POLICY BRIEF 27

Public Agricultural Research Investments: India in a Global Context

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Introduction

Agricultural research and development (R&D) investments are a crucial determinant of agricultural productivity through the introduction of improved crops and cropping practices, labor-saving technologies, improved quality of food storage, processing, and marketing. In addition to newly developed technologies, existing technologies need to be better disseminated. Considerable empirical evidence indicates high rates of return from agricultural R&D investments in the range of 40-50 percent (Alston *et al*., 2000), making agricultural research a cost-effective way for governments to accelerate agricultural development.

India has invested considerably in its public agricultural research system during the past few decades (Pal and Singh, 1997). As a result India now ranks fourth in terms of total investments in public agricultural R&D in the world, following United States, Japan, and China[1]. Notwithstanding, with increasing integration of world agri-food markets agricultural development is now taking place in the global context. Agricultural production is becoming market-driven, intensified, diversified and commercialized, as well as is confronting second-generation technological problems like degradation of land and water resources and changing pest problems. This implies revisiting agricultural research, in terms of investments and research focus, in a global context. This brief presents such an overview of the major trends in human and financial resources into India's public agricultural R&D system in a global context. The underlying dataset was developed by the Agricultural Science and Technology Indicators (ASTI) initiative of the International Food Policy Research Institute (IFPRI) and NCAP and is based on an extensive survey of all government, nonprofit, and higher-education agencies involved in agricultural research in India. Data on human and financial resources were collected through a postal survey during the period 2004-06[2].

Manpower and financial resources in India's public agricultural research

The bulk of agricultural research in India is in the public domain, which includes the Indian Council of Agricultural Research (ICAR), the State Agricultural Universities (SAUs), and various other government and higher-education agencies[3]. In 2003, India invested more than 20 billion rupees in public agricultural research(in 2005 prices)[4] — equivalent to about 1.4 billion in 2005 international dollars using purchasing power parity (PPP) indices (Table 1)[5]. PPPs are synthetic exchange rates used to reflect the purchasing power of currencies, typically comparing prices among a broader basket of goods and services than do conventional exchange rates. This figure covers only research activities and excludes expenditures on education made by ICAR, SAUs, and the other agencies in the survey sample. ICAR and the SAUs shared 43 and 50 percent, respectively, of the total public agricultural R&D investments. There are many other public research agencies that also conduct agricultural research; the major being the Indian Council of Forestry Research and Education (ICFRE). The other government-based agencies together accounted for only 5 percent of total spending. Higher-education agencies not part of the SAU system, such as agriculture-related faculties and departments at general universities, accounted for only 2 percent of the public spending on agricultural R&D.

Most agricultural R&D agencies in India do not have a full research mandate. Unsurprisingly, staff at SAUs and other higher-education agencies spend a considerable time on teaching/education (42 percent). In ICAR institutes, teaching activities, accounted for only 3 percent of total staff time. Other than deemed universities, education activities involve mostly through guiding university students with their thesis preparations. Research, as well as transfer of technologies and other research outputs, remained the main focus of their work (remaining 97 percent). However, some staff in ICAR institutes were also involved in training. In 2003, the public agricultural research system had about 16,700 full-time equivalent (fte) professional research staff comprising 13,089 researchers and 3,615 technicians with university degrees[6].

[1]In 2000, India's public agricultural R&D spending totaled $1.3 billion compared to $4.4, $2.5 and $1.9 billion (2000 international prices) for the United States, Japan, and China, respectively (Beintema and Stads 2008a).

[2]A complete list of agencies involved in agricultural R&D was identified at the onset of the survey and each agency was approached to participate in the survey. To this end, three different survey forms were developed: one for government agencies and nonprofit institutions, one for faculties and schools, and one for the private sector. All forms had different sets of questions with the one for government agencies and nonprofit institutions requesting the most detail.

[3]Public agricultural research is defined to include government agencies, higher-education agencies, and nonprofit institutions (thereby excluding business enterprises) and includes research on crops, livestock, forestry, and fisheries research as well as agriculturally related natural resources.

[4]Financial data presented here are in 2005 prices. When expressed in current prices, total 2003 spending is 19 billion rupees. Note that the total spending figures in this brief includes only research and exclude teaching and extension activities. These data are comparable with earlier estimates. .

[5]Expenditure in current local currency units were first deflated to 2005 international dollars using a local implicit GDP deflator (base year 2005), and then converted to international dollars using a 2005 purchasing power parity (PPP) index; which was 14.67 for India. Both the GDP deflators and PPP index are taken from the World Bank (2007 and 2008).

[6]There are no estimates readily available for head-count number of scientists. However, if FTE is converted into head count numbers, the estimates will be slightly higher than those reported by Jha and Pandey (2006).

