Science Research Reporter, **5**(2): 137-146, (Oct. - 2015)

Online, Open Access Available at http://jsrr.net
ISSN: 2249-2321 (Print); ISSN: 2249-7846 (Online)
Research Article

Germplasm conservation of Maize, Sorghum, Millets and vegetables from Dhadgaon and Akkalkuwa tribal block of Nandurbar district, Maharashtra State

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Article Info

Received: 01-08-2015,
Revised: 09-09-2015,
Accepted: 11-09-2015

Keywords:
Landraces of crops, diversity, traditional on-farm conservation

Abstract

Tribal communities are custodians of crop diversity and traditional knowledge associated with agriculture. Nandurbar is a tribal district of Maharashtra State.and major communities are Pawara, Bhilla and Kokanaresiding in Dhadgaon and Akkalkuwa blocks.Area under study has unique crop diversity which includes maize, sorghum, minor millets and pulses. Due to modern agriculture and intervention of hybrids, traditional crop diversity is disappearing at a faster rate. There is an urgent need to0 document, collect and conserve neglected and underutilized germplasm resources through community participation which are playing very vital role in sustainable agriculture. The area of Dhadgaon and Akkalkawa was visited for crop land races diversity. From 19 villages, total 227 farmers were interviewed, out of which 92 farmers actively participated in germplasm collection survey during the period of November 2010 to September 2011. It was a good opportunity to collect Indigenous Traditional knowledge (ITK) associated with crop cultivation, harvesting and seed storage practices associated w0ith farming system. During field survey, documentation of crop landraces of Sorghum, Maize, Millets, and Rice was done. It includes 42 types of Sorghum, 46 types of Maize, 89 types of Millets, 32 types of Rice and 18 different types of Vegetables along with legume plants with respect to their specific traits. Reasons behind its existence and disappearance has been recorded. Initiative was taken for on farm conservation of selected landraces of Maize and Sorghum wit0h community participation.

INTRODUCTION

Now-a-days tribal culture and traditionsare attracting researchers for various reasons all over the world. It is an inter-disciplinary approach which deals with the medicinal plants, pharmacology, plant geneticsresources and socio-economics of rural people. World population is increasing and it is expected to have nine billion people in 2050 as against six billon today (Vohra, 1991). The biggest sources of biodiversity in tropical countries are threatened due to over exploitation, changing ecosystems and global warming. Department of Environment food and rural affairs warned against temperature increase of as much as 3-4 ^{o} C towards the same time line in India(Singh, 2002). Further more it is speculated that an increase of only 2^{0}C will have consequences in terms of shifting of cultivation pattern and yield reduction of rice and wheat, which are staple food for more than one third of the world population. (Podulosi *et al*, 2009)

Naturally there is variation in social and cultural practices and food resources used by tribal communities. Singh *et al*. (2000) reported agro-biodiversity of Andaman group of Island tribals for

various purposes like wild and cultivated fruit crops, wild and cultivated vegetables, wild and cultivated spices, aromatic and medicinal plants. In recent years, natural wealth is disappearing due to habitat destruction and developmental activities like roads, dams, social and cultural development in tribal areas (Kulkarni, 2005).

The spread of modern landraces and hybrids which began in the mid-1960s has made an important impact on small farmers of India (Pray and Nagarajan, 2009). The loss of crop genetic resources can be linked to the spread of modern agriculture. Uniform cultivar over wide areas has resulted in abandonment of genetically variable, indigenous varieties by subsistence farmers (Altieri and Merrick, 1987).

Millets are among the oldest cultivated crops in the world and cultivated over more than 35.8 million ha around the world as per estimates for 2007 (FAO, 2007). They are referred as coarse cereals and this term is highly misleading in view of their nutritional profiles and strategic importance to the livelihood of millions of people (Bala Ravi, 2004). Millets comprise two main groups of species, major millets includes Sorghum and pearl millets. Minor millets are represented by six cultivated species, Little millets, Indian barnyard millets, Kodo millet, Foxtail millets, Finger millets, Proso millet. In India minor millets are cultivated mainly as rainfed crop and occupy an area of about 2.7 million ha which is about 12% of the whole area under coarse cereals in the country (Seetharam, 2006).

