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RESEARCH ARTICLE

Towards Strengthening the National Herbarium of Cultivated Plants with Rice Landrace Diversity

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Landrace diversity in rice was enriched at the National Herbarium of Cultivated Plants (NHCP), ICAR-NBPGR, New Delhi with addition of over 1,000 herbarium specimens. The samples were selected from material grown for characterization under an ICAR-DBT project on "Mainstreaming rice landraces diversity in varietal development through genome-wide association studies: a model for large-scale utilization of gene bank collections of rice". The paper discusses the role of NHCP in preserving landraces of rice and follow same model to other crop landraces. Addition of 17 important landraces with their characters and associated passport information data would help the users working in different fields.

Introduction

A herbarium provides a traditional classical approach for use of crop genepool diversity, variation in species, particularly in cultivated plant taxa (Harlan and de Wet, 1971; Funk, 2003). The genetic diversity stored in the form of herbarium specimens with all available data serves as an important resource of additional data for research and breeding.

Large-scale expeditions undertaken in the 19th century lead to the scientific advancement of biogeography, plant evolution, phylogenetic, systematic and biodiversity, ecology, etc. Plant explorers invariably use herbarium specimens collected from diverse habitats to synthesize information to plan and maximize their search to tap genetic diversity across phyto-geographic regions (Funk, 2018). Herbarium studies offer a quick approach to familiarize users with the species in general and landraces in particular of the target area. Using the characters of landrace and associated data, facilitate to examine the differences and their variation pattern under one roof (Diane *et al*., 2010; Bhaskar *et al.,* 2016; Pandey *et al.,* 2016). Moreover, the herbarium also serve as base material for various studies, besides preserving the plant specimen passport information (locality, habit, habitat, flowering, and fruiting time, etc.), facilitates researchers in confirming and determining the identity of new/doubtful material.

Many of the landraces and primitive cultivars have already vanished and some are on the verge of it due to the high yielding modern cultivars. The remaining ones are deteriorating gradually due to natural hybridization during seed multiplication, natural selection or genetic drift and unsuitable growing conditions. In recent times impetus on landraces conservation is mainly due to threat and vulnerablity. Unlike the wild taxa, location of crop landraces for collection remains confined due to their agro-ecological need, specificity and selection by the farmers who have played a pivotal role in age-old conservation.

The National Herbarium of Cultivated Plants (code-NHCP) at ICAR-National Bureau of Plant Genetic Resources, New Delhi, India holds significant collections of cultivated taxa and wild relatives/weedy relatives of both native and exotic origin, and taxa of potential value identified under plant genetic resources (PGR) programme (Pandey *et al*., 2015; Pandey *et al*., 2020). The NHCP is listed in the Index Herbarium which is a global directory of public herbaria in different regions (Holmgren and Holmgren, 1998; http://sciweb. nybg.org/science2/IndexHerbarium.asp). It occupies an important place among the 25 major Indian herbaria mainly dealing with plant genetic resources (Singh, 2010; Nayar *et al*., 2014). NHCP differs in its mandate from the general herbaria across the country in representing wide range

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of variability in crop plants depicted as cultivars, primitive types/ landraces, wild/semi-domesticated forms and crop wild relatives (CWR)/ weedy types and also the minor economic species collected from different agro-ecological regions of India under various PGR programmes including the introduced material under various research programme and vouchers of research material deposited.

Among the major crops of Indian origin, the cultivated rice (*Oryza sativa* L.) are also rich in the genetic diversity including the wild progenitors (Patra *et al*., 2016). In first effort of its own kind, a systematic approach towards collections of rice landraces from neglected regions, across eco-geographical regions, tribal/north-eastern region has been attempted to enrich the repository of NHCP. The germplasm of rice retrieved and purified from the National Genebank, was raised in the experimental area at Indian Agricultural Research Institute (IARI), New Delhi, India. This paper mainly aims to highlight the role of NHCP in general and landraces of rice in particular in complementing the holdings of plant genetic resources and their documentation. The objectives of this work are to introduce the readers about the role of NHCP in preserving of landraces of various crops, including rice; and follow same model to other crop landraces.

Materials and Methods

A total of 10,086 rice landraces collected from different rice growing areas of India out of 1,15,152 (as on December 2021) accessions of rice landraces collected from different agro-ecogeographical regions of the country and conserved in the National Gene Bank, ICAR-NBPGR, New Delhi formed the basis of this study (http://www.nbpgr.ernet.in/Research_Projects/Base_Collection_in_NGB.aspx). The germplasm of rice landraces was characterized during *kharif* 2020-21 at IARI fields, New Delhi under the ICAR-DBT project on "Mainstreaming rice landraces diversity in varietal development through genome-wide association studies: a model for large-scale utilization of gene bank collections of rice".

Of 10,086 rice landraces, more than 1,000 samples were selected based on uniqueness of morphological characters, geographic representation, and other unique traits. Three specimens of each accession were selected and processed as per herbarium standard method (Jain and Rao, 1977). For processing and drying of the specimens no preservatives were used except sprinkling with the naphthalene powder to keep specimens under insect-free conditions. The label data were drawn from the original databank 'as it is'. Besides a subset of over 50 mature spikes were added in spike collection of NHCP.

