

# Innovative Seed Consortium Strengthening the Postrainy Sorghum Seed Systems in India

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## 1. Introduction

Sorghum (*Sorghum bicolor* [L.] Moench) is grown both in rainy (*Kharij*) and postrainy (*Rabi*) seasons in India for multiple uses. Of the total sorghum area of 6.5 m ha, postrainy sorghum is grown on ~ 4 m ha area in the black soils under receding soil moisture, after the cessation of rains. The majority of postrainy sorghum production is concentrated across the states of Maharashtra, Karnataka and Andhra Pradesh (Trivedi, 2008; Rana et al., 1999; Hosmani and Chittapur, 1997). Postrainy sorghum growing areas are characterized by low rain fall, low temperatures at flowering time and terminal drought and most of the times sorghum is the only crop option for meeting the food and fodder needs of communities in these areas (Murty et al., 2007; Pray and Nagarajan, 2009; Belum Reddy et. al., 2012; Kholova et al., 2013). Because of these constraints the productivity of postrainy sorghum is low (grain yield ~0.7 t ha<sup>-1</sup>). However the grain and stover quality obtained from postrainy sorghum is preferred by the farmers and markets, therefore of higher value. Across postrainy sorghum ecologies, the landrace cultivars possessing white bold lustrous grains, with photoperiod sensitivity, cold tolerance, shoot fly resistance and terminal drought tolerance, like M 35-1, Dagadi are popular with farmers. There are some improved varieties developed by Indian national program but they are not available to most farmers. The seed replacement ratio is very low (20%) (Fig 1). Further, the market opportunities for grain and fodder are limited restricting it to a subsistence production system. This paper deals with the current status of postrainy sorghum seed systems and innovative approaches to improve the quality seed availability to farmers.

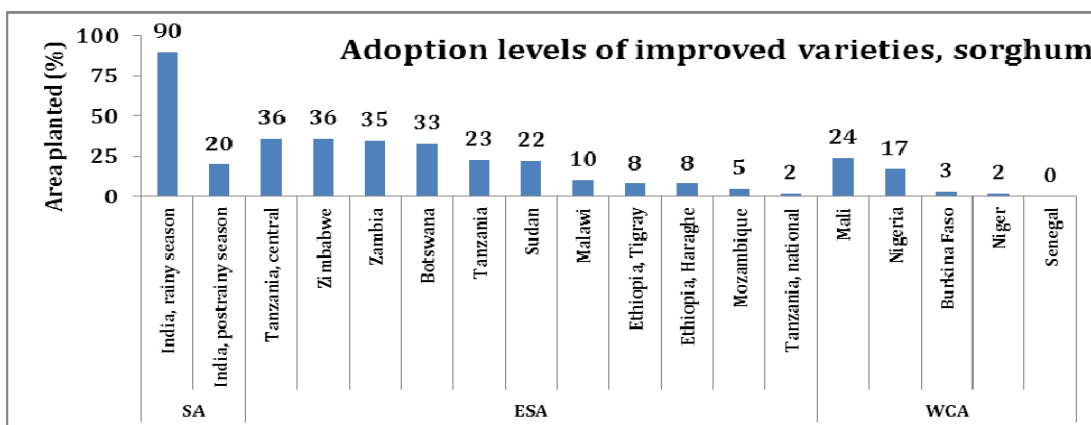


Fig. 1. Adoption levels of improved cultivars in sorghum rainy and postrainy seasons in India and other countries

## 2. Sorghum seed systems in India

Sorghum seed system is very unique in the country with two contrasting situations. Hybrids are the cultivar choice in rainy season sorghum and hybrid adoption by farmers is up to 95% in states like Maharashtra though there are wide variations in adoption across the states in India. The public and private sector seed companies developed hybrids rule the market, and seed requirement is predominantly met by the vibrant formal seed system by private sector seed companies and public sector seed agencies like National Seeds Corporation (NSC) and state seed development corporations in different states (for e.g. Mahabeej in Maharashtra). In case of postrainy season, open-pollinated varieties are the cultivar choice because of stringent quality considerations and lack of appropriate hybrids and inadequate hybrid seed production and supply.

