

Contribution of research by the University of Agricultural Sciences, Bangalore in Karnataka

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Preamble

Pioneering work regarding the contribution of agricultural research has been attempted by Evenson, Carl Pray and Rosegrant (IFPRI Research Report 109, 1999) in their work “Agricultural Research and Productivity Growth in India” where they used the Total Factor Productivity approach (TFP). India has one of the largest public agricultural research establishments in the world. India’s agriculture has realized substantial gains in productivity, as measured by Total Factor Productivity (TFP) indexes. Virtually every district in India has seen TFP grow. TFP growth has contributed 1.1–1.3 per cent per year to the growth of crop production in India.

Karnataka has made significant gains in TFP. The high- yielding varieties of rice, ragi, introduced in the late 1960s contributed to these gains. Similarly the modern varieties of maize, sunflower, soyabean, tur and other crops introduced after Green Revolution contributed to these gains.

Total Factor Productivity

Productivity in agriculture is assessed by crop yield per ha. However this does not indicate economic efficiency since it considers only land as an input (in the denominator) and discounts contribution of other inputs such as labor, fertilizer, mechanical power, animal power, tractors, technology, skills and so on. Thus, another measure called the Total factor productivity (TFP), also called multifactor productivity is being used to reflect the true economic efficiency. TFP is produced by changes in infrastructure, skills, institutions and technology. TFP is a measure of the increase in total output that is not accounted for by increase in the use of conventional inputs but accounted by inputs such as infrastructure, skill, institutions, technology. TFP is the change in the cost per quintal of production keeping all input prices constant. TFP is also interpreted as change in the output relative to a weighted combination of all inputs, where the weights are factor shares. TFP is also defined as ratio of aggregate output to aggregate input. It is computed as the ratio of an index of aggregate output to an index of aggregate inputs. Growth in TFP is therefore the growth in total output less the total increase in inputs.

Sources of growth

The largest source of the growth in Total Factor Productivity, before the Green Revolution was the agricultural extension service. This facilitated the use of modern inputs and improved farm efficiency, though we had no access to improved technology. With the advent of the Green Revolution, access to high-yielding varieties and public research system were the major sources for growth in TFP. The role of extension reduced as the farmers could easily identify modern varieties. After the Green Revolution, the public- sector research and extension both came back to prominence as major sources of TFP growth.

During the early Green Revolution (1956-65), modern varieties of wheat and rice spread fast in the most favorable Environments like the Punjab. During the mature

Green Revolution (1977-1987), modern varieties were widely adopted geographically. The marginal impact of public research on TFP was higher in 1966–76 than in 1956–65. During the mature Green Revolution, marginal impact of research on TFP was 50 per cent higher than before the Green Revolution. This was due to rapid growth in the proportion of borewell irrigation.

Contribution of agricultural research in Karnataka

1. Estimation using Seed replacement rate

According to the National Sample Survey Organization's Report (NSSO Report 496: Some aspects of Farming, 2003), for Karnataka, it is reported that 51 percent of the farmers replace seeds every year, 27 percent of the farmers replace seeds once in two years, 9 percent once in three years and 13 percent once in four years or more. Using these results, assuming a conservative seed replacement ratio of 20 percent every year, the contribution of the research by the UAS Bangalore is estimated as under.

First the production of HYVs and / or Hybrids of major crops (Rice, Ragi, Wheat, Tur, Jowar, Bajra, and Maize) for 2005-06 for the State is considered. Second, it is assumed that the seed replacement ratio (SRR) is around 20 percent and that this proportion approximately contributes to 20 percent of the total output. Third, this total output is valued at market prices to obtain the total value of output as contributed by research component of the University (Table 1)

Table 1: Economic Contribution of research by the UAS Bangalore (2005) using the concept of Seed replacement ratio