The area under minor millets cultivation in India has significantly decreased. The factors responsible are characterized by poor agro-ecosystem and largely inhabited by socio-economically fragile farming system which are largely from section of below poverty line (Burkill, 1994). The production systems followed for their cultivation are generally marginal, based mainly on locally available seeds with minimum or no external inputs or often under default organic farming conditions. Mostly, they are grown only in one season with the main monsoon season(June – November)., they are predominantly grown as mixed or intercrop along with fodder yielding crops like maize and sorghum, high value crops such as grain legumes (Pigeonpea, Green gram or Black gram) or oil seed crops (Mustard and Niger) (Patil and Kulkarni ,2011).

The other reason of shrinking number of food crops in the regional and global food basket is restricting the opportunity of farmers in different regions to use their land resources, environment and traditional knowledge. Traditional agro-ecosystems represent centuries of accumulated experience of interaction with the environment by farmers without access to scientific information, external inputs, capital, credit, and developed markets. These skills are locally available and often transferred into farming systems with sustained fashion. Traditional agriculture found more dependable on minor millets because of their extreme hardiness. Little millet and Kodo millet were domesticated in India. Major factor discouraging minor millet cultivation and consumption is associated with improvement in living standard or urbanization and the drudgery associated with its processing.Globally neglected the minor millets and increasing emphasis on few elite food crop species are precariously narrowing the food security basket (Trupp ,1998)

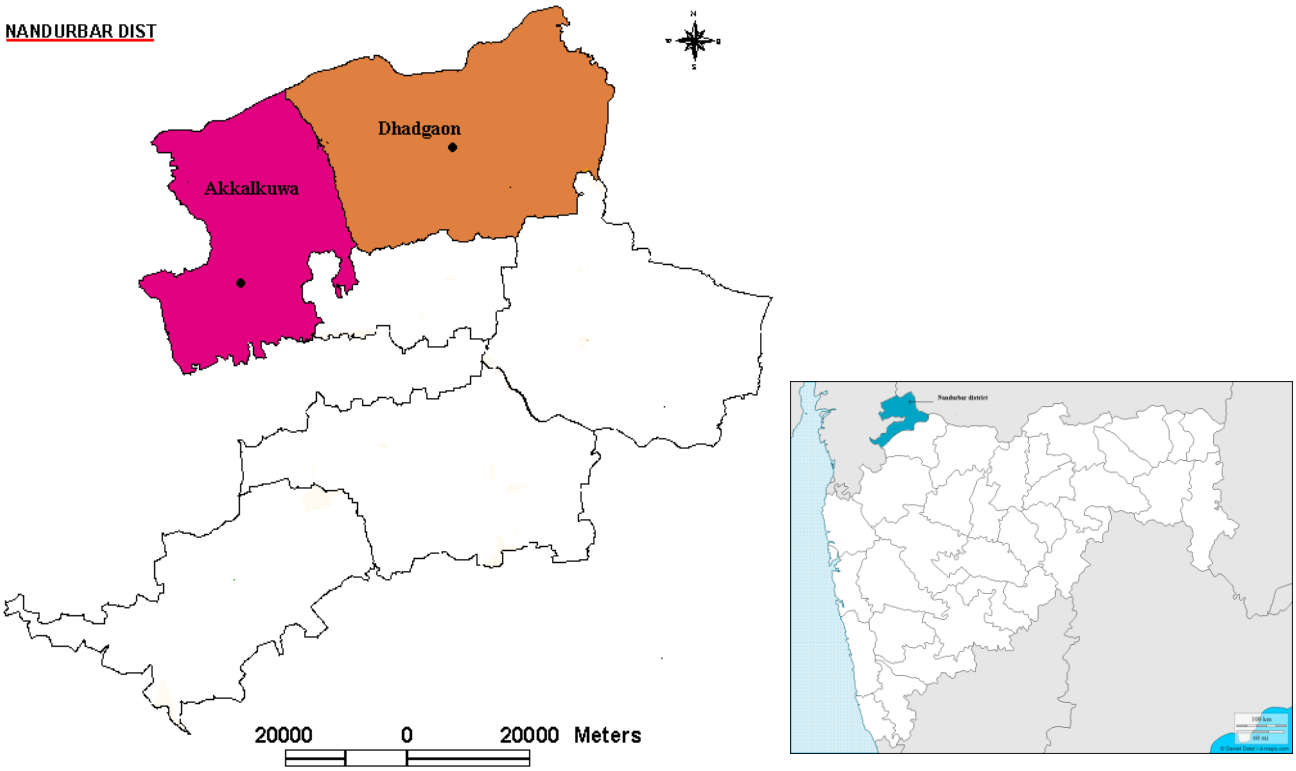
Hilly ranges of India are known for their native crop diversity. These areas have retained the traditional crop varieties and the knowledge regarding their specific qualities. This rich heritage of crop diversity is required to be conserved for mitigating climate change (Patil *et al*., 2009). These landraces are known for their specific qualities like tolerance to biotic and abiotic stress, nutritional characteristics, taste, etc. which are not known to the scientific community and social workers in tribal societies. Scientific evaluation of germplasm of Maize and Sorghum from tribal blocks of Dhadgaon and Akkalkuwa collection needs systematic and accurate data collection before it is vanished forever. (Vashistha *et al*., 20013 and Kavimandan and Khan 2011)