For landrace nomenclature, the authors have relied on data especially for the name(s) of the different landraces stored under the National Genebank database. Validation in some cases was possible through literature but in others, names could not be checked and therefore treated 'as it is'.

Result and Discussion

The NHCP has 25,283 herbarium specimen's representative of 267 families, 1,546 genera and 4,378 species (as on March 31, 2021) of important taxa of plant genetic resource (PGR) (Pandey *et al*., 2021). In the past an effort has been laid for collection and preservation of landraces from the Indian gene center. ICAR-NBPGR has undertaken studies on plant systematics through field and herbarium resources to extract useful information on various eco-geography of crop genepools. In the national perspective, among the existing herbaria which cater to the diversity specific collections of crops plants, and potential taxa of PGR value, the 'National Herbarium of Cultivated Plants' at ICAR-NBPGR, New Delhi with its ten regional stations serves for the benefit of users. The herbarium of the M.S. Swaminathan Research Foundation (MSSRF) at Chennai, India at its Centre for Sustainable Agricultural and Rural Development lays emphasis on similar taxa represented from the Eastern and Western Ghats respectively (Arora, 1994).

Assembling distinct rice landrace diversity

In the past, rice collections were added in the NHCP through specimens/seeds collected from various sources, explorations undertaken in different agro-ecological zones of India, material introduced from abroad under various research/breeding/selection programmes and vouchers deposited of the systematic studies on crop-groups (Pandey *et al.,* 2014, Pandey *et al.,* 2016; Pandey, 2019; Pandey and Pradheep, 2019). Under various PGR activities collections especially the landrace diversity was made from the North-Eastern region, West Bengal and Uttar Pradesh, India (Semwal *et al*., 2014). Earlier holdings of 250 rice landraces were assembled through efforts by the ICAR-NBPGR mainly represented from Bihar, Karnataka, Kerala and Odisha and the machine vision project "Use of Machine Vision for Distinguishing

Among Crop Varieties" at IARI and NATP project. Among the recent landrace collections native rice varieties identified for mother trial seed multiplication (2018-19) in project site of Assam were added through Assam Agriculture University and Foundation for Development Integration, Guwahati, Assam.

Several collections of rice landraces of India were maintained in the Indian Museum (CNH; earlier known as Bengal Economic Museum), Kolkata, West Bengal. A catalogue on races of rice in India compiled before the Bengal Economic Museum became part of the Indian Museum, Kolkata, West Bengal through the province all its districts (The Agricultural Ledger, 1910) provide details on the rice races grown during that time. However, presently the collection of cultivated plants in general and landraces in particular are least represented in global as well as the national herbarium collections. At national level, NHCP is one among the herbaria focusing on cultivated plants study.

Distribution of Landraces

The rice landrace germplasm collections conserved in NGB from different states of the country are denoted by a generic name '*dhan*' in majority of cases but also have a specific name used by traditional farmers. One such example is landrace 'Govindbhog' showing variation in panicle characters. These landraces, are confined to West Bengal, Madhya Pradesh, Chhattisgarh, Uttar Pradesh, and Odisha. Some more examples of similar types are 'Kala nunia', 'Kala namak' that are reported from wider localities.

Among the 1,000 indigenous rice landraces, Odisha and Chhattisgarh were the major contributors of representation followed by Madhya Pradesh, Karnataka and Kerala. Other states were less represented in the collection (Fig. 1). The list of landraces name and affiliation of state of origin and cultivation are provided in Annexure 1. A total of 99 exotic landraces are represented from 22 countries; the top listed were Bangladesh, followed by Philippines, China and others (Fig. 2).

These landraces under cultivation are represented from diverse regions of the country and are routinely collected and conserved in the national collection (Joseph and Abdul, 1998; Mark, 2014; Ghosh *et al*., 2019; Rana *et al*., 2009). Apart from the morphological diversity, they showed diverse potential to adapt to the climatic changes and allelic variation for resistance to biotic and abiotic stresses (Hyles e*t al.*, 2020). For example, *boro* rice of Assam is known for suitability in water logged area having stagnant water or flood conditions. The diversity was noted for colour and size of kernals, aroma, growing season (*Sali, bora, aus* in North Eastern Region; *kuruvai, samba* in southern region), the inflorescence type, or the spikelet arrangement, etc.

Some of the selected landraces included in NHCP are discussed below (arranged alphabetically):

Ambemohar: small grain aromatic rice is popularly grown in Maharashtra but also popular in other parts of the country. It is also known for its excellent flavour among the non-basmati rices.

Badshabhog: this landrace is primarily with the state of Chhattisgarh and is characterized by highly aromatic small grain. It finds its origin during Mughal regime and the word 'bhog' is the offering to 'Hindu Gods'. However, this landrace is also grown in West Bengal, Odisha, Madhya Pradesh, Uttar Pradesh, Bihar, Jharkhand, Assam and Maharashtra.

Basmati: is a speciality group of rice known world over for its long grain quality and excellent aroma. It fetches premium export value in the international market. Majority of the produce comes from the Indo-Gangetic plains or the Tarai region of the country.

*Chennallu***:** is one among various landraces that have been used in India for their medicinal purpose. It grown by 'Mavilan' tribe of Kerala who administer popped rice soaked in water to feed to diarrhea patients.

