mask crop smell and repel animals. This practice is effective avoiding animal attraction during flowering and fruit setting.

Smoke barriers: Smoke is also serving as a remedy for wild animal attack on crops. According to Saura, burning dry leaves or cow dung cakes at night creates smoke, which keeps animals away.

Protection by dogs: Recent times, they use the services of dogs to recognize the presence of wild animals. Barking of dogs indicates the presence of human being.

Tribal views on wild animal attack: Saura tribal communities in Mahendragiri traditionally live in harmony with forest and wildlife. They possess deep understanding



Protection Net for Backyard Farming

about animal behaviour and forage practices. They respect the rights of all living beings, and believe in mutual coexistence with wildlife. Saura keep certain healthy forest patches untouched as sacred groves for maintaining habitat balance. Healthy forest patches indirectly reduce wildlife pressure on crop lands. Prevailing norms and customary laws among Sauras regulate hunting and over exploitation and at the same time protecting sacred patches of forest help in maintaining ecological balance and reducing conflict with wildlife





Papaya in Bari Chasa

3.2.2. Bari chasa

Bari Chasa, practiced in homestead gardens, focuses on perennial crops, vegetables, and spices, providing year-round nutrition and household needs. Bari Chasa (homestead gardens) relies on proximity to household water sources, such as stored rainwater or small bamboo channels directing water from nearby springs. Moisture conservation is achieved through mulching with leaf litter and crop residues. In Bari Chasa, household waste, livestock manure, and ash from cooking fires are applied to maintain fertility. Women play an important role in cultivation, selection of crop species, seed selection, allocating area for different crops and harvesting of crops. They nurture soil fertility and adopt low cost and less intensive irrigation methods. This land use system provides year-round nutrition, spices, and fruits; supports household

food security and cultural rituals.

Bari Chasa supports diverse crops—banana, papaya, jackfruit, mango, turmeric, ginger, chili, and leafy greens. This diversity enhances household nutrition and provides spices and fruits for cultural rituals.

Bari Chasa evolved as a complementary system to Bogodo and Bila Chasa, designed to utilize land adjacent to Saura households. Bari Chasa is practiced in small homestead plots, ensuring year-round access to fresh produce. Its uniqueness lies in intensive land use, proximity to water sources, and integration of perennial crops with seasonal vegetables.

Bari Chasa ensures dietary diversity and provides cash income through surplus fruits and spices. It plays



a critical role in food security during lean seasons. Bari Chasa conserves landraces of fruits, spices, and vegetables adapted to local ecology, contributing to resilience and cultural heritage.

Farm implements used in Bari chasa



Digging Stick (Khunti)

A wooden stick used for making holes for seeds and checking soil depth.



Hand Hoe (Gubuda)

An iron-bladed hoe for loosening soil, planting, and weeding.



Small Spade and Sickles

For soil preparation, cutting weeds, and harvesting vegetables.



Grinding Stones (Silbatta)

Used for processing spices and condiments grown in Bari Chasa.



Irrigation Implements

Bamboo pipes or small channels for directing water from nearby sources.



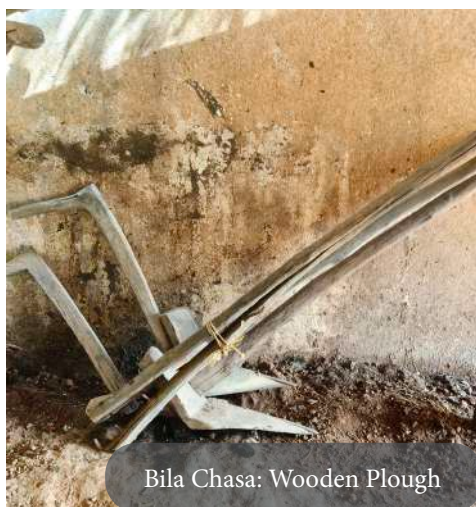
Bamboo Baskets and Trays

For carrying manure, compost, and harvested produce.

These implements indicate the age-old practices followed in Bari chasa. They are produced based on local technology, locally available resources and suitable to local agro-ecology.



Bogodo Tools



Bila Chasa: Wooden Plough



Seed Storage Container



Bila Chasa Paddy

3.2.3. Bila chasa

Bila Chasa is a settled agricultural system giving emphasis for producing staple rice and other crops on a rotation basis. This method utilizes moist lower slopes and valley edges for sequential cropping—starting with indigenous paddy followed by pulses and vegetables—ensuring staple grain supply and protein sources. Under Bila chasa, sequential cultivation starts with Indigenous paddy followed by pulses (pigeon pea, horse gram) and vegetables like colocasia, beans, and cucurbits. During Monsoon, they cultivate paddy and then drought resistant crops like pulses and vegetables.

Bila Chasa depends on natural water retention in low-lying terraces. Farmers utilize seasonal streams and rainfed gullies, and also construct temporary earthen or bamboo channels to divert water to Bila chasa.

Water management is entirely gravity-based, indicating their traditional wisdom. In Bila Chasa, fertility is sustained through crop rotation, which enhances nitrogen fixation and soil structure. Leaf litter from adjacent forests and decomposed biomass enrich the soil naturally.

This system conserves indigenous landraces of paddy, pulses, and vegetables adapted to hill ecology. Sequential cropping enhances soil fertility through nitrogen fixation and organic recycling, reducing dependency on external inputs.

Its ecological uniqueness lies in utilizing natural water retention zones without disturbing forest integrity. By maintaining soil moisture and reducing erosion, Bila Chasa contributes to watershed stability and microclimate regulation.



Farm implements used in Bila chasa

In Bila chasa, the Saura tribes use simple, traditional implements suited for moist valley lands and sequential cropping. Common tools include:



Digging Stick (Khunti)

Used for making planting holes and loosening soil for paddy and pulses.



Hand Hoe (Gubuda)

Iron-bladed hoe for soil preparation, weeding, and planting vegetables after paddy harvest.



Wooden Plough

Occasionally used for leveling terraces and preparing soil in lower slopes.



Sickles

For harvesting paddy and cutting fodder.



Threshing Implements

Wooden sticks for manual threshing of paddy and pulses.



Bamboo Baskets and Trays

For carrying seeds, manure, and harvested produce.



Water Management Tools

Bamboo pipes or small channels to divert water from springs or streams to Bila plots.

These implements reflect traditional ecological knowledge, emphasizing low-cost, sustainable farming adapted to rainfed conditions. They are made from locally available materials like wood, bamboo, and iron, and maintained within the community.

Conclusion

These systems together reflect TEK in land selection, soil and water management, crop diversity conservation, and nutrient recycling. Rituals, collective labor, and seed-saving practices reinforce cultural values and ecological ethics. These practices reflect low-input, sustainable farming, ensuring soil health and water conservation while

supporting diverse crops for food and nutrition. Together, they form a resilient socio-ecological model that balances subsistence needs with biodiversity conservation, though increasingly threatened by deforestation, policy neglect, and climate variability.



Monji Puja Traditional Festival

4. Evidence Mapped to FAO GIAHS Criteria

FAO's GIAHS programme recognizes remarkable land-use systems and landscapes rich in globally significant biodiversity, evolved through co-adaptation between communities and their environments. Eligibility is assessed against five criteria: (i) Food & Livelihood Security, (ii) Agro-biodiversity and ecosystem functions, (iii) Local and Traditional Knowledge, (iv) Cultures, value systems and social organisations (Agri-Culture), and (v) Landscapes & Seascapes features.

4.1 Food & Livelihood Security

The Saura tribes of Mahendragiri sustain their livelihoods through an integrated socio-ecological system

comprising Bogodo chasa (rainfed cultivation on terraced hillslopes), and livestock rearing and forests. Non-Timber Forest Products (NTFPs) such as fruits, tubers, honey, medicinal herbs, bamboo, and leaf plates, which ensure food security and generate supplementary income. These resources are harvested sustainably, reflecting deep traditional ecological knowledge and cultural practices.

Bogodo, a traditional form of shifting cultivation, involves clearing small forest patches to grow mixed crops like millets, pulses, and tubers, offering dietary diversity and resilience in rainfed conditions. This system reinforces social cohesion through collective labor and rituals, though it faces threats from



Integrated Socio-Ecological Livelihood System



Diverse Traditional Farming Practices

deforestation and restrictive policies. They cultivate multiple crops (refer section 3) for their food security.

They also use the homesteads (Bari chasa) for the cultivation of perennial tree crops, vegetables, pulses and other crops that are vital for the household food security. Bila chasa (terrace wet cultivation) conserves diverse landraces of paddy, pulses and vegetable cultivation. These three land-uses together contribute food, nutrition and livelihood security of Saura tribes in Mahendragiri.

4.1.1. Livestock and Livelihoods

Livestock rearing, primarily goats, cattle, and poultry, complements farming by providing meat, and manure for soil fertility, while serving as a financial buffer during crop failures or economic stress. These components are interlinked - forest fodder supports livestock, and livestock manure enriches homesteads - creating a circular livelihood model rooted in indigenous knowledge. Despite mounting challenges from land-use change, climate variability, and market pressures, the Saura livelihood system remains a culturally embedded and ecologically adaptive strategy, underscoring the need for policy support and participatory conservation to ensure its sustainability.

4.1.2. NTFP collection - Livelihoods of Saura tribes in Mahendragiri

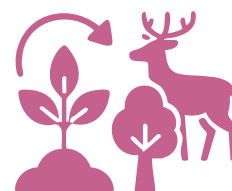
Saura households collect a broad range of NTFPs—wild tubers and



Turmeric Cultivation

greens, fruits, honey, medicinal plants, lac/resin, broom grass, and fibres—supplementing diets and generating cash when sold in local markets. For Saura tribes in Mahendragiri, NTFPs contribute a significant share of household cash income and constitute a vital safety net during lean agricultural seasons.

Women's labour is central in NTFP gathering, post-harvest processing, and market vending.



4.1.2.1. NTFP - Wild fruits collected from forest for food purposes

Forest is an important source of food for the Saura tribal communities. They collect fruits, leaves, seeds, tubers and tender shoots for food purposes. Seven important species (listed in the table) they collect frequently. These NTFPs form an important source of food for the tribal communities and serve the nutritional requirements of people.

