Ecology, Economy and Society–the INSEE Journal 5 (1): 139-176, January 2022

RESEARCH PAPER

The Erosion of Biodiversity and Culture: Bankura District of West Bengal as an Illustrative Locale

Debal Deb*

Abstract: The decimation of biodiversity at the species, genetic, and ecosystem levels as a direct consequence of the industrial resource use mode is well documented in human ecology and conservation literature. Not only wild biota but also domesticated crop landraces have been pushed to extinction by industrial land-use systems. The process of biodiversity erosion impinges on, and is augmented by, the decimation of local cultural elements, such as food cultures, the vocabularies of local languages, house architecture, and an inchoate appreciation of the non-use value of biodiversity, i.e., beyond its instrumental value. This process of biocultural erosion is evident in the district of Bankura, West Bengal, India, and this article collates evidence from over two decades of my research on the biodiversity and cultural elements of the region. The replacement of a traditional eco-centric ethic with an industrial ethic, and its consequent impacts on biodiversity and local cultural traditions in this region, is illustrative of the global process of biodiversity loss

Keywords: Biodiversity, Biophilia, Culinary art, Language, Tradition, West Bengal

1. INTRODUCTION

A plethora of studies have documented the process of the loss of biodiversity and traditional cultures as a consequence of the urban–industrial mode of land use, economic growth, and market integration (UNEP 2005; Elmqvist et al. 2016; Irvine et al. 2016; Ceballos, Ehrlich, and Dirzo 2017; Aswani, Lemahieu, and Sauer 2018; Curtis et al. 2018; Brondizio et al. 2019; Sánchez-Bayo and Wyckhuys 2019; Rosin et al. 2020). The loss of the biotic components of local ecosystems, in turn, impinges on the local cultural fabric, which evolved alongside the direct and indirect use values of biodiversity. Industrial land use, and an industrial ethic, gradually

* Centre for Interdisciplinary Studies 186A, Kalikapur Canal Road, Kolkata, India, debdebal@gmail.com

Published by Indian Society for Ecological Economics (INSEE), c/o Institute of Economic Growth, University Enclave, North Campus, Delhi 110007.

ISSN: 2581–6152 (print); 2581–6101 (web).

DOI: https://doi.org/10.37773/ees.v5i1.487

displace *biophilia* (Fromm 1973)—love and respect for life—inherent in indigenous societies, characterized by an inchoate appreciation of the non-use value of biodiversity, i.e., beyond its instrumental value (Kellert and Wilson 1993; Deb and Malhotra 2001). This process of loss of life forms is often not obvious and is not recorded in mainstream biodiversity research until certain species are lost from a local ecosystem. Owing to the complexity and multiplicity of biocultural interactions on the social, psychological, and ethical planes, the process of decay of local cultures is more insidious and seldom described in biodiversity research, although this decay may accentuate further loss of biodiversity. The process of biocultural decay is captured only in local case studies (e.g., Byers, Cunliffe, and Hudak 2001; Pauchard *et al.* 2006; Amici et al. 2015; Elmqvist *et al.* 2016) on urban–industrial land-use change and its impacts on biodiversity and indigenous knowledge systems. In this essay, I present a case study of a southwestern district of West Bengal, India, to describe a long-drawn process of decay of biodiversity and local cultural heritage. In this effort to document the process of biocultural erosion, I describe biodiversity under two broad rubrics—wild and domesticated biota. However, the usage of the term "wild" warrants the following caveat.

On the ecosystem level, there is hardly any entity that is purely "wild", in the sense of "pristine" or "untrammelled" by human intervention. Rather, all existing forest and wetland ecosystems on all lived continents have either been created or modified by human activities. Nearly three-quarters of terrestrial nature has long been shaped by diverse histories of human habitation and use by indigenous peoples (Lombardo *et al.* 2020; Ellis *et al.* 2021). The imagining of a "pristine" or "virgin" wild land is an old European construct, created to distinguish the "West as civilization" from the rest of the world as wilderness (Clement and Junqueira 2010; Fletcher *et al* 2021). As Ellis *et al.* (2021, 7) write,

> Depicting human use of nature largely as a recent and negative disturbance of an otherwise human-free natural world is not only incorrect but has profound implications for both science and policy. Across the vast majority of this planet, traditional, indigenous, and contemporary cultural natures, together with their interwoven peoples and histories, and not areas free from human influence, are essential for understanding and sustaining terrestrial nature, including its biodiversity and contributions to people.

Dissociating "wild" ecosystems such as forests and wetlands from "the spiritual, economic, and cultural needs of past and present indigenous and local inhabitants" (Fletcher *et al.* 2021, 3) in any part of India would thus be unrealistic. I intend to discuss these human economic and cultural

interconnections with nature—both wild and domesticated—to describe the process of biocultural erosion in the district of Bankura.

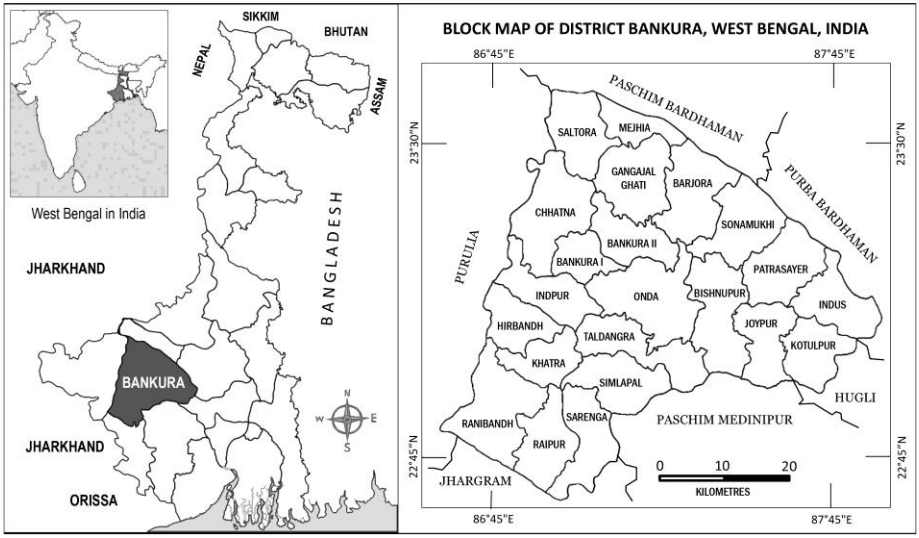
2. THE STUDY SITE

The district of Bankura in the state of West Bengal, India (Fig. 1), is a part of the lateritic extension of the Chota Nagpur Plateau. It supports dry deciduous forest vegetation and is situated between 22° 38' N and 23° 38' N and between 86° 36' and 87° 46' E. The district is a part of an ancient land mentioned in historical texts as Rarh Bengal. The Tirumalai inscription of 1024 CE mentions four geopolitical units in the area—Tandabutti (also known as Dandabhukti in the historical literature), Takkanaldam, Vangaladesh, and Uttiraladam, of which Takkanaldam originally, Dakshina Rarha)—the southern portion of Rarh—consists of today's Bankura, Birbhum, Bardhaman, and Hoogly districts (Ghosh 1992). The *Bhaivishya Purana*, composed between the fifteenth and sixteenth centuries CE, mentions Tungabhum, which is today's Raipur Community Development Block in the district. Mallabhum refers to the kingdom of the Malla dynasty of Bishnupur (sixteenth to seventeenth century), which spread over the current administrative blocks (hereafter blocks) of Bishnupur, Indas, Kotulpur, Onda, and most of Bankura (O'Malley 1996 [1908]).

A major part of the district was once covered with dense forests inhabited by forest people. As the *Açaranga Sutta*, a Jain text of ca. fifth century BCE (Jacobi 1884) depicts, Mahavira, the founder of Jainism, had been travelling in the pathless country of Vajjabhumi and Subbabhumi of Ladha (Rarha), where forest people attacked him.

The geographical features of the district are summarized in Table 1. More than a fifth of the district's land area is under forest cover. Scheduled Tribes and Scheduled Castes comprise over 42% of the district's population and constitute the region's "ecosystem people" (*sensu* Gadgil and Guha 1995), who largely depend on agriculture and non-timber forest produce for their livelihoods.

Figure 1: Map Showing Community Development Blocks of Bankura District in the State of West Bengal



Credit: Heerak Nandy, Kolkata, 2021

Table 1: Geographical Features of Bankura District

Descriptor	Statistical Figure	Reference
Total area	6,882 sq km	Bankura District Administration (2021a)
Total state forest area	1,482 sq km	West Bengal Forest Department (WBFD 2019)
% of forest cover	21.53	WBFD (2019)
Conservation reserve	43.70 sq km	WBFD (2019)
Reserved forest	80 sq km	WBFD (2019)
Protected forest	1,311 sq km	WBFD (2019)
Unclassified forest	91 sq km	WBFD (2019)

Descriptor	Statistical Figure	Reference
Wasteland	2.38 sq km	RSP Green Development and Laboratories (2019)
Water bodies	265.61 sq km	RSP Green Development and Laboratories (2019)
Average annual rainfall	130–160 cm	RSP Green Development and Laboratories (2019)
Net area cultivated	1,615.071 sq km	Bankura District Administration (2021a)
Gross cropped area	3,114.921 sq km	Bankura District Administration (2021a)
Cropping intensity	192.86%	Bankura District Administration (2021a)
Total population	35,96,674	CensusIndia (2011)
No. of households	7,66,902	Census India (2011)
% Scheduled Caste	32.65	Census India (2011)
% Scheduled Tribes	10.25	Census India (2011)

3. METHODS AND DATA SOURCES

Drawing on published literature and my research in the region over the past 24 years, I collate the signs and evidence of the processes and consequences of the loss of biodiversity at the species, genetic, and ecosystem levels and the erosion of traditional cultural entities in this region as a paradigmatic, contemporaneous example. The data were collected during my field research in three ways:

(a) Extensive survey in the region: Phased inventorying of biodiversity of forests, sacred groves, sacred ponds, rare trees, and extant crop and animal landraces between 1996 and 2017. Ecological inventories of forests and

sacred groves were compiled in multiple line transects, while belt transects (3 km × 50 m) were employed for inventorying roadside vegetations, as described in my respective publications (Deb 2007a; Deb 2014; Deb and Roy 2021; Deb *et al.* 2018).
(b) Individual interviews and group discussions with local residents: I gathered their perceptions of various elements of biodiversity. Such interactions were mostly informal but also based on a structured questionnaire for recording people's perception of the non-use value of forests and wildlife (Deb 2014).

In addition, I drew on my field notes during farmer workshops, Year of Science Awareness (2004) programmes, and nature camps with local youth groups from 1997 to 2010 held in all parts of the district.

(c) Participant observations: During the period 1996–2010, I lived in Bishnupur block to conduct my participatory research on the folk traditions of natural resource-use modes and cultivate folk crop landraces in my conservation farm. I accompanied women's groups during their foraging of wild foods and participated in folk ceremonies held at sacred groves, ponds, and rice farms.

The subject population in my interviews and the interactants in my participant observation exercises consist of rural farmers, including Scheduled Tribe and Scheduled Caste families, who are largely dependent on the provisioning services of local ecosystems.

