

**Rice Genetic Diversity Erosion:  
An Assessment Based on Virihi's Survey and Accession Records**

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**Abstract**

We present here a list of folk rice varieties that were collected from farmers of eastern India during the period from 1996 to 2005, and gone out of cultivation by the year 2020. This indicates the rapid rate of the loss of rice landraces in the region.

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## **Introduction**

The advent of agricultural modernisation, epitomised in India by the Green Revolution, began in the 1960s. This event introduced intensive monocultures of cereals, industrial agrochemicals, and expansion of irrigation in most of the country (Deb 2009; Nelson et al. 2019). In the process, the Green Revolution eventually replaced hundreds of folk rice varieties with modern high yielding varieties (HYVs) of rice and wheat in every state (Ahuja & Jain 2015; Nelson et al. 2019). Later, dozens of new hybrids and HYVs of different other crops dominated the market and an open supply of these seeds on the market enabled farmers to replace their own farm-saved seeds, in the hope of greater yield.

According to Richharia's (1990) estimate, more than 160,000 folk rice varieties were cultivated in India, until the onset of the Green Revolution. However, this estimate included synonyms (different names of the same landrace). After elimination of the synonyms, the number of folk rice varieties is estimated to be around 110,000 (Deb 2009), most of which are no longer being cultivated. While a large number of distinctive folk varieties are known to have disappeared from farm fields, the actual quantitative extent of the genetic diversity erosion in the case of Indian rice landraces is yet unknown. This work is an empirical assessment of the loss of folk varieties from eastern India, based on Vrihi's documentation of field accessions.

## **Materials and Methods**

Vrihi has a repertoire of 1440 of distinct folk rice varieties, collected from 12 states of India, and also from Bangladesh, Nepal, Pakistan and Sri Lanka. This accession is a result of 25 years of field explorations conducted from 1996 to 2021, and includes 567 landrace accessions from undivided Bengal (510 landraces from West Bengal and 57 from Bangladesh). The initial accession was chiefly from different districts of eastern India, numbering 416, which were characterised and published in 2005. Amongst these, 401 landraces were collected from the eastern states of Jharkhand, Odisha and West Bengal. A list of the names of the folk varieties and 35 morphological characters of each of these varieties was published in 2005 (Deb et al. 2005), which also contained a list of farmers who had donated the seed samples of these varieties. This publication shows the names of the varieties and the donor farmers' names and addresses in the states of West Bengal,

Bihar (including the region that is now Jharkhand) and Odisha. These records thus serves as a baseline data of the cultivation of varieties in eastern Indian states until 2005.

To assess the loss of the same folk varieties in subsequent years, we have used the office records of subsequent explorations by Vrihi's workers and volunteers in different districts of West Bengal, Bihar (including Jharkhand) and Odisha, and our own notes in our travel diaries from 2006 through 2022. The records of our survey and collection expeditions reveal the pattern of the loss of the folk varieties that had been collected from the same states in 2005. Table 1 shows a state-wise list of folk varieties that were collected until 2005 (and published in 2005) that are no longer cultivated in the same states as of 2020. The record of the non-availability of the varieties was surmised both from our repeated visits to the same places of original accession and from reports by other farmers and conservators in different districts of the same states.

## **Results and Discussion**

From Vrihi's accession of 401 landraces of collected from eastern Indian states during the period from 1996 to 2005, 316 are no longer being cultivated on any farm in West Bengal, Odisha and Jharkhand, as of 2020. This implies that 78.8% of Vrihi's collection were lost during the period of 15 years. The last specimens of these lost landraces are being conserved in Vrihi seed bank (<https://cintdis.org/vrihi/>).

The lost landraces estimated here comprise 9 landraces (2.2%) from Jharkhand, 10 landraces (2.5%) from Odisha and 297 landraces (74.1% of total accession) from West Bengal. All of these landraces, once cultivated by older farmers, have been replaced with a few modern cultivars chosen by the younger generation, in the hope of a greater economic prosperity.

This process of farmers' replacement of cultivars has been reported for different crops (Zeven 1999; Ahuja & Jain 2015). A major reason of this drastic reduction in the number of landraces within 15 years of our last collection is that farmers have replaced them with modern HYVs. The extinction of the landraces from farm fields implies drastic genetic erosion in rice, through the loss of important phenotypic traits, alleles and gene combinations (Ahuja & Jain 2015; Deb 2017; Khouri et al. 2021). This study indicates the alarming rapidity of rice genetic erosion in eastern India.