Table 4. Major wild edibles collected for food purpose

| Species Name | Local/Tribal Name | Part Collected | Use |
|--------------------------------------|----------------------------|----------------------|-----------------------------------|
| <i>Diospyros melanoxylon</i> | Jhunu/Kaitha Leaf Fruit | Fruit | Eaten fresh, seasonal nutrition |
| <i>Bauhinia vahlii</i> | Siali | Tender leaves, seeds | Leaf used as plates; seeds edible |
| <i>Ziziphus oenoplia</i> | Kaincha | Fruit | Consumed as seasonal fruit |
| <i>Syzygium cumini</i> | Jamun | Fruit | Eaten fresh; used for beverages |
| <i>Phoenix acaulis</i> | Khajuri | Tender shoot | Consumed raw |
| <i>Mangifera indica</i> (wild mango) | Ban Amb | Fruit | Food and pickles |
| <i>Caryota urens</i> | Jungli Chhaj | Pith | Used to prepare nutritious gruel |

4.1.2.2. NTFP - Wild tubers collected by Saura from Mahendragiri forest

Just like wild fruits, wild tubers also form an important food for the Saura tribal communities in Mahendragiri. They collect diverse tubers from

forest. They form staple food during famine time or during the food scarce periods. However, consumption of certain species demand unique processing to make it edible. The Saura holds unique knowledge about the processing and detoxification of these tubers.

Table 5. Wild tuber collected by Saura for food purpose

| Scientific Name | Local/Tribal Name (Saura) | Part Used | Major Uses |
|--------------------------------|-----------------------------|-----------|--|
| <i>Dioscorea bulbifera</i> | Pithakanda / Pita Kanda | Tuber | Boiled and eaten; famine food; (requires detoxification before eating) |
| <i>Dioscorea pentaphylla</i> | Jangali Kanda / Pania Kanda | Tuber | Boiled or roasted; important seasonal food. |
| <i>Dioscorea hispida</i> | Bacha Kanda | Tuber | Edible after long washing and boiling; used during lean seasons. |
| (detoxification required) | Jamun | Fruit | Eaten fresh; used for beverages |
| <i>Dioscorea alata</i> | Bili Kanda / Kanda-mula | Tuber | Boiled, cooked as curry; high energy food. |
| <i>Dioscorea oppositifolia</i> | Kendu Kanda | Tuber | Commonly eaten after boiling; staple wild tuber. |
| <i>Pueraria tuberosa</i> | Bhui Kand / Pani Kand | Tuber | Eaten raw or cooked; increases stamina, used as tonic. |

| | | | |
|---|---------------------------|----------------|---|
| <i>Curcuma angustifolia</i> | Tikhur | Rhizome | Used for making cooling drinks, porridge; digestible starch source. |
| <i>Costus speciosus</i> | Jomla Kanda / Keu | Rhizome | Consumed after cooking; also used for digestive issues. |
| <i>Amorphophallus paeoniifolius</i> (wild) | Oal / Jangli Oal | Corm | Consumed after boiling; used in curries; (requires detoxification) |
| <i>Colocasia esculenta</i> (wild) | Arvi / Beni | Tuber, petiole | Cooked as curry; staple leafy and tuber food. |
| <i>Ipomoea mauritiana</i> | Krushna Kanda | Tuber | Eaten boiled; also used as medicinal food for strength. |
| <i>Asparagus racemosus</i> | Satawari | Tuberous root | Eaten as vegetable; also improves nutrition, especially for women. |
| <i>Helicteres isora</i> (tuberous form occasionally used) | Marodphali | Root | Consumed for digestive and nutritional support. |
| <i>Smilax zeylanica</i> | Kumarika / Rampachh Kanda | Tuber | Eaten after boiling; also used for increasing vitality. |

Box 1. Detoxification of tubers – practiced by Saura tribes in Mahendragiri

Detoxification Process followed by Saura tribes (traditional knowledge)

Certain wild tubers require detoxification to make it edible and safe to eat. Saura tribes follow traditional methods for detoxification of tubers, especially Dioscorea.

- **Repeated Boiling:** The slices are boiled in water for 2–3 cycles, each time discarding the water to leach out bitter and toxic compounds. This process reduces the bitter taste and remove toxicity from tubers.
- **Soaking in Running Water:** Tubers are peeled and sliced in to pieces, and then pieces are soaked in running stream water or fresh water for 24–48 hours to dilute bitterness and remove toxicity.
- **Cooking or Roasting:** Detoxified tubers are then cooked as curry or roasted before eating, sometimes mixed with tamarind or sour agents to improve taste.

4.1.2.3. Commercially important Medicinal plants collected by Saura from Mahendragiri

The forest in Mahendragiri Mountains is rich in diverse medicinal plants.

The Saura tribes collect commercially important medicinal plants (as NTFP) for marketing purpose. They collect fruits, leaves and stems of medicinal trees for marketing and household uses.

Table 6. Commercially important medicinal plant species

| Species Name | Local/Tribal Name | Part Collected | Use |
|-----------------------------|-------------------|----------------|--|
| <i>Terminalia chebula</i> | Harida | Fruit | Used for digestive disorders, enhancing immunity |
| <i>Terminalia bellerica</i> | Bahada | Fruit | Used in Triphala, cough and cold |
| <i>Phyllanthus emblica</i> | Amla | Fruit | High vitamin C; used in tonics |
| <i>Adhatoda vasica</i> | Basanga | Leaves | Treats respiratory ailments -shrub |
| <i>Vitex negundo</i> | Begunia | Leaves | Anti-inflammatory, used in fevers |
| <i>Tinospora cordifolia</i> | Gulanha | Stem | Immunity booster -climber |
| <i>Gloriosa superba</i> | Agnishikha | Tuber | Used for treating joint pain |

Table 7. Other commercially important NTFPs

| Species Name | Local/Tribal Name | Part Collected | Use |
|------------------------------|-------------------|----------------|---|
| <i>Diospyros melanoxylon</i> | Kendu Patra | Leaf | Leaf used for bidi-making; major income source |
| <i>Madhuca longifolia</i> | Mahua | Flower, seed | Liquor brewing, edible oil; high-value NTFP |
| <i>Schleichera oleosa</i> | Kusum | Seed | Oil extraction - used commercially for soap and cosmetic production; used as Lubricants; potential in the production of biodiesel/ bio-energy |
| Honey (Wild) | Ban Madhu | Honey | Sold for income; used as medicine and food |
| <i>Zanthoxylum rhetsa</i> | Tejovati | Fruit and seed | Dried fruits and seeds are used as spice in gourmet cuisines globally. |

Sustained NTFP availability relies on healthy forest ecosystems around Mahendragiri. Degradation (storms, deforestation) directly affects household incomes and seasonal food buffers. Market for NTFP, value addition of commercially important species are important for strengthening the livelihoods of Saura households depend on NTFP collection and marketing.

4.2 Agro-biodiversity & Ecosystem Functions

Mahendragiri Mountains sustains a unique agrobiodiversity system shaped by indigenous practices of the Saura tribes. Central to this system is Bogodo, a traditional shifting cultivation that integrates diverse crops and landraces adapted to rainfed conditions. Millets such as *Eleusine coracana* (finger millet) and *Panicum sumatrense* (little millet), pulses like *Cajanus cajan* (pigeon pea) and *Vigna radiata* (green gram), tubers (*Ipomoea batatas*), and spices (*Curcuma longa*, *Zingiber officinale*) form the core of crop diversity, ensuring food security, nutritional resilience, and climate adaptability. These landraces exhibit traits such as drought tolerance and low input requirements, reinforcing ecological sustainability.

Livestock rearing in Mahendragiri is an integral component of agrobiodiversity, providing food, manure, and economic resilience while maintaining traditional knowledge systems. Ethno-veterinary practices and conservation of local breeds such as indigenous goats and cattle ensure sustainable animal health management and preserve genetic diversity, reinforcing cultural heritage and ecological adaptability.

4.2.1. Land use types, Agrobiodiversity and Landraces

The Saura follow subsistent farming in three different types of land. Bogodo chasa (semi-permanent terrace farming), Bari chasa (homestead gardens, close to the settlement -

cultivate perennial tree crops and vegetables) and Bari chasa (lower elevation, relatively flat and wet field; irrigated by gravitational power, diverted from perennial streams/springs through channels made out of bamboo or stones).

Bogodo Chasa is a semi-permanent land use system, where forest patches are cleared by burning, and terraces are built using local resources, and on the basis of contours, facilitating water retention and soil management for raising crops like millets, pulses, oilseeds, tubers, and spices are cultivated together to optimize soil fertility and minimize pest risks. The survey shows that Saura tribes cultivate 10 to 20 crops at a time. Under Bogodo cultivation, Saura farmers broadcast seeds of multiple crops together on terraced hill slopes, allowing them to grow in a mixed system and harvest sequentially at different times to ensure continuous food supply and dietary diversity.

4.2.2. Agrobiodiversity in Mahendragiri – conserved by Saura tribes under Bogodo practice

1. Cereals and Millets (Primary Crops)

Millets are the foundation crops of Bogodo systems—suited to upland and dry slopes. Millets are their staple food and they conserve unique varieties that are suitable for Bogodo cultivation and tolerate the harsh environment.



Indigenous Agrobiodiversity System

Mahendragiri Mountains sustains a unique agrobiodiversity system shaped by indigenous practices of the Saura tribes. Central to this system is Bogodo, a traditional shifting cultivation that integrates diverse crops and landraces adapted to rainfed conditions.

Table 8. Cereal diversity maintained in Bogodo

| Crop | Local Name (Saura) | Scientific Name | Characteristic / Role |
|-------------------------|--------------------|----------------------|---|
| Finger millet | Mandia | Eleusine coracana | Staple food; drought-tolerant; rich in calcium. |
| Foxtail millet | Kangu | Setaria italica | Early maturing; used in preparing porridge and brewing light alcoholic beverage |
| Little millet | Suan | Panicum sumatrense | Thrives on poor soils; good for intercropping. |
| Proso millet | Cheena | Panicum miliaceum | Fast growing; suited for shallow soils. |
| Maize | Makai | Zea mays | Rainfed crop, suitable on mid-slopes; used as grain and fodder. |
| Paddy (local landraces) | Sali dhan | Oryza sativa (local) | Grown in lower terraces with moisture retention. |

2. Pulses and Legumes

Pulses are essential protein source for the tribal communities. They also enhance soil fertility through nitrogen fixation. Because of its importance in diet and farming systems (as soil nutrient enhancer), pulses play an important role in Bogodo cultivation in Mahendragiri. They cultivate landraces of pulses that are well adapted to the local agro-ecology.