Earlier studies showed that the postrainy season sorghum crop was grown on 4.8 million ha (CMIE 2007) in India, Maharashtra has highest area of 3.2 million ha under sorghum which requires 32,000 tons of seed @ 10kg ha<sup>-1</sup>. Formal sector is able to meet ~12% of seed requirement and balance ~88% seed supply is from informal sector, mostly from farmers own saved seed (Table 1).

**Table 1: State-wise area under postrainy season sorghum cultivation, seed requirement and seed sources in India (2011-2012)**

State	Area under cultivation (lakh ha)	Present varieties in cultivation	Total Seed requirement (in tons)	Seed supplied by formal seed sector	Seed supplied by informal seed sector (in tons)

				(in tons)	
Maharashtra	32	M 35-1, Dagadi, Phule Vasudha and Parbhani Moti	32,000	4,000* (12.5%)	28,000** (87.5%)
Karnataka	13	M35-1, Muguti, Annigiri, DSV-4 and DSV-5	13,000	<10%	>90%
Andhra Pradesh	2	M35-1, Budda Mallelu, Udgir local, Saayi Jonnalu, Dagdi local, CSV216R	2,000	INA	INA
Gujarat	0.1	BP 53, Surat 1, GJ 108, Malvan, solapuri, Gundari,	100	INA	INA
Other states	1	INA	1000	INA	INA
Total	48.1		48,100		

\* Formal sector-supply by private/corporations (Maharashtra state seed Development Corporation/NSC)

\*\* Informal sector-Farmers own saved seed, local markets, friends, relatives, govt. subsidised seed supply.

INA=Information not available

The private sector is not forthcoming for multiplying the open pollinated varieties (OPVs) of postrainy sorghum for various reasons.

1. There is no proprietary advantage in multiplying varieties in public domain
2. In case of postrainy season adapted varieties (or hybrids), the seed produced in postrainy season has to be marketed in next postrainy season which means they need to wait for 8 months to market them and hence the returns on investment are realized late.

3. The margins for private seed companies are low in production and marketing of open pollinated varieties (OPVs) when compared to hybrids market and there are not many improved hybrids with all the farmers preferred traits available in postrainy sorghum

Under these circumstances, it is primarily the public sector seed agencies and state agricultural universities partially catering the needs of farmers for sorghum seed supply in postrainy season and majority of the of farmers (~80%) source their seed from own sources (Informal sector). Therefore there is an urgent need to improve the postrainy sorghum seed production and availability. ICRISAT and partners proposed an “seed consortium” model (Fig 2) comprising of various partner institutions like Department of Agriculture, Agriculture universities, Seed certifications agency, State and National seed corporations, Private seed companies, NGOs, SHGs, KVKs with a basic objective to enhance availability of improved variety seed at right time and for right price to increase production and productivity of sorghum.

#### **4. Interventions to enhance postrainy sorghum seed production and supply**

Considering the large gap between on-station yields (2.5–3.0 t ha<sup>-1</sup>) and on-farm yields (0.75- 0.8 t ha<sup>-1</sup>) in postrainy season sorghum, ICRISAT partnered with Governments, Private, Public and people institutions; the Indian Institute of Millets Research, Hyderabad, Vasant Rao Naik Marathwada Krishi Vidyapeeth (VNMKV) – Parbhani and Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, Krishi Vigyan Kendra’s (KVKs), State seed development corporation (Mahabeej), National seeds corporation (NSC), Private seed companies, and Farmers associations (FAs), with an aim of harnessing individual resources and knowledge to increase crop productivity and farmers’ incomes by reducing the gap between on-station sorghum yields and farmers yields and by adding value to grain and stover and by providing market linkages, under an international project HOPE (Harnessing the Opportunities for Productivity Enhancement in Sorghum and Millets).

The Bill and Melinda Gates Foundation (BMGF) funded the HOPE project implemented in 11 countries including India during 2009-2014 (<http://hope.icrisat.org>). Earlier efforts on postrainy sorghum improvement by Indian NARS resulted in release of improved varieties with farmers preferred traits. In the absence of suitable seed system to deliver these varieties, farmers’ still use old local varieties like Maldandi (M35-1), Dagadi, Zipri, Jut, Dudhmogra, Bondri, Cheetpuri, Shalu, Khadki, Manthi, and Dukrilocal. Concerted efforts by HOPE team in supplying the improved seed, technologies, knowledge, input and credit systems, value addition and market linkages made a remarkable change in

the postrainy sorghum value chain in the project areas in Maharashtra, India. The project commenced in 2009.