4. BIOCULTURAL INTERFACES: A RESIDENT OBSERVER'S VIEW

I describe here how the local people perceive different categories of biodiversity, the integration of local cultures with biodiversity, and the impact of modernization on both biodiversity and local cultures. This paper is essentially a review and integrative summary of my prior research work and experience gathered over three decades in the district. I discuss here the status of biodiversity in the context of local cultures in two broad categories—"wild biota", which includes vegetations, wetlands, and undomesticated flora and fauna, and "agrobiodiversity", comprised by domesticated biota.

4.1 The Wild Biota

The wildlife of the district includes forest lands, sacred groves and ponds, and the wild flora and fauna in the district. All the "wild" vegetations and wetlands in the district have in fact been managed by humans over centuries.

4.1.1 Forest

The multi-tier mixed deciduous forests of the extended Chota Nagpur plateau, including the lateritic districts of Bengal, were destroyed in the second half of the nineteenth century, when the British colonial forest policy transformed all native forests into silvicultural timber farms—initially for building railroads and ships, from the late 1850s, and later and more importantly, for military use during the World Wars in 1914–1918 and 1940–1944 (Flint 1998; Sivaramakrishnan 1999). The existing sal forests of southwestern Bengal are a consequence of the clearing of all commercially "inferior" species to ensure a sustained supply of class A timber from sal (*Shorea robusta*), teak (*Tectona grandis*), asan (*Terminalia tomentosa*), and sisu (*Dalbergia sissoo*). Seventy years after Independence, however, the country's Forest Directorate continues with the same colonial forestry parlance of "inferior species" and "minor forest products" and the same colonial silvicultural agenda of maintaining "tree farms" of commercial value. Populations of native tree species have been replaced with exotic species, such as *Eucalyptus tereticornis* and *Acacia auriculiformis*, chiefly to feed paper mills and for pulpwood export. Although the new Forest Policy (2000) explicitly emphasizes conservation and prohibits clear-felling of any forest, the practice of rotational harvesting of sal forests in the state has not stopped, while the professed goals of conservation of local biodiversity and providing support to rural economies have been compromised.

The state's forest physiognomy and biodiversity improved with the evolution of joint forest management (JFM), begun in the early 1980s in West Medinipur district, and officially approved by government orders in 1989 and 1990 (Deb 2013; Deb and Malhotra 1993). The task of forest protection was shared by villagers, who were motivated by the increased supply of non-timber forest products (NTFP) in the patches of forest they protected (Malhotra, Deb, and Vasulu 1992). More than 2,000 forest protection committees (FPCs) sprang up in the forest villages of the southwestern districts, mostly through the villagers' own agency. A government order of 1989 placed local forest officials on top of the FPCs and arranged for 25% of the sale proceeds to be paid to FPC members after eight years of rotational harvest of sal poles (Deb 2013). However, this arrangement disgruntled many villagers—"why should we protect the forest with so much diligence if it is cleared after eight years, only to go back to the state of getting no NTFP?" Besides, bureaucratic high-handedness and corruption, often accompanied by collusion with panchayat heads (Banerjee 2004; Deb 2007b; 2013), undermined the participatory nature of JFM, and relegated all decision-making power back to forest officials, for whom "participatory management" meant an "I do, you participate" policy (Deb

2009a, 413) aimed at enhancing forest revenue from commercial plantations. During 1989–2000, thousands of native dipterocarp species were extirpated for the plantation of exotic species, chiefly Eucalyptus tereticornis (Deb 2013; Deb 2014). With the continuation of state authority over forest usufructuaries, "the interests of primary collectors dependent on NTFPs have been ignored… for the sake of safeguarding the state revenue" (Palit 1999: 25).

All the forests in the district are protected forests, where villagers have the right to collect selected NTFPs. A few forest habitats in the district host a wide range of faunal diversity. Owing to the large number of migratory birds visiting the area, Mukutmanipur has now been declared a conservation reserve.

Neither the Forest Department (FD) nor the West Bengal State Biodiversity Board (WBSBB) has taken account of the conservation status of flora in the state. An indefinite number of rare floral species has been pushed into the Endangered (EN) and Critically Endangered (CR) categories of the IUCN (2001) Red List, as instanced by the extinction of Vitex glabrata from the state (Deb 2008; Deb 2019c).

4.1.2 Vegetations Outside the Forest

All over India, trees outside forests contribute to vegetation cover. An estimated 2.68 billion trees outside forests contribute an equivalent additional area of 9.99 M ha, contributing to about 13% of the country's total area under tree cover (FSI 2003). Stands of vegetation outside forest lands constitute important elements of the rural landscape and portray the traditional Indian mode of living integrated with biodiversity. Clusters of non-forest vegetation exist throughout the district of Bankura in the form of home gardens, alongside roads and ponds, and as village sacred groves.

Home Gardens

Home gardens are a form of land-use system that involves managing the trees and shrubs within individual house compounds. The biodiversity and economics of the home gardens of southern India and the north-eastern states have received much attention (George and Christopher 2020; Das and Das 2005; Ramakrishnan, Das, and Saxena 1996), but the home gardens of Bengal remain neglected in biodiversity surveys. Almost every village homestead in Bankura district harbours diverse plants to meet household needs for fruits (mango, jackfruit, *Aegle marmelos*, and *Moringa oleifera*), cattle fodder (leaves of jackfruit, *Feronia limonia*, and S*yzygium cumini*), fuel (leaves of *Acacia auriculiformes*, twigs of *A. nilotica*), medicinals (*Azadirachta indica*, *Aegle marmelos*, *Ocimum sanctum*), wood for construction

(*Syzygium cumini, Holoptelea integrifolia, Alangium lamarckii*, and *Gmelina arborea*), and household articles such as mats and baskets (leaves of *Borassus flabolifer* and *Phoenix sylvestris*). Further, many plants are commonly raised for ornamental and religious uses. In addition, species of no direct economic use are also maintained (Deb 2014).

Trees on Roadsides and Pond Margins

An ancient tradition in most of Bengal is to line pond margins with numerous trees. Palmyra palm, date palm, drumstick (*Moringa oleifera*), and bamboos are the most commonly used trees for this purpose. Trees along pond banks used to be the primary source of palm wood for use in building the roofs of huts in every village. As the practice of planting palm trees has discontinued over the past few decades, villagers have been compelled to replace their traditional house architecture with expensive concrete structures.

Roadside trees throughout the district are a rich bank of biodiversity. In many places, there is considerable species richness that supports a wide range of vertebrate fauna, including tree frogs, lizards, birds, and mammals like palm civets and bats. A study of two forest fringe villages in Bishnupur block, conducted along three belt transects (3 km x 50 m each) to inventory all trees outside the state forest, revealed that several indigenous hardwood trees (e.g., *Cordia macleodii, Crateva nurvala, Ficus krishnii, Vitex glabrata, and Ternanthera monopetala*) existed in non-forest habitats but not in the adjacent forest stands managed by the FD (Deb 2014). The absence of these native tree species in the state forest tracts was corroborated by our extensive inventory of rare trees conducted afresh in 2017 (Deb et al. 2018) as well as unpublished data obtained from forest range officers and the conservator of forest (research) in the district. Moreover, a few native floral species (e.g., *Cordia dichotoma, Crateva nurvala, and Ventilago maderas-patana*) are found in higher densities in non-forest vegetations than in the state forest patches (Deb 2014).

Many of the trees on roadsides and pond margins have no direct economic use value. While economists can surmise some indirect use value for such trees, including carbon sequestration, albedo reduction, soil binding, and biodiversity enrichment, villagers had not been aware of these global ecological services while planting them. Rather, the existence value and bequest value of the trees with "no uses" are prominent. Trees like *Crateva nurvala, Haldina cordifolia, Oroxylum indicum, Soymida febrifuga,* and *Streblus asper* are never harvested for food, fuelwood, or medicinal purposes and are not popularly known for distinctive ecological services such as soil binding or albedo reduction (Deb and Malhotra 1993, 2001). Yet, they are frequently

maintained on roadsides, pond margins, and even on homestead lands (Deb 2014). This testifies to our conjecture that people in these villages planted these trees because they value the existence of diverse trees in their surroundings rather than their instrumental value.

Sacred Groves

Sacred groves (SGs) constitute natural or near-natural patches of vegetation in or on the outskirts of villages (Deb 2007a; 2008b), where harvesting of any living matter is generally prohibited. These SGs constitute a glorious example of traditional cultural institutions fostering biodiversity conservation and helping conserve a range of rare and endemic life forms (Gadgil and Guha 1992; Deb and Malhotra 2001).

In Bankura district, every block, and almost every panchayat area, has a sacred grove that is known by the generic name "*than*". Most of these groves are a legacy of ancient tribal SGs. All Santal hamlets contain sacred groves called Baram-*than*, Salui-*than*, and Jaher-*than*. Many of the older SGs have come under the pale of subaltern Hinduism and are named after subaltern Hindu deities, such as Bhairab, Dharmaraj, Chandi, Sitala, Manasa, and Buri-Ma, and represent the historical transformation of belief systems, while retaining the sanctity of the grove. An SG in Dariapur village, Sonamukhi block, contains an image of a Jain *tirthankar* (saint and spiritual guide), although the grove is named Bhairab-*than*. This image is worshipped as an incarnation of Bhairab, a deity of the Hindu pantheon. Several sacred groves in the district are consecrated for a female deity named Sini, who is traditionally worshipped by tribal and Scheduled Castes. Choudhury Kamilya (1992) has discussed in detail the origin of, and the rites associated with, Sini-*thans* across Rarh Bengal and given a list of 95 Sini-*thans* in the district. No image of any deity exists in these old SGs. Byaghrasini-*than* in Boidhya village of Bishnupur block, Berasini-*than* and Jadusini-*than* in Panchal, and Kutasini-*than* in Kanaipur village, Sonamukhi block, and Madana-*than* in Chhandar village, Barjora block, are examples. However, Jina Sini of Bankura town and Bamni Sini of Shukla village of Sonamukhi block are warrior goddesses on horseback, whose exquisite idols are worshipped. Such images are a legacy of the continuous process of "Sanskritization" (Srinivas 1956), by which Brahminical Hinduism subsumes and transforms indigenous, non-Brahminical cultural elements. Some of these "Sanskritized" groves have concrete platforms, roofs, and images of the deity. The removal of wood for use in the construction of temples is an important cause for the thinning of several SGs.

The construction of highways, railways, and power-line extension, along with industrial growth, has expunged many SGs from the district. In

addition, the erosion of the belief system associated with SGs has led to wood theft for commercial use in several villages (Fig. 2A). Uncontrolled cattle grazing has in many cases stopped the process of regeneration of SG vegetation, leading to the decimation of the grove (Fig. 2B). In many places, the SG has been replaced with a temple with one or two trees (Fig. 2C) or a concrete platform on an empty parcel of land (Fig. 2D).

Most of the SGs in the district are small, spanning less than 500 m2 area, rarely exceeding 2,000 m2 (Deb 2017a). It appears that the taxic diversity of the SG biota is independent of the grove area. Diverse plant families corresponding to more than eight species occur in most of the small SGs, whereas Tapoban Pahar SG in Gangajalghati block, covering 6,700 m2, contains only a single species of *Eucalyptus tereticornis* (Mitra et al. 2017). Such exotic plantations are a result of modern commercial plantation drives. Except for such exotic plantations, many of these SGs are rich in biodiversity, hosting rare and endangered life forms such as *Vitex glabrata*, whose last specimen in the state was recorded in a perforated SG at a crossroads in Chhandar village (Deb 2008; 2014).