Table 9. Pulses and Legumes cultivated by Saura under Bogodo

| Crop | Local Name | Scientific Name | Remarks |
|------------|------------|-----------------------|--|
| Pigeon pea | Arhar | Cajanus cajan | Long-duration crop; provides food and fuel. |
| Black gram | Biri | Vigna mungo | Short-duration; grown as intercrop with millets. |
| Horse gram | Kulthi | Macrotyloma uniflorum | Drought-resistant; food and fodder source. |
| Green gram | Muga | Vigna radiata | Used as intercrop; improves soil fertility. |
| Cowpea | Borboti | Vigna unguiculata | Dual-purpose crop—vegetable and pulse. Improves soil fertility |

3. Oilseeds

They cultivate oilseeds for edible oil. The community possess knowledge to extract oil from these crops. Oils are also valuable for rituals. Edible oils are important source of income and they are exchanged for money or as a barter. Farmers also opined that cultivation of oilseeds are good for enhancing soil health. They are intercropped with millets. Flowers attract bees and other pollinators, increasing the crop productivity.

Table 10. Oilseeds cultivated under Bogodo

| Crop | Local Name | Scientific Name | Uses |
|--------|------------|---------------------|---|
| Niger | Rasi | Guizotia abyssinica | Major oilseed; important edible oil for the Saura; attracts bees; intercrop with millets. |
| Sesame | Til | Sesamum indicum | Used in festivals and oil extraction. |
| Castor | Jada | Ricinus communis | Boundary crop; provides shade and serve as natural pest repellent. |

4. Vegetables and Tubers

Vegetables and Fruits are important food groups grown under Bogodo cultivation by Saura tribes in Mahendragiri. They are mostly grown in moist terraces or bund edges. Diverse vegetables and tubers are integral part of their diet. They provide year round nutrition for Saura tribes. They cultivate diverse landraces, that are adapted to local agro-ecology.

Table 11. Vegetables, Roots and Tuber diversity maintained in Bogodo

| Crop | Local Name | Scientific Name | Role / Note |
|-------------------------|---------------------------|---------------------|--|
| Colocasia | Saru | Colocasia esculenta | Staple tuber; thrives in wet soils. |
| Yam | Pani kanda / Baigun kanda | Dioscorea spp. | Rich energy source; stored for lean seasons. |
| Sweet potato | Alu kanda | Ipomoea batatas | Used as food and feed; high in starch. |
| Pumpkin | Kakharu | Cucurbita maxima | Common boundary creeper. |
| Ridge gourd | Jhinga | Luffa acutangula | Seasonal vegetable; improves soil cover. |
| Beans (French/ cluster) | Sem / Barbati | Phaseolus vulgaris | Legume vegetable; soil improver. |

5. Spices and Condiments

Spices are also cultivated under Bogodo, yet their cultivation is limited for household use. Spices are integral part of their diet, medicine and cultural practices.

Table 12. Spices and Condiments in Bogodo

| Crop | Local Name | Scientific Name | Use |
|----------|------------|---------------------|--------------------------------------|
| Turmeric | Haladi | Curcuma longa | Edible, medicinal and ritual use. |
| Ginger | Ada | Zingiber officinale | Household spice and herbal medicine. |
| Chili | Lanka | Capsicum annum | Condiment and pest deterrent. |

6. Fruit and Perennial Crops (on Terrace Boundaries)

Terrace bunds and adjacent forest patches support perennial and semi-wild fruit trees that enhance nutrition security and soil stability. They also provide shade and regulate micro climate. These fruits also seen in their settlements.

Table 13. Fruits diversity maintained by Saura in Bogodo

| Crop / Species | Local Name | Scientific Name | Role / Use |
|----------------|------------|--------------------------|----------------------------------|
| Banana | Kadali | Musa paradisiaca | Intercropped near moist patches. |
| Papaya | Peepara | Carica papaya | Short-duration fruit crop. |
| Jackfruit | Panasa | Artocarpus heterophyllus | Food security and fodder. |
| Mango | Amba | Mangifera indica | Shade and seasonal fruit. |
| Custard apple | Sitaphala | Annona squamosa | Drought-tolerant fruit crop. |

4.2.3. Agrobiodiversity in Bari chasa (Homestead Garden)

Bari Chasa, practiced in homestead gardens, focuses on perennial crops, vegetables, and spices, providing year-round nutrition and household

needs. Saura cultivate multiple crops and varieties in their homegardens. Women play an important role in cultivation, selection of crop species, seed selection, allocating area for different crops and harvesting of crops under Bari Chasa

Table 14. Crops cultivated in Bari chasa

| SI No | Common name | Trade name | Botanical Name |
|-------|--------------------------|---------------------|-----------------------------|
| 1 | Kadali (Bantala) | Raw banana | Musa paradisiaca |
| 2 | Gaja Bantal kadali | Raw banana | Musa paradisiaca |
| 3 | Cheni Champa Kadali | Ripening banana | Musa paradisiaca |
| 4 | Champa kadali | Ripening banana | Musa paradisiaca |
| 5 | Singapuri bantala kadali | Raw banana | Musa paradisiaca |
| 6 | Ranga kadali | Ripening banana Red | Musa paradisiaca |
| 7 | Amruta bhanda | Papaya | Carica papaya |
| 8 | Munica(sajana) | Drumstick | moringa oleifera |
| 9 | Bhaji saga | Amaranthus | Amaranthus spp. |
| 10 | Karamanga jhata | Wingbeans | Psophocarpus tetragonolobus |
| 11 | Simba | Dolicus | Dolichos spp. |
| 12 | Jhani | Ridge gourd | Luffa acutangula |
| 13 | Kankada | Spine gourd | Momordica dioica |
| 14 | Kakudi | Cucumber | Cucumis sativus |
| 15 | Kakharu | Pumpkin | Cucurbita pepo |
| 16 | Lau | Bottle gourd | Lagenaria siceraria spp. |
| 17 | Baigana | Brinjal | Solanum melongena |

| | | | |
|----|----------------|---------------------|--------------------------------|
| 18 | Bhajiri | Tomato | <i>Lycopersicon esculentum</i> |
| 19 | Sana Bhajiri | Tomato cv. Cherri | <i>Lycopersicon esculentum</i> |
| 20 | Bada Bhajiri | Tomato cv Mankada | <i>Lycopersicon esculentum</i> |
| 21 | Lanka | Chili cv Suryamukhi | <i>Capsicum annum</i> |
| 22 | Lanka (Dhanai) | Chili cv Dhanai | <i>Capsicum annum</i> |
| 23 | Lanka Desi | Chili cv Desi | <i>Capsicum annum</i> |
| 24 | Lanka dhala | Chili cv Dhala | <i>Capsicum annum</i> |
| 25 | Barugudi | Cow peas | <i>Vigna unguiculata</i> |
| 26 | Semi | Dolicus | <i>Dolicus spp.</i> |
| 27 | Bhendi | Okra | <i>Abelmoschus moschatus</i> |
| 28 | Ranga bhendi | Okra red | <i>Abelmoschus moschatus</i> |
| 29 | Semili kanda | Cassava | <i>Manihot esculenta</i> |
| 30 | Langala kanda | Dioscorea | <i>Dioscorea spp.</i> |
| 31 | Ganthi kanda | Dioscorea | <i>Dioscorea spp.</i> |

4.2.4. Agrobiodiversity in Bila chasa (Valley terrace cultivation)

Bila Chasa is a settled agricultural system giving emphasis for producing staple rice and other crops on a rotation basis. This method utilizes moist lower slopes and valley edges

for sequential cropping—starting with indigenous paddy followed by pulses and vegetables—ensuring staple grain supply and protein sources. Under Bila chasa, sequential cultivation starts with Indigenous paddy followed by pulses (pigeon pea, horse gram) and vegetables like colocasia, beans, and cucurbits.

Table 15. Crop diversity under Bila chasa

| SI No | Common name | Trade name | Botanical Name | Botanical Name |
|-------|-------------|------------|-------------------------------------|----------------|
| 1 | Desi dghan | Paddy | <i>Oryza sativa</i> | 1 |
| 2 | Baihunda | Paddy | <i>Oryza sativa</i> cv. Baiya hunda | 1 |

| | | | | |
|----|------------|-------------|----------------------------|--------------------|
| 3 | Ratnachudi | Paddy | Oryza sativa cv Ratanchudi | 1 |
| 4 | Lalata | Paddy | Oryza sativa | Released varieties |
| 5 | Masuri | Paddy | Oryza sativa | Released varieties |
| 6 | 1001 | Paddy | Oryza sativa | Released varieties |
| 7 | Muga | Moong bean | Vigna radiata | 2 |
| 8 | Biri | Urad bean | Vigna mungo | 2 |
| 9 | Baigan | Brinjal | Solanum melongena | 2 |
| 10 | Bhajiri | Tomato | Lycopersicon esculentum | 2 |
| 11 | Mula | Radish | Raphanus sativus | 2 |
| 12 | Bhaji saga | Amaranthus | Amaranthus spp. | 3 |
| 13 | Beans | Beans | Phaseolus spp. | 2 |
| 14 | Lobia | Cow peas | Vigna umbellate | 2 |
| 15 | Kakharu | Pumpkin | Cucurbita pepo | 2 |
| 16 | Kakudi | Cucumber | Cucumis sativus | 2 |
| 17 | Jhani | Ridge gourd | Luffa indica | 2 |

Beyond cultivated species and local breeds, Mahendragiri's forests provide a rich array of Non-Timber Forest Products (NTFPs), including wild edibles, honey, bamboo, and commercially important species like *Diospyros melanoxylon* and *Madhuca longifolia*. Over 300 medicinal plants, such as *Tinospora cordifolia* and *Andrographis paniculata*, contribute to traditional healthcare and income generation. This diversity underpins

multiple ecosystem functions: provisioning services through food and NTFPs; regulating services via carbon sequestration, soil stabilization, and watershed protection; supporting services through nutrient cycling and pollinator habitats; and cultural services embedded in sacred groves and ritual practices.