A total of six clusters – Sanpuri (District: Parbhani), Limbaganesh (Dist. Beed) and Wakulni (Dist. Jalna) in Marathwada area (Eastern Maharashtra) and Hivare Bazar (Dist. Ahmednagar), Borkarwadi (Dist. Pune) and Aurad (Dist. South Sholapur) under Western Maharashtra region were selected for technology dissemination considering the large area under postrainy sorghum in these clusters. Seed of selected (farmers participatory varietal selection) and released varieties such as Parbhani Moti, Parbhani Jyoti, Phule Vasudha, Phule Chitra and Akola Kranti was distributed for cultivation in the project areas and farmers were trained to use improved crop management practices. The following improved crop production technologies were demonstrated across all villages of the project areas.

- 1) In-situ moisture conservation
- 2) Use of improved cultivars
- 3) Seed treatment and spacing
- 4) fertilizer management
- 5) Saving of own seed for future use

In the first five years of project implementation, the project directly covered >41,000 farmers directly and the impact of the interventions reached more than 300,000 farmers in Maharashtra state through secondary diffusion. The implementation of improved technologies in farmers' fields led to significant increase in grain productivity by 39% and stover productivity by 29% (Table 2) in project villages. The results from early adoption studies indicated that the HOPE interventions enhanced technology adoption rates, reduced the yield gaps (by 30%), increased the productivity and gave higher returns to farmers (36-41%). They also indicated that for every single farmer covered by HOPE project directly, 5-6 non-HOPE farmers benefitted. Dissemination of technologies (improved varieties seeds) through secondary channels like farmer to farmer, relatives, friends and gifts to their kith and kin spurred the production. <http://www.cgiar.org/consortium-news/hope-leads-to-increased-sorghum-yields>

**Table 2: Average yields of improved varieties demonstrated in project locations in Maharashtra (2009-2014)**

Region	Grain yield(t ha <sup>-1</sup> )*	Fodder yield(t ha <sup>-1</sup> )*	Percent increase over local variety		No. of farmers participated
			Grain	Fodder	
Marathwada	0.99	3.08	40	23	21,190

region					
Western Maharashtra	1.37	3.27	38	40	20,100

With these interventions farmers got convinced and are showing more inclination for growing improved varieties. Considering that seed is one the major constraints, an innovative ‘Seed Consortium’ was formed during 2013 involving Department of Agriculture, Indian NARS, public and private sector seed agencies, seed certification agency, KVKs, SHGs, NGOs, and farmers with defined roles and responsibilities in production and distribution of seed (Fig 2).