MATERIALS AND METHODS

Topography: Nandurbar district falls in Narmada valley of Satpura ranges.These Ranges fall in two river valleys, Narmada in north and Tapi in the south. Satpura ranges are perpendicular to Western Ghats. Rock type is sedimentary in nature. Forest types are dry deciduous to semi evergreen.

A predominantly tribal pocket having 62 per cent population of *Bhilla*, *Kokana Pawara* and *Parmar*in Dhadgaon and Akkalkuwa. (Map)

Map of Study Area



Agro-climatic conditions

Rainfall: The district receives precipitation mostly from the south-west monsoons between June and October, and few showers of rains in November and May. The rainfall in the district varies from 525 mm. to 1150 mm. Average rain fall is 767 mm.

Soil: Soils of the study areas are formed from sedimentary formations. Soil colour is brown to yellowish brown. Soils are of lighter type on the hill slopes, while they are clayey deep in plains. Soil erosion is a severe problem and it affects local agriculture. Farmers are marginal and they hold land from 1 acre to 20 acres. The fertility status of soils is very poor in nitrogen contents and level of nitrogen varies from 0.02 to 0.051 %. Available phosphate is very low, from traces to 12.64 mg % and available K_2O content is moderate.

Agriculture:

Agriculture is main occupation of tribal community. Crops are cultivated in three seasons based on availability of water. Local rain-fed crops are Jowar, Maize, Minor millets (including Little millet, Barnyard millet, Foxtail millet), Finger millet. Pulses include Black gram, Gram, Red gram and Horse gram. Vegetables include varied shapes and sizesof gourds and nine landraces of Beans.

Table 1. Dhadgaon and Akkalkuwa area of Nandurbar district.

Particular	Details
Location	Dhadgaon andAkkalkuwa
Number of villages	18
Number of farmers involved in study	92
Number of farmers contacted	227
Crops under study	Maize, Sorghum , Millets
Period of study	Nov 2010 – Sept 2011

Table 2. Selection of villages in study area

District	Name of Block	Villages under study
Nandurbar	Dhadgaon	Bilgaon, Bijari, Bhujgaon, Ghatali, Kalibel, Padali, Survani, Pathali, Toranmaal, Khadaki, Maal, Goramba.
Nandurbar	Akkalkuwa	Bardi, Vehagi, Patbara, Orapa, Chiwalutar, Nimbi pada –Maal pada

Traditional cultivation practices were documented for each traditional landrace. Seed exhibition was organized to identify the seed saver groups of traditional crop varieties and primary data collection through group discussion with participants of seed exhibition.Secondary data about crops was collected from Krishi Vigyan Kendra, Kolada, District Nandurbar and CRS, Urali Kanchan. Specific data was collected from identified seed saver through personal interview.

Scientific information about traditional crops was collected from resourceful local personsand documents. Samples were also collected during field visits and seed exhibition which was held on 13th Jan 2011.

Sample collection:

During sample collection primary data was generated through seed exhibition and meetings. Specific information was collected from seed savers through personal interviews. The collected sample includes cobs of maize, panicles of sorghum and grains of millets. All samples were packed and protected from damage by moisture or pest by sun drying.

