

**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 1400 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 expeditions from 1996 to 2021. The initial accession was chiefly from different districts of eastern India, numbering 416. 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 collected from eastern Indian states during the period from 1996 to 2005, 320 are no longer being cultivated on any farm in West Bengal, Odisha and Jharkhand, as of 2020. This implies that 79.8% 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/>).

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.

References

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

Landrace	Synonym	Accession Code	State of Origin
BAGH JHAPTH		BGJT	Jharkhand
BASTAR		BSTR	Jharkhand
BHURI-SAL		BHSL	Jharkhand
HATIPANJAR		HTPR	Jharkhand
LAL DHEPA		LLDP	Jharkhand
MEGHNAD-SAL		MDSL	Jharkhand
PARBAL		PRBL	Jharkhand
RABAN-SAL		RBSL	Jharkhand
SONAM		SNAM	Jharkhand
CHITRA KANHAI		CTRK	ODISHA
DEULA BHOG		DLBG	ODISHA
GADABA		GDBA	ODISHA
GURUJI		GURJ	ODISHA
KURO BAGAR		KRBG	ODISHA
KUSUM GENDA		KMGD	ODISHA
MOTI		MOTO	ODISHA
SEKARA		SKRA	ODISHA
AASH		AASH	West Bengal
AGNIBAN		AGBN	West Bengal
AGNI-SAL		AGSL	West Bengal
AKSHAY RANI		AKRN	West Bengal
AMAR-SAL		AMSL	West Bengal
ASANLEYA		ASLY	West Bengal
ASHPHAL		ASPL	West Bengal
ASHU		ASHU	West Bengal
ASHWIN DHULIA		ASDL	West Bengal
ASHWIN JHARIA		ASJP	West Bengal

Landrace	Synonym	Accession Code	State of Origin
AUSHA BONKATA		AUBK	West Bengal
BABUILATA		BBLT	West Bengal
BADABONA		BDBN	West Bengal
BAID DHUSURI		BDDR	West Bengal
BAID DULAH		BDDL	West Bengal
BAID KALAM KATHI		BDKT	West Bengal
BAIDRAS		BDRS	West Bengal
BAJAL		BAJL	West Bengal
BAKUL PHOOL		BKFL	West Bengal
BALARAM SAL		BRSL	West Bengal
BALI BHAJNA		BLBJ	West Bengal
BANK CHUR		BKCH	West Bengal
BANKATA		BNKT	West Bengal
BANKUI		BNKI	West Bengal
BANSH GAJAL		BSGL	West Bengal
BANSH KANTA		BSKT	West Bengal
BANSHMOTI		BSMT	West Bengal
BANSH MUGRI		BSMR	West Bengal
BANSH PATA		BSPA	West Bengal
BANSH PATI		BSPT	West Bengal
BANSH TARA		BSTA	West Bengal
BANYA SAL		BNSL	West Bengal
BARDHAMAN PANLOI		BNPL	West Bengal
BENA JHURI		BNJR	West Bengal
BENA PHOOL		BNFL	West Bengal
BEGUN BECHI		BGCH	West Bengal
BHALKI		BHLK	West Bengal
BHASAMANIK		BHMK	West Bengal
BHIM-SAL		BMSL	West Bengal
BHURI		BHRI	West Bengal

Landrace	Synonym	Accession Code	State of Origin
BHURISHULAH		BHSA	West Bengal
BHUTIA		BHTA	West Bengal
BHUT MOORI		BTMR	West Bengal
BIRALA		BRLA	West Bengal
BIROI		BROI	West Bengal
BIRPANA		BRPN	West Bengal
BISHMONI		BSMN	West Bengal
BOCHI		BCHI	West Bengal
BOCHI GONDRI		BCHG	West Bengal
BODRESH		BDRH	West Bengal
BOKRA		BKRA	West Bengal
BOMBAI MUGI		BMMG	West Bengal
BORNI		BRNI	West Bengal
BOUBHOG		BOBG	West Bengal
BOU DULALI		BODL	West Bengal
BUDBUD SAL		BDSL	West Bengal
BULLET		BULT	West Bengal
CHAITANYA		CHTN	West Bengal
CHAKRAMALA		CKML	West Bengal
CHANDRAKANTA		CHKT	West Bengal
CHAPA KHUSI		CHKS	West Bengal
CHENGA		CHNG	West Bengal
CHENG-SAL		CHSL	West Bengal
CHERKI JHULLOOR		CKJL	West Bengal
CHERKIRAJ		CKRJ	West Bengal
CHHOTO NUNIYA		CTNN	West Bengal
CHILA PATNAI		CLPT	West Bengal
CHURNOKATHI		CHNK	West Bengal
DAKSHINALAGHU		BNLG	West Bengal
DANAGURI		DNGR	West Bengal