The ecosystem services provided by Mahendragiri's landscape are multifaceted:



Provisioning services:

Food through Bogodo, Bari and Bila chasa, NTFPs (Mahua flowers, Kendu leaves, bamboo, honey), medicinal plants (>300 species), and livestock fodder.



Regulating services:

Carbon sequestration by forests, soil erosion control through ground cover and tree roots, and watershed protection sustaining perennial streams.



Supporting services:

Nutrient cycling via leaf litter and livestock manure, biodiversity conservation through mixed cropping and sacred groves.



Cultural services:

Sacred groves, rituals linked to Mahua flowering, and Saura art reinforce cultural identity and ecological stewardship.

The interplay of crop diversity, conservation of local breeds of animals, forest resources, and indigenous knowledge creates a resilient socio-ecological system. However, pressures from deforestation, shortened fallows, and policy constraints threaten this balance, underscoring the need for participatory conservation and agroecological intensification to sustain Mahendragiri's agrobiodiversity and ecosystem functions.



Bogodo: Niger Crop Cultivation

4.3 Local & Traditional Knowledge Systems and Adapted Technologies

The Saura tribes of Mahendragiri possess a rich corpus of Traditional Ecological Knowledge (TEK) that underpins their Bogodo cultivation and forest-based livelihoods.

Crop protection from wild animals employs indigenous strategies—thorny live fences (Euphorbia, bamboo), watch towers, smoke barriers, and deterrent crops like chili and castor. Ethno-veterinary practices

rely on herbal remedies using turmeric, garlic, and forest herbs for treating wounds and infections, while conservation of hardy local breeds of goats and cattle sustains livestock resilience. TEK also governs NTFP collection, emphasizing seasonal harvest, leaving portions for regeneration, and avoiding destructive practices. They also hold knowledge to detoxify the tuber for making it edible.

Ethnobotanical expertise supports primary healthcare through medicinal plants for ailments such as fever, dysentery, and snakebite.



Traditional Ecological Knowledge (TEK) of Saura Tribes

The Saura tribes of Mahendragiri possess a rich corpus of Traditional Ecological Knowledge (TEK) that underpins their Bogodo cultivation and forest-based livelihoods.

Implements used by Saura tribes: They use simple, locally made farm implements in Bogodo cultivation



Khunti (Digging Stick):

A traditional wooden stick used for loosening soil and testing soil depth during land preparation.



Gubuda (Hand Hoe):

An iron-bladed hoe for planting, weeding, and minor soil work.



Wooden Plough:

Occasionally used for leveling terraces and preparing soil in relatively flat patches.



Axes and Sickles:

For clearing vegetation, cutting shrubs, and harvesting crops.



Bamboo Implements:

Used for constructing terraces, fencing, and temporary water channels.



Storage Implements:

Bamboo containers for seed storage, ensuring protection from pests and moisture.

These implements reflect indigenous engineering adapted to local ecology, requiring minimal external inputs and emphasizing sustainability. They are lightweight, repairable within the community, and often crafted from locally available materials like wood, bamboo, and iron.

4.3.1. Ecological Knowledge and Its Application by Saura tribal Community

Over generations, the Saura tribal communities inhabiting in Mahendragiri, have developed a rich body of traditional ecological knowledge about their surroundings, including the conservation and utilisation of flora, fauna and natural resources for their survival and wellbeing. This knowledge is transmitted orally from generation to generation through folklores, rituals and daily practices, represents a living heritage of sustainable ecosystem management. Regular interaction with the forest environment helped them to acquire a cumulative understanding of plants, animals, soils, water, and climate—used to sustain their livelihoods and maintain ecological balance.

Components of traditional ecological knowledge (TEK) and its applications

The traditional knowledge possessed by Saura tribal community encompassing multiple dimensions of nature-human interaction. Important domains of traditional knowledge and its applications are explained below.

Agroecology:

The key component of the traditional ecological knowledge comprises of unique agricultural practices evolved in this ecology. They have developed an indigenous cropping pattern (multiple crops with varying maturity for harvest), management of soil, water retention, retaining soil



Formation of Spring

moisture, managing soil fertility, limited burning of forest for agriculture purpose, constructing terraces based on contours, for water management and arresting soil erosion, prediction of weather including rain and droughts, and protecting crops from wild animals, pest etc. They conserve landraces of millets, paddy, pulses, vegetables – that are well suited to the agroecology of Mahendragiri.

Areas of application of traditional ecological knowledge in agroecology

Selection of Bogodo patches for cultivation: They apply their traditional ecological knowledge in selecting appropriate land patch for Bogodo cultivation. They consider the slope of the patch (preferably <30 degree) for selecting land under Bogodo cultivation. They assess the soil texture, depth, water holding capacity and colour of the soil for determine whether the land is suitable for Bogodo. They construct terrace on the basis of its contour to reduce



water runoff and soil erosion. Terracing helps to retain soil moisture.

They conserve crop diversity and follow mixed cropping to ensure household food security and reduce pest and disease risks. They cultivate millets (ragi, foxtail, little millet), pulses, oilseeds, and vegetables in mixed cropping systems. Intercropping of pulses maintains soil fertility. Landraces of crops or varieties that tolerate the harsh environment of Mahendragiri are cultivated. They have been conserving diverse landraces suitable to Bogodo and meet their multiple requirements -food, nutrition, fodder and medicine.

No external inputs are applied for soil fertility enhancement. They leave Bogodo patches fallow for years for natural regeneration of soil fertility. They allow litter and humus deposit on Bogodo land for retaining soil fertility.

The farmers are keen to select healthy panicles/plants for seed purposes. Seeds are treated properly and moisture levels are maintained. Seeds are stored in specific container to avoid pest attack. Women are engaged in seed selection, seed processing and storage. Containers made out of bamboo is used for the storage of seeds.

Forest Conservation:

The Saura live in harmony with the nature and are keen to conserve the forest resources. They conserve species that provide food, fodder, medicine, raw material and income for them. Occasional hunting or trapping of animals enrich their diet.

They collect tubers, mushrooms, fruits and honey from forest for consumption purposes. They collect bamboo, firewood and timber (from Bogodo land) for market.

Protection of forest

They worship forest spirits and shoulder the responsibility of the protection of forest. They protect patches of primary forest as sacred sites and dedicated to their ancestors or nature spirits. These forest patches serve as micro reserve of biodiversity, conserving rare species of flora and fauna. Sacredgroves/primary forest patches serve as shelter for wild animals, and healthy forest system will reduce wild animal attack to crops in Bogodo. They also host diverse flora of conservation value.

Community regulated harvest of NTFPs

Non-Timber Forest Produces are important source of income, food and nutrition for the tribal community. They harvest Bamboo, honey, tubers, mushrooms, fruits and other economically important species from forest. However, they follow collective norms and practices including seasonal collection, leaving part of the plant uncut for regeneration, controlling over harvest and destructive harvest and follow no-harvest rules during flowering and fruiting seasons. Such community regulated collective norms and ethics maintain forest regeneration and species continuity.

Controlled burning/ fire

Controlled burning after monsoon reduces dense undergrowth without harming tree regeneration. They consider the wind direction, wind



speed for burning the vegetation.

Ethnobotanical information about forest resources

They hold vast knowledge about wild edible species, flowering and fruiting, geographical distribution, regeneration methods, sustainable harvest of NTFPs including fruits, tubers and honey. They also collect medicinal plants for their primary healthcare needs.

Water and soil management

Saura tribes hold knowledge on traditional practices to conserve soil, retaining soil fertility and moisture for good harvest. They use contour methods to construct terraces that facilitate soil conservation and water management. They also protect seasonal springs and waterbodies for conserving water. The regular interaction with forest helped them to acquire knowledge about indicator species – that ensure presence of water and soil nutrients.

Ethno-veterinary and Livestock Knowledge

Saura conserve native breeds of animals including goat, sheep, cow, bulls and buffaloes. These livestock are integral part of their livelihoods and culture. Saura possess ethno-veterinary knowledge about livestock care.

Herbal remedies are prepared using various medicinal plants, turmeric, garlic, and forest herbs to treat wounds, parasites, and infections.

They also prefer indigenous cattle and goat breeds for their hardiness, disease resistance, and low input needs.

Primary healthcare

The Saura tribe hold unique knowledge about plant species and their medicinal properties, which are transmitted through oral traditions. The traditional healers collect medicinal plant from forest for treating ailments like - fever, dysentery, joint pain, snake bites, etc.

Indigenous Weather and Climate Knowledge

They hold knowledge about weather changes, based on signals from the nature. Blooming of mahua (*Madhuca indica*) and migration of birds predict onset of monsoon. They also predict rainfall intensity based on wind direction, cloud colour and insect activity.

Challenges

There is a limited recognition of traditional practices in current agricultural and forest management programmes. Migration of youth from Mahendragiri is affecting the oral transmission of knowledge. Increasing deforestation and land use changes challenges the significance of traditional ecological knowledge, because they deal more with traditional land use practices. Frequent occurrences of extreme climate events altering the reliability of traditional weather indicators.

Way ahead

Traditional ecological knowledge has its own significance. However, to increase the reliability and current applications of TEK, there is a pressing need to document and validate this knowledge stream. This necessitates collaborative research to record knowledge hold by local community



Integration of TEK with modern science is also inevitable to integrate insights from traditional ecological knowledge in biodiversity conservation programmes and forest management.

Formal recognition of the role of indigenous communities and participatory forest management programme with indigenous communities participation (and their knowledge) can ensure forest conservation. The livelihoods of these communities largely depend on the health of forest ecosystems.

Reward and recognition of knowledge holders, traditional healers and forest stewards will help to protect the knowledge. Digitalisation of knowledge is also an option.

Revitalizing and integrating this knowledge with scientific innovations can promote sustainable ecosystem management, biodiversity conservation, and climate resilience not only in Mahendragiri but across India's tribal landscapes.



Bogodo: Pearl Millet Field

4.4 Cultures, Value Systems and Social Organizations (Agri-Culture)

The Saura tribes of Mahendragiri exhibit a deeply integrated agri-culture, where farming practices, cultural values, and social organization are inseparable.

Agriculture is not merely an economic activity but a cultural expression rooted in collective decision-making and customary norms. Land selection for Bogodo cultivation involves rituals seeking permission from Dharani Penu (Earth deity), reflecting spiritual ties to nature. Sacred groves and forest patches are preserved as ancestral and ecological sanctuaries, reinforcing a value system of mutual coexistence and resource stewardship.

