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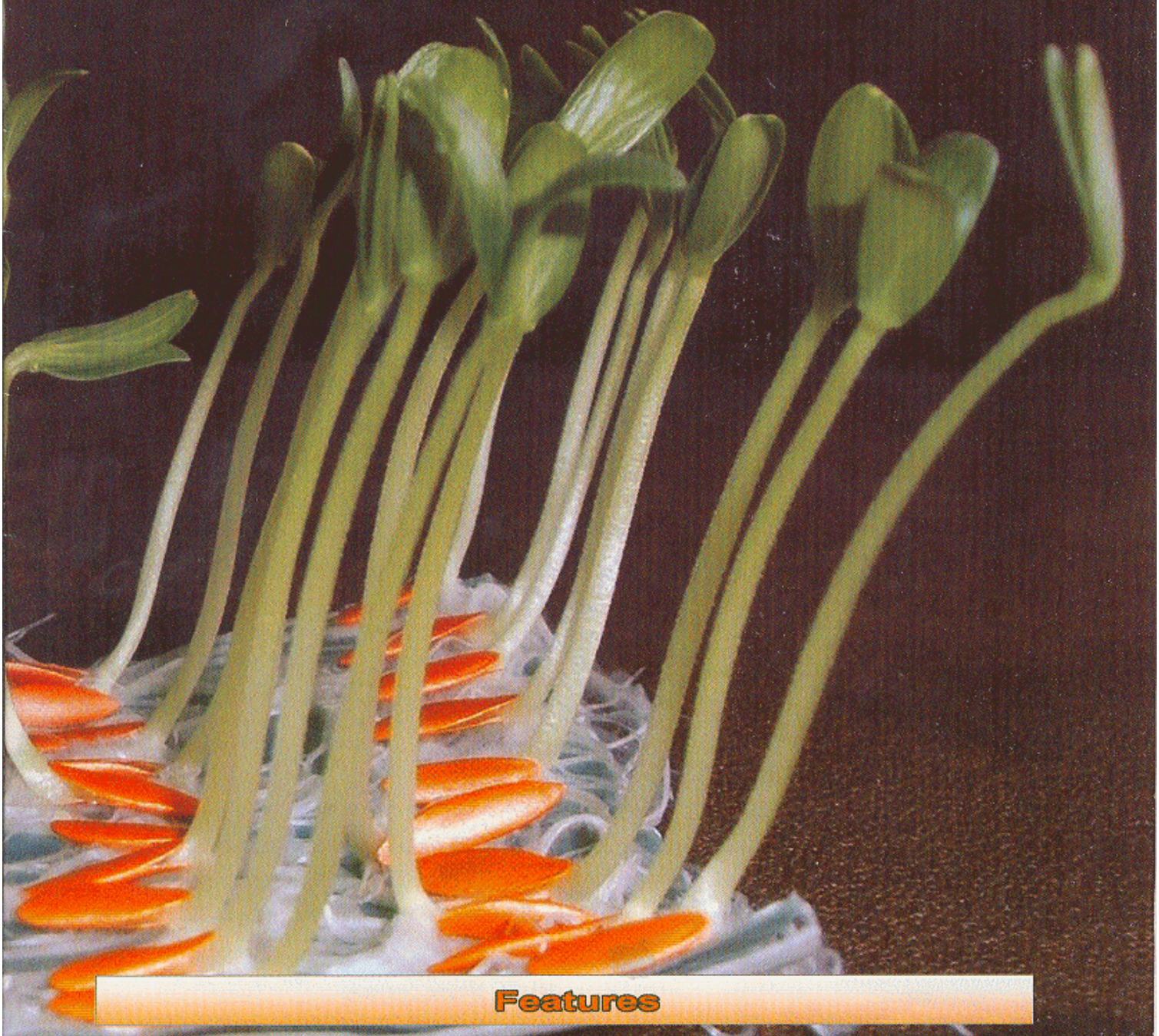

Features

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Harnessing public-private partnership for enhanced impacts of crop improvement research: The case of sorghum

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Public-private partnership as a strategy in research and development (R&D) is gaining popularity among international agricultural research centers (IARCs). According to a preliminary report, constructive partnerships exist because of common interests despite differing incentives. Crafting a relationship is a function of the extent to which the partners utilise their comparative advantages.