Chinikapoor: is a long slender grain type of landrace from Uttar Pradesh which is classified under aromatic group. It is also known under cultivation in Maharashtra, West Bengal and Chhattisgarh.

Eravapandy: a traditional rice landrace from Kerala is being used in the international and national breeding programmes. It is known as a source of gall midge resistance.

Gobindbhog: the traditional rice landrace with aroma is used during special occasions and offered to the God Gobind (Lord Krishna) and hence the name 'Gobindbhog'. It is a fine grain aromatic rice which has got GI tag from West Bengal. This is also grown in the neighbouring states, Uttar Pradesh, Odisha, Chhattisgarh and Madhya Pradesh. In present landrace holdings a lot of variation among the morphological traits was recorded. This traditional/cultural practices of aromatic

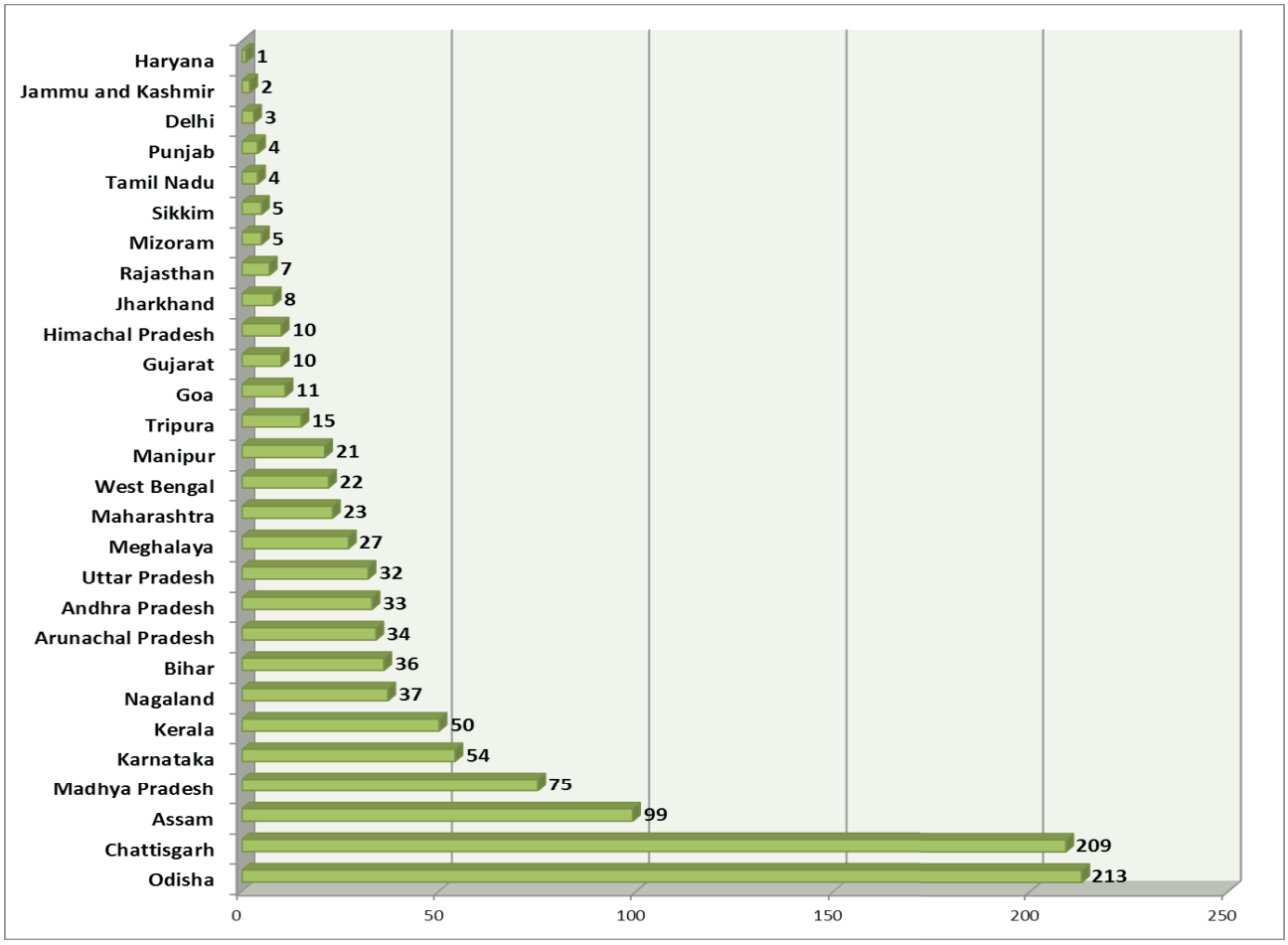

Fig. 1. Herbarium specimens of rice landraces at NHCP represented from different states of India (bar represents total landraces from that state)

rice being offered to god must have also been practiced for other landraces of different region and with the same terminology 'Gobindbhog'.

Hathia panjara: it is a traditional landrace from Chhattisgarh which has characteristic double spikelets and also lodging resistance. The landrace has an average taste and medium market value but yields high in conditions when no commercial fertilizer is used.

Ishwarakora: finds its place in the pedigree of the 77 CVRC released rice varieties in the country. This landrace is known for tolerance for both abiotic to biotic stresses.