Table 3. Data collected from different sources

Particular	No	Points of Discussion
Seed exhibition (43 farmer, 16 students)	1	Landrace diversity, traditional cultivation practices, crop preference.
Field visit meetings with villagers	46	Landrace diversity, traditional cultivation practices, festivals and rituals associated with farming, specific traits of landraces.
Visit to KVK, Kolada	3	General discussion about crop and vegetable diversity, predominant pest/ diseases of crops in the area, referencing,

RESULTS

The area of Dhadgaon and Akkalkuwa visited for crop land races diversity in 19 villages and total 227 farmers were interviewed, out of which 92 farmers actively participated in germplasm collection survey during the period of November 2010 to September 2011. It is observed that 11 landraces of Maize crop exist in the region out of which 46 samples were collected. Second crop is sorghum having 10 landraces out of which 42 samples were collected from farmers. In this area rice is also grown having 6 land races and 32 samples were collected. While considering millets, Barnyard millets 5 land races and 36 were grown successfully in the region. Litter millets have 4 land races out of which 30 are still grown in the region. Foxtail millets have only 2 landraces and 15 local cultivars were collected. Kodo millets were scare in the region and only 1 type and 2 cultivars were collected. Along with cereal crop legumes were cultivated in the region having one landrace of Horse gram. Two land races of Red gram, Bengal gram, Black gram and Soyabean were collected. Local names were given to each type and 19 types are present in Maize and Sorghum too. Diversity of Sorghum, Maize and Millets and their abundance commonly grown and rare in the region are discussed. These rare types of Sorghum are Mothi, Ratali or Kehari Mukka of Maize and other rare millets need to be conserved on urgent basis.

Table 4. Crop landraces grown in study area

Crop	Scientific name	Local name	No. of landraces under cultivation
Maize	*Zea mays*L.	Doda/mukkai	11
Barnyard millet	*Echinochloa colona* L.	Banti/Boti	5
Finger millet	*Eleusine coracana* (L.) Gaertn.	Nagali	4
Kodo millet	*Paspalum scrobiculatum*L.	Kodara	1
Red gram	*Cajanus cajan*(L.) Millsp.	Tuvi/Tuwar/Tur	2
Horse gram	*Macrotyloma uniflora* (Lam.) Verdc.	Khulto/Tulshya	1
Rice	*Oryza sativa*L.	Haal	6
Sorghum	*Sorghum bicolor* (L.) Moench.	Juwar	10
Little millet	*Panicum sumatrense* Roth ex Roemer & Schultes	Mor/Mar	4
Foxtail millet	*Setaria italica* (L.) Pal.	Bhadi/Padi	2
Bengal gram	*Cicer arietinum*L.	Sani/Chana	2
Black gram	*Vigna mungo*(L.) Hepper.	Udadi	2
Soya bean	*Glycine max*(L.) Merr.	Gandi tur	2

Table 5. Sample collection from Dhadgaon and Akkalkuwa

No	Crop Name	Total samples
1	Maize	46
2	Sorghum	42
3	Little millet	30
4	Barnyard millet	36
5	Foxtail millet	15
6	Finger millet	6
7	Rice	32
8	Kodo millet	2

They are local landraces and survived in drought conditions ,resistant trait having 2-5 years seed viability. This later trait is very significant. Other landraces mentioned above are being cultivated since drought of 60s. Soybean crop has been introduced from Madhya Pradesh around 30-40 years ago. Farmers cultivate same landrace and it differs from hybrid soybean. Millets have rich diversity,abundant millet landraces have good quality of grain and market value to locally known as *Bhagar*. Common landrace *Hani kalimor* has good taste. A large number of landraces are seen in the region which may be because of the microclimatic variations in the area, which are commonly cultivated and stabilized in different villages. Many combinations of rainfall and temperature are having influence on the varieties of different millets. One other reason for disappearance of landraces may be small landholdings forcing the farmers to select varieties with better yields to ensure food security.

Table 6. Status of Sorghum types from Dhadgaon and Akkalkua

No	Location	Mani/Onvhi juwar	Mothi/ Vodi juwar	Gujarati/ Dudhmogara/ malvi juwar	Chikani juwar	Dadar (Rabi Juwar)
1	Bhagadari	*			*	
2	Behadakund	*		*	*	
3	Surwani	*		*		
4	Bijari	*		*	*	
5	Kakadada	*		*	*	*
6	Bhujgaon	*		*	*	*
7	Kalibel	*		*		*
8	Padali	*	*	*	*	*
9	Ghatali	*		*		
10	Khadaki (Toranmal)	*	*	*	*	
11	Vehagi	*	*		*	*
12	Bardi		*		*	*
13	Orapa				*	
14	Patbara	*		*	*	
15	Bhauti hamlet (Toranmaal)	*	*	*	*	
16	Pathali	*	*	*	*	
17	Nimbipada	*		*	*	
18	Goramba		*		*	
19	Bilgaon	*		*	*	

