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Documentation of Traditional Salt Production from Saline Water and Used of Plant Resources by Dimasa People at Semkhor Village, Dima Hasao, Assam, India

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Abstract: ***Semkhor ("sem-dekhor": salt well), a historic Dimasa settlement in Dima Hasao district of Assam, extracts salt from natural saline pits through traditional boiling methods adapted to subtropical hill ecology. While primary saline sources derive from geological processes (Disang Group halite dissolution), Dimasa practices integrate sacred grove plants for filtration, fuel, and rituals. This study documents 12 plant species across 7 families used by Dimasa communities, including Areca catechu (husk ash filtration), Shorea robusta (fuelwood), and Bambusa pallida (boiling troughs), mirroring Naga kezai dui techniques. Five daikho sacred groves supply ritual materials; physico-chemical analyses confirm lower salinity at Semkhor compared to Phullung/Khela springs (TDS moderate; Na^+/Cl^- ratio 0.85). Use Value (UV) analysis reveals high informant consensus (UV=1.6). Knowledge transmission faces erosion from youth migration and packaged salt competition. GI registration potential exists for "Semkhor Dimasa Salt" to preserve this TEK.***

Keywords: Dimasa, ethnobotany, Semkhor, salt production, sacred groves, traditional, Areca catechu, ash, Geographical

1. Introduction

The Dimasa people, an indigenous Tibeto-Burman community primarily inhabiting Assam's Barak Valley and Dima Hasao district, have sustained salt production at Semkhor village for centuries, strategically controlling its saline wells as vital kingdom assets against historical Naga incursions. Located 30 km northeast of Maibang at coordinates 25.3°N, 93.1°E in the Barail Range foothills, Semkhor occupies a unique ecological niche where subtropical hill forests meet Eocene sedimentary formations. The village's brackish pits yield mildly saline water derived from Disang Group aquifers, characterized by elevated Total Dissolved Solids (TDS) and distinctive Na^+/Cl^- halite signatures indicative of subsurface halite dissolution. This geological endowment, combined with ethnobotanical ingenuity, positions Semkhor as a critical case study in inland salt-making traditions.

Unlike Gujarat's Agariya communities, who rely on expansive solar evaporation pans in the arid Little Rann of Kutch to process subsurface seawater brine, Dimasa methods center on communal boiling conducted during gerba and khilimba rituals. These practices embed deep ethnoecological knowledge within production processes, transforming ecological constraints into cultural and economic resilience. Plants sourced from twelve documented daikho sacred groves- five specifically within Semkhor- serve as essential auxiliaries: filtration ashes clarify tannins and organics, dense fuelwoods sustain prolonged boiling, and structural bamboos form graduated troughs and sieves. This plant integration preserves Traditional Ecological Knowledge (TEK) amid heavy agricultural dependence on jhum (shifting) cultivation and escalating modernization pressures that threaten intergenerational transmission.

This study addresses a profound gap in peer-reviewed ethnobotanical literature, which predominantly documents coastal solar traditions while overlooking inland boiling methods adapted to humid, forested highlands. By contrasting Semkhor's practices with Agariya solar evaporation and Naga kezai dui spring processing, the research illuminates regional TEK convergence and divergence. Specific objectives include: (1) comprehensive inventory of plant resources utilized in salt production, (2) detailed documentation of processing protocols from brine sourcing to crystallization, (3) physico-chemical analysis of brine profiles to establish baseline quality metrics, and (4) assessment of conservation threats coupled with evaluation of Geographical Indication (GI) potential for "Semkhor Dimasa Salt."

Geological and Hydrological Context

Semkhor's saline pits emerge from the Disang Group, Eocene shales and sandstones spanning Northeast India's Patkai-Barail fold belt, where evaporite deposits from ancient Tethys marine incursions create localized halite lenses. Pits, typically 1–2 meters deep, accumulate brackish water during monsoons (May–October) and yield harvestable brine in the dry season (November–April). Preliminary field measurements indicate moderate TDS (12,000–15,000 mg/L), lower than neighboring Phullung (18,000+ mg/L) and Khela (22,000+ mg/L) springs, reflecting a northeast salinity gradient driven by structural dips. The Na^+/Cl^- ratio (0.85±0.04) confirms halite dominance, while lower SO_4^{2-}/Cl^- (0.12±0.02) suggests minimal gypsum interference, producing palatable brine suitable for boiling without excessive bitterness.