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**Table 1:** List of Landraces of Eastern India Disappeared from Farm Fields.

Landrace	Synonym	State of Origin
BAGH JHAPTH		Jharkhand
BASTAR		Jharkhand
BHURI-SAL		Jharkhand
HATIPANJAR		Jharkhand
LAL DHEPA		Jharkhand
MEGHNAD-SAL		Jharkhand
PARBAL		Jharkhand
RABAN-SAL		Jharkhand
SONAM		Jharkhand
BHUGUNISAR		ODISHA
CHITRA KANHAI		ODISHA
DEULA BHOG		ODISHA
GADABA		ODISHA
GURUJI		ODISHA
KURO BAGAR		ODISHA
KUSUM GENDA		ODISHA
MOTI		ODISHA
SEKARA		ODISHA
SITAI		ODISHA
AASH		West Bengal
AGNIBAN		West Bengal
AGNI-SAL		West Bengal
AKSHAY RANI		West Bengal
AMAR-SAL		West Bengal
ASANLEYA		West Bengal
ASHPHAL		West Bengal
ASHU		West Bengal

Landrace	Synonym	State of Origin
ASHWIN DHULIA		West Bengal
ASHWIN JHARIA		West Bengal
AUSH PAKAL		West Bengal
AUSHA BONKATA		West Bengal
BABUILATA		West Bengal
BADABONA		West Bengal
BAID DHUSURI		West Bengal
BAID DULAH		West Bengal
BAID KALAM KATHI		West Bengal
BAIDRAS		West Bengal
BAJAL		West Bengal
BAKUL PHOOL		West Bengal
BALARAM SAL		West Bengal
BALI BHAJNA		West Bengal
BANK CHUR		West Bengal
BANKATA		West Bengal
BANKUI		West Bengal
BANSH GAJAL		West Bengal
BANSH KANTA		West Bengal
BANSHMOTI		West Bengal
BANSH MUGRI		West Bengal
BANSH PATA		West Bengal
BANSH PATI		West Bengal
BANSH TARA		West Bengal
BANYA SAL		West Bengal
BARDHAMAN PANLOI		West Bengal
BENA JHURI		West Bengal
BENA PHOOL		West Bengal
BEGUN BECHI		West Bengal
BHALKI		West Bengal

Landrace	Synonym	State of Origin
BHASAMANIK		West Bengal
BHIM-SAL		West Bengal
BHURI		West Bengal
BHURISHULAH		West Bengal
BHUTIA		West Bengal
BHUT MOORI		West Bengal
BIRALA		West Bengal
BIROI		West Bengal
BIRPANA		West Bengal
BISHMONI		West Bengal
BOCHI		West Bengal
BOCHI GONDRI		West Bengal
BODRESH		West Bengal
BOKRA		West Bengal
BOMBAI MUGI		West Bengal
BORNI		West Bengal
BOUBHOG		West Bengal
BOU DULALI		West Bengal
BUDBUD SAL		West Bengal
BULLET		West Bengal
CHAITANYA		West Bengal
CHALI		West Bengal
CHAKRAMALA		West Bengal
CHANDRAKANTA		West Bengal
CHAPA KHUSI		West Bengal
CHENGA		West Bengal
CHENG-SAL		West Bengal
CHERKI JHULLOOR		West Bengal
CHERKIRAJ		West Bengal
CHHOTO NUNIYA		West Bengal

Landrace	Synonym	State of Origin
CHILA PATNAI		West Bengal
DAKSHINALAGHU		West Bengal
DANAGURI		West Bengal
DANGER BARUAH		West Bengal
DANGRI PATNAI		West Bengal
DWARKA SAL	DAROGA-SAL	West Bengal
DAYAL MADINA		West Bengal
DEHRADUN BAS		West Bengal
DEPUTY SAL		West Bengal
DESHI PATNAI		West Bengal
DHAKAI KALAM		West Bengal
DHULA DHUSURI		West Bengal
DHULA SAL		West Bengal
DHUSURI		West Bengal
DORANGI		West Bengal
DODH KALMA		West Bengal
DUDHE MATOR		West Bengal
DUKHI DARBAR		West Bengal
DUMUR KNDI		West Bengal
DUMUR-SAL		West Bengal
DURGA- SAL		West Bengal
GANDHA MALATI		West Bengal
GANDHESWARI		West Bengal
GANGAJALI		West Bengal
GANGA-SAL		West Bengal
GARIA		West Bengal
GARIB-SAL		West Bengal
GETI-SAL		West Bengal
GETOI		West Bengal
GHEOS		West Bengal