*: Indicates presence of landrace

Mani juwar is an early type with very nutritious straw and hence it is profusely cultivated. Common landrace *Gujarati juwar* has good yield and taste. *Chikani juwar* is preferred for its better nutritional value and traditional sweets are prepared from it. It is mostly cultivated for captive use. *Mothi Juwar* requires more water which is not assured due to variation in monsoon precipitation. This adversely affects the yield of crop. Hence its cultivation is drastically reduced. It is prone to a disease Chikta in which sticky liquid is produced from the panicle resulting in lower grain formation. (sorghum crop is denominated as Juwar in pawara language). *Mothi/ Onahir mukkai* requires more than 4 months and good quality soil. Due to reduction in rains and less fertile soils productivity and vigor of crop is reduced. People are not interested to cultivate this landrace of Maize. *Safed mukkai* and *Chhoti mukkai* has better taste. *Ratali/Kehari mukkai*has red pigment. The grain from this variety (ratali) is prone to weevil infestation during storage,the seed viability is low. This variety is cultivated only for domestic use.

Vegetable diversity:

Vegetable diversity includes various varieties of Gourds, beans and cucumber. These varieties of vegetables were conserved for consumption and traditional festivals(*Puja)*. Tribals conserve vegetable diversity through kitchen gardens, mixed cropping or inter cropping. Edible gourds are used for consumption by steaming or cooking. Non-edible gourds (*Lagenaria spp)* have four varieties. They serve the purpose of utensil making for storage of water, brewing of *Mahua* liquor and in festival (*Holi*). In *Holi* festival men/ boys use these bottle shaped gourds to tie around their body. During dancing in circle it makes specific sound. Smaller bottle gourds are also used to make spoon like utensils which are used in *Puja* to serve offerings to god and ancestors.

Table 7. Status of Maize types from Dhadgaon and Akkalkua

No	Location	SafedMokkai	Mothi /Onahir mukkai	Choti mukkai	Ratala duda/ Kehari Mukai
1	Bhagadari	*	*		*
2	Behadakund		*	*	
3	L. Surwani				
4	Bijari		*		
5	Kakadda	*	*		
6	Bhujgaon				
7	Kalibel	*		*	
8	Padali				
9	Ghatali	*			
10	Khadaki (Toranmal)	*	*		
11	Vehagi		*		
12	Bardi		*		
13	Orapa		*		*
14	Patbara		*	*	
15	Bhauti hamlet (Toranmaal)	*	*		
16	Pathali		*	*	
17	Nimbipada		*	*	
18	Goramba		*	*	
19	Bilgaon				

*: Presence of landrace in village

Table 9. Status of land races from Dhadgaon and Akkalkuwa area

Crop	Abundant	Common	Rare
Sorghum	*Mani juwar*	*Gujarati juwar, chikani juwar*	*Mothi juwar*
Maize	*Onahir mukkai*	*Safed mukkai, chhoti mukkai*	*Ratali/Kehari mukkai*
Millets	*Vodi Banti, Hani Banti, Sasari Padi*	*Nilai Banti, Mothi safed mor, Hani kali mor, Hani safed mor.*	*Chikani bhadi, Sasari Padi large grain, Chikani bhadi large grain, Safed nagali, Ratali Nagali, Kodaro*

DISCUSSION AND CONCLUSION

Scientific information about genetic wealth conserved by tribal communities is useful for selecting genotypes for resistance or tolerance to wide range of biotic and abiotic stresses. The yield of rice has been dramatically improved due to conservation of intra-specific wide varieties. Rural or tribal people who have conserved biological diversity, remained poor, while those who have applied modern technology to convert biodiversity into economic wealth became rich. The wild variety of genetic diversity of plants is still available in tribal areas, due to harmony with nature which is inherited in the culture and life of tribal societies (Swaminathan, 1996).

Table 10. Status of local vegetable diversity from Dhadgaon and Akkalkuwa

Vegetable	Scientific name	Local name	No. of landraces under cultivation
Edible round gourd	*Lagenaria siceraria* (Molina) Standl.	Tumada	5
Bean	*Lablab purpureus*(L.) Sweet.	Waal	8
Cucumber	*Cucumis sativus*L.	Kakada	1
Round cucumber	*Cucumis melo* L.	Kasara	1
Ridge gourd	*Luffa acutangula*(L.) Roxb.	Dudka	2
Yard long bean	*Vigna unguiculata* (L.)Walp.	Wadala	1

Traditional crop diversity has uniqueness in its characters. This diversity is survived in areas based on its adaptation to local climate, soil and topography. Information on *in-situ* or on farm conservation of minor millets is very scanty. On farm conservation is a dynamic process because varieties managed by the farmers continue to evolve in response to natural and human selection leading to crop population with better adaptive potential for the future (Brush, 2000). This is particularly relevant in the context of climate change. Climate change, soil erosion are main factors affecting traditional farming system. Jackson and Lloyde (1991) stated that such genetic loss is influenced by climate change and that is already having a drastic impact on the world's agriculture.