Jal dooba: is a traditional rice variety from Odisha suitable for sub-mergence tolerance. It is very late duration variety with strong culm suitable for cultivation under lowland conditions.

Kala joha: cultivar has unique aroma, super-fine kernel, good cooking qualities, antioxidant properties and excellent palatability. It is grown mainly in Assam and other North-eastern states. It has comparable aroma and quality as that of other scented rices of India, except the elongation ratio. The Johah as GI status given to 43 known varieties of the Joha rice which are grown in the region.

Lalnakanda: a sticky and aromatic rice from Odisha and Tarai Himalayan region which is popular for preparation of soups. It finds a better price as compared to the other common landraces in the region/country.

Mohan bhog: it is one of the non-basmati farmer's varieties from Madhya Pradesh. This landrace is grown traditionally for small grain and high aroma occupies sizable acreage due to aroma, fineness and tolerant to biotic and abiotic stress.

Pokkali: it is a unique saline tolerant rice variety that is cultivated in an organic condition in the water-logged coastal regions of Alappuzha, Thrissur and Ernakulam

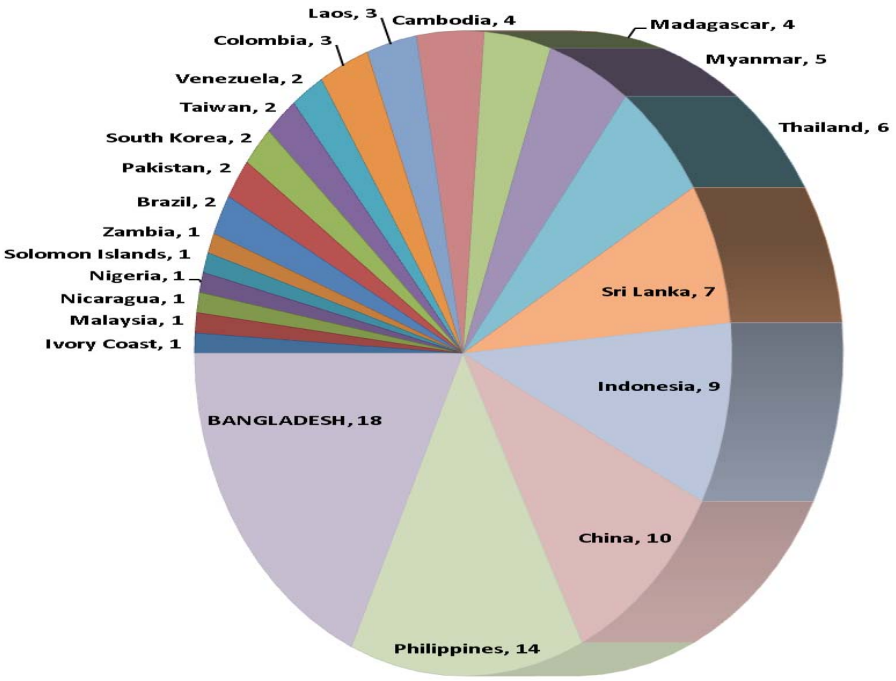

Fig. 2. Herbarium specimens of rice landraces at NHCP from different countries (no. represents landraces from the country)

districts. The organically-grown Pokkali is famed for its peculiar taste and its high protein content. It is one of the important landraces from which the major 'Saltol locus' was derived and used in breeding programme. The 'saline tolerance' trait was derived from other important landraces, viz. *Getu*, *Nona bokra* and others.

Potti akkullu: it is mostly grown in coastal districts specifically for the straw used to thatch the huts and as a feed the cattle. It has compatible degree of resistance to foot-rot disease.

Thavalakannan: is a landrace from Kerala, finds its use in pedigree of 19 CVRC rice varieties. This is one of the popular varieties of Palakkadan Matta (bold red rice with a unique taste); drought resistant, flood tolerant known for resistance to rice tungro virus (RTV) and BPH, also it is more nutritious, as good source of iron, zinc and vitamin B6. It can thrive under low input costs.

Tulapunji: is a landrace from West Bengal which has an excellent aroma with medium-long grain.

Herbarium specimens of landraces depicted flag leaf and part of stem, panicle and kernel at mid maturity with husk colour fully developed and in most cases kernel with awns. Since the kernels are the most distinguishing traits in a landrace, herbarium sheet with panicle and seed stored in pouches are attached on the sheet. The data recorded in the herbarium label provided characters of kernel, awans-colour, length, size; flag leaf-size, and angle; stem ribs and hairyness, stiffness, hollowness, etc. Some characters like stem type, lower leaf size, resistant traits and tiller numbers, aroma was noted in the label information (Fig. 3).

NHCP intends to facilitate landraces of crops for PGR studies

The NHCP intends to facilitate users for study on landraces and knowledge upgradation on the following:

- Support information diverse ecological of collecting sites, range of ecological amplitude and locating ecotypic variation.
- Charting distribution of crop landraces and its mapping for *ex-situ* representation
- Assessing gaps in the collection and conservation, prioritizing areas for future collecting, especially rare and localized types.
- Providing information on ethnic reference, preferences of users, agro-ecology
- Potential, physiological or stress traits (water logged, salinity tolerance, medicinal value, etc.).