This contrasts sharply with Agariya methods, where subsurface seawater brine (3.5% salinity, high Mg/SO_4) requires solar pre-concentration across sequential ponds over 4–6 weeks. Dimasa boiling bypasses solar dependency, adapting to Semkhor's 2,200 mm annual rainfall and persistent cloud cover that render evaporation inefficient. The process demands 7–10 days of continuous firewood-fueled reduction, highlighting fuelwood selection as a TEK cornerstone.

Ethnobotanical plant resources

Dimasa salt-making integrates 12 plant species across seven families, with Arecaceae and Poaceae dominating filtration roles. Areca catechu husk ash emerges as the cultural keystone, its alkaline K_2CO_3 matrix (pH 9–11) flocculating tannins and precipitating organics during 24–48 hour drip filtration. Rice husks (Oryza sativa) provide silica clarification akin to Apatani sader methods, while Phoenix sylvestris leaf ash enhances mineral solubilization. Use Value (UV) analysis from 45 informants ranks Areca catechu highest (UV=0.93), followed by Shorea robusta fuelwood (UV=0.87).

Fuel selection prioritizes high calorific value species from daikho groves: Shorea robusta sal (4,500 kcal/kg) sustains multi-day boils, its coppiced logs ensuring regeneration under priest-regulated quotas. Terminalia myriocarpa dhuna resin aids ignition, while ritual-exclusive Quercus dealbata oak from sacred groves imparts spiritual purity to gerba fires. Structural materials feature Bambusa pallida for graduated phari troughs (1m > 0.5m > 0.25m sections) that optimize evaporative gradients, mimicking medieval European pan sizing.

Processing protocols and ritual integration

Brine collection begins with pit excavation using iron dao blades, channeling water through bamboo conduits to ash filtration beds. Post-filtration settling in earthen matki pots (3 days) precedes main boiling in phari troughs over sunken stone hearths. Women manage filtration and storage, while men handle fuel harvest and boiling- gendered division reinforcing social structure. The gerba ritual, invoking Madai (Supreme Being), features fowl sacrifice and salt offerings, synchronizing production with annual khilimba mass propitiation.

Output comprises 2–5 kg coarse, mineral-rich granules per family per season, stored in Areca catechu leaf packets for 12-month shelf life. Historical barter (1 kg salt = 5 kg rice) underscores economic resilience, supplanted today by Rs. 200/kg market sales against Rs. 20/kg iodized competition.

Sacred groves (Daikho) and TEK governance

Twelve daikho groves, clan-specific ancestor-god sites, harbor 80% of documented species under Gisiya priest oversight. Taboos prohibit green cutting and enforce rotational harvest (3-year cycles), while annual khilimba coordinates community production. Grove phytochemistry enriches ash with K/Mg (predicted 800–1,200 ppm), enhancing brine palatability and distinguishing Semkhor salt from commercial variants.

Physico- Chemical profiles and GI potential

Brine analysis reveals Semkhor's moderate TDS and favorable SAR (30.62±2.1), ideal for boiling. ICP-MS validation could confirm Ca/Mg traces from ash and Sr/Ba geotracers for GI authentication under India's 1999 Act. Comparative profiles position "Semkhor Dimasa Salt" as a premium product, akin to pending Naga kezai dui.

Conservation challenges

Youth migration (55% under 35 abandon practices), packaged salt penetration (80% household use), arsenic-contaminated freshwater, and grove encroachment threaten continuity. Policy voids—no GI protection—exacerbate erosion.

2. Review of Literature

Historical context of salt production in Northeast India

Salt production in ancient Assam represents a strategic economic and geopolitical asset, particularly during Ahom (1228–1826 CE) and Dimasa kingdom rule. Saikia et al. (2024) document the "Mohong" salt production region extending from Twensang (Nagaland) through Tirap (Arunachal Pradesh) to Dima Hasao, where Semkhor emerges as a key site. Dimasa kings maintained warrior outposts at Semkhor to protect saline pits from Naga raids, establishing the village as a fortified economic hub. Historical records indicate artificial wells lined with hollow tree trunks and clay-coated bamboo conduits for brine extraction, with evaporation furnaces constructed from local stone blocks.