Social organization is clan-based, with village councils regulating land use, resolving disputes, and enforcing norms for sustainable harvest of Non-Timber Forest Products (NTFPs). Collective labor during sowing, harvesting, and crop protection fosters social cohesion, while festivals linked to Mahua flowering and harvest cycles strengthen cultural identity. Oral traditions, Saura wall paintings, and ritual songs transmit ecological knowledge across generations.

The Saura tribes demonstrate a strong commitment to forest regeneration by leaving Bogodo plots fallow for several years, allowing natural vegetation and soil fertility to recover. They follow sustainable harvesting norms for NTFPs, such as seasonal collection, leaving parts of

plants uncut, and avoiding destructive practices to ensure species continuity. Hunting is regulated by customary laws, and sacred groves are maintained to conserve wildlife, reducing conflict with wild animals and promoting coexistence rather than indiscriminate killing.

The Saura worldview emphasizes reciprocity with nature, evident in practices like mixed cropping, fallow management, customary laws guiding restrictive hunting, commitment for forest regeneration, and ethno-veterinary care for livestock. Their value system prioritizes biodiversity conservation, food security, and cultural continuity over market-driven monocultures. This integrated agri-culture represents a resilient socio-ecological model, though increasingly challenged by deforestation, policy neglect, and youth migration.

Kinship Structure and Family Organization

Saura follow extended family system, locally called as Birinda system, consisting of descendants of a common male ancestor across four to five generations living adjacent in a settlement. Marriage within Birinda is not permitted. Nuclear families and extended families coexist.

Saura practice several forms of marriage arrangements. They practised bride capture, elopement and marriage through negotiation. Now days they give more importance to marriage through negotiations, as it strengthens village networks. Bride live with groom's family after marriage.

Council of Elders take critical decisions to settle disputes among individuals and families. They also take

Integrated Agri-Cultural System of Saura Tribes

Farming in Mahendragiri is a cultural expression for the Saura tribes, blending agriculture with spiritual and social values. Practices like land selection rituals honoring Dharani Penu, preservation of sacred groves, and collective decision-making reflect deep ecological ethics and resource stewardship.



Forest Regeneration and Sustainable Practices

decisions on ritual organization and community discipline.

Priests have a critical role. They follow a distinctive Shamanic Traditions, where Shaman (women) serve as intermediary between the living and ancestral spirits. Shamanic Traditions and Shaman (often women) play key role in ensuring wellness or healing health (physical and mental), conducting ancestral rites, interpreting misfortunes and rectifying and guiding community spiritual order.

Economic Organization and Communal Life

Agriculture and Forest-Based Economy

Traditionally engaged in Bogodo cultivation, but many Sauras in Mahendragiri are excel in terraced wet cultivation and water management. They also make utilise garden land near their homesteads for raising crops for food and nutrition. Livestock rearing is part and parcel of their culture, traditions and is a survival strategy. Collection of NTFPs, and in limited way, they engage in pottery, basketry and

weaving.

They believe in collective labour. Collectivisation takes place according to kinship or neighbourhood. Collective efforts can be observed in Bogodo land preparation, wet terraced rice cultivation, preparation of food for social gathering and rituals etc. Elders play vital role in identifying Bogodo land for cultivation. Collective efforts can also be found in controlling wild animal attack on crops.

Religion, Rituals, and Social Cohesion

They worship ancestral spirits, natural forces, and numerous local deities and Hindu deities.

Collective festivals and trance based shamanic rituals that reinforce communal bonds. They preserve sacred groves – as a respect towards ancestral spirit and pristine forest patches for the wildlife.

Religion plays a foundational role in social order, kinship continuity, and ecological knowledge.



Integrated Agriculture and Landscape Management



Bari Chasa: Finger Millet Field

4.5 Landscapes and Land-use Features

The Saura tribes of Mahendragiri inhabit a mosaic of landscapes comprising dense forests, hill slopes, valleys, and terrace-based agricultural patches. Forests serve as a primary resource base, which underpin food security and income. Sacred groves within forests are preserved for spiritual and ecological functions, reflecting cultural values of conservation.

Agri-landscapes

Agricultural land use is dominated by Bogodo cultivation, a traditional terrace farming system adapted to hill slopes. Saura farmers construct small terraced plots stabilized with stone bunds to conserve soil and moisture, enabling mixed cropping of millets, pulses, tubers, and spices. Lower slopes and valley edges are reserved for moisture-loving crops like paddy and colocasia, while uplands support drought-tolerant millets and pulses.

Bari chasa (homestead garden) and Bila chasa (terrace wet paddy, pulses and vegetables) are other land uses providing food. They divert perennial streams and springs to irrigate the crops, bamboo or stone channels are dug to flow the water to Bari or Bila chasa. Bari chasa allow them to cultivate perennial tree crops, pulses and vegetables – mainly for household consumption. They play an important role in the food and nutritional security of the Saura tribes in Mahendragiri. Bila chasa facilitate cultivation of diverse landraces of paddy, and further sequentially they cultivate pulses and vegetables. Crop rotation, mulching, leaf litter and cow dung enhance soil fertility. They have never applied external inputs for plant protection and soil fertility.

Settlements are strategically located near forest edges and Bogodo fields for easy access to resources. Livestock grazing occurs in fallow lands and forest fringes, linking animal husbandry with forest fodder availability. This integrated land-use system reflects a resilient socio-ecological model, balancing



Integrated Land-Use System for Food Security



Customary Rules for Conservation and Resource Management



Bari Chasa: Backyard Farming

subsistence needs with biodiversity conservation.

The Saura tribes follow customary rules that ensure harmony between land use and forest conservation. First, land for Bogodo cultivation is selected collectively under village council oversight, respecting ancestral tenure and prohibiting clearing of forests outside customary boundaries. Second, they enforce norms for sustainable harvest of NTFPs, including seasonal collection, leaving parts of plants for regeneration, and banning destructive practices. Third, hunting is regulated by cultural taboos and community laws, while sacred groves are maintained as biodiversity refuges, reducing wildlife pressure on crop lands and minimizing human-wildlife conflict.

Landscape and seascape features

Mahendragiri is a mountainous system exhibiting diverse natural landscapes and waterscape elements. It consists of rugged hill systems, deep forested valleys, sacred cultural sites, and waterscapes that collectively shaping a unique natural environment. Mahendragiri is also home to indigenous communities like Saura, who shape these landscapes for multiple uses.

The high elevation hill ranges harbour rich floral and faunal diversity. Mahendragiri has been declared as 'Biodiversity Heritage Site' by the State Biodiversity Board, Government of Odisha in 2022.

Natural Landscape diversity

Mountain Landscape

Mahendragiri is characterized by rugged granite hill ranges that consists of steep ridges, rocky cliffs, and densely vegetated slopes.

Valleys, Slopes, and Plateau Zones

Valleys and plateaus also enrich the landscape diversity of Mahendragiri. Mid-level slopes are covered with dense vegetations, especially diversity of tree species. However, intersection portions of hills/ slopes open into relatively flat plateaus. These flat plateaus are historically been used as sacred groves.

Forest Ecosystems

Diverse forest types are found in Mahendragiri. Forest vegetation varies with altitude. Lower slopes are characterized by high rainfall and deep soil. Lower slopes of the hills are covered with dry deciduous forest types. These zones also host wildlife like elephant, spotted deer, flying squirrel etc.

Semi evergreen and mixed forests are found on mid to upper elevation/ slopes. The tribal farmers collect medicinal plants and various Non-timber forest produces from mixed forests. These zones also harbour diverse endemic and threatened plant species.

Hill tops host open, wind-swept plateaus and are characterized by grass-shrub mosaic due to strong winds, rocky surfaces and shallow soils.

Along the Mahendratanaya river and numerous (seasonal or perennial) springs, one can find out riparian tree species, seasonal wetland vegetation



and moisture loving herbs and ferns. These riparian forests are critical for hydrological function and wildlife movement.

Waterscape Elements

Rivers and Streams

River Mahendratanya originates from Mahendragiri, flowing eastward and drains into the Bay of Bengal. Tribal communities consider river Mahendratanya as a revered water course as it carves through dense forests, creating natural springs, micro wetlands and enriches riparian habitats that support human and wild life. This river plays a vital role in water security and irrigating crops. The river connecting the Mahendragiri with Sea. The river also nourishes forests and support wild life.

Waterfalls and Seasonal Flows

Slope hills and steep gradients create seasonal waterfalls during Monsoons in Mahendragiri. Water from interconnected streams, seasonal springs and waterfalls form the unique waterscape of Mahendragiri and playing vital role in maintaining soil moisture, groundwater recharge, and the survival of riparian and wetland flora.

Seascape

The river Mahendratanya hydrologically connects Mahendragiri with Bay of Bengal (Sea). The eastern slopes of Mahendragiri are open to sea winds. Trekkers also stated that on clear sky, one can view the sea from hill tops from the eastern slopes. Depressions on the Sea and cloud movement support rich rainfall.



Little Millet from Bogodo Chasa



Growing Infrastructure at the Cost of Forest

5. Threats and Risks

Mahendragiri's socio-ecological system faces multiple threats that undermine biodiversity conservation and the cultural integrity of Saura livelihoods.

Deforestation and land-use change, driven by expanding settlements, infrastructure projects, and unsustainable extraction of forest resources, fragment habitats and reduce the availability of Non-Timber Forest Products (NTFPs).

Shortened fallow cycles in Bogodo cultivation, caused by population pressure and limited land availability, accelerate soil degradation, reduce forest regeneration, and erode the ecological sustainability of traditional farming systems. This compromises crop diversity and the conservation of indigenous landraces adapted to

harsh hill environments.

Climate variability and extreme weather events further exacerbate risks, affecting rainfed agriculture and water availability. Market pressures and policy neglect promote monocultures and external inputs, threatening the resilience of traditional agroecological practices.

Loss of traditional ecological knowledge (TEK) due to youth migration and weakening oral transmission disrupts community-based resource management, including sustainable NTFP harvesting, ethno-veterinary practices, and forest stewardship. Wildlife conflict intensifies as shrinking forests push animals closer to crop fields, while hunting norms and sacred grove protection are



Ecological and Cultural Threats

Mahendragiri faces deforestation, habitat fragmentation, and reduced NTFPs due to expanding settlements, infrastructure, and unsustainable resource extraction. Shortened fallow cycles degrade soil and erode traditional farming sustainability.

increasingly disregarded.