Owing to the customary ring of protection around these groves, many animals tend to prefer SGs for nesting and breeding. Deb, Deuti, and Malhotra (1997) recorded in the neighbouring district of West Medinipur that many birds, including the threatened species, large Indian parakeet (*Psittacula eupatria*), distinctly prefer SGs for nesting. My survey has also recorded (Deb 2008; 2021a) that apart from the SGs, the nesting habitats of birds and bats also receive cultural protection in indigenous cultures. For instance, Khejurbediya village of Bankura-2 block is famous for a cluster of old trees that are a breeding habitat of egrets (*Ardea alba*). In Majdiha village in Onda block, a cluster of trees is a permanent roosting habitat for greater Indian fruit bats (*Pteropus medius*). In both places, villagers consider the groves as sacred and never harm the animals. This care and empathy toward all life forms used to be an inherent characteristic of all indigenous cultures (Kellert and Wilson 1993), and Bankura's cultural tradition is no exception.

Figure 2: Stages of Dilapidation of Sacred Groves. A: Removal of Trees: Kuchishol, Onda Block (2006). B: Thinning and Grazing in the Grove: Bonkati, Bishnupur Block (2002). C: Trees Displaced by a Temple: Beliatore, Borjora Block (1998). D: An Altar with No Tree in the Grove: Panchal, Sonamukhi Block (2003).

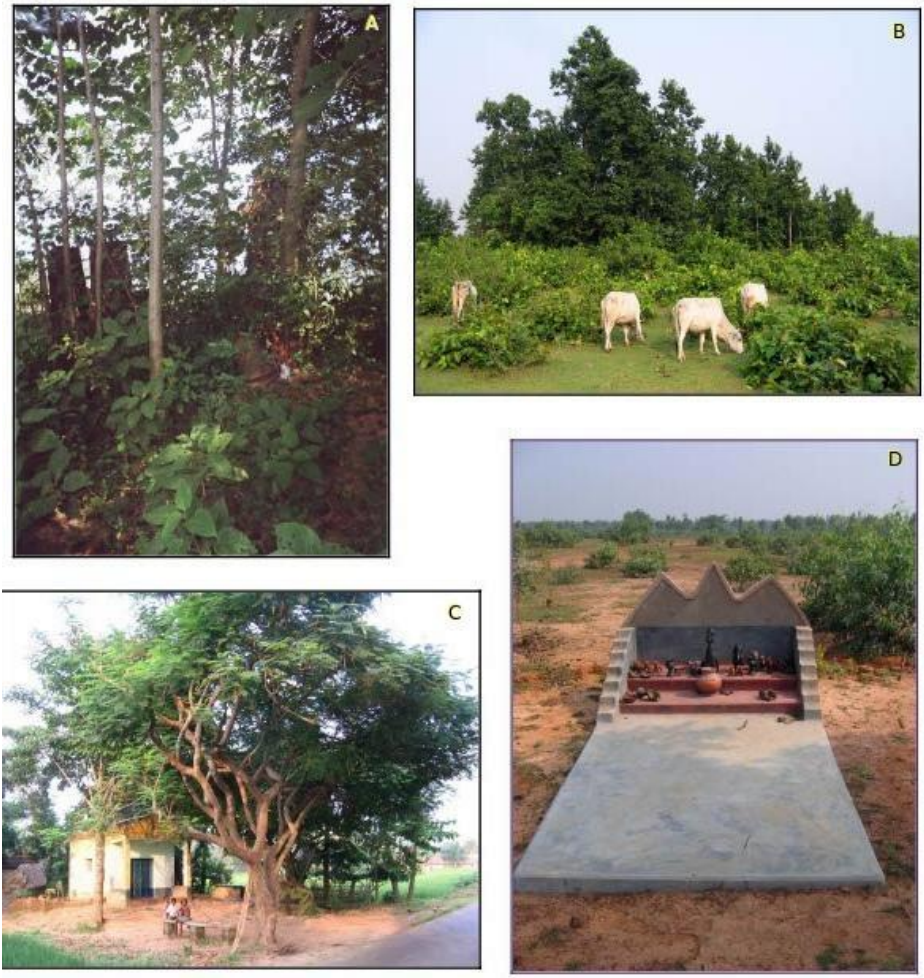


Photo credit: Author

Numerous SGs were clear-felled by the FD during the colonial period, and there are hardly any SGs remaining inside the forest lands managed by the department. In line with the historic colonial attitude, a large section of the FD continues to treat the forest as commercial "tree farms" at the expense of the stated goal of conservation. While old-growth trees are now extremely rare in the forest, due to the rotational felling of sal trees since

the 1970s, corruption in the FD, in collusion with a few political heads in the village-level administration, has destroyed many village forests outside the FD's jurisdiction. An explicit example is the clear-felling of 130 old-growth sal (*Shorea robusta*) trees in Rajarbandh SG in Bhalukkhulya *mouza* of Radhanagar forest range, Bishnupur block, in early 2005. This SG is a priest family's property, exempt from land tax by a royal edict several centuries ago, and contained over 200 old-growth sal trees and a multitude of other species, including *Madhuca longifolia, Lagerstroemia parviflora, Diospyros melanoxylon,* and a rare species, *Tamilnadia uliginosa*. During a felling operation as a part of the District Working Plan of 2005, the FD encroached into the SG and removed 130 mature sal trees without informing the landowner. The FD officials, in collusion with a handful of executive members of the village FPC, did not pay heed to the objections of the hired labourers and villagers. As the destroyed SG was not in the jurisdiction of the FD, the harvest was off the FD's official records and the booty was shared among the officials. My protest letters to the highest echelons of the state FD, demanding disciplinary measures against the erring officials and compensatory reafforestation in the SG, failed to elicit any official response. Subsequently, in 2006, the FD filed two suits (No. 4 C/2006 and No. 5 C/2006) at Bishnupur Sub-Divisional Court, accusing me and my associates of wood theft from the forest (Deb 2007b). The suits continue after 15 years, while the unique ecosystem of the ravished SG has disintegrated.

In addition to clearing of trees, extension of roads and industrial growth are a major threat to the existing SGs, most of which are already derelict. Numerous groves have been perforated by roads, and some have been cleared off: the fragmentation of an ancient SG at the crossroads of Chhandar village (Deb 2014) is an example of the first kind, and a small SG at the bus stand in Pakhanya village is an example of the second.

The existence of SGs is also threatened by the modern educational curriculum, which fosters a repudiation of traditional modes of customary land use as retrogressive and inculcates an industrial ethic that reduces the value of biodiversity to a price tag. Thus, sacred habitats in the district are considered little more than an institution of superstition, which may be disposed of for an immediate economic benefit. In some cases, outside agents (like a road contractor) initiate such destruction, but, in many others, the local youth do not mind depleting the SGs of their villages for a quick buck.

4.1.3 *Wetlands*

A large number of wetlands have been "reclaimed" or filled up for

urbanization and highway projects. Of the existing ponds and small lakes, many have been adapted for the pisciculture of exotic carp and predatory African sharptooth catfish (*Clarias gariepinus*). Prior to the release of fish fry for rearing into the pond, "pond preparation" with a saponin-rich mahua (*Madhuca longifolia*) oil cake (Deb and Banerjee 1987) eradicates all zooplanktonic species, amphibia, and "weed fish" species. Consequently, the native aquatic ecosystem structure is irretrievably lost. Moreover, the voracious African catfish (*Clarias gariepinus*), introduced in the 1980s in the district, devours all aquatic crustaceans, molluscs, amphibia, and even domestic ducks. Though the Government of India issued an order on 29 June 2000 prohibiting the rearing of this fish in ponds and tanks, the order is not effectively enforced in the district.

A few unique biodiversity-rich ponds still exist in Bankura. In the village of Chhandar, Bodher Pukur is an ancient sacred pond that is not used by villagers for bathing, washing, or fishing. The name is a corrupt derivation of "Bouddher" (pertaining to Buddhists), indicating that it was originally associated with a Buddhist shrine by the pond. The Buddhist influence in the district during the Pala imperial dynasty, until the consolidation of the Malla dynasty in Rarh Bengal sometime between 1298 and 1350 CE, is evidenced by the Buddhist stupas in the region (Sanyal 2018). Bodher Pukur, therefore, seems to be at least 600 years old.

The pond surface is covered with floating vegetation (Fig. 3) comprised by a complex assemblage of diverse grasses and herbaceous flora. The pond water contains many photosynthetic bacteria that can survive in the atrophic water, eight fish species, two frog species, and a population of a large leech, *Poecilobdella manillensis* (Deb 2003; 2008b). Villagers report that until the 1970s, a few turtles could also be found in the pond. The description of the turtle (olive shell with a central ridge and thin stripes) matches with the *Kachuga tentoria flaviventer*, which is a species never reported from the southwestern districts of Bengal. However, this turtle no longer exists in the pond.

Figure 3: The Bodher Pukur Sacred Pond with Floating Vegetation, in Chhandar Village

Photo credit: Author, 2003

Another sacred pond exists in Belboni village by the Durgapur–Bankura State Highway. All the households of two nearby hamlets depend on this pond for drinking water, although there are tube wells as well in the village (Deb 2008). The pond ecosystem was in the past constituted by a unique composition of organisms, including an otter family that was exterminated in the early 1980s. As of 2008, the zooplankton community of this pond included the protist *Difflugia sp.* and Bdelloid rotifers, which presumably kept the pond water free from pathogenic microbes (Deb 2008). However, this unique ecosystem disintegrated in 2010 when the villagers pumped out the water and removed the bottom sediment from the pond for "renovation"—an activity that removed the littoral plankton and benthic fauna (Deb 2021a). An examination of the pond water after the perturbation revealed the disappearance of *Difflugia sp.* and the dominance of *Mesocyclops spp.* in the planktonic community.

4.1.4 Endangered Plants

Over centuries, various elements of folk religious tradition and customs were assimilated into the mainstream Hindu religion. In this process of

Sanskritization, new meanings, messages and significance have been attached to folk deities and customs, even by restructuring or incorporating the Brahminical mythology into folk stories of local deities and rituals (Xavier 2010). Thus, several trees (such as *Aegle marmelos, Ficus benghalensis*, *F. religiosa*, and *Crateva nurvala*) and animals (barn owl, hanuman langur) held sacred in native animistic traditions are also considered sacred in mainstream Hindu culture (Deb and Malhotra 2001). Many of these trees, such as the banyan (F. benghalensis), mahua (*Madhuca longifolia*), and sal (*Shorea robusta*) are keystone species in the local ecosystem. Several trees with no direct economic use have been incorporated into indigenous ceremonies. Thus, karam (*Haldina cordifolia*), rohin (*Soymida fabrifuga*), and manasa (*Euphorbia neriifolia*) are essential in the eponymous ceremonies in the indigenous cultures of Rarh Bengal (Deb and Malhotra 2001).