Fig. 3. Herbarium specimens of rice landraces: (1-2) with important notes on label; (3-4) landrace 'Govindbhog' showing variation in panicle characters

- Source of material availability for molecular studies

Advantages of representing diversity in herbarium

Due to quick adoption of high-yielding rice varieties during last 4-5 decades, landraces have been restricted to localized cultivations (Deb, 2005). For plant genetic resources study, depiction of rice landraces diversity, in the form of genebank conservation and preserving in herbarium were found benificial, as evaluated below:

- Characters of full panicle available over separated seeds conserved in the genebank
- Character assessment of landrace identity based on morphological characters such as flag leaf, stem strength, kernel size, etc.
- Available seed/ kernel/husk as complementary seed collections with herbarium specimens
- Easy access of large landrace samples at a time for comparative study
- Comparitive analysis of wider landrace diversity
- Samples available for other studies (morphological, biochemical, molecular)
- Exchange/access to digitized images for larger users without legal hassles
- Easy demonstration and teaching of landrace diversity

Conclusions

National Herbarium of Cultivated Plants (NHCP) at ICAR-NBPGR since 1980's after its functioning has done a commendable work in field of taxonomy and systematics of taxa of PGR relevance. Co-ordinated efforts at the national level need to be streamlined to evaluate priorities of crops of PGR relevance to gear up work on the management of genetic resources on the one hand and for basic research on cultivated plant taxonomy (which is more intricate but needs better deal), particularly when India happens to be a centre of diversity for many crop plants.

At national level, link with other herbaria working on PGR needs to be established. With the existing infrastructure for cultivated taxa, the NHCP take responsibility to priorities adding more crop landraces in phased manner to facilitate greater success of national programme.