Landrace	Synonym	Accession Code	State of Origin
DANGER BARUAH		DRBR	West Bengal
DANGRI PATNAI		DRPT	West Bengal
DWARKA SAL	DAROGA-SAL	DKSL	West Bengal
DAYAL MADINA		DLMD	West Bengal
DEHRADUN BAS		DHDB	West Bengal
DEPUTY SAL		DDSL	West Bengal
DESHI PATNAI		DPTN	West Bengal
DHAKAI KALAM		DKLM	West Bengal
DHULA DHUSURI		DDSR	West Bengal
DHULA SAL		DLSL	West Bengal
DHUSURI		DHSI	West Bengal
DORANGI		DRNI	West Bengal
DODH KALMA		DHKM	West Bengal
DUDHE MATOR		BHMT	West Bengal
DUKHI DARBAR		DKDR	West Bengal
DUMUR KNDI		DMKD	West Bengal
DUMUR-SAL		DMSL	West Bengal
DURGA- SAL		DGSL	West Bengal
GANDHA MALATI		GDMT	West Bengal
GANDHESWARI		GDSR	West Bengal
GANGAJALI		GGJL	West Bengal
GANGA-SAL		GGSL	West Bengal
GARIA		GRIA	West Bengal
GARIB-SAL		GBSL	West Bengal
GETI-SAL		GTSL	West Bengal
GETOI		GTOI	West Bengal
GHEOS		GHOS	West Bengal
GHORA-SAL		GRSL	West Bengal
GITA SHREE		GTSR	West Bengal
GOCHARI PATNAI		GRPT	West Bengal

Landrace	Synonym	Accession Code	State of Origin
GORAH		GORA	West Bengal
GOUR-NITAI		GRNT	West Bengal
GUJURI BHOG		GGBG	West Bengal
GURUJI		GURJ	West Bengal
HALUD GATHI		HDGT	West Bengal
HAMAI		HAMI	West Bengal
HANSGUJI		HSGJ	West Bengal
HANUMAN JATA		HNJT	West Bengal
HARIR JHINGA		HRJN	West Bengal
HATI CHAMPA		HTCP	West Bengal
HEERA		HIRA	West Bengal
HEERA MOTI		HRMT	West Bengal
HINCHE SAROO		HCHS	West Bengal
ICHHA MATI		ICHM	West Bengal
INDRA-SAL		IDSL	West Bengal
JAL KAMINI		JLKN	West Bengal
JAMAI NADU		JMND	West Bengal
JAMAI-SAL		JMSL	West Bengal
JASHUA		JSHA	West Bengal
JATA		JATA	West Bengal
JATA KALMA		JTKM	West Bengal
JATA LETA-SAL		JLSL	West Bengal
JHANTI-SAL		JHSL	West Bengal
JHINGA		JHNG	West Bengal
JHITI PITI		JHPT	West Bengal
JHULI		JHLI	West Bengal
JHULOR		JHLR	West Bengal
JIRA-SAL		JRSL	West Bengal
JUGAL		JUGL	West Bengal
JUNGLI JATA		JLJT	West Bengal