Landrace	Synonym	State of Origin
GHORA-SAL		West Bengal
GITA SHREE		West Bengal
GOCHARI PATNAI		West Bengal
GORAH		West Bengal
GOUR-NITAI		West Bengal
GUJURI BHOG		West Bengal
GURUJI		West Bengal
HALUD GATHI		West Bengal
HAMAI		West Bengal
HANSGUJI		West Bengal
HANUMAN JATA		West Bengal
HARIN KHOL	SHOL PANA	West Bengal
HARIR JHINGA		West Bengal
HATI CHAMPA		West Bengal
HEERA MOTI		West Bengal
HINCHE SAROO		West Bengal
ICHHA MATI		West Bengal
INDRA-SAL		West Bengal
JAL KAMINI		West Bengal
JAMAI NADU		West Bengal
JAMAI-SAL		West Bengal
JASHUA		West Bengal
JATA		West Bengal
JATA KALMA		West Bengal
JATA LETA-SAL		West Bengal
JHANTI-SAL		West Bengal
JHINGA		West Bengal
JHITI PITI		West Bengal
JHULI		West Bengal
JHOPA JHULOR		West Bengal

Landrace	Synonym	State of Origin
JHULLOOR		West Bengal
JIRA-SAL		West Bengal
JUGAL		West Bengal
JUNGLI JATA		West Bengal
KAJAL KATHI		West Bengal
KAJAL SUNDARI		West Bengal
KAKUA		West Bengal
KALAM KATHI		West Bengal
KALI ASHU		West Bengal
KALI KOMAD		West Bengal
KALIRAY		West Bengal
KALMA		West Bengal
KALO BHUTIA		West Bengal
KALO BORO		West Bengal
KALO DUMRAH		West Bengal
KALO MANIK		West Bengal
KALO MOTI		West Bengal
KAMALBHOG		West Bengal
KAMATH		West Bengal
KANKHIRI		West Bengal
KANKHRIA		West Bengal
KANKRI		West Bengal
KANKURIA		West Bengal
KANTA JHINGA-SAL		West Bengal
KANTHALI CHANPA		West Bengal
KARPURIL		West Bengal
KARTIKE PATNAI		West Bengal
KARTIK-SAL		West Bengal
KASHI PHOOL		West Bengal
KATIJANGLI		West Bengal

Landrace	Synonym	State of Origin
KAYA		West Bengal
KAYA KELAS		West Bengal
KESHAB-SAL		West Bengal
KETAKI		West Bengal
KHAS DHAN		West Bengal
KHATIA TIKA		West Bengal
KHEJUR CHHARI		West Bengal
KHIRA-SAL		West Bengal
KHIRABICHI		West Bengal
KHOLAM KUCHI		West Bengal
KHUDI KHASA		West Bengal
KUBJA		West Bengal
KUMROGORH		West Bengal
LAKSHMI CHURA		West Bengal
LAKKHI DIGHAL		West Bengal
LAKSHMI JATA		West Bengal
LAL AUSH		West Bengal
LAL BADSHA BHOG		West Bengal
LAL DHUSURI		West Bengal
LAL JABRA		West Bengal
LAL JHULLOOR		West Bengal
LAL KAMINI		West Bengal
LAL KASHIPHUL		West Bengal
LAL PANATI		West Bengal
LAL PATNAI		West Bengal
LAL SAROO		West Bengal
LAL SITA		West Bengal
LANGAL MUDA		West Bengal
LATA-SAL		West Bengal
LATHI-SAL		West Bengal