Deb (2014) reported the threatened status of *Crateva nurvala, Cordia macleodii, Ficus krishnii, Tamilnadia uliginosa,* and *Vitex glabrata* (Tables 2a and 2b), surviving in a few old SGs and inferred to be Critically Endangered (CR) in the state, based on the IUCN (2001) Red List criteria: B1 (extent of occurrence estimated to be <100 sq km), B2 (habitat severely fragmented; observed, inferred, or projected decline in area, extent and/or quality of habitat), C (number of mature individuals <250), C2 (no subpopulation containing >50 mature individuals), and D (population size estimated to number <50 mature individuals). Among these CR trees, *V. glabrata* was represented by the last specimen in the state in an SG perforated by a crossroads at Chhandar village. In 2016, this tree was cut down by a stall owner under the tree (Deb 2019c; 2021a). However, the CR status inferred from the surveys conducted in West Bengal and adjacent states may not conform to the global status of the species, as the same species may exist in a few other states of India and other countries.

Cordia macleodii is another CR tree in the district, which was first recorded in the district by Sanyal (1994). The National Herbarium collection contains a few specimens from the district of West Medinipur. However, the Bengali and Santali names of the tree, Sitapatra and Jugia, respectively, are not mentioned in any taxonomic literature, and thus, as the botanical identity of the tree was unknown to the local residents, botanists were unable to identify the tree from its vernacular names. Furthermore, the taxonomic literature does not mention some of its important characteristics. One of the morphological characteristics of Sitapatra is that scratches on the upper surface of the leaf elicit permanent black marks (Fig. 4), which is a feature so prominent that local folklore includes a story of an exiled Sita writing her message on the leaf of this tree to send to her husband, Rama—hence the Bengali name of the tree—"Sita's letter" (Deb et al. 2018; Deb 2019c).

While Sitapatra is now identified as *C. macleoidii*, the occurrence of flowers with five (pentamerous) and six (hexamerous) petals and stamens on the same tree (Fig. 4) contrasts the tetramerous and pentamerous flowers of *C. macleoidii* recorded in taxonomic literature. Furthermore, none of the earlier texts describing *C. macleodii* mentions the occurrence of male and female flowers on different trees. Therefore, Sitapatra appears to be a likely subspecies of *C. macleodii*, previously undescribed (Deb *et al.* 2018). My extensive survey, conducted from 2002 to 2014 and in 2017, recorded the existence of only five mature individuals of Sitapatra in two discrete locations of Bankura district and nowhere else in the entire state of West Bengal (ibid.).

Table 2a: A Brief List of Threatened Wild Taxa in Bankura District (Flora)

Vernacular Name	**Botanical Name**	**Location of Occurrence (Block)**	**No. of Mature Individuals**	**Status in District***	**Reference**
Bhadu	*Vitex glabrata*	Barjora	Last specimen felled in 2016	EW	Deb (2019c)
Sitapatra	*Cordia macleodii*	Bishnupur, Sonamukhi	6	CR	Deb et al. (2018)
Bharna	*Crateva nurvala*	All blocks	<800	EN	Deb (2014)
Krishna bat	*Ficus krishnii*	Bishnupur, Onda, Patrasayar, Ranibandh, Taldangra	4	CR	Deb (2014)
Pidra	*Tamilnadia uliginosa*	Bishnupur, Onda, Ranibandh, Sonamukhi, Taldangra	<200	EN	Deb (2014)
Leda	*Ternanthera monopetala*	All blocks, except Bankura-I	<1000	R	Deb (2014)

Table 2b: A Brief List of Threatened Wild Taxa in Bankura District (Fauna)

Vernacular Name	**Botanical Name**	**Location of Occurrence (Block)**	**No. of Mature Individuals**	**Status in District***	**Reference**
Tricarinate hill turtle	*Melanochelys tricarinata*	Chhatna, Ranibandh, Bishnupur, Sarenga	<500	CR	Unpublished data
Bon rui	*Manis crassicaudata*	Bishnupur, Ranibandh, Sarenga, Taldangra	<100	EN	Unpublished data
Bhondar	*Lutrogale perspicillata*	Bishnupur, Ranibandh, Sarenga	<50	CR	Unpublished data
Shajaru	*Hystrix indica*	Chhatna, Onda, Taldangra, Ranibandh, Sarenga	< 2 sightings in 25 years	EN	Unpublished data
Chita biral	*Prionailurus bengalensis*	Chhatna, Ranibandh, Sarenga	n.d.	R	Unpublished data

* IUCN (2001) criteria applied to each species in the state of West Bengal.
CR = Critically Endangered; EN = Endangered; EW = Extinct in the wild; R = Rare.

Source (for Tables 2a & 2b): Author's compilation, 2021

Figure 4: Sitapatra (A) Mature Leaf Showing Permanent Mark after Writing (B) Twig (C) Dry Flowers, Without and With the Calyx (D) Pentamerous Corolla (E) Hexamerous Corolla

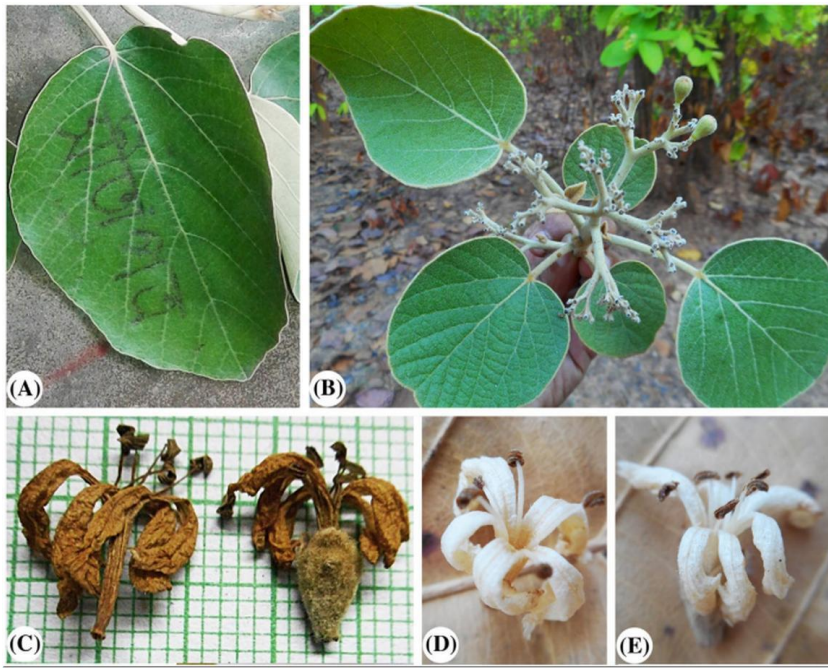


Photo credit*:* Author, 2018

4.1.5 Endangered Fauna

Several animals mentioned in folklore and zoological records, such as the leopard, are no longer found in the district of Bankura. Tiger hunting is depicted in the terracotta images on the walls of Jor Bangla temple (built possibly in the seventeenth century), and folklore commemorates King Bir Hambir for having slain a tiger, but the animal has been extinct from the southwestern districts altogether since the eighteenth century. The wolf is the largest predator that still exists in the district forest.

Birds in Mukutmanipur Conservation Reserve include winter visitors like the lesser whistling teal, red-crested pochard, gadwall, common coot, swallows, wagtails, darters, spot-billed duck, grebes, buntings, rufous-tailed lark, and different terns. The honey buzzard (*Pernis ptilorhynchus ruficaulis*), which preys on the honey and larvae of the wild honeybee, *Apis dorsata*, is rarely sighted, but a nesting pair was recorded in 2008 in Binodbati village

of Bishnupur block. Following conservation efforts at Basudha farm in collaboration with villagers, the number of breeding pairs increased by 2020 to six, nesting in the village and the neighbouring forest area.

Most of the district forests are habitats for elephants and constitute parts of eastern India's elephant corridors. However, the Ranibandh-Sutan forest tract is currently out of the elephant migration route, and the Mayurjharna Elephant Reserve, spanning across southern Bankura and West Medinipur districts, is now a "dead project" (Bankura District Administration 2021b).

The conservation status of faunal biodiversity is hardly mentioned in official district survey reports. These reports are often based on older reports, seldom match the current status of species, and are replete with largely unreliable information about rare and endangered flora and fauna. For example, the *District Survey Report of Bankura* (RSP Green Development and Laboratories 2019) mentions the prevalence of the American porcupine (*Erethizon dorsatum*) "throughout the area" (p. 19). The reports of the FD likewise give fictitious reports of the distribution of some animals that have not been sighted in the region over the past two decades. In contravention of the spurious official data about the district's fauna, I describe the status of animals based on my own surveys in the district following the IUCN (2001) Red List criteria, regardless of their status published in the national database. For instance, the Indian porcupine (*Hystrix indica*) is rarely sighted in the district. Over the past three decades, our extensive survey failed to record either a direct sighting of the animal or indirect evidence of its existence (such as its quills), indicating that the animal is likely EN in the district.

The smooth-coated otter (*Lutrogale perspicillatas*) is Critically Endangered (Possibly Extinct)[1] in the district (Table 2b), primarily due to extermination by people in their zeal to protect the fish in their ponds. The tricarinate hill turtle, (*Melanochelys tricarinata*), found in and around Susunia hill and the southern Bankura forests, is now extremely rare and probably CR. The Indian pangolin (*Manis crassicaudata*) is also EN in the district and was occasionally sighted in the Bishnupur and Ranibandh forest ranges over the past 20 years. Sadly, on each sighting, the local youth in Bishnupur block were unable to name the animal; I was only able to record these sightings after the youth came to me to confirm the animal's identity. Although official reports of the state FD mention the existence of the wild cat (*Felis*

[1] "Critically Endangered (Possibly Extinct) […] is not a new IUCN Red List Category, but is a flag developed to identify those Critically Endangered species that are in all probability already extinct but for which confirmation is required; for example, through more extensive surveys being carried out and failing to find any individuals" (IUCN n.d.).

chaus) and the fishing cat (*Prionailurus viverrinus*) in the district, there is no evidence of the former's existence in the 21 forest ranges of the district over the past 20 years, while the latter is rarely sighted in the southern blocks of the district (unpublished records).

4.2 Agrobiodiversity

This section is meant only to indicate the trend in the decline in domesticated biodiversity in the district. I will highlight a few special instances that are scarcely mentioned in scientific literature.

4.2.1 Agroecosystems

Beginning with the advent of the Green Revolution in the late 1960s, traditional multiple cropping practices were replaced with a monoculture of cereals and vegetables, leading to low crop diversification, with a predominance of rice monoculture, in the southwestern districts of West Bengal (Chakraborty and Mistri 2017; Das et al. 2016; De and Chattopadhaya 2010; GRBNEP 2011; Paul *et al.* 2020). Farm architecture across West Bengal has also been homogenized with the removal of large trees from farm fields, which used to serve as breeding and nesting habitats for a multitude of fauna such as owls, nightjars, open billed storks, lizards, frogs, and other natural enemies of crop pests. An increasing number of modern rice farmers are also applying a range of highly toxic insecticides (Banerjee *et al.* 2016). In addition, the national agricultural research institutions promote widespread use of herbicides (e.g., Pathak *et al.* 2019), which the farmers of Bengal, including Bankura district, are increasingly applying to their farms (Kumar 2020). Herbicides are known to eliminate grasses, broadleaved flora, frogs, birds, and pollinators (Annett, Habibi, and Hontela 2014; Relyea and Jones 2009), thereby truncating several trophic levels of the farm food web and reducing long-term farm productivity (Deb 2009b; 2020).