Customary rules often conflict with formal forest conservation policies.

Their traditional norms permit clearing small forest patches for Bogodo cultivation and controlled burning, which are restricted under state conservation laws. Similarly, community-regulated NTFP harvesting and crop protection practices clash with strict protection measures, highlighting the need for co-management approaches that integrate indigenous knowledge with biodiversity conservation.

These cumulative pressures jeopardize biodiversity, agrobiodiversity, and cultural heritage, calling for urgent interventions—such as participatory forest governance, TEK documentation, and climate-resilient agroforestry—to safeguard the life and livelihoods of Saura communities.



Climate and Socio-Economic Pressures

Climate variability, extreme weather, and market-driven monocultures undermine rainfed agriculture and agroecological resilience. Policy neglect and youth migration accelerate the loss of traditional ecological knowledge (TEK) and community-based resource management.



Governance Conflicts and Need for Co-Management

Customary practices like controlled burning and NTFP harvesting clash with strict conservation laws, creating governance conflicts. Urgent interventions—such as participatory forest governance, TEK documentation, and climate-resilient agroforestry—are needed to safeguard biodiversity and Saura livelihoods.



Planting Trees: Traditional Agroforestry



Bogodo: Pearl Millet Field

6. Dynamic Conservation Action Plan (2026–2030)

The Saura tribes consider forests, streams, and sacred groves as living ancestors, and are deeply committed to conserve the hill ecosystems. They conserve biodiversity through Bogodo chasa, a low impact terrace-shifting system that allows long fallows for natural regeneration, and through Bari and Bila chasa, which rely entirely on organic inputs and careful water management. They safeguard medicinal plants, regulate harvesting of forest produce, and maintain sacred sites that function as de facto conservation zones. Their cultural norms, taboos, and community decision making ensure that the landscape remains ecologically balanced for future generations.

However, Mahendragiri is undergoing tremendous conservation pressure due to multiple reasons, including climate change, population pressure, changing perceptions and preferences of local community, presence of external institutions and governance issues.

The Focus Group Discussions (FGDs) conducted among various stakeholders, shared their concern over the depletion of biodiversity, eroding traditional wisdom, and lack of interest among youngsters in traditional agricultural practices. Based on the FGDs, we have developed a dynamic conservation strategies for Mahendragiri



**Dynamic
Conservation
Strategies for
Mahendragiri**



Millet Consumption

- Establish a community-led GIAHS Steering Committee and village custodians' network.
- Participatory mapping of terraces, sacred groves, water sources and biodiversity patches (GIS).
- Community seed banks for millets, pulses, paddy and vegetables; annual seed fairs and exchanges.
- Registration of Farmers' varieties under PPVFRA
- Documentation of the contribution of Saura tribes in Mahendragiri on their role in conserving crop genetic resources
- Characterization of existing crop genetic resources conserved by Saura in Mahendragiri
- Document the genetic characteristics of landraces of millets, pulses, paddy, vegetables and other crops
- Harmony between customary laws and forest management systems at local level – through advocacy and trust building
- NTFP value addition & market linkages (processing of mahua flowers, kendu leaves, oils, spices).
- Strengthen institutional mechanism for regulating -unscientific, untimely, destructive, unsustainable and over harvest of NTFPs
- Form cooperatives of NTFP collectors for facilitating value addition and marketing
- Medicinal plant conservation plots and documentation of healer knowledge with prior informed consent.
- Soil and water conservation (terrace repair, mulching, bamboo channels, micro-checks).
- Crop-wildlife conflict mitigation (barrier species, watch towers, rotational guarding, smoke lines).
- Women's enterprise support (microcredit, training for value-added products, market kiosks).
- Develop ecosystem based disaster risk reduction strategies
- Promote sacred groves and sacred forests
- Youth apprenticeship for TEK documentation and climate-resilient agroecology.
- Monitoring & evaluation aligned to GIAHS criteria; annual reporting to FAO and State departments.



FGD: Data Collection Process

7. Governance and Stakeholder Engagement

Lead applicant: [M.S. Swaminathan Research Foundation]

Partners: Community leaders and healer associations; Forest & Agriculture Departments; Panchayat raj institutions; universities/NGOs; FAO Country Office.

Mechanisms: quarterly multi-stakeholder meetings; free, prior and informed consent; benefit-sharing for knowledge documentation; grievance redress.



Handicrafts Making



8. Monitoring, Indicators and Evidence

Key indicators: Household dietary diversity; NTFP income share; number of landraces conserved; number of varieties registered as farmers' varieties, area under terraces and sacred groves; women-led enterprises; wildlife incidents; soil erosion proxies; TEK documentation records; governance and sustainable harvest of NTFPs, establishment of NTFP value addition units, governance meetings.





Wooden Chakki for Millet Processing

Annexes

A1. Maps (site boundary, land-use, elevations)

A2. Medicinal plants list and healer protocols.

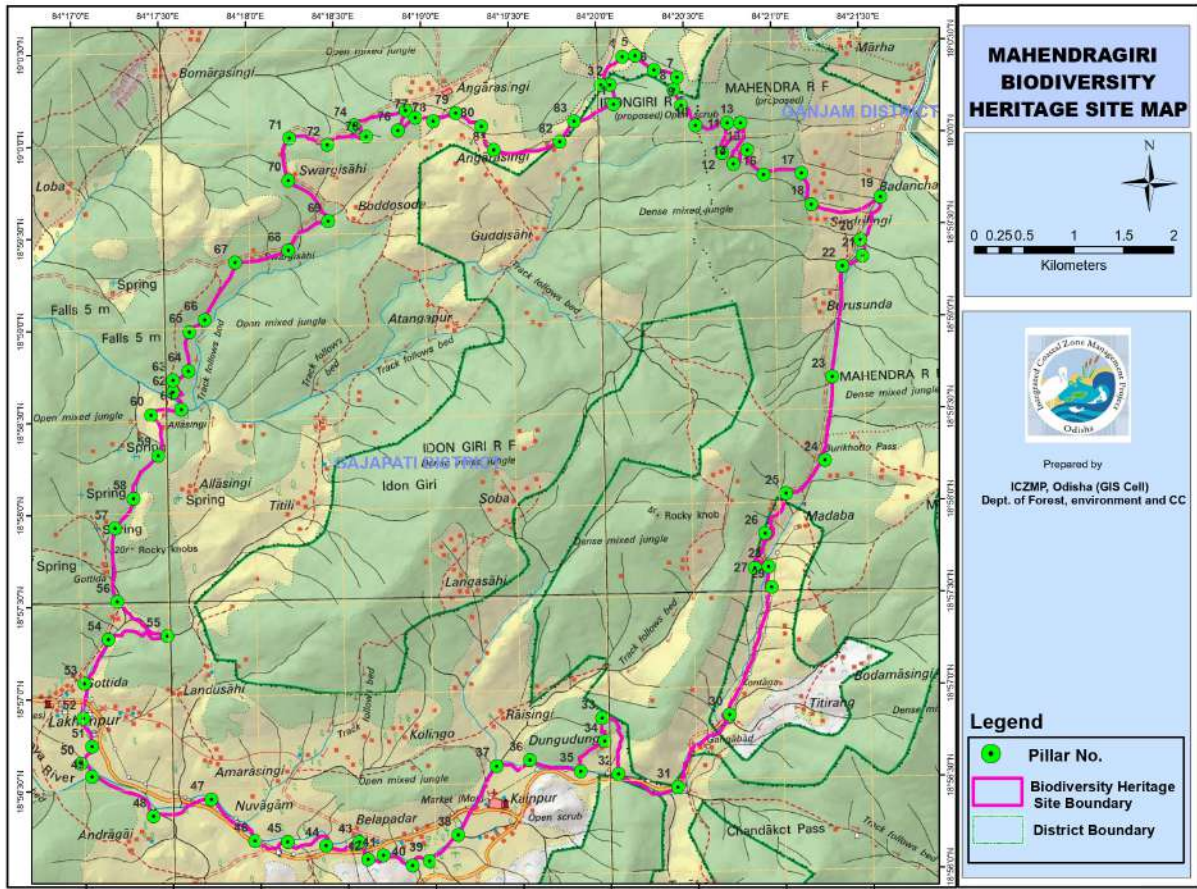
A3. Indigenous agricultural practices in Mahendragiri

A4. Profile of Mahendragiri

A5. Bibliography and citations.

A6. Photo plates of terraces, sacred groves, tools, fences and biodiversity

Annexure A1. Maps (site boundary, land-use, elevations)



Annexure 2. Medicinal plants in Mahendragiri

The Saura hold rich knowledge about medicinal properties of plant species around them. The traditional healers access multiple species and prepare different herbal formulations to cure range ailments, exposed by tribal people.

The Mahendragiri forest harbors rich diversity of medicinal plants, key to traditional healthcare practices. There are medicinal trees, shrubs, herbs, climbers and tuber species that are used extensively in tribal healthcare and for ensuring wellness.

The healers use leaf, bark, fruit, roots of different species for medicinal purposes. The healers, tribal women and men hold knowledge about different species. Unique knowledge about species and their usage is transmitted orally.

A2.1. Medicinal trees:

The present generation hold knowledge about over 20 species of trees and their medicinal properties. They are used to cure cardiac issues, healing wounds, digestive issues, respiratory diseases, skin care, controlling diabetics, etc.