Sorghum and Maize landraces have good fodder value as well as these are highly nutritious than hybrid varieties. These local types have problem of productivity due to climate change and low soil fertility level. In many parts of the country, different varieties are still chosen for needs, definitely not for the yields alone. They were chosen for their ability to withstand in droughts or floods, resistance to pests, susceptibility to disease, salinity tolerance, time of maturity, size of the grains, colour, aroma, taste, keeping qualities and nutritional values.

Minor millets are landraces because they survived in drought conditions andseeds viability, remain for 2-3 years These sturdy varieties are excellent to give food security even in worst climatic changes. Millets require less water, less external inputs, short duration of cropping pattern and they have good nutritional value. They have retained their place in on-farm conservation. On farm conservation alone can safeguard and enrich indigenous knowledge (IK) and cultural traditions associated with genetic diversity, which are as critical as the genetic diversity itself and for its sustainable use. The loss of cultural diversity and IK affects the self esteem and visibility of local community members, in particular women, who have been generously safeguarding and transmitting knowledge over generations and for whom these represent important assets of their own food culture and identity (Sajise,, 2003).

Traditional agriculture practices are very eco-friendly as there is less or no use of chemicals. Over a period of time all these landraces have become accustomed to natural farming. This may be one of the reasons for their low productivity. In this connection, on-farm conservation of local varieties is being pursued through a blend of ex-situ at the MSSRF community Gene Bank in Chennai and dissemination of the `Village gene seed grain bank'. All India co-ordinate small millet improvement project operated at UAS, Bangalore and other institutions in India were deployed in the initial farmer participatory variety selection (Joshi and Witcombe, 1996). At Kolli hills (Tamil Nadu) and Jeypore (Orissa) during 2002-2004, on elimination of several low yielding exotic and photosensitive accessions, the initial selection short listed 180 accessions. During the second selection cycle, 33 promising varieties (14 Finger millet, 11 Little millet 8 Forxtail millet) at Jeypore and 29 varieties (9 Finger millet, 9 Little millet and 11 Foxtail millet at Kolli hills were identified by farmers as the best accession.

Based on the demonstration trials on farmers fields, the application of supplementary doses of fertilizers to Little millets and Finger millets was found to enhance productivity significantly. Another experiment on the cropping systems was operated which involves growing six rows of Little millet or Finger millet or Foxtail millet with two rows of Pigeon pea proved to be more productive and profitable. Results from 198 field demonstrations revealed that use of improved cultivation practices contributed to an increase of grain yield and in fodder yield over traditional practices (Rojas *et al*. 2009).

In this project emphasis was laid on quality seed production, training farmers in scientific methods and variety identification. These efforts will be useful for variety characterization, purification and seed handling during harvest, threshing, drying and storage. Farmers were encouraged to produce quality seeds of local and selected varieties and share with others. These activities will spread quality seeds and help in disseminating improved agronomic practices demonstrated by the project (Patil *et al.* 2015) .

These millet crops have good vigor, productivity, superior food and fodder values. These crops are virtually free from insects-pests in the field, while they are affected by a very few major diseases. Vary rarely plant protection measures are used by farmers. On this background very little information is available on geographic distribution of on-farm conserved minor millets. This diversity should be conserved by the international and national community in view of the on-going genetic and cultural erosion and climate change scenarios which calls for urgent mapping of local plant genetic resources (Padulosi *et al*. 1999).

ACKNOWLEDGEMENTS

Authors are thankful to Shri G.G. Sohani, President BAIF Development Research Foundation, Pune for encouragement. All the staff members from MITTRA, Nandurbar for their valuable co-operation during field work.

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How to Cite this Article:

Sanjay Patil, Ketaki S. Patil,Prafulla Sawarkar and D.K. Kulkarni, 2015. Germplasm conservation of Maize, Sorghum, Millets and vegetables from Dhadgaon and Akkalkuwa tribal block of Nandurbar district, Maharashtra State. *Science Research Reporter*, **5**(2): 137-146.