4.2.2 Crop Genetic Diversity

A multitude of crops and animals have been domesticated in India (Fuller 2011; Larson and Fuller 2014), expanding the region's biodiversity with thousands of landraces that are adapted to local environmental conditions and "are named, selected and maintained by the traditional farmers to meet their social, economic, cultural and ecological needs" (Teshome *et al.* 1997, 256). Each crop landrace and each domesticated animal breed is a unique genomic assortment that reveals the astounding genetic diversity of the species. Nevertheless, just as the human-made landscapes are excluded from the mainstream understanding of "nature conservation", the genetic diversity of domesticated biota is often excluded from the conventional

discourse of biodiversity.

Until the early 1970s, 5,556 rice landraces were grown in West Bengal, most of which are now extinct from farm fields (Deb 2005; 2019a). With the advent of the Green Revolution, thousands of folk rice landraces have been replaced with a handful of high-yielding varieties (HYVs). As of date, no more than 320 landraces are in cultivation across West Bengal (Deb 2019a; updated records of Vrihi, unpublished), implying the loss of ca. 93% of indigenous rice genetic diversity. Many of the landraces extant in Bankura district have remarkable osmotic stress tolerance (Karmakar et al. 2012). The current records of Vrihi (1997–2021, unpublished), the country's largest folk rice seed bank, indicate that the number of landraces currently in cultivation in Bankura does not exceed 22, which is a rapid reduction from the 45 recorded till 2005 (Deb 2005).

The aesthetic appeal of lemma and palea colour, bran colour, aroma, and the culinary qualities of many rice landraces are important for their cultivation in indigenous food cultures. Several landraces are also known for their therapeutic properties in folk medicine. In traditional medicine, the pink starch of Kelas, an upland variety, is a diet for lactating women to cure their peripartum anaemia (Deb 2017; 2019a). Dudheswar was known to enhance growth in children, and Paramai-sal was believed to be a diet for good health (Deb 2017). Recent studies (Deb, Sengupta, and Pradeep 2015; Sen Gupta *et al.* 2017) reveal that grains of Kelas contain a high amount (34.6 mg/kg) of iron, while Parmai-sal rice is rich in manganese (124.60 mg/kg) and zinc (20.7 mg/kg), which are all important dietary micronutrients. The bran of the Parmai-sal and Khas Dhan rice varieties also contain high amounts of arachidonic acid and docosahexaenoic acid, essential for neonatal brain development (Ray et al. 2021). A large range of vanishing rice landraces, such as Gopalbhog, Kharishabhog, and Sada Kaya, are rich in B1, B5, and B6 vitamins (Roy *et al.* 2020; Mondal, Datta, and Deb 2021). These findings highlight the need for conservation of folk crop varieties for the nutritional security of the poor.

Table 3: Endangered Crop Landraces and Animal Breeds of Bankura District

Crop Plant	**Landrace**	**Animal**	**Breed**
Khero *(Citrullus lanatus)*	Unnamed	Cow *(Bos indicus)*	Birbhuiyan
Mustard *(Brassica oleracea)*	Tori	Chicken *(Gallus gallus domesticus)*	Selection from Chittagung
	Jhanti#		Selection from Aseel
Ekangi kasturi *(Kaempferia galanga)*	Unidentified#		
Aubergine *(Solanum melangena)*	Lurka		
	Kalo tuni		
Rice *(Oryza sativa ssp. indica)*	Ash gangajal*		
	Gangajali*		
	Khaskani#		
	Mihi nagra#		
	Punjab-sal#		
	Sada Kalma#		
	Sada Kaya#		
	Sada Kelas*		
	Tetku#		

* Extinct from entire Bengal
# Conserved on Basudha farm, Odisha
Source: Author's compilation, 2021

The traditional farmers of Bankura used to grow a multitude of millets and several landraces of aubergine, bottle gourd, mustard, and sesame. All these landraces are forgotten, along with the knowledge of mixed cropping. Until the early 1990s, traditional Bankura farmers in Onda and Bishnupur block

used to grow at least 20 different crops on their vegetable farms in the same season (personal observation). This practice has given way to monocultures of a few selected crops, entailing a permanent dependence on exogenous seeds and agrochemicals, and several crops have become obsolete in the process. An example is Khero, the white-flesh watermelon (*Citrullus lanatus)*. Mohanta and Mandal (2019) have examined the agronomic properties of several Khero genotypes, which only a handful of modern farmers in Bankura are cultivating. With the advent of several hybrid varieties, traditional landraces are becoming scarce. Several local landraces of aubergine, sesame, and mustard have become CR, grown in only a handful of small farms in the district (Table 3). The ancient practice of growing the mustard landraces, Jhanti and Tori, between rows of rice in the Rabi season (Deb 2020) has also become obsolete, owing to the prevalent practice of rice monoculture.

4.2.3 Domesticated Animal Diversity

FAO's Domestic Animal Diversity Information System (FAO n.d.) records 80 Indian breeds of cattle, while the National Bureau of Animal Genetic Resources (NBAGR) has registered 50 breeds of domestic cattle in India. However, neither list includes the Birbhuiyan breed of Rarh Bengal. This breed is characterized by its short stature, relatively small distance between the horns, and low milk yield (Table 4). This breed, with an outstanding ability to survive on low water uptake, shows a remarkable adaptation to the dry summers of the region. Unfortunately, no research and documentation of this cattle breed are yet published. The breed was common in most tribal villages of Bankura until the 1980s. However, with the increasing trend of adopting modern hybrid cattle breeds, the Birbhuyan faces imminent extinction (Table 3).

In Ranibandh block, an unnamed, distinctive breed of fowl was noticed in the Santal hamlets in the Ranibandh forest beat. This breed, apparently a native selection of the indigenous Aseel breed, has not been recorded elsewhere and is nearing extinction. Another breed of fowl was recorded in Saltora block. This breed is similar to the Chittagong breed but has a larger and heavier build, probably attained through local selection over generations. It is imperative that the WBSBB as well as the State University of Animal Husbandry undertake the task of documenting their genetic characteristics and taking appropriate measures to conserve these endangered animal breeds.

Table 4: Key Morphological Characters of the Birbhuyan Breed of Cattle

Breed Descriptors	Mean Value
Head length (cm)	380
Body length (cm)	1,440
Tail length (cm)	760
Front leg length (cm)	630
Hind leg length (cm)	570
Distance between horns at base (cm)	120
Distance between ears (cm)	190
Ear length (cm)	200
Ear width (cm)	70
Distance between udders, front (cm)	70
Distance between udders, rear (cm)	50
Calving interval (days)	438
Milk yield per day (L)	1.16

Source: Author's compilation, 2021

5. THE CULTURAL IMPACTS OF BIODIVERSITY LOSS

Because biodiverse landscapes are the historical product of human intervention to maintain the direct and indirect use values of biodiversity (Jackson and Palmer 2015; Fletcher *et al.* 2021), the loss of species and genetic diversity has adverse effects on diverse aspects of the local cultures, including social norms and perceptions. Fromm (1973) argued that degradation of the biotic landscape serves to evaporate biophilia, leading to expressions of psychopathology in individual members of the society. Culture includes "the setting and language that people use to describe their

environment and their relationship with the land" and implies "the underlying concepts of their words and the corresponding actions" appropriate for the use and maintenance of biodiversity (Gómez-Pompa and Kaus 1992: 277). The disappearance of life forms from the indigenous landscape therefore not only leads to the abrogation of several use values of those biota, but also the loss of their names, social functions, ecological services and cultural significance from public memory. I discuss a few aspects of the cultural impacts of biodiversity loss on different levels.

5.1 Degeneration of Biophilia

The degeneration of biophilia and the confinement of the value of life forms to their instrumental value is evident in most of the villages of Bankura. In Boidhya village of Bishnupur block, a small group of open billed stork (*Anastomus oscitans*) used to nest in an old tamarind tree, which the villagers cut down in 2017, on the pretext of keeping the place "clean".

The ancient institution of sacred groves is collapsing in many places, including in tribal villages. Around the industrial township of Barjora, all the SGs have been stripped of old-growth trees for timber. Removal of trees for commerce is becoming a frequent occurrence in many remote tribal villages too.

5.2 Loss of the Cultural Value of Life Forms

Numerous ceremonies associated with seed sowing and harvesting marked the agrarian culture of Bengal (Deb 2021b). In Bankura, the Nal Sankranti ceremony was observed on the last day of the month of Ashwin (mid-September), when most rice varieties start flowering. This ceremony involves planting a few seedlings of nal grass (*Phragmytes karka*) and a few wild rice (*O. rufipogon*) plants in the north-western margin of a plot of cultivated rice. This ceremony is a ritual expression of the farmers' celebration of the flowering of rice, in expectation of a good harvest. As industrial agriculture has become a market-driven activity, bereft of any cultural significance, ritual ceremonies have disappeared from the cultural calendar of the region.

Local food cultures pivot on local food crops. Several rice landraces of Bankura district were traditionally used to make *muri* (crisped rice) and *chireh* (beaten rice). Several rice landraces were preferred for cooking specific culinary delicacies. For example, Kaya rice was traditionally preferred for making *aské pithé*. Jhinge-sal and Danaguri were preferred for preparing *patisaptah*. Small-grained, aromatic rice varieties, such as Khaskani and Khudi khasa, were used to prepare rice pudding. With the disappearance of these landraces, many of these culinary delicacies have been lost and

forgotten (Deb 2021a; 2021b). Farmers have also abandoned the cultivation of a special aromatic rhizome crop, ekangi kasturi (*Kaempferia galanga*), traditionally used in making a special kind of chutney, whose recipe is now forgotten.

5.3 Loss of Words and Knowledge Base

With the disappearance of an animal or a crop landrace, the names and uses of these life forms are eventually lost from the collective memory. The example of the villagers of Arjunpur and Sonamukhi forgetting the Bengali and Santali names of the pangolin mentioned above implies a cultural decay that is as deplorable as the loss of species. As the vocabulary used to describe ecosystem components forms the foundation for the resulting knowledge base that evolves, the loss of species is soon followed by the loss of words, eventually leading to severe erosion of the biocultural knowledge base (Frainer *et al.* 2020; Maffi and Woodley 2010). A majority of modern youth of Bankura do not know the Bengali and Santali names of not only rare trees like *Cordia macleodii* but also of many relatively common trees like *Crateva nurvala* and *Soymida fabrifuga*. Consequently, these trees no longer enjoy traditional cultural protection, and some of the eponymous festivals are devoid of the use of these trees, which remain unidentified in the villages. This phenomenon represents a "generational amnesia", which occurs when older individuals fail to pass their experiences to future generations (Papworth *et al.* 2009).

The loss of biocultural knowledge may elicit apprehension of evil from unfamiliar organisms and facilitate the process of further biodiversity loss. For instance, in 2010, the youth in a forest fringe village in Bishnupur block tried to kill a python fearing that it was a deadly venomous snake. Likewise, local youths no longer recall the names of many rare flora and fauna.