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ANNEXURE 1

Check-list of landraces* in NHCP

S. No.	State	Landraces (in alphabetical order)*
1	Andhra Pradesh	*Akashmelo, Baiyagunda, Basmati, Battagunda, Chokmanthu, Danwar, Dasara mathi, Davedya, Deshi, Kasturi, Deshi kuseri, Dhouri, Dodgui, Dukke, Errabadal, Gadakhunta, Hathi panjar, Jajin, Jira, Kakdiha, Kanhai, Karidhan, Karendole, Kasam Chudi, Kolhapur Scented, Mettavari, Milagrosa, Nandi, Potti Akkulu, Raipuri hagurma, Sukla Gurmatia, Swarrna, Yerrasannadhanyam*
2	Arunachal Pradesh	*Amkel Ahu, Ampakhi, Amyong Ahu, Grondla,Jajoni bardhan, Jakar, Khamti Sali, Mugme, Serpum, Sukarakaya, Thio Sali, Tinin, Tuying Sali, Thayang, Upma*
3	Assam	*Aanjan, Abrini mi mittem, Ahima Fhutki Sali, Aihati, Bamak, Bardhan Sali, Boga balam, Bogabora, Biriajam, Borh, Pual Sali, Chokuwa, Chit Muchhi, Dangor bayahunda, Darmali, Daria, Darma, Daula, Dhipa bhajana, Dhubuli, Dudha dhan, Ful badam, Hampori Chokura, Heera jyota, Jahari, Jikal, Julami, Kala joha, Ketchadi, Kharka Jaha, Khokhadi, Koimurali, Kothiya, Laicha, Lashur khudwani, Lawadaba, Losmon bhug, Mairen, Menaka, Narayanpuria, Paita bora, Raimukhi sali, Raksail, Ramsali, Rangun Sali, Reia dhan, Santisaha, Sadian Pakhi, Shaitya Sali, Sikkim Basmati, Silguri, Solpuna, Sonajul, Sonamoti, Solpuna, Sonaril, Sorujahingia dhan, Sunasur lahi sali, Tapar, Tulsi joha, Tumai*
4	Bihar	*Abonisail, Banglasafri, Barogawa, Bhadia dhan, Budha dhan, Chaurai, Dahia, Daria, Darnia, Deobhog Gamiri, Garemalet, Givalpor, Gola dhan, Jaisinga, Jhara, Jhulanwa, Kajaroo, Kalikamod, Kariokanha, Koya, Luchai, Lahama, Lahana, Manipur, O Muslim Dhan, Ratho munda, Rajal dhan, Rasbhog, Sagarbhog, Samer dhan, Sarkarma, Tehri sukla, Tikar*
5	Chhattisgarh	*Aardhana luchai, Aelmidi, Ajankati, Alsengha Goda, Bachcha kalam, Bagabardhana, Bahush bod, Bakoi, Bamia, Barangi, Baranmburia Barondao, Basangi, Basua bhog, Bega Hudi, Bhainsamundaria, Bhatha bhulau, Bhata Gadakhunta, Bhatta Gadakuta, Bhata Gurmatia, Bhata kabari, Bhata kaliyari, Bhata swarna, Bhatama karam, Bhejari Deshi, Birla Bhanga, Black pattu, Bodikaluni, Bodama Raipur, Bolandabazar, Budha Koila, Budma Wadlu, Bhudkud, Chah, Changpalngat, Chaurala, Chhote Baikoni, Chhote Sathka, Chingar Chopa, Chinsura, Chiraiphola, Chmuchiggum, Dahi Gurmatia, Dai, Damar, Dapa, Dengi chudi, Dhaiya Dhan, Dhumniya, Dodga, Dol, Diwadi, Dudhnag, Dudhiya Potiya, Durdulanga, Fangsin, Gahi, Gajara, Gampuriya, Gandhak, Gathu dhan, Gatta, Ghathul, Gitti, Gobindbhog Goda, Gurmatia Naguir, Hansir, Hardi Ganth, Haruna luchia, Harrakanth, Hiran Pongari, Kajla bunde, Kakadisar, Kakamaranga, Kalamali, Kalapana, Kalchi, Kalkh, Kali Mai, Kandjhiya, Kankariya, Kankari phooli, Karanga dhan, Kariya benikath, Karni, Kathir, Kekering, Khargilas, Khariko john, Kari Koliyari, Khairka khuchi, Khera Basang, Kher Khouli, Khuti, Kkiyaketiki, Kodesarlu, Koharin, Kolyar, Kordur Kati, Kosari, Kunkhari, Kurlukh, Kurma, Jangal Jihati, Jal, Jaleminda, Jhilli Maniphool, Jhilliparag, Jholar, Jiladar, Jira chudi, Jouchang, Juagonar Sali, Jugul banku, Lagin Chudi, Lakshmi belag, Lalat, Lali Majhoi, Laludhan, Lallu Sagar, Latiya Gurmatia, Lati luchai, Laza, Lim Chudi, Loharsidhi, Luhera, Mahsuri dwarf, Malchi, Malko, Malrani kajar, Mandri, Mandariya, Maradmalkhan, Mati Tenga, Matko, Mauha, Mekarajhundi, Mogenga, Moirang, Mote, Moti dhan, Muhar, Makhanguda, Mukhara, Nagu barhi, Namba, Narangi, Nawa Singul, Nijo, Nimdhan, Nirgubi, Niwadi, Orayeeboot, Padari, Pahuni, Pandrin, Parbat kala, Parau Gurmatia, Patelpachisi, Pinwari Luchai, Pipariya, Pita luchai, Pode, Pohasal, Pora, Poran Sona, Punai Solto, Safed Deshi, Saina Goda, Sam Pasan, Sadka, Sathaka, Satlamara, Shadhar Champa, Shahnagar, Sindur Chinga, Soap, Sona Kathi, Sukharuwala, Sukla Pora, Surhi, Surmati, Raigadhiya Gurmatia, Raishri, Rajhusa, Rani kajal, Ruiphool, Taitungal, Thumsi, Tjumaki, Tolbal, Turiya, Umariya, Uswa, Vijaya mahsuri, Vilayat Chudi, Viranjphool, Wanga Walk*
6	Delhi	*Basmatibahar, Punjabi*
7	Goa	*Banakumar, Barik Katsal, Dhamna Pinda, Dhavopandyo, Kalomanik, Kempadu, Middlekendal, Nanya, Sambarsal, Surja Mukhi, Zadi Dangar*
8	Gujarat	*Baresal Madheli, Chandanchur dhan, Fulako, Karikaman, Karnatara, Khadrhiyalal Kimari, Kodakuri, Lal Goda, Local*
9	Haryana	*Tiu*
10	Himachal Pradesh	*Chandan Kath, Dhonal, Jaldhepa, Jaran, Jiridhan, Kuruvai, Rudha, Tiu, Zag*
11	Jammu and Kashmir	*Biyee, Govindbhog*
12	Jharkhand	*Alubilu, Brusabkisan Hathi Panjara,Kanamati, Mangur Mudi, Mansoori Dhan, Ranikajal Dhan, Tenkarola*
13	Karnataka	*Anilam Anil, Arrampottan, Bangara kolee, Bangara Sanna-3, Banka, Bebbana, Beliki, Boo jaddu, Chandravali, Chippige, Dugga bhalha, G 1, Gamnada Batta, Gidhan Pakhi, GK-5, GK-7, GK-9, Hompal Gidda, Honasu, Intan Gidda, Jeervel, Jeerugodu, Kadulile, Kaggali kecrona, Kamdari, Kanakunja, Kappu batta, Kari Alshi, Kari kandaka, Kariga Javele, Karidadi gossi, Kari Swarna, Kavekantak, Kempu doddisal, Kochuthonnuran, Krishna Leela, Kurud, Manjupani, Mavaokar, Misse batta, Moranda, Mugad Suganda, Nawali, Nazar Bat, Neergula batta, Neermullare, Pokkali, Puhkutt Kodi-2, Punkutt kodi-1, Putta batta, Rahodaya, Sanna batta-2, Sanna mallige-2, Somsali.*
14	Kerala	*Ambala dhan, Ambe, Ariyan, Athiyan Kootumundon, Buh, Choman, Chenkayama, Chethuvadi, Chopru Ekyu, Clamme, Cult. Kurathache, Cutt. Kunnurai, Dilbaxa, Eravapandy, Farm Chitteri, Guria karma, Harikat dhan, Jaya, Karaga, Kattasemba, Kegie, Kempathi bhatta, Kottar Samba, Kozhppulli Pokkali, Lavdhan, Luchyee, Madhu, Mangari, Maji Ranga Bardhan Sali, Maraninboota, Methi Mahipal, Munnamvila, Navara, Nahazing, Nouva, Onavatan, Palguna, Panancheri, Pandakari, Phote local, Rajakayama, Sakthi, Thaichundan, Thavalakanan, Thekkancheera, Thotta kaima, Tulsiphwi, Veluthadichan*