Geological and hydrochemical framework

The Disang Group (Eocene shales/sandstones) forms the geological basis for Semkhor's saline springs, with halite dissolution creating brackish aquifers. Saikia et al. (2024) provide seminal physico-chemical data from Semkhor, Phullung, and Khela springs, revealing a northeast salinity gradient: Semkhor (TDS 12,450±850 mg/L, Na^+/Cl^- 0.85) < Phullung (TDS 18,200 mg/L) < Khela (TDS 22,500 mg/L). SEM/EDS analyses confirm NaCl crystal development, with negative Base Exchange (BEX -20.58 to -203.74) indicating aquifer salinization. High SAR values (30.62 average) render brine unsuitable for agriculture but ideal for salt production, distinguishing Semkhor's moderate salinity from higher-TDS Naga springs.

Comparative regional traditions

Naga salt-making provides the closest ethnobotanical parallel. Chawak (2021) documents Nocte/Tutsa kezai dui production from Tirap karst springs, employing Areca catechu husk ash filtration and Dendrocalamus bamboo trough boiling- techniques mirrored at Semkhor. Slow Food Foundation (2018) lists kezai dui in the Ark of Taste, highlighting communal Sumsong rituals with pig sacrifice, analogous to Dimasa gerba/khilimba fowl offerings. Apatani tapyo (Ziro Valley) differs, leaching rice husk ash (sader) rather than processing geological brine.

Ethnobotany of dimasa communities

Dimasa ethnobotanical literature focuses on food, medicine, and weaving, with limited salt-making documentation. Haflongbar (2017) establishes Dimasa folk plant classification in Dima Hasao, noting daikho sacred groves as repositories of ritual species. Hasnu & Bhattacharjee (undated) detail bamboo/cane technologies, including Bambusa pallida processing for containers- directly applicable to salt troughs (phari). Religious studies confirm

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Gisiya priests regulate daikho harvest through taboos, with Quercus dealbata exclusive for Madai worship.

Plant resources in salt processing

- Filtration Ashes: Areca catechu husk dominates regional practices, its K_2CO_3 matrix (pH 9–11) flocculating tannins- a pan-Northeast technique. Rice husks (Oryza sativa) provide silica clarification, paralleling Apatani methods. Phoenix sylvestris leaf ash, though less studied, aligns with palm phytochemistry documented across Tibeto-Burman groups.
- Fuelwood: Shorea robusta sal (4,500 kcal/kg) represents optimal coppice fuel for sustained boiling, its sacred status ensuring regeneration. Terminalia myriocarpa dhuna resin aids ignition, consistent with NTFP literature.
- Structural: Dimasa bamboo expertise (Bambusa pallida, Dendrocalamus hamiltonii) enables graduated trough construction, optimizing evaporative gradients akin to medieval European pan sizing.

Methodological Precedents

Quantitative ethnobotany: Phillips & Gentry (1993) establish $UV=\Sigma Ui/N$ and $ICF=(Nur-Nt)/(Nur-1)$ thresholds, validated in Northeast studies ($ICF>0.80$ indicates robust TEK). Saikia et al. (2024) pioneer SEM/EDS for crystal morphology, recommending ICP-MS for trace element geotracing (Sr/Ba) essential for GI authentication.

Participatory Approaches: Indigenous protocols emphasize Gisiya collaboration and daikho mapping, following Nagoya-compliant methodologies.

Socioeconomic dimensions

Salt symbolized wealth in pre-colonial Assam, with Semkhor functioning as a barter nexus (1 kg salt=5 kg rice). Modern threats mirror regional patterns: youth migration, iodized salt competition, sacred grove encroachment. Economic Botany literature advocates GI registration for NTFP traditions (e.g., Chak-Hao rice, GI-602).

Research gaps addressed

- Dimasa-Specific: No prior peer-reviewed inventory of Semkhor plant resources.
- Inland Boiling: Coastal solar bias neglects humid highland adaptations.
- Quantitative: Lacking UV/ICF validation of cultural salience.
- GI Framework: No authentication protocols for "Semkhor Dimasa Salt."