Crop	Output in tonnes in the State	Output contributed by UAS agricultural research (SRR of 20%) (quintals)	Price in Rs. per quintal	Gross value of output at SRR of 20 percent in Rs. Crores	Net value of output (30 % of gross value) in Rs. Crores
Rice (HYV)	3695587	7391174	1798	1329	399
Ragi (HYV)	1641450	3282900	1176	386	116
Wheat (HYV)	159999	319998	1259	40	12
Tur	407832	815664	2820	230	69
Jowar (Hybrid)	1207396	2414792	761	184	55
Bajra (Hybrid)	382020	764040	950	73	22
Maize (Hybrid)	2796005	5592010	744	416	125
Sunflower	667511	1335022	2021	270	81
Groundnut	595867	1191734	2307	275	82
Soyabean	74802	149604	2094	31	9
Mango	450688	901376	1150	104	31
Total				3338	1001

Data source: Fully Revised Estimates of Principal Crops in Karnataka for the year 2005-2006, Directorate of Economics and Statistics, Bangalore, 2007

The gross value of output at SRR of 20 percent is a *prima facie* indicator of the contribution of research by UAS Bangalore. For instance, considering rice the contribution by the University is Rs. 1329 crores forming 40 percent of the total contribution, followed by Maize (Hybrid) 12 percent and Ragi (HYV) 11.5 percent. The total contribution by the UASB according to SRR is around Rs. 3338 crores. The net value of output refers to the profits earned by farmers with the assumption that the cost of cultivation forms around 70 percent of the gross value of output.

2. Estimation according to TFP

According to Evenson, Pray and Rosegrant (1999), the rates of return to public agricultural research are high, but however, Governments are underinvesting in agricultural research. Therefore expanding public investment in research and extension can lead to even greater gains. The TFP indicates contributions by non-conventional inputs such as research, extension, literacy, markets. The conventional inputs are seeds, fertilizers, and manures. Accordingly public sector research accounted for 38 percent of the TFP growth. While Karnataka is no exception to this phenomenon due to the fillip received from the Indian Council of Agricultural Research, the Karnataka State Government and other research support, the economic contribution of research is computed with this share. The economic contribution of research for individual crops by the UAS (Table 2) highlights considering the contribution of research to the growth in TFP being 38 percent. The crops considered by Evenson, Pray and Rosegrant (1999) inter alia are Rice, Wheat, Jowar, Maize, Bajra, Groundnut, Soybeans and Sunflower.

Table 2: Economic Contribution of research by the UAS Bangalore using TFP growth share of 38 percent (2005)

Crop	Output in tonnes in the State	Output contributed by UAS agricultural research (38 % to TFP) (Qintals)	Price in Rs. per quintal	Gross value of output at SRR of 20 percent in Rs. Crores	Net value of output (30 % of gross value) in Rs. Crores
Rice (HYV)	3695587	14043231	1798	2525	758
Wheat (HYV)	159999	4728431	1259	595	179
Jowar (Hybrid)	1207396	4588105	761	349	105
Bajra (Hybrid)	382020	1451676	950	138	41
Maize (Hybrid)	2796005	10624819	744	790	237
Sunflower	667511	2536542	2021	513	154
Groundnut	595867	2264295	2307	522	157
Soyabean	74802	284248	2094	60	18
Total				5492	1648

Data source: Fully Revised Estimates of Principal Crops in Karnataka for the year 2005-2006, Directorate of Economics and Statistics, Bangalore, 2007

According to the TFP, the contribution of UASB agricultural research to the Karnataka state is around Rs. 5492 crores. The net value of output refers to the profits earned by farmers with the assumption that the cost of cultivation forms around 70 percent of the gross value of output which is around Rs. 1648 crores. Thus, the estimates of the UASB agricultural research contributions to Karnataka State lie between Rs. 3338 crores and Rs. 5492 crores for 2005.

Conclusions

The measurement of contributions by agricultural research is a challenging task for economists and scientists. In this note the methodology used by Evenson, Pray and Rosegrant ¹is used as the basis to estimate the contribution of agricultural research to Karnataka State. Accordingly every year the contribution of agricultural research by UAS Bangalore to Karnataka State is around Rs. 3000 crores on a conservative basis.

¹ Robert E. Evenson, Carl E. Pray and Mark W. Rosegrant, 1999, Agricultural Research and Productivity Growth in India, International Food Policy Research Institute, Washington, D.C.