S. No.	State	Landraces (in alphabetical order)*
15	Madhya Pradesh	*Aama Ghul, Ajan Piwari, Anakodan, Angian, Auria Buta, Badhumani, Badsa bhog, Bag Moonch, Baka, Bakawand, Balsen, Batri, Binjo, Bohita, Budali, Budali Banko, Bega hudi, chhote Haslo, Chiraigudi,Chhui Khadan, Chhura,Chhoti Luchai, Desa, Dhan Deshi, Dhawra Basant, Dhodki bhath, Deshi lal mota, Gajudhai, Gajraj, Halikilal Luchai, Jaimahakali, Kadamphool, Kallu Kamod, Kardi, Karmi, Kelakhamish, Kosam Khadi Badi, Kota Deshi, Koram, Kubri Mohar, Kusiyari, Kuwalari, Laloo, Lal Bahari, Lal Baurash, Lalmati, Lalkotam, Luchai Safed, Luji, Lunagi, Matraj, Motisar, Mudri Gurmatia, Mazhla Gurmatia, Nadawar, Nago, Nagesar, Nariayal Jhopa, Ragunath, Ramkaroni, Ranikaja, Ratad deshi, Rated, Saitu Gurmatia, Sikiya, Sironj, Surmalia, Sisath, Viranch*
16	Maharashtra	*Ayakhu Ketezuwa, Buh, Dodaki, Dhanesal, Gharkhat, Halvaziniya, Himasal, Iswra kora, Lavesal, Lavha mugad, Masins rice, Marisal, Palashkeda barik, Pandharisal, Phougak, Picharde, Shennel, Sonephala, Sonebhat, Takebhat, Taothali, Vargol*
17	Manipur	*Akhi joha, Changmansan, Chalau, Changadi, Darria, Hmgmihsiangmatsn, Makodo, Mandu, Maora, Minil Bija Bini, Napchong, Phoungang Angan phou, Phonlem, Phazai, Sonajuli Sali,Taothabi Angouba, Tong Khollen bhupal, Tumai, Tumai Angouba*
18	Meghalaya	*Gelon, Dalleymarshi, EB:17, Lowguti, Kbarim, Mekatchu, Mimitim Michibol, Mima Mitambing, Narajib, Sona Juli Sali, Siltukri Sali, Tharrangsing*
19	Mizoram	*Karusi, Malapotipatnai, Sukulemba, Tzulu Narila*
20	Nagaland	*Asin Mai, Athikan, Chali, Changphai, Chusuro Mono, Eravapandy, Hai Dhorom Dhan, Konra, Laloo, Longi, Moyou, Ncpateni, Nangcha Tsuk, Nziera, Origasho, Rajpateni, Rugopet, Ribolu, Ropu, Saheb juha, Shimoi, Sitabanwas, Soloh Kabu, Sonporo Ekyov, Sungro Ekyu, Suli Tsuk, Suli Tsuk Tsokunkvu, Surudaka dhan, Tahzyah, Teheang,Thiethieru, Tikapateni, Tipfu Shye, Tzu Mabok/Tzumasu, Yamkok*
21	Odisha	*Alsanga, Anaikomban, Arkal bhat, Bachakalam, Badhimami, Basgati, Basan, Baskbanda, Basmati Aman, Bayalachampa, Benigiri, Bhondu, Bhogi, Bhojni, Bhutah Gay, Biranchi pool, Bodi, Bodki, Bogihali, Changang, Chikoo, Chheligudia, Chenga, Chinai, Chinikapoor, Chingfore Chokua, Chirainokhi, Chotasail, Chilakat, Chilhar, Chinai,Chirhola, Chittal chini, Chittikannerulu, Chhotobelki, Cuttack chandi, Daanr, Dakhuri khuji, Dalbadal, Daliya, Dalipohala, Danger, Dasahar Amathi, Dasarakanta, Dasara Mathi, Deepak, Dekaradokar, Deulbhog, Dhal champa, Dhalakiri, Dhamsi, Dhaneberwa local, Dhara Dhuta, Dharial, Dudhasai, Dhaud, Dhikash, Dhobjira, Dhola Champa, Dhenkisali, Dhula kakara, Edolia, Gandhak, Gayasu, Gobindbhog. Gudumani,Haldi jhota, Hangnyang, Hardighati, Haribhog, Harratkhat, Himalaya, Horujhangia, Jabra Mardan, Jaga Balia, Jaladhuti, Jaldoba, Jaradola, Jhati, Jorkusumalu, Kalchi, Kaliasia, Kamal, Kamod, Kanai bashicn, Kanchi, Kanchi Ratna Chudi, Kanthabako, Kanthamala, Karangaguda, Karprui dhan, Kartik pateni, Kaldeyakhuji, Keppu, Khaojee, Kuchi Siliguti, Kurippala, Kuruma, Kusumakunda, Laktimachi, Lalkanda dhan, Langphou Phougang, Latika, Latamoul, Lera, Loudubi, Madhi, Madmalen, Mahamya, Mainaguri, Mahulbahal, Matarmala, Matchkati, Mehapal, Mohilkuchi, Motakhatia, Motara, Mukusuala, Muskhbadji, Mypali, Nagana, Naherkeli, Nai badhai, Naikani, Nalikalam dhan, Nanimundi, Nathmohan, Nazate Khudwani, Nazusamba, Nimekanta, Oabu Jiuku, Pahad jhili, Pakhuda Chhada, Panama komba, Pandavi, Papasaphuli, Parijathiki, Pavurturma, Poibasangi, Puage, Rajmlli, Rajuhendi, Ramaboiti, Ranga Lachai, Ranganath, Rangobhonda, Rangabankoi, Rangoon Samba, Rangakalama, Rangsuri, Rangisali, Raskola, Ratna, Ratan Chudi, Ratna Pokhiai, Ratanpanjar, Red Sirumani, Runiakali, Saanra, Sadadumracn, Sakar Mator, Salakana, Sanakumaguntha, Sareada, Sajani, Salekdam, Septidhan, Shalaidhonti, Sharad Chadi, Sornavari, Singha, Singhujnupa, Siulipana, Sthani Halva, Suka, Sukal Mundi, Sukarkaya, Sukasari, Suna Khadika, Sunamuibarapanua, Sundarbhajna, Sundarsali, Surda, Swarna, Tamthomamdinh, Taramukhi, Tella balchilu, Tetilia, Tinikalam, Thapulin khudwani, Ujog, Upusali, Useli*
22	Punjab	*Basmati Bahar, Basmati Kamon, Chalu Jeera, Jhetinbari*
23	Rajasthan	*Duggabhalha, Katghora Mansara, Scgera, Suthar*
24	Sikkim	*Dalleymarshi, Darash dhan, Krishna bhog Khavarisal, Salalai,*
25	Tamil Nadu	*Murungukaran*
26	Tripura	*Bedi, Chennallu, Dup Galong,Gangaorasad, Lal Koram,Lanka Pora, Murali early, Panikelash, Jamrai, Dharial, Galra, Sinduri, Latakalasuna Mukhi Asus, Sayari,*
27	Uttar Pradesh	*Badukaibatiyari, Beniga, Cheenajohan, Daftol, Dakhinkalma, Dalbadal, Dhaniya, Dudha kalama, Faram Chudi, Goviindbhog, Jarhen, Julysal, Kabrabadam, Kapoor Kanti, Local dhan,Lurca, Luhera, Mwarhi, Pyapachini, Red Ratha, Sarfed nakanda, Sarankrahm, Sondhi, Sullenpur, Thakur bhog, Timili*
28	West Bengal	*Dudhkanthi, Durar phool, Gangia, Govind bhog, Hijli, Kakro, Kala chudi, Kookley, Lalnkanda, Malgoindi, Mansara dhan, Mariach bhog, Marich mukhi, Patnai Sagar, Rani dhan, Ratan pakhia, Sadabochi, Simlaya, Suna phulia, Tulai panji*