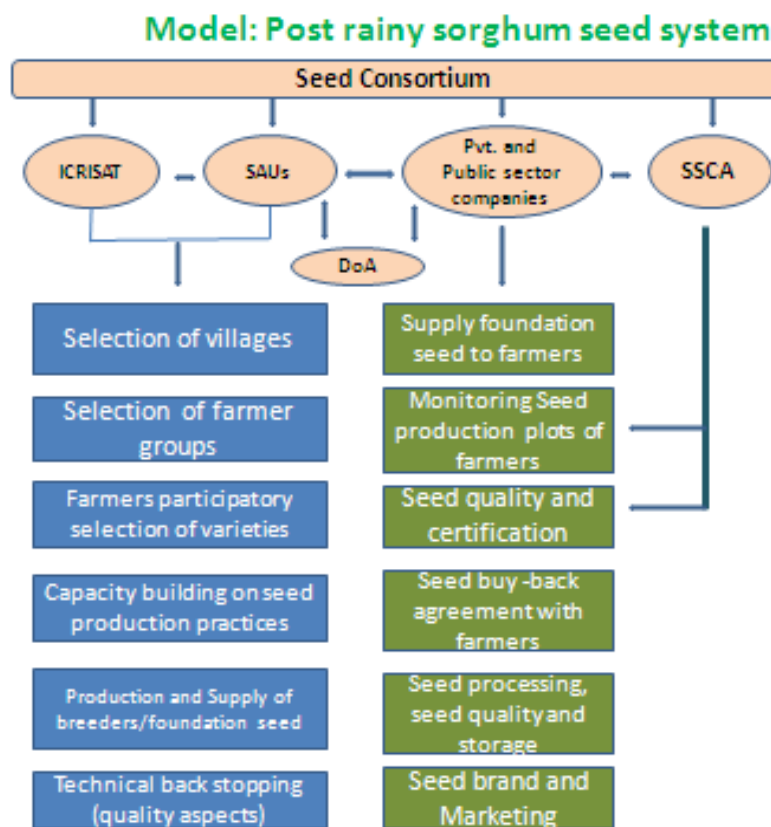


Fig 2: Seed Consortium Model

### 5. Operationalization of seed system model

Based on the finding of baseline survey (Pokharkar et al., 2014) on existing seed systems of post rainy sorghum in Maharashtra, a model ‘Seed Consortium’ was developed to multiply improved varieties and distribute to farmers. The seed consortium model includes ICRISAT, IIMR, private, public sector seed companies, State Agriculture

Universities (SAU), Krishi Vigyan Kendras (KVKs), Self-help groups (SHGs), Non-Government organizations (NGOs), and farmers.

In this model, we envisaged a decentralized seed production and centralized seed procurement and distribution in initial years but eventually we will shift to decentralized seed production and distribution. The public sector research and development institutions (ICAR, SAUs and ICRISAT) and private sector seed companies engage in partnership research to develop improved products and the private sector seed companies and public sector seed agencies play a critical role in seed production, procurement and dissemination of these improved products to farmers. The seed consortium partners meet annually and develop work plan to produce specific quantity of seeds annually to reach farmers.

#### **i) Roles and responsibilities of consortium members:**

Each participating member in the Seed Consortium has a designated role play as given below.

1. State Agriculture Universities: Two agricultural universities MPKV and VNMKV are the members of the consortium and they have developed varieties. The selected released varieties Phule Vasudha, Phule Chitra, Phule Revati, Parbhani Moti are multiplied by them on research farm and supply Breeder/ and Foundation seed to public sector seed company (Mahabeej) for production of certified seed. The scientists from Universities and Mahabeej jointly select villages and farmers for seed production. The Govt. of Maharashtra is encouraging farmers by paying an incentive of Rs. 500/- per quintal (100kg) of seed produced by the farmers under seed village scheme and all the seed producers under Seed Consortium were roped in to this effort.
2. Public sector seed corporation (Mahabeej): Mahabeej has agreed to reduce gradually production of local variety M35-1 (Maldandi) to promote improved released varieties. They have entered into **buy-back agreement** with farmers with a prefixed minimum price of seed procurement and agreed to pay 20% more over the grain price in the market at the time of procurement. The seed harvesting and transportation to processing plant is the responsibility of farmers and processing, grading, branding and marketing is Mahabeej' s responsibility.
3. NGOs, KVKs: Participating KVKs have merged their village seed production programs with our program and benefited by increased access to foundation

- seed, training facilities in Universities for training seed farmers and other crop production incentives and market linkages provided through consortium.
4. State seed certification agency: Mahabeej has taken responsibility to register farmers name and area for seed certification. The main function of seed certification agency (Maharashtra State Seed Certification Agency) is to monitor purity of the variety and certify the quality and quantity of seed produced by the farmers. The expenses incurred for monitoring the seed crop and issuing the certificate for seed produced by the farmer was borne by the Consortium.
  5. Department of Agriculture: Department Agriculture was the prime driver in all operations of the Consortium. The Commissioner and Director of Agriculture participated in Consortium work planning meetings and guided all the officials to actively participate in the Consortium programs.

### **ii) Capacity building**

Seed producing farmers were trained on seed production technique, maintenance of isolation distance, sowing practices, other agronomic practices to be followed for the sorghum seed crop. The seed growers were trained to identify off types, rogues and their removal from the seed plots and to maintain the quality of seed production. Further, trainings organized after harvest and at the time of seed processing to impart knowledge on seed cleaning, seed grading, seed treating, seed storage, seed packaging aspects, and how to draw the representative seed sample, for seed testing/local seed testing method to assess the seed germination and quality.