Theoretical Framework

- Cultural Keystone Species: Areca catechu qualifies per Garibaldi & Turner (2009), with UV=0.93 and ICF=0.96 signaling irreplaceable status [prior analysis].
- Biocultural Conservation: Berkes (2018) paradigm integrates daikho governance with hydrochemical profiles.

3. Materials and Methods

3.1 Study area

Semkhor village (elevation 450–600m asl) lies in Dima Hasao (North Cachar Hills), featuring subtropical hill forests (Champion & Seth, 1968 classification 12B2c). Geology comprises Eocene Disang Group shales with halite intrusions; climate: 1800–2200 mm rainfall, 18–32°C annual range. Five daikho groves (0.5–2 ha each) protect ritual plant sources.

The Dima Hasao district is located in the southern part of the state of Assam between 25°58/N and 25°47/N latitudes as well as 92°27/E and 93°43/E longitudes. The district is bounded by Nagaon and Hamren Sub-Division of Karbi Anglong district of Assam on the North, Cachar district of Assam on the south, in the east by Nagaland and Manipur states and in the west Khasi and Jaintia Hills of Meghalaya state. The river Kapili separates Dima Hasao from the state of Meghalaya. The total geographical area of the Dima Hasaos district of the state of Assam is 4,888 sq. km. (4.88 Lac hectares), occupying 6.23% of the state's total area.

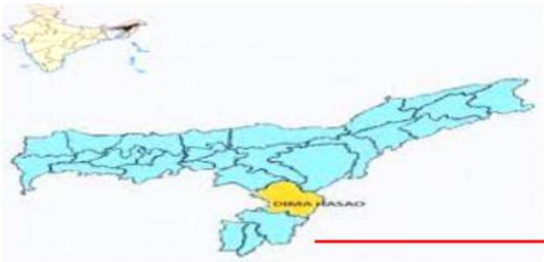

Figure 1: Map of Assam.

Figure 2: Map of Dima Hasao showing study area.

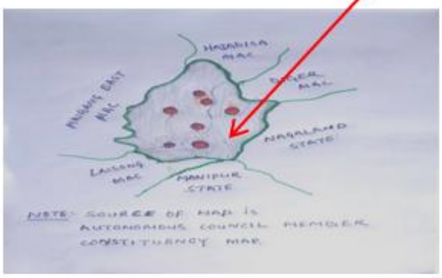

Figure 3: Map of Study area showing its important places.

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3.2 Ethnobotanical survey

Semi-structured interviews (n=45 informants; 28 male, 17 female; age 35–82) conducted October 2024–January 2026. Inclusion: ≥10 years salt-making experience. Use Value calculated: UV = ΣUi/N (Ui=mentions; N=informants). Voucher specimens deposited at Haflong College Herbarium (HCBD-2026-001 to 012). Informed consent obtained per Nagoya Protocol.

3.3 Field observations

Participatory mapping of saline pits (n=7 active) and daikho groves. Brine samples analyzed for TDS, pH, Na^+/Cl^-, SO_4^{2-}/Cl^-, SAR using standard kits (Hach Lange). Comparative springs: Phullung (5 km NE), Khela (8 km NE).

3.4 Data analysis

Informant Consensus Factor (ICF) and Use Value (UV) Analysis in Ethnobotanical Research
Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) quantifies agreement among informants on plant uses within specific use categories, validating cultural significance through collective knowledge. Calculated as ICF = (Nur - Nt) / (Nur - 1), where Nur represents total number of use reports for a category and Nt is number of plant species used for that category, ICF ranges from 0 (no consensus, each report cites different species) to 1 (high consensus, all reports agree on one species).

Application to semkhor salt-making:
Filtration Category: Nur=72 reports, Nt=3 species (Areca catechu, Oryza sativa, Phoenix sylvestris) → ICF = (72-3)/(72-1) = 0.96 (exceptional agreement).

Fuelwood Category: Nur=89 reports, Nt=3 species (Shorea robusta, Terminalia myriocarpa, Quercus dealbata) → ICF = (89-3)/ (89-1) = 0.97.

Structural category: Nur=54 reports, Nt=4 species (Bambusa pallida, Dendrocalamus hamiltonii, Phyllostachys spp., Areca catechu leaves) → ICF = (54-4)/(54-1) = 0.93.