Table 1—Composition of public agricultural research expenditures and professional research staff, 2003

	Total spending[a]		Professional research staff		
	2005[b] rupees	2005 international (PPP) dollars	Researchers	Technicians with university degrees	Total
	(millions)		(full-time equivalents)		
ICAR (93)	9,051	617	4,034	2,228	6,262
Other government(16)	1,080	74	1,019	na[c]	1,019
SAUs (35)	10,381	708	7,677	1,387	9,064
Other higher education (16)[a]	410	28	358	na[c]	358
Public-sector total (160)	20,923	1,426	13,089	3,615	16,704

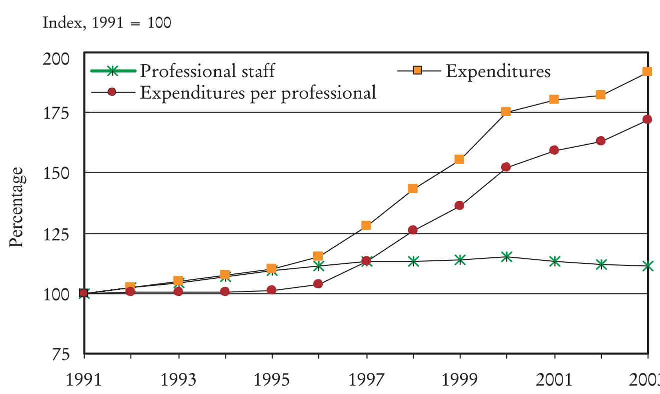
Sources: Beintema et al. (2008) based on data from the Agricultural S&T Indicators (ASTI) database.

Note: Total spending and professional research staffs were adjusted to separate out time and subsequent financial resources spent on education using time allocation information given by the various agencies. Figures in parentheses indicate the number of agencies included in each category. See Beintema et al. (2008) for a full list of these agencies.

a. Expenditures for the other higher education agencies in our sample are estimates based on average expenditures per researcher at the SAUs.
b. Expenditure data corresponds to the year 2003.However expressed in 2005 prices

Public spending in agricultural R&D in India, in inflation adjusted terms, grew substantially during 1991–2003 at an average rate of 6.4 percent per year (Figure 1). Most of the growth took place in the late 1990s; the annual growth rate during 2000-03 was 2.9 percent, although considerably lower, still impressive. This process of growth has been ongoing for a number of decades: From 1961 to 2001, public investments, by central and state governments, increased tenfold (Pal and Byerlee 2006).

Figure 1—Composition of public agricultural research expenditures and total professional research staff, 2003



Sources: Beintema et al. (2008) based on data from the Agricultural S&T Indicators (ASTI) database.

Notes: 1992-94 spending data and 1992-95 researcher data have been extrapolated. Professional staff includes researchers and technicians.

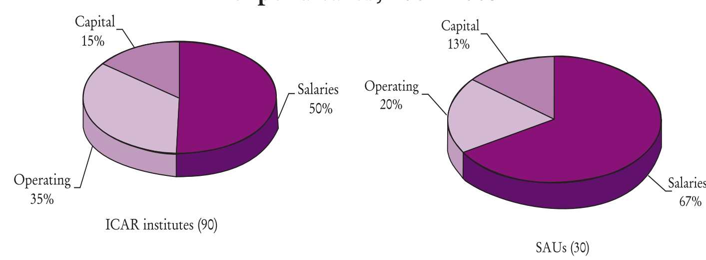
During 1991–2003, the total number of fte professional staff in agricultural research increased at an annual growth of 1 percent per year. However, during 2000-03 the number of professional staff declined by about 500 fte's. This decline was confined to the researcher category at ICAR as well as SAUs. The number of technicians with degrees however continued to increase during these years. This decline was a result of retirement of the staff accompanied by non-recruitment of the researchers in equal number.

The robust growth in spending with almost constant number of professional staff resulted in a strong increase in financial resources (i.e., salaries, operational costs, and capital investments) per professional staff from Rs 0.7 million in 1991 to more than Rs 1.2 million in 2003, in constant prices—equivalent to a growth of almost $50,000 to $85,000 in 2005 international (PPP) prices.

Allocation of research resources

The allocation of research budgets across salaries, operating costs, and capital costs influences the efficiency of agricultural R&D. During 2001-03, the agencies under ICAR spent 50 percent on salaries, 35 percent on operating costs, and 15 percent on capital investments (Figure 2). The cost structures for the ICAR institutes have been comparatively stable since the mid-1990s, except for 1998-99 when salary shares were slightly higher. The SAUs spent relatively more on salaries; 67 percent of their total investments during 2001-03.