Table A2.1. Medicinal Trees accessed by Sauras in Mahendragiri

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|--------------------------------|---------------------|--|
| <i>Terminalia arjuna</i> | Arjuna | Used for cardiac disorders, blood purification, wound healing. |
| <i>Terminalia chebula</i> | Harida / Haritaki | Treats constipation, digestive issues, infections. |
| <i>Terminalia bellirica</i> | Bahada | Used for respiratory problems, skin diseases, part of Triphala. |
| <i>Azadirachta indica</i> | Neem | Antiseptic, antibacterial, used for skin infections and malaria. |
| <i>Aegle marmelos</i> | Bael | Treats diarrhoea, dysentery, improves digestion. |
| <i>Syzygium cumini</i> | Jamu / Jamun | Controls diabetes, strengthens digestion. |
| <i>Oroxylum indicum</i> | Sion / Shyonak | Used for asthma, arthritis, inflammation; part of Dashamoola. |
| <i>Barringtonia acutangula</i> | Hijjala | Helps treat diarrhoea, haemorrhoids, and skin disorders. |
| <i>Woodfordia fruticosa</i> | Dhawai | Astringent; used in Ayurvedic fermentations, dysentery. |
| <i>Madhuca longifolia</i> | Mahua | Flowers used for energy; bark for skin ailments. |
| <i>Pterocarpus marsupium</i> | Bijasal | Anti-diabetic, improves wound healing. |
| <i>Albizia lebbek</i> | Siris | Treats cough, asthma, skin allergies. |

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|-----------------------------|---------------------|--|
| <i>Ficus religiosa</i> | Peepal | Used for respiratory issues, skin problems, digestive disorders. |
| <i>Ficus benghalensis</i> | Banyan | Bark used for diabetes, diarrhoea, wounds. |
| <i>Phyllanthus emblica</i> | Amla | Rich in Vitamin C; boosts immunity, digestive health. |
| <i>Alstonia scholaris</i> | Chhatim | Treats malaria, respiratory issues, fever. |
| <i>Cassia fistula</i> | Sunari / Amaltas | Treats skin diseases and jaundice. |
| <i>Dalbergia sissoo</i> | Sissoo | Used for bone health, skin diseases, fever. |
| <i>Holarrhena pubescens</i> | Kurchi | Highly effective for dysentery and stomach infections. |
| <i>Boswellia serrata</i> | Salai | Resin used for arthritis, inflammation, wound healing. |
| <i>Saraca asoka</i> | | |

A2.2. Medicinal herbs

The tribal women are keen to conserve, collect and utilize diverse species of herbaceous plants for their healthcare needs. Herbaceous medicinal plants are mostly used by women for primary healthcare. They collect these plants from forest, forest peripheries, farmlands and homesteads.

Table A2.2. Medicinal herbs accessed by tribal communities in Mahendragiri

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|------------------------------------|---------------------|--------------------------------------|
| <i>Centella asiatica</i> (L.) Urb. | Brahmi | Memory enhancer, wound healing |
| <i>Ocimum sanctum</i> L. | Tulsi | Cold, cough, immunity booster |
| <i>Eclipta alba</i> (L.) Hassk. | Kesuri | Hair growth, liver tonic |
| <i>Acorus calamus</i> L. | Bach | Digestive aid, respiratory disorders |
| <i>Boerhavia diffusa</i> L. | Punarnava | Diuretic, kidney disorders |
| <i>Achyranthes aspera</i> L. | Apamaranga | Skin diseases, anti-inflammatory |
| <i>Hemidesmus indicus</i> R.Br. | Anantamul | Blood purifier, urinary disorders |
| <i>Desmodium gangeticum</i> | Salparni | Fever, tonic for weakness |

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|--------------------------------|---------------------|-------------------------------|
| <i>Leucas aspera</i> (Willd.) | Guma | Cold, cough, insect bites |
| <i>Justicia adhatoda</i> L. | Adusa | Bronchitis, asthma |
| <i>Phyllanthus niruri</i> L. | Bhui amla | Jaundice, liver disorders |
| <i>Andrographis paniculata</i> | Kalmegh | Fever, liver tonic |
| <i>Aerva lanata</i> (L.) Juss. | Kapurijadi | Kidney stones, urinary issues |
| <i>Coleus aromaticus</i> Benth | Karpuravalli | Cough, digestive aid |
| <i>Mimosa pudica</i> L. | Lajkuli | Piles, wound healing |

A2.3. Medicinal shrubs

Just like herbaceous species, shrubs are also important in primary healthcare. Medicinal shrubs are used to treat ailments like cough, asthma, bronchitis, hypertension, toothache, digestive disorders, pain and for wound healing.

Table A2.3. Medicinal Shrubs accessed by Saura tribes in Mahendragiri

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|--------------------------------------|---------------------|--|
| <i>Adhatoda vasica</i> Nees | Basanga | Treats cough, asthma, bronchitis |
| <i>Rauvolfia serpentina</i> Benth | Patalgaruda | Hypertension, insomnia |
| <i>Zanthoxylum armatum</i> DC | Tejbal | Toothache, digestive aid |
| <i>Clerodendrum serratum</i> L. | Bharangi | Anti-inflammatory, respiratory disorders |
| <i>Vitex negundo</i> L. | Nirgundi | Joint pain, wound healing |
| <i>Phyllanthus amarus</i> Schum | Bhui amla | Liver disorders, jaundice |
| <i>Andrographis paniculata</i> | Kalmegh | Fever, liver tonic |
| <i>Solanum nigrum</i> L. | Kakmachi | Skin diseases, ulcers |
| <i>Justicia adhatoda</i> | Adusa | Bronchitis, cough |

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|-----------------------------------|---------------------|-----------------------------|
| <i>Aegle marmelos</i> Corr. | Ghungchi | Anthelmintic, contraceptive |
| <i>Aegle marmelos</i> Corr. | Bela | Diarrhea, dysentery |
| <i>Azadirachta indica</i> A. Juss | Neem | Skin infections, antiseptic |
| <i>Holarrhena antidysenterica</i> | Kutaja | Dysentery, diarrhea |
| <i>Murraya koenigii</i> | Bhursunga | Digestive aid, diabetes |
| <i>Cassia tora</i> L. | Chakunda | Skin diseases, laxative |

A2.4. Medicinal climbers

There are climbers and creepers used to cure health related issues. Traditional healers of the Saura tribes collect these climbers for preparing herbal medicine to cure multiple ailments.

Table A2.4. Climbers accessed for medicinal uses

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|----------------------------------|---------------------|---------------------------------------|
| <i>Tinospora cordifolia</i> | Guduchi | Fever, immunity booster |
| <i>Cissus quadrangularis</i> L. | Harjora | Bone fractures, joint pain |
| <i>Pergularia daemia</i> | Utaran | Skin diseases, wound healing |
| <i>Cyclea peltata</i> | Padmapatra | Rheumatism, fever |
| <i>Dioscorea bulbifera</i> L. | Pindalu | Digestive aid, piles |
| <i>Trichosanthes cucumerina</i> | Chichinda | Worm infestation, digestive disorders |
| <i>Cardiospermum halicababum</i> | Kanphuti | Rheumatism, skin ailments |
| <i>Abrus precatorius</i> L. | Ghungchi | Anthelmintic, contraceptive |
| <i>Ipomoea quamoclit</i> L. | Lata kusuma | Fever, cough |
| <i>Tylophora indica</i> | Antamul | Asthma, bronchitis |
| <i>Smilax zeylanica</i> L. | Kumarilata | Blood purifier, urinary disorders |

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|-----------------------------------|---------------------|----------------------------------|
| <i>Entada rheedii</i> Spreng. | Gada lata | Snake bite antidote |
| <i>Momordica dioica</i> Roxb. | Kakrol lata | Diabetes, digestive aid |
| <i>Marsdenia tenacissima</i> | Dudhi lata | Cancer therapy (traditional use) |
| <i>Asparagus racemosus</i> Willd. | Satavari lata | Female reproductive health |

A2.5. Medicinal tubers accessed by Saura tribes in Mahendragiri

Tubers not only provide food for the Saura, they also used for preparing medicine by traditional healers.

Table A2.5. Tuber crops used in traditional medicine by Saura tribes

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|-------------------------------------|---------------------|--|
| <i>Dioscorea bulbifera</i> L. | Pindalu | Treats piles, digestive disorders |
| <i>Dioscorea alata</i> L. | Kandalu | Nutritional tuber, energy tonic |
| <i>Dioscorea pentaphylla</i> L. | Jangali kand | Rheumatism, body pain |
| <i>Curcuma longa</i> L. | Haladi | Anti-inflammatory, wound healing |
| <i>Curcuma aromatica</i> Salisb. | Ban haladi | Skin diseases, blood purifier |
| <i>Zingiber officinale</i> Roscoe | Ada | Digestive aid, cough |
| <i>Costus speciosus</i> | Kebuk | Diabetes, urinary disorders |
| <i>Amorphophallus paeoniifolius</i> | Olua | Piles, constipation |
| <i>Coleus forskohlii</i> Briq. | Pashanbheda | Kidney stones, hypertension |
| <i>Ipomoea batatas</i> L. | Sakarkand | Nutritional, energy booster |
| <i>Curculigo orchoides</i> Gaertn. | Talamuli | Aphrodisiac, tonic |
| <i>Typhonium trilobatum</i> L. | Ghatula | Anti-inflammatory, pain relief |
| <i>Gloriosa superba</i> L. | Kalihari | Abortifacient, arthritis (used with caution) |

| Scientific Name | Local / Tribal Name | Medicinal Uses |
|------------------------|---------------------|-----------------------------|
| Zingiber zerumbet L. | Ban ada | Fever, digestive disorders |
| Hedychium spicatum Sm. | Kapur kachri | Respiratory ailments, tonic |

A2.6. Medicinal plant Conservation issues

Medicinal plants are integral part of the tribal culture, and in their healthcare practices. These plants have multiple uses, some are edible while some provide income for the tribes. Both medicinal plants and the traditional wisdom associated with its uses are under trouble due to multiple reasons. Habitat destruction, lack of transmission of knowledge from older generations to new, lack of interest on medicinal plants and traditional healthcare practices by Saura younger generation, lack of proper documentation of medicinal uses of these plants etc are critical issues.

There is a pressing need to conserve these resources. Professor Swaminathan always emphasized the need for integration of traditional wisdom with frontier science to meet the challenges of healthcare and conservation of medicinal plants. Such an integration has to protect the intellectual property rights of tribes and benefit the public.

Annexure 3. Indigenous Agriculture practices in Mahendragiri

Introduction

The Saura tribes of Mahendragiri sustain their livelihoods through a complex, integrated system of subsistence agriculture deeply rooted in traditional ecological knowledge (TEK). Their farming practices are adapted to the hilly terrain and forest ecology, combining multiple land-use systems that ensure food security, nutritional diversity, and cultural continuity. Among these, Bogodo Chasa, Bari Chasa, and Bila Chasa represent the core components of Saura agriculture.