5.4 Disintegration of the Communitarian Ethos

This dissolution of the cultural ring of protection around biodiversity signals the erosion of the traditional perception of the intrinsic value of biodiversity and of the communitarian ethos. The communitarian ethos shaped resource-use ethics in indigenous societies to protect their resource base. The foundation of this conservation ethic associated with customary biodiversity use is the user community's drive to ensure the long-term availability of resources over generations. Any exhaustive or "profligate resource use" (Gadgil and Guha 1992) would draw community disapprobation, which is known to strongly deter individual selfish behaviours against the common good (Faber, Petersen, and Schiller 2002; Deb 2009a). Thus, the wild food gatherers (mostly women) of Bengal villages used to leave at least a few mushrooms on the forest floor to ensure

that some spores of the fungi would replenish the stock in the next season. Likewise, after extirpating wild tubers, the women used to either replant the vine or leave a piece of the tuber intact underground. No individual was allowed to extract a quantity of items exceeding what would suffice her family for the day. The "customary harvesting quotas" of Bengal's rural cultures are recorded to have persisted till the 1990s (Deb and Malhotra 2001). With the rapid spread of modernization and market integration, customary gathering norms have largely disappeared from local cultures. Most of the old ponds, traditionally maintained as sources of drinking water for the entire hamlet, have now been converted into pisciculture ponds of private households. Villagers near industrial towns often extract old-growth trees from SGs for a quick earning from the wood sale. In 2010, a Santal young man in Bonkati hamlet in Bishnupur block, cut down the only specimen of an 80-year-old *Ventilago maderaspatana* from his village SG to buy a bottle of spirit (Deb 2021a). The last known specimen of bhadu (*Vitex glabrata*) tree in the state (Deb 2014), recorded to have existed in Chhandar village of Barjora block, was cut down in 2016 (Deb 2019c). Such violations of customary conservation norms no longer elicit resistance or remonstration from the village community.

Crop seeds in all agrarian cultures used to be a commons, shared among members of the community and exchanged with other communities (Bray 1994; Sajise *et al.* 2012; Song *et al.* 2019; Deb 2019b, 2021a). In all agrarian societies until the 1970s, hundreds of rice landraces were developed by unnamed, unknown farmer-breeders who shared their creations with all members of the community. The farmers of Bankura, who had created the aromatic rice landrace Khudi khasa, and the farmer(s) who had discovered the health benefits of Kelas rice never claimed intellectual proprietorship over their innovations. More recently, in the 1990s, Mr. Asit De, a farmer in Bankura district, developed a new rice variety named Asit Kalma (Deb 2005; Deb 2021a) and distributed its seeds for free among numerous farmers in the district. Like all traditional innovations, which are widely accepted by the community and transmitted across generations, this new variety was incorporated into the region's agricultural repertoire as a common property of all farmers. However, the rapid expansion of seed commerce in the district marked the decay of the seed commons. The abolition of the seed exchange custom has since led to a loss of self-respect among indigenous farmers, who now rely entirely on the commercial supply of seeds and wait on statutory agricultural institutions for knowledge about new seeds and markets. This process has further contributed to the abolition of hundreds of farmer landraces and farmer markets for the sale of farm produce and artisanal crafts.

A significant mark of the disintegration of the cohesive bond within the community is the disappearance of *gânta* - a reciprocal labour exchange tradition that existed in all villages of Bankura, which was akin to *ayni* in Peru, *bez* in Ladakh, and *parma* in Nepal (Deb 2009a). Until the early 1980s, hired labour in agriculture was unknown in the region, because farmer neighbours used to share the tasks of land tilling, seed sowing, transplanting, crop harvesting, and housebuilding. After the 1980s, however, socio-political changes in the state accentuated the industrial ethic in production systems, highlighted private gains, introduced hired labour in agricultural lands, and fractured the autonomy of the rural community.

6. CONCLUSION

Despite my attempts to give an objective depiction of the status of biodiversity and associated local cultural traditions, this narrative fails to conceal my despair and consternation at the tempo and extent of biocultural loss and decay in the region, which I feel is irreversible. This despondent view is bolstered by the failure of statutory institutions to conserve the state's wealth of biodiversity (Deb 2007a; 2008b; 2013). Specifically, the state forest directorate has, over the past four decades, raised plantations of commercially valued exotics in all state forest lands at the expense of indigenous biodiversity (Deb 2013; 2014). In parallel, the state's promotion of cereal monocultures (Eliazar Nelson, Ravichandran, and Antony 2019), combined with perverse subsidies in agrochemicals and electricity (Aktar, Sengupta, and Chowdhury 2009; Shah and Verma 2014), has caused local extinctions of numerous organisms and disintegration of agroecosystems. The replacement of community control of water resources with individually owned pump sets has encouraged *ad libitum* withdrawal of groundwater for irrigation, resulting in a rapid decline of the water table (Deb 2009a). The forestry and the agricultural development agenda in all states continue to deplete the biodiversity of forests and agroecosystems throughout the country (Deb 2009a; Deb and Malhotra 1993; Gadgil and Guha 1995), oblivious to all evidence of the biodiversity loss that is leading to the decline of ecosystem productivity and resilience (Brzezina, Kopainsky, and Mathijs 2016; DuVal, Mijatovic, and Hodgkin 2019; Hector 2011; Liebman and Schulte 2015; Tilman, Reich and Isbell 2012; Vandermeer and Perfecto 2016); Bankura district is no exception. Neither the FD nor the WBSBB has taken any initiative to conserve the endangered biota and biodiversity-rich sacred groves and ponds. My decade-long communications with these statutory institutions about the threatened status of biodiversity in the sacred ponds in Belboni and Chhandar and about the last specimen of *Vitex glabrata* (eventually destroyed in 2016) are

evidence of the bureaucratic lethargy and nonchalance towards biodiversity conservation.

In view of this deplorable role of custodian institutions in biodiversity conservation, citizens' action is the only option for effectively safeguarding the district's wealth of biodiversity, which constitutes the foundation of local cultures, biocultural knowledge bases, and the food and livelihood security of the poor. However, given the continuing industrial enclosure of the commons and the evaporation of the communitarian ethos, I feel it imperative to conclude with this note of despair that the prospect of citizens' action restoring the biocultural integrity and biodiversity-based economy in the region is bleak.

ACKNOWLEDGEMENTS

I am thankful to Prof. Sheeladitya Pal of Christian College, Bankura, for his encouragement to write this article. I am grateful to my research associates, Debdulal Bhattacharya, Shanti Roy, and Debashis Mukherjee of Bankura, for their help with the collection and verification of several data, and to Mr. Arindam Chakraborty of Tribeni, Hooghly, for his help with the identification of animal breeds.

FUNDING

The author declares no funding support for this work.

CONFLICT OF INTEREST

The author declares no conflict of interest.

REFERENCES

Aktar, Wasim, Dwaipayan Sengupta, and Ashim Chowdhury. 2009. "Impact of Pesticides Use in Agriculture: Their Benefits and Hazards." *Interdisciplinary Toxicology* 2 (1): 1-1. https://doi.org/10.2478/v10102-009-0001-7.

Amici, V, S Landi, D Rocchini, E Santi, and A Chiarucci. 2015. "Anthropogenic Drivers of Plant Diversity: Perspective on Land Use Change in a Dynamic Cultural Landscape." *Biodiversity and Conservation* 24: 3185-199. https://doi.org/10.1007/s10531-015-0949-x

Annett, Robert, Hamid R Habibi, and Alice Hontela. 2014. "Impact of Glyphosate and Glyphosate-based Herbicides on the Freshwater Environment." *Journal of Applied Toxicology* 34 (5): 458-79. https://doi.org/10.1002/jat.2997.

Aswani, Shankar, Anne Lemahieu, and Warwick HH Sauer. 2018. "Global Trends of Local Ecological Knowledge and Future Implications." PLoS One 13 (4):

e0195440. https://doi.org/10.1371/journal.pone.0195440.

Banerjee, Ajit K. 2004. "Tracing Social Initiatives Towards JFM." In From Root to Canopy, edited by VK Bahuguna, D Cabistrano, K Mitra, and S Saigal, 45-56. New Delhi: Commonwealth Forestry Association (India Chapter)/Winrock International-India.

Banerjee, Indranil, SK Tripathi, A Sinha Roy, and Parama Sengupta. 2014. "Pesticide Use Pattern Among Farmers in a Rural District of West Bengal, India." *Journal of Natural Science, Biology and Medicine* 5(2): 313-316. https://doi.org/10.4103/0976-9668.136173

Bankura District Administration. 2021a. "Agriculture." Last modified November 9, 2021. https://bankura.gov.in/agriculture/.

Bankura District Administration. 2021b. "Wild Life Hotspots." Last modified November 9, 2021. https://bankura.gov.in/wild-life-hotspots/.

Bray, Francesca. 1994. The Rice Economies: Technology and Development in Asian Societies. San Francisco: University of California Press.

Brondizio, ES, J Settele, S Díaz, and HT Ngo, eds. 2019. Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Bonn: IPBES. https://ipbes.net/global-assessment.

Brzezina, Natalia, Birgit Kopainsky, and Erik Mathijs. 2016. "Can Organic Farming Reduce Vulnerabilities and Enhance the Resilience of the European Food System? A Critical Assessment Using System Dynamics Structural Thinking Tools." *Sustainability* 8 (10): 971. https://doi.org/10.3390/su8100971.

Byers, Bruce A, Robert N Cunliffe, and Andrew T Hudak. 2001. "Linking the Conservation of Culture and Nature: A Case Study of Sacred Forests in Zimbabwe." *Human Ecology* 29: 187-218. https://doi.org/10.1023/A:1011012014240.

Ceballos, Geraldo, Paul R Ehrlich, and Rodolfo Dirzo. 2017. "Biological Annihilation Via the Ongoing Sixth Mass Extinction Signaled by Vertebrate Population Losses and Declines." Proceedings of the National Academy of Sciences of the United States of America 114: E6089-E6096. https://doi.org/10.1073/pnas.1704949114.

Census India. 2011. "Bankura District, West Bengal." The 15th National Census Survey. https://www.censusindia2011.com/west-bengal/bankura-population.html (Updated 2021).

Chakraborty, Kshudhiram and Biswaranjan Mistri 2017. "Irrigation System and Pattern of Crop Combination, Concentration And Diversification in Barddhaman District, West Bengal." NEHU Journal XV (2): 45-65. https://nehu.ac.in/public/downloads/Journals/NEHU-JOURNAL-Jan-Dec-2017-A4.pdf.

Choudhury Kamilya, Mihir. 1992. Anchalik Debata: Lok Samskriti (Local Deities: Folk Cultures, in Bengali). Bardhaman: University of Burdwan.

Clement, Charles R and André B Junqueira. 2010. "Between a Pristine Myth and an

Impoverished Future." *Biotropica* 42 (5): 534-536. https://doi.org/10.1111/j.1744-7429.2010.00674.x.

Curtis, Philip G, Christie M Slay, Nancy L Harris, Alexandra Tyukavina, and Matthew C Hansen. 2018. "Classifying Drivers of Global Forest Loss." *Science* 361 (6407): 1108-1111. https://doi.org/10.1126/science.aau3445.