Figure 2—Cost category shares of government agency expenditures, 2001-2003

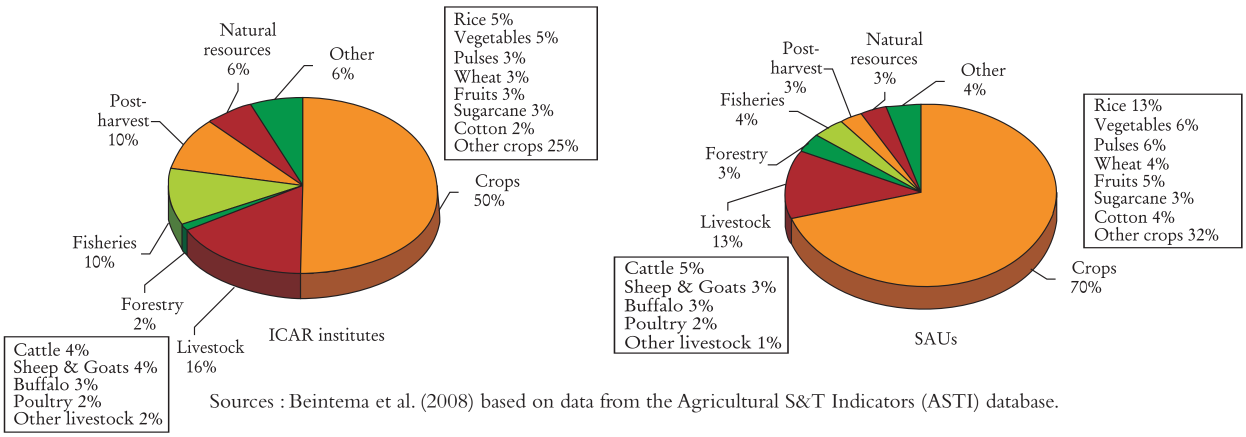


Sources: Beintema et al. (2008) based on data from the Agricultural S&T Indicators (ASTI) database.

Notes: Salaries include all staff remuneration expenditures; operating expenditures include expenditure on maintenance of buildings, cars, and equipment, as well as other items such as gasoline, electricity, stationery, books, agricultural inputs, staff training, travel, etc.; capital expenditures include all expenditures related to the purchase or rental of items that last longer than a year such as research equipment, furniture, computers, cars and vehicles, land and buildings.

The allocation of resources among various lines of research is a policy decision and reflects priorities for research. Figure 3 shows the commodity-wise allocation of fte researchers in ICAR institutes and SAUs. In 2003, more than one half of ICAR researchers were engaged in crop research; SAUs researchers spent a considerably higher portion of their research time on crops research (70 percent). Across crops, rice received a greater focus followed by vegetables, pulses, wheat, fruits, sugarcane, and cotton. Livestock accounted for 16 and 13 percent of the resources at ICAR institutes and SAUs, respectively with cattle research accounting for the major part of these. Forestry, natural resources, postharvest, and fisheries research at SAUs accounted for 3-4 percent each. Fisheries and postharvest research were more prominent at ICAR institutes (10 percent each). The trend was as pointed out by Jha and Kumar, 2006 who had reported that research on foodgrains ranked first, followed by horticulture and livestock.

Figure 3—Commodity focus of professional research staff of ICAR and SAUs, 2003



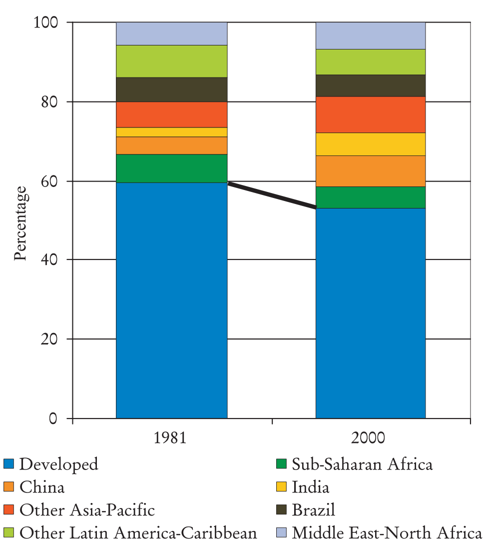
Sources : Beintema et al. (2008) based on data from the Agricultural S&T Indicators (ASTI) database.

India's Agricultural Research in a Global Context

The latest available information on the status of global agricultural R&D investments shows that worldwide, public investments in agricultural research increased by more than 50 percent, in inflation-adjusted terms, from an estimated $ 16 billion in 1981 to $ 23 billion in 2000 (in 2005 international prices) (Figure 4). Asia and the Pacific specifically has continued to increase their regional share: 23 percent in 2000 compared to only 13 percent in 1981. Most of this relative growth took place during the 1990s. In contrast, the corresponding share for sub-Saharan Africa continued to decline, falling from 7 to 5 percent share of the global total between 1981 and 2000.