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the most important crops for the semi-arid tropics (SAT) where 560 million poor people in 55 countries of Africa and Asia live. Sorghum is a major source of food, feed and fodder in the SAT. Of late, bright prospects for sorghum is in the offing due to its remarkable stalk sugar content making it as an alternative feed stock source for bio-ethanol production in the light of depleting fossil fuel reserves and the associated higher prices and environmental pollution. Sorghum's productivity has been threatened by worsening environmental problems like drought, soil degradation apart from biotic stresses such as pests and diseases. Non-availability of improved cultivars twinned with traditional low-input cultural management practices also exacerbates the situation. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) regards these factors as interrelated and crop genetic enhancement is one facet in which the center has made headway in improving sorghum productivity by addressing these issues.

Considering the greater contribution of the hybrids to the grain/fodder yields compared to improved pure-line varieties in almost every production environments, ICRISAT since last three decades has been engaged in developing genetically improved sorghum hybrid parents. These hybrids parents are extensively being utilised by most private seed companies (PSCs), which have derived tremendous benefits through the development and marketing of hybrids to the farmers. Considering this synergistic informal public-private partnership between ICRISAT and PSCs, the former together with a few PSCs thought of formalisng the partnership as a means to take ICRISAT's products to farmers at a much faster rate while partially augmenting its financial support to sorghum improvement research.

In 2000, ICRISAT-Private Sector Hybrid Parents Research Consortium (HPRC) was initiated with some PSCs based in India, Indonesia and Egypt that formalised support to sorghum and pearl millet hybrid parents' research at ICRISAT[5]. Then in 2003, the consortium agreement was reviewed which led to the inclusion of pigeonpea. Simultaneously, separate consortia for each crop–sorghum, pearl millet and pigeonpea were formulated to facilitate smooth running. ICRISAT was the first among the 15 IARCs, which initiated the consortium mode of partnership with the PSCs. The Agri-Science Park, which is ICRISAT's hub for fostering public-private partnership for commercialising science-generated technologies and knowledge through innovative market mechanisms, consists of four (4) sub-units, one of which is the HPRC. The Sorghum HPRC (also other crops HPRC) has been highly successful as evidenced from increased membership from five in 2000 to 16 in 2006. Also, the HPRC provided a model resulting in private sector's participation not just in crop improvement but also in bio-pesticide research and development, natural resource management and in agri-business entrepreneurial assistance in India.

In the present study we have attempted to assess the impact of Sorghum HPRC and the relevance of its improved hybrid parents/germplasm that emanated from the research conducted under the consortium arrangement on the PSCs hybrid development and delivery capabilities. The benefits derived by consortium members from the hybrids developed based on ICRISAT-bred hybrid parents, its economic return to the members and the farmers and extent of farmers' adoption of PSCs improved hybrids are considered as key indicators of the impact of ICRISAT-Private Sector Sorghum HPRC.

A good mix of formal and informal means of assessment was used to obtain the information from the 16 PSCs who are members of the Sorghum HPRC. The consortium members' offices are located in the states of Andhra Pradesh, Maharashtra, Gujarat, and Karnataka. A survey questionnaire and an interview guide prepared by ICRISAT together with representations from the consortium members were used for eliciting the information. Major information obtained includes number of hybrids developed, the extent of utilisation of ICRISAT-bred sorghum germplasm by the PSC's and its impact on R&D capabilities, economic returns to PSCs and the farmers' extent of adoption of the sorghum hybrids. Field visits in demonstration plots and research laboratories as well as informal interviews with various actors of the entire production system are dovetailed with the interviews. This allowed better understanding of PSCs sorghum hybrids development and marketing activities.

The 10 consortium members have marketed a total of 15 sorghum hybrids, with each company having marketed at least one hybrid . This is just about one-fourth of the estimated 54 hybrids marketed by PSCs in India, which are based on ICRISAT-bred improved sorghum hybrid parents, or their derivatives.

In all the 15 hybrids, one of the parents [either A-line (seed parent) or the R-line (male parent)] has ICRISAT-bred

germplasm. Figure 1 shows the extent of ICRISAT's hybrid parents' use in the development of hybrids that are marketed by PSCs in India. Of the total 15 hybrids from the 10 PSCs, six restorer-lines have 50-75 percent ICRISAT-bred improved germplasm; four hybrids have both the hybrid parents with 25-50 percent ICRISAT-bred germplasm material; two hybrids with both the A- and R- lines with 100 percent ICRISAT-bred improved germplasm; two hybrids have only R-line with 100 percent ICRISAT-bred germplasm, one hybrid involves both A- and R-lines bred by ICRISAT. These results clearly indicate that these 15 sorghum hybrids marketed by PSCs are largely based on ICRISAT-bred improved hybrid parents, specifically for A-line (9 of the 15 hybrids are based on ICRISAT-bred A-lines).