Landrace	Synonym	Accession Code	State of Origin
KAJAL KATHI		KLKT	West Bengal
KAJAL SUNDARI		KLSD	West Bengal
KAKUA		KKUA	West Bengal
KALAM KATHI		KMKT	West Bengal
KALI ASHU		KLSH	West Bengal
KALI KOMAD		KKMD	West Bengal
KALIRAY		KLRY	West Bengal
KALMA		KLMA	West Bengal
KALO BHUTIA		KLBH	West Bengal
KALO BORO		KLBR	West Bengal
KALO DUMRAH		KLDR	West Bengal
KALO MANIK		KLMK	West Bengal
KALO MOTI		KLMT	West Bengal
KAMALBHOG		KMBG	West Bengal
KAMATH		KMTH	West Bengal
KANKHIRI		KKHR	West Bengal
KANKHRIA		KKRA	West Bengal
KANKRI		KNKR	West Bengal
KANKURIA		KNKA	West Bengal
KANTA JHINGA-SAL		KJSL	West Bengal
KANTHALI CHANPA		KLCP	West Bengal
KARPURIL		KPTL	West Bengal
KARTIKE PATNAI		KTPT	West Bengal
KARTIK-SAL		KTSL	West Bengal
KASHI PHOOL		KSFL	West Bengal
KATIJANGLI		KTJL	West Bengal
KAYA		KAYA	West Bengal
KAYA KELAS		KYKL	West Bengal
KESHAB-SAL		KSSL	West Bengal
KETAKI		KTKI	West Bengal

Landrace	Synonym	Accession Code	State of Origin
KHAS DHAN		KHDN	West Bengal
KHATIA TIKA		KHTK	West Bengal
KHEJUR CHHARI		KHCR	West Bengal
KHIRA-SAL		KRSL	West Bengal
KHIRABICHI		KRBC	West Bengal
KHOLAM KUCHI		KHCH	West Bengal
KHUDI KHASA		KHKH	West Bengal
KUBJA		KBJA	West Bengal
KUMROGORH		KRJR	West Bengal
LAKSHMI CHURA		LXCR	West Bengal
LAKKHI DIGHAL		LXDL	West Bengal
LAKSHMI JATA		LXJT	West Bengal
LAL AUSH		LLSH	West Bengal
LAL BADSHA BHOG		LLBG	West Bengal
LAL DHUSURI		LDSR	West Bengal
LAL JABRA		LJBR	West Bengal
LAL JHULLOOR		LJLR	West Bengal
LAL KAMINI		LKMN	West Bengal
LAL KASHIPHUL		LKFL	West Bengal
LAL PANATI		LPNT	West Bengal
LAL PATNAI		LPTN	West Bengal
LAL SAROO		LLSR	West Bengal
LAL SITA		LLST	West Bengal
LANGAL MUDA		LGMD	West Bengal
LATA-SAL		LASL	West Bengal
LATHI-SAL		LTSL	West Bengal
LEBU-SAL		LBSL	West Bengal
LETA-SAL		LESL	West Bengal
LOHA GORAH		LAGR	West Bengal
LOHA JANGI		LHJG	West Bengal

Landrace	Synonym	Accession Code	State of Origin
LUGDHI-SAL		LGSL	West Bengal
LULI-SAL		LLSL	West Bengal
MADRARAJ		MDRJ	West Bengal
MAHA MAYA		MHMY	West Bengal
MAJHI JHULLOOR		MJLR	West Bengal
MALA		MALA	West Bengal
MALABATI	ORA METEH	ORMT	West Bengal
MALLIKA		MLKA	West Bengal
MALLIKA-SAL		MLSL	West Bengal
MALSIRAJ		MLSR	West Bengal
MANIK KALMA		MKLM	West Bengal
MANIK-SAL	LAL PESHARI	MKSL	West Bengal
MARICH MUKHI		MMKH	West Bengal
MARICH MUKUL		MMKL	West Bengal
MARICH-SAL		MRSL	West Bengal
MEDI		MEDI	West Bengal
MEGI		MEGI	West Bengal
MENDI		MNDI	West Bengal
MOHIPAL		MHPL	West Bengal
MOTA DHUSURI		MDSR	West Bengal
MOTI		MOTB	West Bengal
MOUL		MOUL	West Bengal
MUGAI		MGAI	West Bengal
MUGAI-SAL		MISL	West Bengal
MUGIMANSARA		MMSR	West Bengal
MUKHI BALAM	MURGI BALAM	MBLM	West Bengal
MUKTA		MKTA	West Bengal
MURGI-SAL		MRGL	West Bengal
NABANNA-SAL		NBSL	West Bengal
NABBOIBHADOI		NBHD	West Bengal