Training programs conducted on-station (University) and on- farm (in the villages) by technical staff of universities jointly by seed certification officials. Mahabeej staff joined the programs to announce their buy-back agreement and assurance of seed procurement to develop confidence levels in seed producers. During seed production period university technical staff used to visit the farmers' fields and gave technical advice to farmers on crop production. Most of these villages were earlier adopted under HOPE project. Hence, all most all farmers in the villages are well-versed with improved crop production technologies has given fillip to the seed production program.

### **iii) Seed Production**

The first seed consortium meeting conducted at Pune in April 2013, under the chairmanship of commissioner of Agriculture. Higher officials of Department of Agriculture and Universities Vice chancellors, Directors of Research, Advisor to Dryland Agriculture



Mission, Seed certification agency officials, General Manager- Mahabeej and Private seed company's representatives participated in the meeting.

There was consensus among the consortium partners to develop robust seed system for postrainy sorghum in Maharashtra and the Commissioner of Agriculture has extended all support under seed village program for the benefit of seed growing farmers (Anon, 2009). Accordingly seed production was undertaken in 341 ha in the 2013 postrainy season and 429 tons of seed produced (Table 3). All the seed produced in both the regions was procured by the Mahabeej as per buy-back agreement signed with the farmers.

**Table 3: Seed production during 2013**

S.no.	Partners	Target seed production area(ha)	Seed production area in ha	Quantity of seed produced in tonns
1.	MPKV (Western Maharashtra)*	250	243	263
2.	VNMKV (Marathwada region)**	250	198(98)	166
	<b>Total</b>	<b>500</b>	<b>341</b>	<b>429</b>

\* MPKV area Average yield -10.18 q/ha

\*\*VMMKV area average yield- 17 q/ha from 98 ha

In the year 2, postrainy season 2014, the targets of area was double over year 1. Some of the seed plots were rejected by Certification Agency for want of isolation. In spite of this 1000 tons of certified seed was produced and distributed to farmers. Seed production is undertaken in 2000 ha in the 2015 postrainy season in Western Maharashtra.

## 6. Way forward

Seed Consortium has made a headway in a short span of time. There are some important issues to be addressed for developing sustainable postrainy sorghum seed chain in India.

### 1. Varietal Denotification

- i) A review of existing list of released and notified varieties do reveal that old varieties are still find place in package of practices
- ii) Continued production of seed of old varieties by state corporations is rather counter productive
- iii) Denotifying old and obsolete varieties irrespective of whether they are from public or private sector to allow the seed multiplication of the released improved cultivars.

### 2. Cultivar replacement rate(CRR)

- i) State must ensure production of Breeder/Foundation seed of rainfed crops and multiplication and replacement of seed to increase CRR progressively.
- ii) CRR will happen through technology up gradation and extension work and govt. policies
- iii) For achieving the desired levels of CRR, adequate quantities of improved varieties seed has to be produced and made available to farmers
- iv) Varietal replacement rate is a continuous process, the new varieties released from time to time should flow into seed value chain will improve the raising farming income and profitability

### 3. Seed mission

Developing and implementing rainfed agriculture seed mission -with a built in mechanism of supporting the cost of seed production for five years by the Govt. by adopting public –Private –Partnership with effective coordination and convergence mechanisms

### 4. Advocacy

Advocacy is very critical. By increasing access to high yielding varieties/hybrids on priority basis to enhance adaptation rate to bridge the productivity gap and increase production

### 5. Selection of cultivars

Appointing a joint committee comprising of Indian council of agriculture Research (ICAR), State agriculture Universities (SAUs), public and private seed sector representatives and farmer groups to select rainfed crop varieties /hybrids suitable for different agro-ecological areas, farmers/market preferences and multiply them selectively for distribution to farmers.

## 6. Seed production

Promoting contract seed production program by advanced indenting of the seed of specific improved cultivars to both public and Private Sector Seed Companies including KVKs, and community based organizations with technical support and capacity building program for production of quality seed.

## 7. Policy and funding support frame

- i) An enabling policy environment help in production and dissemination of improved variety seed of rainfed crops.
- ii) Provision of funds and support for seed multiplication and dissemination activities at least for 5 years.
- iii) Strengthening extension services for creating awareness and demonstration of rainfed agricultural technologies.

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