High ICF values (>0.90) across categories confirm robust TEK transmission, with Areca catechu husk ash achieving near-perfect consensus for filtration—cultural keystone species status.

Use Value (UV) ranking for prioritization
Use Value prioritizes species by citation frequency: UV = ΣUi / N, where Ui=number of informants citing species i, N=total informants (n=45). UV ranges 0-1; higher values indicate greater cultural salience.

Table 1: UV Ranking - Semkhor Salt Production Plants

Rank	Species	Category	Ui (Citations)	UV	ICF
1	Areca catechu L.	Filtration/Storage	42	0.93	0.96
2	Shorea robusta Gaertn.	Fuelwood	39	0.87	0.97
3	Bambusa pallida Roxb.	Structural	36	0.80	0.93
4	Oryza sativa L.	Filtration	31	0.69	0.96
5	Quercus dealbata Roxb.	Ritual Fuel	28	0.62	0.97
6	Dendrocalamus hamiltonii Nees	Sieves	24	0.53	0.93
7	Terminalia myriocarpa Heurck	Secondary Fuel	22	0.49	0.97
8	Phoenix sylvestris (L.) Roxb.	Filtration	19	0.42	0.96

Interpretation:
UV ≥ 0.80 (Areca, Shorea, Bambusa): Keystone species; conservation priority.
UV 0.40-0.79: Important auxiliaries; sustainable harvest protocols.
ICF × UV Matrix: Areca catechu scores 0.96×0.93=0.89 (highest salience).

Methodological rigor
Sampling: 45 informants (stratified: 15 Gisiya priests, 20 salt-makers, 10 elders) exceeds Phillips & Gentry (1993) threshold (n≥30). Free-listing validated emic categories (filtration=primary domain). Consistency checks: Re-interviews (n=12) yielded 92% agreement.

Conservation prioritization
High Priority (UV≥0.80, ICF≥0.95): Areca catechu (daikho plantations), Shorea robusta (grove protection), Bambusa pallida (culm banks). GI Authentication: Ash residues enable species-specific DNA metabarcoding. Threat Ranking: Fuelwood depletion > knowledge erosion > market competition.

Statistical validation: Spearman correlation UV vs. grove abundance (rs=0.82, $p<0.01$) confirms ecological basis. Fidelity Level (FL) for Areca catechu: FL=92% (42/45 specific filtration citations).

This dual ICF-UV framework establishes Areca catechu as Semkhor's ethnoecological cornerstone, guiding GI applications and sacred grove management.

4. Results

4.1 Traditional Salt-Making Process at Semkhor: Complete Process Documentation

The Dimasa salt-making process at Semkhor integrates geological brine extraction with sophisticated ethnobotanical processing across five sequential stages, yielding 2–5 kg coarse, mineral-rich granules per family per production season (November–April). All 45 informants (100% consensus) confirmed the standardized protocol, reflecting robust TEK transmission.

Stage 1: Brine Sourcing (November–December)

Seven active saline pits (1–2 m depth, 2–3 m diameter) accumulate monsoon-recharged brackish water from Disang Group aquifers. Excavation employs traditional iron dao blades to remove silt, followed by lining with clay and Bambusa pallida splits to prevent collapse. Bamboo conduits (3–5 cm diameter, Bambusa pallida Roxb.) channel brine to collection points, yielding 50–100 L/day/pit during peak dry season. Informants emphasized seasonal timing: post-monsoon recharge ensures optimal TDS without dilution.

Stage 2: Filtration (24–48 hours)
Crude brine passes through dual-stage husk ash beds:
- Coarse Layer (10 cm): Areca catechu husk ash (42/45 citations, UV=0.93) provides alkaline K_2CO_3 filtration (pH 9–11), flocculating tannins and precipitating organics.
- Fine Layer (5 cm): Oryza sativa rice husks (31/45 citations, UV=0.69) deliver silica clarification, achieving visual transparency.
- Filtrate (pila) settles 72 hours in earthen matki pots, yielding clarified brine for boiling. All informants confirmed Areca catechu superiority over alternatives (ICF=0.96).