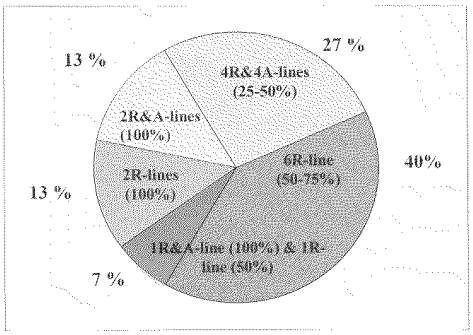

Figure 1. Number of ICRISAT-bred A-lines and R-lines and the extent of their germplasm (%) utilisation in sorghum hybrids marketed by PSCs in India.

The in-house capacity of consortium members is reflected in their ability of developing new hybrid parental lines. The PSCs with a well-developed R&D capability produced an average of 74 A- and B-lines and 48 R-lines. Even fledgling PSCs are able to produce new hybrid lines using ICRISAT-bred improved germplasm (Table 1). Gleaned from this study is the merger of 'small' companies as a means to pool facilities and even manpower to minimise cost of operation. The reasons being, as claimed by one company-respondent, the hybrid seed industry is a risky venture because of the enormous number of players not just from the organised and unorganised private sector but also the public sector, with the latter constituting to about 35 percent. In spite of this, the major incentive that propels continued presence of the seed industry in the development and delivery of work on sorghum hybrids is not just demand but the emerging niches sorghum has in terms of alternative uses like ethanol and poultry feed ration production[6].

'*Sorghum is a small grain with big gains*' is veritable as shown by the data on the economic returns of PSCs. Many of the PSC-respondents showed inhibitions in providing data on economic returns from the development and marketing of sorghum hybrids. This was not surprising considering intensive competition and PSCs own trade secrets, which prevented PSCs showing such reservations. From the data of one seed company who marketed hybrids having ICRISAT-bred improved germplasm lineage, the net profit is estimated at US$ 266,667 of the approximate gross return, which ranges from US$ 444,444 to US$711,111 in five years. Inferences that can be drawn from this are the high economic returns to PSCs from the development and marketing of sorghum hybrids and the significant benefit of consortium arrangement. The success of this partnership is because of shared vision and commitment to help improve sorghum productivity despite some variations in economic returns. To date, the HPRC has been a beacon for shared responsibility or teamwork on: (a) providing resource-poor farm households with quality seeds and (b) pooling of resources where ICRISAT provides improved germplasm material and PSCs develop and deliver the hybrids to the farmers in quickest possible time thereby espousing on comparative advantages, which in turn is a 'win-win' proposition for both.

Table 1. New lines of sorghum developed by private seed companies in India

Company	Total number of lines	
	A- & B-Lines	R-Lines
C5	25	25
C22	256	118
C2	51	21
C12	23	27
C6	15	50

The popularity of hybrids has triggered increased hybrid seed production activity which has resulted in significant economic benefits to farmers and several seed villages have prospered in Andhra Pradesh and Karnataka. As hybrids seed production fetches about three times higher income compared to commercial crop production[5] and that the seed production is taken up in optimum production conditions, participation in hybrid seed production has been found to be a

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reliable livelihood option for farmers. The net profit is approximately US$ 706-852 per hectare (Table 2). Besides, an assured income from hybrid seed production, farmers are also able to eke out small income of US$ 22–100 per hectare from selling stover (residue after the harvest of the grains), although, farmers' option, in most cases, is to keep it for maintaining their livestock, especially during dry seasons.

Table 2. Economic benefit to farmers through hybrid seed production

Particulars	Value
A-line seed yield (kg/ha)	2,250-2,500
Price offered (US$/kg)	0.40–0.56
R-line seed yield (kg/ha)	500-1,500
Price offered (US$/kg)	0.08–0.73
Stover yield (kg/ha)	1,000-4,500
Price offered (US$/kg)	0.022
Gross income (US$/ha)	1356–1622
Input costs (US$)	650–770
Net profit (US$/ha)	706–852

Data from PSCs hybrid seed sales in the last five years (2001-2005) showed an increasing trend in farmers' cultivation of hybrids. Sustained cultivation of sorghum hybrids in India is due to favorable cost-benefit ratio estimated at 1:1.4 (ref. 7). Despite higher cost of production of hybrids, the extent of their adoption is significant as exemplified by the remarkable area planted to two hybrids - JKSH 22 (ref. 8) (Figure 2) and VJH 540 (ref. 5) (Figure 3) marketed by PSCs. These two hybrids are developed based on ICRISAT-bred hybrid parents. The popularity of the hybrids has been attributed to high grain yield potential, bold grain and early maturity.