*: name as stored in NGB database

ANNEXURE 2

Some of the selected landraces included in NHCP and their passport data

S. No.	IC No	Vernacular Name	Coll Date	Coll. no./other ID	Locality	Latitude/Longitude	
1	IC323554	Ambemohar	3/1/2000	Ambemohar	Maharashtra	NA	NA
2	IC99994	BadshahBhog	10/21/1985	P-111	Dehradun, Uttarakhand	30.3165	78.0322
3	IC323620	Basmati	3/1/2000	NA	Punjab	NA	NA
4	IC461262	Chennallu	NA	AC-3765	NA	NA	NA
5	IC300525	ChiniKapoor	3/1/2000	C:30I KH-99-1482	Raipur, Chhattisgarh	21.2514	81.6296
6	IC598101	Eravapandy	5/19/2012	RJR-681	Adilabad, Telangana	19.7327	78.6427
7	IC124946	GobindBhog	3/28/1974	CGR:5363	Bastar, Chhattisgarh	19.2073	81.9339
8	IC342613	Hathipanjara	1/31/2002	VKG21/6	Khunti, Jharkhand	23.0833	85.2833
9	IC460410	IswaraKora	NA	NCS976/ AC-17976	Maharashtra	NA	NA
10	IC514380	JALDOBA	4/12/2005	IRGC-45863	NA	NA	NA
11	IC323725	Kalajoha	3/1/2000	KalaJoha	Assam	NA	NA
12	IC462111	Lal Nakanda	7/4/2006	JBS-884 /AC-20907	Koraput, Odisha	18.8561	82.7347
13	IC115058	Mohanbhog	11/22/1977	CGR:8509	Mandla, Madhya Pradesh	22.5979	80.3714
14	IC324584	Pokkali	10/28/1990	M-14/90/ NIC 4909	Ernakulam, Kerala	10.0833	76.5483
15	IC323750	PottiAkkullu	3/1/2000	MTU-1	Andhra Pradesh	NA	NA
16	IC324567	Thavalakannan	1/1/1989	V.4449	Kerala	NA	NA
17	IC594017	Tulaipanji	12/31/2011	DP/HNS-2006	South 24 Parganas, West Bengal	22.1894	88.8143