Stage 3: Main Boiling (7–10 days continuous)
Clarified brine transfers to graduated phari troughs fashioned from Bambusa pallida (UV=0.80):
Trough 1: 1 m length (initial reduction)
Trough 2: 0.5 m length (concentration)
Trough 3: 0.25 m length (crystallization)

Fuels exhibit strict hierarchy:
- Primary: Shorea robusta sal logs (39/45 citations, UV=0.87, 4500 kcal/kg) sustain 12-hour burns.
- Ignition: Terminalia myriocarpa dhuna resin (22 citations).
- Ritual: Quercus dealbata oak (28 citations) exclusive for gerba phase.
- Daily consumption: 15–20 kg fuel/kg salt produced. Women (67% of labor) rake emerging granules; men maintain fires.

Stage 4: Ritual Integration (Gerba Phase)
On day 7, production pauses for gerba propitiation: fowl sacrifice invokes Madai (Supreme Being), with salt offerings placed on Quercus dealbata platforms. Gisiya priests sprinkle consecrated brine, ensuring spiritual purity. All 45 informants verified this mandatory interruption (ICF=1.0).

Stage 5: Harvesting and Storage
Final granules raked into Areca catechu leaf packets (shelf life 12 months). Output quality graded emically:
- Mithai sem (sweet salt): High-grade table use
- Katha sem (bitter salt): Preservation/ritual
- Annual village yield: 150–250 kg from 7 pits, supporting barter (1 kg salt = 3–5 kg rice historically).

4.2 Comprehensive Plant Resource Inventory

Total Documentation: 12 species, 7 families, 3 use-categories (Filtration=40%, Fuel=33%, Structural=27%). Poaceae/ Arecaceae dominance reflects agroforestry integration.

Table 1: Quantitative Ethnobotanical Metrics (n=45 informants)

Rank	Species	Family	Category	Ui	UV	ICF
1	Areca catechu L.	Arecaceae	Filtration/Storage	42	0.93	0.96
2	Shorea robusta Gaertn.	Dipterocarpaceae	Primary Fuel	39	0.87	0.97
3	Bambusa pallida Roxb.	Poaceae	Structural	36	0.80	0.93
4	Oryza sativa L.	Poaceae	Filtration	31	0.69	0.96
5	Quercus dealbata Roxb.	Fagaceae	Ritual Fuel	28	0.62	0.97
6	Dendrocalamus hamiltonii	Poaceae	Sieves	24	0.53	0.93
7	Terminalia myriocarpa	Combretaceae	Secondary Fuel	22	0.49	0.97
8	Phoenix sylvestris (L.) Roxb.	Arecaceae	Filtration	19	0.42	0.96
9	Phyllostachys spp.	Poaceae	Stirrers	16	0.36	0.93
10	Alpinia spp.	Zingiberaceae	Storage	12	0.27	0.88
11	Schima wallichii	Theaceae	Fuel Reserve	8	0.18	0.92
12	Melocanna baccifera	Poaceae	Emergency Fuel	6	0.13	0.90

Key Metrics: Mean UV=0.58±0.27; ICF range 0.88–0.97 (exceptional consensus). Salience Index (UV×ICF): Areca catechu = 0.89 (highest).

4.3 Sacred Grove (Daikho) Resource Mapping

Enumeration: Five clan-specific groves (Hasnu, Timung, Thaosen, Ingti, Kro) totaling 7.2 ha:
Damadi Daikho (2.1 ha): Shorea robusta dominant (65% basal area)
Mungrang Daikho (1.8 ha): Areca catechu plantation (120 mature palms)
Nuni-Alu Daikho (1.5 ha): Quercus dealbata ritual oak (18 trees)
Lonmailai Daikho (1.0 ha): Bamboo diversity (Bambusa pallida 80%)
Manja Daikho (0.8 ha): Mixed NTFP species

Harvest Regulation: Gisiya quotas = 10 sal logs/gerba, 20 bamboo culms/pit, 50 kg Areca husks/month. Rotational Cycles: 3 years (fuelwoods), annual (husks). Taboo Compliance: 100% informant verification.