Figure 2. Marketed seed quantity and area of adoption of sorghum hybrid, JKSH 22 in rainy season areas in major sorghum growing states in India.

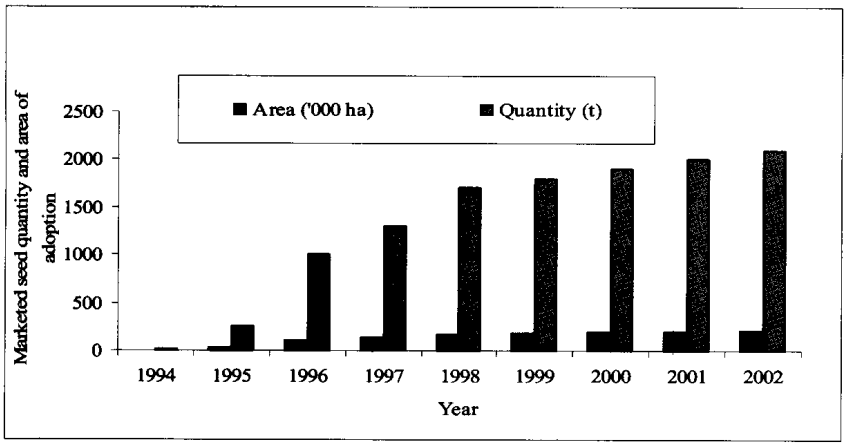
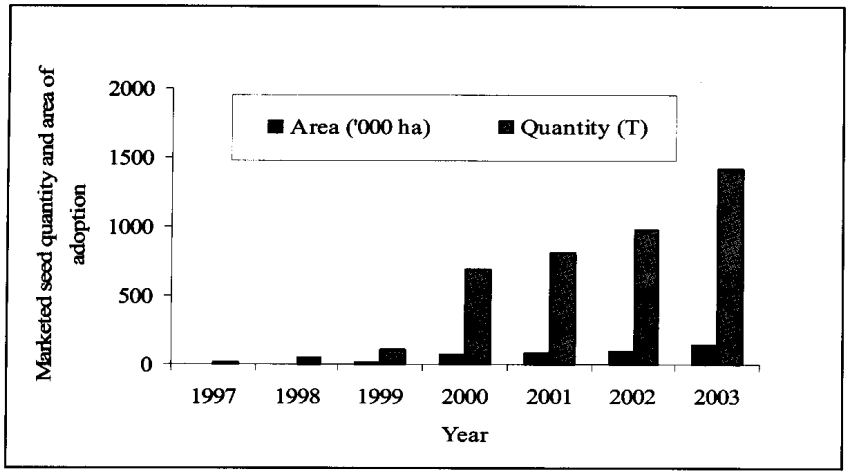


Figure 3. Marketed seed quantity and area of adoption of sorghum hybrid, VJH 540 in rainy season areas in major sorghum growing states in India



The impact of ICRISAT's partnership with PSCs on sorghum hybrid research and development in the form a unique HPRC is evident in the number of sorghum hybrids developed and marketed from PSCs perspective and in the extent of utilisation of sorghum hybrid parents' in the marketed hybrids from ICRISAT's perspective. The 15 sorghum hybrids developed and marketed by PSCs are based at least on one ICRISAT-bred hybrid parents or its derivatives. ICRISAT's improved germplasm used in the development and marketing of the 15 sorghum hybrids by 10 PSCs and their extent of adoption by farmers in India is a hallmark of the effectiveness of a good alliance. The PSCs' capability to develop in-house hybrid parents based on ICRISAT-bred improved germplasm has significantly improved. The use of ICRISAT-bred hybrid parents/improved germplasm has resulted in substantial economic returns to PSCs from marketing hybrids and to farmers from hybrid seed production and commercial cultivation. The synergy between ICRISAT and PSCs has resulted in reduction of time lag in hybrid parents and hybrid development and delivery of hybrids to farmers as exemplified by increased area under hybrids. The tremendous success of ICRISAT-led sorghum HPRC indicates the power of public-private partnerships that can be harnessed by other public sector research and development organisations to enhance the impact of crop improvement research.

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