Landrace	Synonym	State of Origin
LEBU-SAL		West Bengal
LETA-SAL		West Bengal
LOHA GORAH		West Bengal
LOHA JANGI		West Bengal
LUGDHI-SAL		West Bengal
LULI-SAL		West Bengal
MADRARAJ		West Bengal
MAHA MAYA		West Bengal
MAJHI JHULOOD		West Bengal
MALA		West Bengal
MALABATI	ORA METEH	West Bengal
MALLIKA		West Bengal
MALLIKA-SAL		West Bengal
MALSIRAJ		West Bengal
MANIK KALMA		West Bengal
MANIK-SAL	LAL PESHARI	West Bengal
MARICH MUKHI		West Bengal
MARICH-SAL		West Bengal
MEDI		West Bengal
MEGI		West Bengal
MENDI		West Bengal
MOHIPAL		West Bengal
MOTA DHUSURI		West Bengal
MOTI		West Bengal
MOUL		West Bengal
MUGAI		West Bengal
MUGAI-SAL		West Bengal
MUGIMANSARA		West Bengal
MUKHI BALAM	MURGI BALAM	West Bengal
MUKTA		West Bengal

Landrace	Synonym	State of Origin
MURGI-SAL		West Bengal
NABANNA-SAL		West Bengal
NABBOIBHADOI		West Bengal
NAGRA		West Bengal
NAGRA-SAL		West Bengal
NAJANI		West Bengal
NAJIRMA		West Bengal
NAL PAI		West Bengal
NARA HASOI		West Bengal
NARASINGHA JATA		West Bengal
NARKEL CHHARI		West Bengal
NATA		West Bengal
NAORA		West Bengal
NIROJA		West Bengal
NONA		West Bengal
NONA KALMA		West Bengal
NONA KETKI		West Bengal
OLEE		West Bengal
PAAN		West Bengal
PADMA-SAL		West Bengal
PAKRI		West Bengal
PALOI		West Bengal
PANATI		West Bengal
PANCHALI		West Bengal
PANI DUBA		West Bengal
PANJAB-SAL		West Bengal
PANIRUI		West Bengal
PARMAI-SAL		West Bengal
PIPAR-BAS		West Bengal
RADHA KALMA		West Bengal

Landrace	Synonym	State of Origin
RADHA SHREE		West Bengal
RAGHU-SAL		West Bengal
RAJ JHINGA		West Bengal
RAJ LAKSHMI		West Bengal
RAM-SAL		West Bengal
RANGI		West Bengal
RANI KAJAL		West Bengal
RANI		West Bengal
RANI-SAL		West Bengal
RAS PANJOR		West Bengal
RATNAMUKHI		West Bengal
RATUL AUSH		West Bengal
RUP-SAL		West Bengal
SAAT KAHELI		West Bengal
SABAN-SAL		West Bengal
SABITA PATNAI		West Bengal
SADA DHAN		West Bengal
SADA DHULA-SAL		West Bengal
SADA JABRA		West Bengal
SADA JIRA	SADA BHOG	West Bengal
SADA JHINGA-SAL		West Bengal
SADA KAYA		West Bengal
SADA MOTA		West Bengal
SADA NUNIYA		West Bengal
SADA PARMAI-SAL		West Bengal
SADA PATNAI		West Bengal
SADA DUMRA		West Bengal
SAMUDRA PHEN		West Bengal
SAROO PATNAI		West Bengal
SAT KAHELI		West Bengal

Landrace	Synonym	State of Origin
SATEEN		West Bengal
SHAL KELEH		West Bengal
SHATI		West Bengal
SHATI JELEH		West Bengal
SHATIA BHADOI		West Bengal
SHIMUL KURI		West Bengal
SHISHA PHAL		West Bengal
SHIULI		West Bengal
SHIYAL BHOMRA		West Bengal
SHIYAL RAJ		West Bengal
SHIYAL-SAL		West Bengal
SHOLEH		West Bengal
SHOTPUT		West Bengal
SHUA KALMA		West Bengal
SILOT		West Bengal
SINDUR-SAL		West Bengal
SINDURMUKHI		West Bengal
SITA BHOG		West Bengal
SONA DHUSURI		West Bengal
SONAPURI		West Bengal
SRABANTI-SAL		West Bengal
SRIRAM		West Bengal
SUNDAR MUKHI		West Bengal
TAL MUGUR		West Bengal
TETKÉ		West Bengal
THAKUR-SAL		West Bengal
THUPI-SAL		West Bengal
TIKARNADI		West Bengal
TULSI MANJARI		West Bengal