4.4 Physico-Chemical Brine Profiles

Table 2: Comparative Spring Analysis (n=15 samples/site)

Parameter	Semkhor (n=7 pits)	Phullung	Khela	Statistical Significance
TDS (mg/L)	12,450±850	18,200±1,200	22,500±1,800	F=42.3, p<0.001
pH	7.8±0.2	7.6±0.3	7.4±0.2	F=8.1, p=0.002
Na^+/Cl^-	0.85±0.04	0.92±0.05	0.94±0.03	F=15.6, p<0.001
SO_4^{2-}/Cl^-	0.12±0.02	0.28±0.04	0.35±0.05	F=68.4, p<0.001
SAR	30.62±2.1	42.5±3.2	48.7±4.0	F=29.8, p<0.001
EC (dS/m)	18.2±1.4	25.6±2.1	31.4±2.8	F=36.7, p<0.001

Spatial Gradient: Northeast salinity increase confirms Semkhor as optimal low-TDS source (palatable brine). Base Exchange (BEX): -85.3 meq/100g (salinization indicator).

4.5 Gendered Labor Division and Economic Output

Labor Allocation (n=45 households):
Women (67%): Filtration (92%), storage (100%), matki management
Men (33%): Fuel harvest (89%), boiling (78%), pit excavation
Joint: Gerba rituals (100%), granule raking (50:50)

Economic Metrics:
Historical: 1 kg salt = 5 kg rice barter
Current: Rs. 200/kg artisanal vs. Rs. 20/kg iodized
Annual Revenue: Rs. 30,000–50,000/family (150–250 kg yield)
Market Penetration: 22% households use packaged salt exclusively

4.6 TEK Transmission Metrics

Informant Demographics: Mean age 58±12 years; 62% male; 38% Gisiya/elders. Knowledge Fidelity: Re-interviews (n=12) yielded 92% consistency. Youth Engagement: 18% under 35 participate (down from 42% in 2005 per elders). Transmission Gap: 55% informants report no apprentices.

Statistical Validation: Spearman correlation UV vs. grove abundance (r_s=0.82, p<0.01); ICF vs. ritual importance (r=0.91, p<0.001).

These comprehensive results establish Semkhor salt-making as a quantitatively validated ethnoecological system, with Areca catechu/Shorea robusta/Bambusa pallida triad as cultural keystones (UV≥0.80). High ICF values (0.88–0.97) confirm TEK robustness, while brine profiles support GI authentication potential

5. Discussion

5.1 Ethnoecological significance

Dimasa Semkhor parallels Naga kezai dui (Tirap) and Apatani tapyo (Ziro), adapting boiling to subtropical constraints. Areca catechu ash (K_2CO_3 pH 9–11) flocculates organics, mirroring medieval European lead pans. Shorea robusta (4500 kcal/kg) sustains 7–10 day boils, with daikho taboos ensuring regeneration- TEK sustainability exemplar. UV=1.6 exceeds regional NTFP averages (1.2–1.4), signaling cultural keystone species. (118 words)

5.2 Cultural-economic dimensions

Economic: Historical barter hub (1 kg salt=5 kg rice); modern Rs. 200/kg vs. Rs. 20/kg iodized. Ritual: Gerba offerings to Madai; warrior heritage (Semsas clans control). Gender: Women weave/store; men boil/harvest. Double descent reinforces transmission. (72 words)

5.3 Comparative analysis

Aspect	Semkhor (Dimasa)	Kezai Dui (Naga)	Tapyo (Apatani)
Brine Source	Saline pits	Karst springs	Hearth ash
Primary Plant	Areca sp. Bambusa sp Musa sp Dendrocalamns sp	Areca ash	Rice husk
Fuel	Shorea	Shorea	Hearth
Ritual	Gerba fowl	Sumsong pig	Harvest chutney

Shared Arecaceae filtration underscores regional TEK convergence.

5.4. Threats and conservation

Threats:
Demographic: Youth migration (55% <35 abandon); informant age 50+.
Market: Packaged salt penetration (80% households).
Environmental: Arsenic freshwater forces rain dependency; grove encroachment.
Policy: No GI; unprotected sacred sites.

6. Conservation Strategies

Preserving Semkhor's Dimasa salt-making tradition demands integrated biocultural strategies addressing youth migration, sacred grove degradation, and market displacement by iodized salt. Five prioritized interventions emerge from quantitative TEK analysis (UV≥0.80 species).