Das, Ashutosh, Debabrata Basu, and Rupak Goswami. 2016. "Factors Influencing Retailing Performance of Farm Inputs in South 24 Parganas District of West Bengal." Indian Research Journal of Extension Education 10 (3): 49-53.

Das, Tapasi and Ashesh Kumar Das. 2005. "Inventorying Plant Biodiversity in Homegardens: A Case Study in Barak Valley, Assam, North East India." *Current Science* 89 (1): 155-163.

De, Utpal Kumar and Manabendu Chattopadhyay. 2010. "Crop Diversification by Poor Peasants and Role of Infrastructure: Evidence from West Bengal." *Journal of Development and Agricultural Economics* 2 (10): 340-350. https://doi.org/10.5897/JDAE.9000036.

Deb, Debal. 2003. "Sacred Ponds, Pools and Rivers." In Culture and Biodiversity, Vol. I. Ministry of Environment and Forest, Government of India, and Kalpvriksh. http://kalpvriksh.org/wp-content/uploads/2019/05/Culture-and-Biodiversity.pdf.

Deb, Debal. 2005. Seeds of Tradition, Seeds of Future. New Delhi: Research Foundation for Science Technology and Ecology.

Deb, Debal. 2007a. "Sacred Groves of West Bengal: A Model of Community Forest Management." Understanding Livelihood Impacts of Participatory Forest Management Implementation in India and Nepal. Norwich: University of East Angli. https://doi.org/10.2139/ssrn.2403540.

Deb, Debal. 2007b. "Personal Experience of Researching Sacred Groves Adjacent to Joint Forest Management Forests." In Forests, People and Power: The Political Ecology of Reform in South Asia, edited by O Springer-Baginski and P Blaikie, 254-255. London: Earthscan/Routledge.

Deb, Debal. 2008. "Sacred Ecosystems of West Bengal." In Status of Environment in West Bengal: A Citizens' Report, edited by AK Ghosh, 117-126. Kolkata: ENDEV Society for Environment and Development.

Deb, Debal. 2009a. Beyond Developmentality: Constructing Inclusive Freedom and Sustainability. London: Earthscan/Routledge.

Deb, Debal. 2009b. "Biodiversity and Complexity of Rice Farm Ecosystems: An Empirical Assessment." *The Open Ecology Journal* 2: 112-129. https://doi.org/10.2174/1874213000902010112.

Deb, Debal. 2013. "Joint Forest Management." In Status of Environment in West Bengal: A Citizens' Report, edited by AK Ghosh, 96-104. Kolkata: ENDEV Society for Environment and Development.

Deb, Debal. 2014. "The Value of Forest: An Ecological Economic Examination of Forest People's Perspective." In Challenges and Opportunities for the World's Forests in the 21st Century, edited by T Fenning, 123-159. Heidelberg/New York:

Springer. https://doi.org/10.1007/978-94-007-7076-8_7.

Deb, Debal. 2017. "Folk Rice Varieties, Traditional Knowledge and Nutritional Security in South Asia." In Agroecology, Ecosystems, and Sustainability in the Tropics, edited by G Poyyamoli, 117-134. Delhi: Studera Press.

Deb, Debal. 2019a. "Restoring Rice Biodiversity." *Scientific American* 321 (4) (October): 54-61.

Deb, Debal. 2019b. "Food Sovereignty: Opposing the Enclosure of Land, Seeds and Knowledge Commons." In Can Hunger be Defeated?, edited by S Mentschel, 1-48. New Delhi: Rosa Luxemburg-Stiftung/ Yoda Press.

Deb, Debal. 2019c. "My Journey of Rescuing a Tree from Extinction." Filmed at TEDx Bellandur, India. Video, 18:03. https://www.ted.com/talks/debal_deb_my_journey_of_rescuing_a_tree_from_extinction.

Deb, Debal. 2020. "Is the System of Rice Intensification (SRI) Consonant with Agroecology?" *Agroecology and Sustainable Food Systems* 44: 1338-1369. https://doi.org/10.1080/21683565.2020.1779165.

Deb, Debal. 2021a. Bichyuta Swadeshbhumi: Banglar Joiba Sanskritir Luptaboshesher Sandhan (Displaced Native Land: A Search for the Remnants of Biocucultural Heritage, in Bengali). Kolkata: Basudha/Dhyanbindu.

Deb, Debal. 2021b. "Rice Cultures of Bengal." *Gastronomica* 21 (1): 91-101. https://doi.org/10.1525/gfc.2021.21.3.91.

Deb, Debal and Samir Banerjee. 1987. "Muscle Protein Degradation in Fishes Exposed to Mahua Oil Cake." *Environment and Ecology* 5: 704-706.

Deb, Debal and Priyabrata Roy 2021. "Wood and Bark Lignin Contents of Trees from Deciduous Forests of Eastern India." *Experimental Results* 2: 1-10. https://doi.org/10.1017/exp.2021.18.

Deb, Debal, Bo Li, Sanjib K Chattopadhyay, and Avik Ray. 2018. "Identification of an Endangered Tree as a New Record of *Cordia macleodii*, with an Update of Cordia in West Bengal, India." *Webbia Journal of Plant Taxonomy and Geography* 73 (1): 81-88. https://doi.org/10.1080/00837792.2017.1415043.

Deb, Debal, K Deuti, and KC Malhotra 1997. "Sacred Grove Relics as Bird Refugia." *Current Science* 73: 815-817.

Deb, Debal and KC Malhotra. 1993. "People's Participation: The Evolution of Joint Forest Management in West Bengal." In People of India: The Biocultural Dimensions, edited by S. B. Roy and A. Ghosh, 329-342. New Delhi: Inter-India Publication.

Deb, Debal and KC Malhotra. 2001. "Conservation Ethos in Local Traditions: The West Bengal Heritage." *Society and Natural Resources* 14 (8): 711-724. https://doi.org/10.1080/08941920118542.

Deb, Debal, Soujit Sengupta, and T Pradeep. 2015. "A Profile of Heavy Metals in Rice (*Oryza sativa ssp. indica*) Landraces." *Current Science* 109: 407-409.

DuVal, Ashley, Dunja Mijatovic, and Toby Hodgkin. 2019. "The Contribution of

Biodiversity for Food and Agriculture to the Resilience of Production Systems: Thematic Study for the State of the World's Biodiversity for Food and Agriculture." Rome: FAO. https://www.fao.org/3/ca5008en/ca5008en.pdf.

Eliazar Nelson, Anne Raeboline Lincy, Kavitha Ravichandran, and Usha Antony. 2019. "The Impact of the Green Revolution on Indigenous Crops of India." Journal of Ethnic Foods 6. https://doi.org/10.1186/s42779-019-0011-9.

Ellis, Erle C, Nicolas Gauthier, Kees Klein Goldewijk, Rebecca Bliege Bird, Nicole Boivin, Sandra Díaz, Dorian Q Fuller, et al. 2021. "People Have Shaped Most of Terrestrial Nature for at Least 12,000 Years." Proceedings of the National Academy of Sciences USA 118 (17): e2023483118. https://doi.org/10.1073/pnas.2023483118.

Elmqvist, Thomas, Wayne C Zipperer, and Burak Güneralp. 2016. "Urbanization, Habitat Loss and Biodiversity Decline: Solution Pathways to Break the Cycle." In Routledge Handbook of Urbanization and Global Environmental Change, edited by Karen Seta, William D Solecki and Corrie A Griffith, 139-151. London and New York: Routledge.

Faber, Malte, Thomas Petersen, and Johannes Schiller. 2002. "Homo Oeconomicus and Homo Politicus in Ecological Economics." *Ecological Economics* 40 (3): 323-333. https://doi.org/10.1016/S0921-8009(01)00279-8.

FAO. N.D. "Domestic Animal Diversity Information System (DAD-IS)". Food and Agriculture Organization of the United Nations. http://www.fao.org/dad-is/browse-by-country-and-species/en/

Fletcher, Michael-Shawn, Rebecca Hamilton, Wolfram Dressler, and Lisa Palmer. 2021. "Indigenous Knowledge and the Shackles of Wilderness." Proceedings of the National Academy of Sciences of the United States of America 118 (40): e2022218118. https://doi.org/10.1073/pnas.2022218118.

Flint, E P. 1998. "Deforestation and Land Use in Northern India with a Focus on Sal (*Shorea robusta*) Forests 1880-1980." In Nature and the Orient: The Environmental History of South and Southeast Asia, edited by Richard Grove, Vinita Damodaran, and Satpal Sangwan, 421-483. New Delhi: Oxford University Press.

Frainer, André, Tero Mustonen, Sutej Hugu, Tamara Andreeva, Elle-Maarit Arttijeff, Inka-Saara Arttijeff, Felipe Brizoela, et al. 2020. "Cultural and Linguistic Diversities are Underappreciated Pillars of Biodiversity." Proceedings of the National Academy of Sciences of the United States of America 117(43): 26539-26543. https://doi.org/10.1073/pnas.2019469117.

Fromm, Erich. 1973. The Anatomy of Human Destructiveness. London: Holt, Reinehart and Winston.

Fuller, Dorian Q. 2011. "Finding Plant Domestication in the Indian Subcontinent." *Current Anthropology* 52 (S4): S347-S362. https://doi.org/10.1086/658900.

Gadgil, Madhav and Ramachandra Guha. 1992. This Fissured Land: An Ecological History of India. Second Edition. Delhi: Oxford University Press.

Gadgil, Madhav and Ramachandra Guha. 1995. Ecology and Equity. London:

Routledge.

George, M Veena and G Christopher. 2020. "Structure, Diversity and Utilization of Plant Species in Tribal Homegardens of Kerala, India." *Agroforestry Systems* 94: 297-307. https://doi.org/10.1007/s10457-019-00393-5.

Ghosh, Amartya. 1992. "The Gangetic Campaign by the Cholas (11th Century)." Proceedings of the Indian History Congress 53: 79-86. https://www.jstor.org/stable/44142772.

Gómez-Pompa, Arturo and Andrea Kaus. 1992. "Taming the Wilderness Myth". *BioScience* 42(4): 271-279. https://doi.org/10.2307/1311675

GRBNEP (Ganga River Basin Environment Management Plan) 2011. "Trends in Agriculture and Agricultural Practices in Ganga Basin; Part IV: West Bengal." National Ganga River Basin Authority, Government of India. http://cganga.org/wp-content/uploads/sites/3/2018/11/019_SEC.pdf.

Hector, Andy. 2011. "Diversity Favours Productivity." *Nature* 472: 45-46. https://doi.org/10.1038/472045a.

Irvine, Kenneth, Leandro Castello, Andrea Junqueira, and Timothy Moulton. 2016. "Linking Ecology with Social Development for Tropical Aquatic Conservation." *Aquatic Conservation: Marine and Freshwater Ecosystems* 26 (5): 917-41. https://doi.org/10.1002/aqc.2706

IUCN. n.d. "IUCN Red List of Threatened Species." International Union for Conservation of Nature. http://www.iucn.org/resources/conservation-tools/iucn-red-list-threatened-species.