Landrace	Synonym	Accession Code	State of Origin
NAGRA		NGRA	West Bengal
NAGRA-SAL		NGSL	West Bengal
NAJANI		NJNI	West Bengal
NAJIRMA		NJRM	West Bengal
NAL PAI		NLPI	West Bengal
NARA HASOI		NRHS	West Bengal
NARASINGHA JATA		NRJT	West Bengal
NARKEL CHHARI		NRCH	West Bengal
NATA		NATA	West Bengal
NAORA		NORA	West Bengal
NIROJA		NRJA	West Bengal
NONA		NONA	West Bengal
NONA KALMA		NKLM	West Bengal
NONA KETKI		NKTK	West Bengal
OLEE		OLEE	West Bengal
PAAN		PAAN	West Bengal
PADMA-SAL		PDSL	West Bengal
PAKRI		PKRI	West Bengal
PALOI		PLOI	West Bengal
PANATI		PNTI	West Bengal
PANCHALI		PCHL	West Bengal
PANI DUBA		PNDB	West Bengal
PANJAB-SAL		PBSL	West Bengal
PANIRUI		PNRI	West Bengal
PARMAI-SAL		PMSL	West Bengal
RADHA KALMA		RKLM	West Bengal
RADHA SHREE		RDSR	West Bengal
RAGHU-SAL		RGLS	West Bengal
RAJ JHINGA		RJNG	West Bengal
RAJ LAKSHMI		RJLX	West Bengal

Landrace	Synonym	Accession Code	State of Origin
RAM-SAL		RMSL	West Bengal
RANGI		RNGI	West Bengal
RANI KAJAL		RNKL	West Bengal
RANI		RANI	West Bengal
RANI-SAL		RNSL	West Bengal
RAS PANJOR		RPJR	West Bengal
RATNAMUKHI		RTMK	West Bengal
RATUL AUSH		RTSH	West Bengal
RUP-SAL		RPSL	West Bengal
SAAT KAHILI		STKL	West Bengal
SABAN-SAL		SNSL	West Bengal
SABITA PATNAI		SBPN	West Bengal
SADA DHAN		SDHN	West Bengal
SADA DHULA-SAL		SDSL	West Bengal
SADA JABRA		SDJB	West Bengal
SADA JIRA	SADA BHOG	SDJR	West Bengal
SADA JHINGA-SAL		SJSL	West Bengal
SADA KAYA		SDKY	West Bengal
SADA MOTA		SDMT	West Bengal
SADA NUNIYA		SDNN	West Bengal
SADA PARMAI-SAL		SPSL	West Bengal
SADA PATNAI		SPTN	West Bengal
SADA DUMRA		SDRA	West Bengal
SAMUDRA PHEN		SDFN	West Bengal
SAROO PATNAI		SRPT	West Bengal
SATEEN		STIN	West Bengal
SHAL KELEH		SLKL	West Bengal
SHATI		SHTI	West Bengal
SHATIA BHADOI		SHBD	West Bengal
SHIMUL KURI		SMKR	West Bengal

Landrace	Synonym	Accession Code	State of Origin
SHISHA PHAL		SSFL	West Bengal
SHIULI		SHLI	West Bengal
SHIYAL BHOMRA		SYBR	West Bengal
SHIYAL RAJ		SYRJ	West Bengal
SHIYAL-SAL		SYSL	West Bengal
SHOLEH		SHLH	West Bengal
SHOTPUT		STPY	West Bengal
SHUA KALMA		SLKLM	West Bengal
SILOT		SLOT	West Bengal
SINDUR-SAL		SRSL	West Bengal
SINDURMUKHI		SRMK	West Bengal
SITA BHOG		STBH	West Bengal
SONA DHUSURI		SDSR	West Bengal
SONAPURI		SNPR	West Bengal
SRABANTI-SAL		SBSL	West Bengal
SRIRAM		SRRM	West Bengal
SUNDAR MUKHI		SDRM	West Bengal
TAL MUGUR		TMGR	West Bengal
TETKE		TTKE	West Bengal
THAKUR-SAL		TRSL	West Bengal
THUPI-SAL		TPSL	West Bengal
TIKARNADI		TKND	West Bengal
TULSI MANJARI		TMJR	West Bengal