Public agricultural R&D has become increasingly concentrated in just a handful of countries. Among the rich countries, just two countries—United States and Japan—accounted for 56 percent of public spending of the total spending in the developed world in 2000; about the same two decades earlier. Three developing countries—China, India, and Brazil—spent 41 percent of the developing world's public agricultural research total, an increase from 33 percent in 1981. India, China, and Brazil experienced different growth rates since the 1980s (Figure 5). Brazil experienced a negative growth of -1 percent per year during the 1990s (1 percent) compared to 4 and 6 percent per year in China and India, respectively. New evidence show that the growth in total investments in agricultural research in India and China continued in 1990 (Beintema and Stads 2008b).

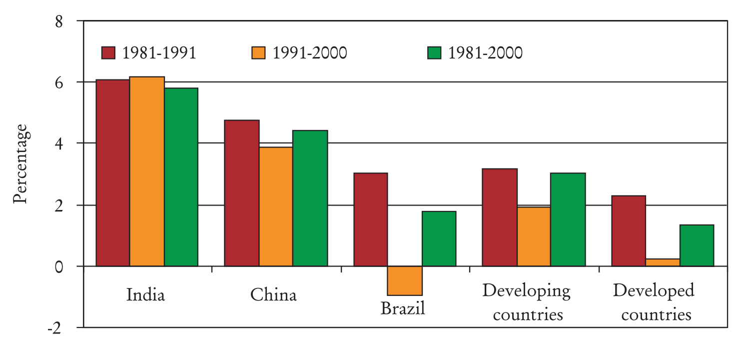
Figure 4— Global public agricultural research expenditures by region, 1981 and 2000



Sources: Beintema and Stads (2008a) based on data from the Agricultural S&T Indicators (ASTI) database.

When moving from absolute to relative levels, we measure the intensity of investments in agricultural research. The most common research intensity indicator is to measure total public agricultural R&D spending as a percentage of agricultural output (AgGDP). The developed countries as a group spent $2.61 on public agricultural R&D for every $100 of agricultural output in 2000, a sizable increase over the $1.62 they spent per $100 of output two decades earlier (Figure 6). Agricultural output grew much faster in the developing countries as group than in the developed countries. As a result, intensity ratios remained fairly stable for the developing countries as group, despite overall higher growth rates

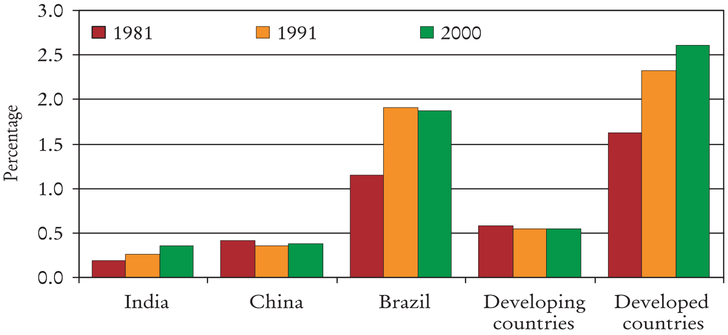
Figure 5—Differences in annual growth rates, 1981-2000



Sources: Beintema and Stads (2008a) based on data from the Agricultural S&T Indicators (ASTI) database.

in agricultural R&D spending in this part of the world. Despite the lower growth in agricultural R&D spending, Brazil's intensity ratio has been considerably higher. In 2000, Brazil's intensity ratio was 1.9 percent, five times the corresponding ratios for China and India. The latter ones are especially low compared to many other developing countries and indicating an underinvestment in agricultural R&D. More recent data for China and India (to 2003/05) show that the intensity ratio remained stable. This is because the large increase in total agricultural R&D spending has been offset by a similar growth spurt in the value of agricultural output.

Figure 6—Differences in intensity ratios, 1981-2000



Sources: Beintema and Stads (2008a) based on data from the Agricultural S&T Indicators (ASTI) database.

Implications

Many developing and developed countries are having constant or even declining investments in agricultural R&D. Only a few larger and more advanced developing countries, such as India, China, and Brazil, are growing substantially in terms of amounts spent on agricultural R&D. These countries' productive and self-sustaining research systems have been able to move to the more upstream stages of R&D process and developed their own set of technologies.

Due to favorable government policies combined with substantial financial support from bilateral and multilateral donors India now has a diverse agricultural system, which has produced technologies that have been highly beneficial for the agricultural sector. But as the focus of agricultural research in India is widening and becoming more complex with the need to encompass issue such as sustainable natural resources, improving food quality and safety, increasing household food and nutritional security, and reducing poverty. This will need a redirection of the country's R&D policy and strategy coupled with sufficient resources.

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