IUCN. 2001. "Red List - Categories and Criteria" (version 3.1). Cambridge: IUCN/SSC Red List Programme. http://www.iucnredlist.org/apps/redlist/static/categories_criteria_3_1#critical.

Jackson, S, and LR Palmer. 2015. "Reconceptualizing Ecosystem Services". *Progress in Human Geography* 39: 122-145. https://doi.org/10.1177/0309132514540016

Jacobi, H. 1884. "Gaina Sutras, Pt. I." In Sacred Books of the East, Vol. 22, edited by F Max Muller. London: Clarendon Press.

Karmakar, Joydip, Rajib Roychowdhury, Rup Kumar Kar, Debal Deb, and Narottam Dey. 2012. "Profiling of Selected Indigenous Rice (*Oryza sativa L.*) Landraces of Rarh Bengal in Relation to Osmotic Stress Tolerance." *Physiology and Molecular Biology of Plants* 18 (2): 125-32. https://doi.org/10.1007/s12298-012-0110-1.

Kellert, Stephen and Edward O Wilson, eds. 1993. The Biophilia Hypothesis. Washington, DC: Island Press.

Kumar, Dileep. 2020. "State of Glyphosate Use in India." Thrissur: PAN India. https://pan-india.org/wp-content/uploads/2020/10/State-of-Glyphosate-Use-in-Inda_Final_low-res.pdf.

Larson, Greger and Dorian Q Fuller. 2014. "The Evolution of Animal Domestication." Annual Review of Ecology, Evolution, and Systematics 66: 115-36. https://doi.org/10.1146/annurev-ecolsys-110512-135813.

Liebman, Matthew and Lisa A Schulte-Moore. 2015. "Enhancing Agroecosystem Performance and Resilience Through Increased Diversification of Landscapes and Cropping Systems." Elementa: *Science of the Anthropocene* 3: 000041. https://doi.org/10.12952/journal.elementa.000041

Lombardo, Umberto, José Iriarte, Lautaro Hilbert, Javier Ruiz-Pérez, José M Capriles, and Heinz Veit. 2020. "Early Holocene Crop Cultivation and Landscape Modification in Amazonia." *Nature* 581: 190-93. https://doi.org/10.1038/s41586-020-2162-7

Maffi, Luisa and Ellen Woodley. 2010. Biocultural Diversity Conservation: A Global Sourcebook. London: Earthscan.

Malhotra, KC, Debal Deb, and TS Vasulu. 1992. "Restitution of Biodiversity in Southwest Bengal Forests." *Journal of the Indian Anthropological Society*. 27: 35-47.

Mitra, Bulganin, Arna Mazumder, Priyanka Das, Imtiaz Imam, and Argha Sarkar. 2017. "Floral Diversity of the Sacred Groves in Gangajalghati, Bikna and Onda Blocks of Bankura District, West Bengal, India." *Journal of Environment and Sociobiology* 14 (1): 29-39.

Mohanta, S, and J Mandal. 2019. "Assessment of Vegetable Purpose Watermelon [*Citrullus lanatus* (Thunb.) Matsum And Nakai] Genotypes Collected from Laterite Belt of Eastern India." *Journal of Pharmacognosy & Phytochemistry* 8 (3): 2508-2512.

Mondal, Priya, Souvik Datta, and Debal Deb. 2021. "Agronomic and Nutraceutical Properties of Indigenous Rice Varieties." In A Handbook of Agriculture and Plant Sciences, edited by D Sinha, 71-92. New Delhi: ABS Publishers.

O'Malley, LSS. 1996 [1908]. Bengal District Gazetteers: Bankura. Kolkata: Government of West Bengal.

Palit, Subhabrata. 1999. Structural Changes in Forest Departments. New Delhi: WWF-India/IIED.

Papworth, SK, J Rist, L Coad, and EJ Milner-Gulland. 2009. "Evidence for Shifting Baseline Syndrome in Conservation." *Conservation Letters* 2 (2): 93-100. https://doi.org/10.1111/j.1755-263X.2009.00049.x.

Pathak, H, BB Panda, and AK Nayak, eds. 2019. Bringing Green Revolution to Eastern India: Experiences and Expectations. Cuttack: ICAR-National Rice Research Institute. https://icar-nrri.in/wp-content/uploads/2019/06/1.-BGREI_press_25may19.pdf.

Pauchard, Anibal, Mauricio Aguayo, Eduardo Peña, and Roberto Urrutia. 2006. "Multiple Effects of Urbanization on the Biodiversity of Developing Countries: The Case of a Fast-Growing Metropolitan Area (Concepción, Chile)." *Biological Conservation* 127 (3): 272-81. https://doi.org/10.1016/j.biocon.2005.05.015.

Paul, Atreya, Amartya Pani, and Arup Bhandary. 2020. "Analysis the Pattern and Role of Crop Concentration and Diversification in Different Blocks of South 24 Pargana District, West Bengal." *SSRG International Journal of Agriculture & Environmental Science* 7 (5): 57-71. https://doi.org/10.14445/23942568/IJAES-V7I5P110.

Pimentel, David and Marcia Pimentel. 1990. "Adverse Environmental

Consequences of the Green Revolution." *Population and Development Review* 16: 329-32. https://doi.org/10.2307/2808081.

Ray, Sandipan, Debal Deb, Amarnath Nandy, Debopriya Basu, Agnideep Aich, Sudipta Tripathy, Sugata Sen Roy, et al. 2021. "Rare and Neglected Rice Landraces as a Source of Fatty Acids for Undernourished Infants." *Current Science* 121 (5): 660-66. https://doi.org/10.18520/cs/v121/i5/660-666.

Relyea, Rick A, and Devin K Jones. 2009. "The Toxicity of Roundup Original Max® to 13 Species of Larval Amphibians." *Environmental Toxicology and Chemistry* 28 (9): 2004-2008. https://doi.org/10.1897/09-021.1.

Ramakrishnan, PS, AK Das, and KG Saxena. 1996. Conserving Biodiversity for Sustainable Development. New Delhi: Indian National Science Academy.

Rosin, Zuzanna. M., Matthew Hiron, Michał Żmihorski, Paweł Szymański, Marcin Tobolka, and Tomas Pärt. 2020. "Reduced Biodiversity in Modernized Villages: A Conflict between Sustainable Development Goals." *Journal of Applied Ecology* 57 (3). https://doi.org/10.1111/1365-2664.13566.

Roy, Priyabrata, Debal Deb, Mousumi Poddar Sarkar, Brindaban Roy, and Tanima Saha. 2020. "An Analysis of B Vitamins in Selected Indian Rice Landraces." Basudha Data Paper #4. Kolkata: Basudha Laboratory for Conservation.

http://cintdis.org/wp-content/uploads/2021/ 06/Basudha_Data-Paper4.pdf

RSP Green Development and Laboratories. 2019. District Survey Report of Bankura District. Howrah: RSP Green Development and Laboratories. https://cdn.s3waas.gov.in/s38e82ab7243b7c66d768f1b8ce1c967eb/uploads/2020/09/2020091496.pdf.

Sajise, Edelweiss E, Teresita H Borromeo, Nestor C Altoveros, and Sancho G Bon. 2012. "Traditional Rice in Central Cordillera, Philippines: Dynamics of On-Farm Management of Varietal Diversity." *Journal of Developments in Sustainable Agriculture* 7 (1): 75-88. https://doi.org/10.11178/jdsa.7.75.

Sánchez-Bayo, Francisco and Kris AG Wyckhuys. 2019. "Worldwide Decline of the Entomofauna: A Review of Its Drivers." *Biological Conservation* 232: 8-27. https://doi.org/10.1016/j.biocon.2019.01.020.

Sanyal, Debdutta. 2018. "Religious Landscape of Early Medieval Rādh Bengal." Sahapedia. https://www.sahapedia.org/religious-landscape-of-early-medieval-r%C4%81%E1%B8%8Dh-bengal-0.

Sanyal, MN. 1994. Flora of Bankura District, West Bengal. Dehradun: Bishen Singh Mahendra Pal Singh.

Sen Gupta, Soujit, Ananya Baksi, Priyabrata Roy, Debal Deb, and Thalappil Pradeep. 2017. "Unusual Accumulation of Silver in the Aleurone Layer of an Indian Rice (*Oryza sativa*) Landrace and Sustainable Extraction of the Metal." *ACS Sustainable Chemistry and Engineering* 5 (9): 8310-15. https://doi.org/10.1021/acssuschemeng.7b02058.

Shah, Tushaar and Shilp Verma. 2014. "Reversing the Perverse Incentives." CGIAR Water Land & Ecosystems. https://wle.cgiar.org/thrive/2014/07/17/reversing-perverse-incentives.

Sivaramakrishnan, K. 1999. Modern Forests: Statemaking and Environmental Change in Colonial Eastern India. New Delhi: Oxford University Press.

Song, Yingjie, Qiong Fang, Devra Jarvis, Keyu Bai, Dongmei Liu, Jinchao Feng, and Chunlin Long. 2019. "Network Analysis of Seed Flow, a Traditional Method for Conserving Tartary Buckwheat (*Fagopyrum tataricum*) Landraces in Liangshan, Southwest China." *Sustainability* 11 (16), 4263. https://doi.org/10.3390/su11164263

Srinivas, MN. 1956. "A Note on Sanskritization and Westernization." *The Far Eastern Quarterly* 15 (4): 481-496. https://doi.org/10.2307/2941919

Teshome, A, BR Baum, L Fahrig, JK Torrance, T John Arnason, and JD Lambert. 1997. "Sorghum (*Sorghum bicolor* (L.) Moench) Landrace Variation and Classification in North Shewa and South Welo, Ethiopia." *Euphytica* 97: 255-263. https://doi.org/10.1023/A:1003074008785

Tilman, David, Peter B Reich, and Forest Isbell. 2012. "Biodiversity Impacts Ecosystem Productivity as Much as Resources, Disturbance, or Herbivory." Proceedings of National Academy of Sciences USA. 109 (26): 10394-10397. https://doi.org/10.1073/pnas.1208240109.

UNEP. 2005. "Synthesis Reports." Millennium Ecosystem Assessment. United Nations Environmental Program. http://www.millenniumassessment.org/en/Synthesis.html.

Vandermeer, John H, and Ivette Perfecto. 2016. "Complexity in Tradition and Science: Intersecting Theoretical Frameworks in Agroecological Research." In Agroecology: A Transdisciplinary, Participatory and Action-Oriented Approach, edited by VE Mendez, CM Bacon, R Cohen, and SR Gliessman, 99-111. Boca Raton: CRC Press.

Vaughan, JG, and CA. Geissler. 2009. The Oxford Book of Food Plants, 2nd Edition. Oxford: Oxford University Press.

Vrihi. 1997-2021. "Register of Rice Landraces Collected From, and Distributed Among, Farmers of India." Unpublished. http://cintdis.org/vrihi/.

WBFD (West Bengal Forest Department). 2019. "Chapter 3. Forest Land, Forest Cover, and Vegetation." Government of West Bengal. http://www.westbengalforest.gov.in/upload/forest_of_wb/st1.pdf.

Xavier, S. 2010. "An Analytical Study on the Sanskritisation of the Deities of Folk Tradition with Reference to Tamil Nadu." Proceedings of the Indian History Congress 70 (2009-2010): 621-634.