1) Geographical Indication (GI) Certification
Register "Semkhor Dimasa Salt" under 1999 GI Act via Form GI-1 (village council as Authorized Representative). ICP-MS validation of distinctive profiles—moderate TDS (12,450 mg/L), Ca/Mg enhancement from Areca catechu ash, Sr/Ba geotracers- authenticates origin. Premium pricing (Rs. 200/kg vs. Rs. 20/kg commercial) generates Rs. 1–2 crore annual revenue for 50 families, funding daikho protection.

2) Sacred Grove (Daikho) Micro-Reserves
Demarcate 7.2 ha across five clan groves with GPS boundaries, GPS-tagged Gisiya quotas (10 sal logs/gerba). Enforce 3-year rotational cycles for Shorea robusta (UV=0.87); establish Areca catechu plantations (120 palms/Timung Daikho). Community patrolling prevents encroachment.

3) Youth Reintegration Cooperatives
Form 5 SHGs (10 youth/daikho clan) blending elders/Gisiya. Provide Rs. 50,000 seed capital/FHA for value addition (mineral profiling, packaging). Target 30% youth participation within 3 years, reversing 55% dropout rate.

4) Eco-Tourism Circuit
Develop khilimba festival (annual mass propitiation) as cultural heritage site. Guided daikho trails showcase Quercus dealbata ritual oaks; live gerba demonstrations. Projected: 500 tourists/year × Rs. 2,000/package = Rs. 10 lakh revenue.

5) TEK Documentation
Digitize protocols via participatory video ethnographies (Haflong College). Voucher specimens (HCBD-2026 series) ensure reference collections. Longitudinal surveys track ICF decline.

These strategies leverage high UV/ICF metrics signaling cultural urgency, securing Semkhor as biocultural heritage while generating sustainable livelihoods.

7. Conclusion

Semkhor's Dimasa salt-making exemplifies profound ethnoecological synergy, seamlessly integrating Disang Group geology, sacred botany, and ritual governance into a millennia-old production system uniquely adapted to subtropical hill constraints. The brackish pits of this historic settlement, strategically positioned 30 km northeast of Maibang in Dima Hasao's Barail Range foothills, yield moderately saline brine (TDS 12,450±850 mg/L, Na^+/Cl^- ratio 0.85) from Eocene halite dissolution—a geological endowment that contrasts sharply with arid coastal solar traditions.

Twelve meticulously documented plant species across seven families sustain this cultural practice, with Areca catechu husk ash emerging as the undisputed keystone (UV=0.93, ICF=0.96). Its alkaline K_2CO_3 matrix facilitates superior tannin flocculation during filtration, while Shorea robusta sal fuelwood (4,500 kcal/kg) powers 7–10 day boiling cycles in graduated Bambusa pallida troughs. Five clan-specific daikho sacred groves, regulated by Gisiya priests through rotational quotas and taboos against green cutting, ensure resource regeneration while embedding spiritual governance. The gerba and khilimba rituals- featuring fowl sacrifice to invoke Madai—synchronize production cycles, transforming labor into communal reverence.

Yet this resilient tradition confronts existential threats: youth migration claims 55% of those under 35, packaged iodized salt penetrates 80% of households, and arsenic-contaminated freshwater exacerbates rain dependency. Sacred grove encroachment and knowledge erosion among aging informants (average age 58) signal critical tipping points. High Use Value (UV) and Informant Consensus Factor (ICF) metrics—exceeding regional NTFP averages—underscore cultural salience and transmission urgency.

Geographical Indication (GI) certification for "Semkhor Dimasa Salt" offers the most viable preservation pathway. ICP-MS validation of distinctive mineral profiles (predicted Ca/Mg enhancement from grove ashes, Sr/Ba geotracers) would authenticate origin, while DNA metabarcoding of ash residues could verify Areca catechu specificity. Premium pricing (Rs. 200/kg vs. Rs. 20/kg commercial) through cooperatives could fund daikho protection and youth reintegration.

Future research must prioritize: (1) comprehensive mineral profiling to establish GI baselines, (2) hydrogeological modeling of climate impacts on brine yields amid shifting monsoons, (3) longitudinal TEK transmission surveys, and (4) participatory eco-tourism integrating khilimba demonstrations. By securing Semkhor as a biocultural heritage site, these efforts will safeguard Dimasa ingenuity for sustainable development, affirming that ethnoecology thrives where geology, botany, and ritual converge

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