Bogodo chasa

Bogodo Chasa is a semi-permanent land use system, where forest patches are cleared by burning, and terraces are built using local resources, and on the basis of contours, facilitating water retention and soil management for raising crops like millets, pulses, oilseeds, tubers, and spices are cultivated together to optimize soil fertility and minimize pest risks. Once they clear the forest, they cultivate for three years and keep it fallow for 10-15 years for regeneration of soil. Traditional ecological knowledge play vital role in selecting the land for Bogodo, constructing terraces based on contours, adopt soil and water management practices (by way of facilitating run off and controlling soil erosion), and cultivate different crops in different terraces. The study shows that Saura tribes cultivate 10 to 20 crops at a time. Under Bogodo cultivation, Saura farmers broadcast seeds of multiple crops together on terraced hill slopes, allowing them to grow in a mixed system and harvest sequentially at different times to ensure continuous food supply and dietary diversity.

Bari chasa

Bari Chasa, practiced in homestead gardens, focuses on perennial crops, vegetables, and spices, providing year-round nutrition and household needs. Bari Chasa (homestead gardens) relies on proximity to household water sources, such as stored rainwater or small bamboo channels directing water from nearby springs. Moisture conservation is achieved through mulching with leaf litter and crop residues. In Bari Chasa, household waste, livestock manure, and ash from cooking fires are applied to maintain fertility. Women play an important role in cultivation, selection of crop species, seed selection, allocating area for different crops and harvesting of crops. They nurture soil fertility and adopt low cost and less intensive irrigation methods. This land use system provides year-round nutrition, spices, and fruits; supports household food security and cultural rituals.

Bari Chasa supports diverse crops—banana, papaya, jackfruit, mango, turmeric, ginger, chili, and leafy greens. This diversity enhances household nutrition and provides spices and fruits for cultural rituals.

Bari Chasa evolved as a complementary system to Bogodo and Bila Chasa, designed to utilize land adjacent to Saura households. Bari Chasa is practiced in small homestead plots, ensuring year-round access to fresh produce. Its uniqueness lies in intensive land use, proximity to water

sources, and integration of perennial crops with seasonal vegetables.

Bari Chasa ensures dietary diversity and provides cash income through surplus fruits and spices. It plays a critical role in food security during lean seasons. Bari Chasa conserves landraces of fruits, spices, and vegetables adapted to local ecology, contributing to resilience and cultural heritage.

Farm implements used in Bari chasa

Hand Hoe (Gubuda): An iron-bladed hoe for loosening soil, planting, and weeding.

Digging Stick (Khunti): A wooden stick used for making holes for seeds and checking soil depth.

Small Spade and Sickles: For soil preparation, cutting weeds, and harvesting vegetables.

Bamboo Baskets and Trays: For carrying manure, compost, and harvested produce.

Grinding Stones (Silbatta): Used for processing spices and condiments grown in Bari Chasa.

Irrigation Implements: Bamboo pipes or small channels for directing water from nearby sources.

These implements indicate the age-old practices followed in Bari chasa. They are produced based on local technology, locally available resources and suitable to local agro-ecology.

Bila chasa

Bila Chasa is a settled agricultural system giving emphasis for producing staple rice and other crops on a rotation basis. This method utilizes moist lower slopes and valley edges for sequential cropping—starting with indigenous paddy followed by pulses and vegetables—ensuring staple grain supply and protein sources. Under Bila chasa, sequential cultivation starts with Indigenous paddy followed by pulses (pigeon pea, horse gram) and vegetables like colocasia, beans, and cucurbits. During Monsoon, they cultivate paddy and then drought resistant crops like pulses and vegetables.

Bila Chasa depends on natural water retention in low-lying terraces. Farmers utilize seasonal streams and rainfed gullies, and also construct temporary earthen or bamboo channels to divert water to Bila chasa. Water management is entirely gravity-based, indicating their traditional wisdom. In Bila Chasa, fertility is sustained through crop rotation, which enhances nitrogen fixation and soil structure. Leaf litter from adjacent forests and decomposed biomass enrich the soil naturally.

This system conserves indigenous landraces of paddy, pulses, and vegetables adapted to hill ecology. Sequential cropping enhances soil fertility through nitrogen fixation and organic recycling, reducing dependency on external inputs.

Its ecological uniqueness lies in utilizing natural water retention zones without disturbing forest

integrity. By maintaining soil moisture and reducing erosion, Bila Chasa contributes to watershed stability and microclimate regulation.

Farm implements used in Bila chasa

In Bila chasa, the Saura tribes use simple, traditional implements suited for moist valley lands and sequential cropping. Common tools include:

Khunti (Digging Stick): Used for making planting holes and loosening soil for paddy and pulses.

Hand Hoe (Gubuda): Iron-bladed hoe for soil preparation, weeding, and planting vegetables after paddy harvest.

Wooden Plough: Occasionally used for leveling terraces and preparing soil in lower slopes.

Sickles: For harvesting paddy and cutting fodder.

Bamboo Baskets and Trays: For carrying seeds, manure, and harvested produce.

Threshing Implements: Wooden sticks for manual threshing of paddy and pulses.

Water Management Tools: Bamboo pipes or small channels to divert water from springs or streams to Bila plots.

These implements reflect traditional ecological knowledge, emphasizing low-cost, sustainable farming adapted to rainfed conditions. They are made from locally available materials like wood, bamboo, and iron, and maintained within the community.

Conclusion

These systems together reflect TEK in land selection, soil and water management, crop diversity conservation, and nutrient recycling. Rituals, collective labor, and seed-saving practices reinforce cultural values and ecological ethics. These practices reflect low-input, sustainable farming, ensuring soil health and water conservation while supporting diverse crops for food and nutrition. Together, they form a resilient socio-ecological model that balances subsistence needs with biodiversity conservation, though increasingly threatened by deforestation, policy neglect, and climate variability.

Annexure 4. Profile of Mahendragiri

Mahendragiri Mountains are located in the Gajapati district of Odisha, forming part of the Eastern Ghats mountain range. The landscape is characterized by rugged terrain, steep slopes, and deep valleys. The hills lie between 18°58'–19°04' N latitude and 84°20'–84°34' E longitude, near the Odisha–Andhra Pradesh border.

Altitudinal variation: The elevation ranges from 200 m in foothills to 1,501 m at Mahendragiri peak, the second-highest peak in Odisha. This variation creates diverse microclimates and vegetation zones.

Historical and Cultural Significance

Mahendragiri is steeped in mythology and history, associated with the Ramayana and Mahabharata. It is believed to be the site where Parashurama meditated and where Pandavas spent part of their exile. Sacred groves and shrines dedicated to Shiva and Parashurama underscore its spiritual importance, making it a centre for pilgrimage and tribal rituals.

Flora

The Mahendragiri hosts approximately 1,300–1,400 species of flowering plants, including trees, shrubs, herbs, and climbers. This diversity spans multiple families such as Fabaceae, Poaceae, Euphorbiaceae, and Rubiaceae, and includes numerous endemic and medicinal species. Dominant species include *Shorea robusta*, *Madhuca longifolia*, *Terminalia arjuna*, *Diospyros melanoxylon*, *Syzygium cumini* and bamboo species (*Dendrocalamus strictus*).

Forest types include dry deciduous and semi-evergreen forests, interspersed with grasslands and scrub. Over 300 medicinal species documented from Mahendragiri, including *Tinospora cordifolia* (Guduchi), *Andrographis paniculata* (Kalmegh), and *Curcuma longa* (Turmeric).

Fauna

Mahendragiri also harbors rich faunal diversity due to its varied altitudinal zones and mosaic of forests and grasslands.

Major Mammals reported in forest tracts include Leopard (*Panthera pardus*), Indian Giant Squirrel (*Ratufa indica*), Wild Boar (*Sus scrofa*), Indian Hare (*Lepus nigricollis*), Jungle Cat (*Felis chaus*), and Sloth Bear (*Melursus ursinus*). The forest also harbour rich avian fauna (Indian Peafowl (*Pavo cristatus*), Grey Hornbill (*Ocyroceros birostris*), Parakeets, Barbets, Drongos – and Pied Cuckoo (*Clamator jacobinus*)). The reptiles represent King Cobra (*Ophiophagus hannah*), Indian Rock Python (*Python molurus*), Monitor Lizards, and various geckos and skinks. Rich diversity of butterflies, bees, and lac insects (linked to Palash trees), supporting pollination and NTFP-based livelihoods.

NTFPs

Mahua flowers and seeds, Kendu leaves, bamboo, honey, medicinal herbs, and wild tubers form the backbone of tribal forest-based livelihoods.

Agricultural Heritage

Bogodo, a traditional shifting agriculture practiced by Saura tribes, involving mixed cropping of millets (Mandia, Suan), pulses (Harada, Muga), tubers (Sakarkand), and spices (Haladi, Ada). Millets dominate due to drought resilience; intercropping ensures food security and soil conservation.

Livestock rearing

Livestock—primarily goats, cattle, and poultry—are integral to livelihoods, acting as a financial buffer during crop failures. Grazing occurs in forest fringes, linking livestock with forest fodder availability.

Tribal Communities and Cultural Traditions

Saura being the major tribal community in Mahendragiri, while Kondh tribes are found in lower valleys. They hold rich oral traditions, wall paintings (Saura art), and observe rituals tied to agricultural cycles and forest resources. Sacred groves are integral to the cultural heritage of Saura, this community-managed patches serve spiritual and ecological functions. Festivals are linked to Mahua flowering, harvest cycles, and worship of hill deities.

Ecological Significance

Mahendragiri acts as a biodiversity hotspot, a watershed for seasonal streams, and a carbon sink. Its mosaic of forests, and Bogodo cultivation landscapes supports ecosystem services vital for local and regional sustainability.

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Annexure 6. Photos



Bila Chasa: Terraced Paddy



Bogodo Chasa Field



Local Breeds of Goat



Bila Chasa: Paddy Field



Bogodo: Pigeon Pea Field



Saura Tribal Woman Harvesting Millet



Desi Bitter Gourd



Bila Chasa: Bottle Gourd



Bogodo Chasa Cucumber



Bogodo Chasa Upland Rice



Bogodo Chasa: Finger Millet Field



Bari Chasa Local Banana Variety



Bogodo Chasa: Desi Sorghum

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