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GROWTH AND PERFORMANCE ANALYSIS OF INDIAN AGRICULTURE RESEARCH SYSTEM

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ABSTRACT

Agricultural research has played a key role in promoting production and productivity, thus helping with poverty reduction in developing countries for the past several decades. Compared with returns to other investments returns to agricultural research and development (R&D) have been one of the highest. All the centre, the ICAR and its research institutes are funded by the union government. The SAUs (state agricultural Universities) involved in research and education funded by state governments. Some funds are transfer from ICAR to SAUs in form of regular grants and schemes. The overall growth rate of agricultural R&D expenditure from 1960-61 to 2010-11 was only 5.35 percent per annum. The agricultural R&D intensity ratio is 0.39 percent which is very low in compare with developed countries i.e. 2-4 percent and developing countries which is 0.75 percent.

KEY WORDS: *Agriculture, R&D, Intensity ,Expenditure.*

INTRODUCTION

Innovation is a matter of production new knowledge or combing existing (and sometimes new) elements of knowledge in new ways as well as diffusing and utilizing it (Johanson, Edquist and Lundvall,2003).The economic performance of agricultural sector in most countries has been largely determined by the organised research and extension services in those countries. FAO and World Bank(2000) have introduced concept of agricultural knowledge and information system to provide a broader prospective on innovation than the more traditional agricultural research system approach. They presented the agricultural knowledge and information system as a model that links people and institutions to promote mutual learning and generate share and utilize agricultural related technology, knowledge and information. This system integrated farmers, agricultural educators, researchers and extensions from various sources for better farming and improved livelihoods. The agriculture sector of the presently developed countries have during the twentieth century, been remarkable successful in overcoming from the exhaustion of the land frontier. Since the middle of twentieth century, these countries (developed countries) have been joined in making transition growth from growth based on the higher pay off input. This transition has been possible in the developed countries by a remarkable institutional innovations and the development of public agricultural research system (Ruttan,2001).

Public agricultural research and development expenditure have become tighter in recent years. This shortage of funding on agricultural R&D following a long period of sustainable growth. In the past several decades, agricultural research system has played a crucial role in accelerating agricultural productivity growth in developing countries that contributed to reducing poverty, hunger, and malnutrition (Nit Pratt and Fan, 2010). There are several studies which shows that there has been impression that public investments in agricultural R&D are in decline (Pray and Umali Deininger,1998).

Agricultural research has played a key role in promoting production and productivity, thus helping with poverty reduction in developing countries for the past several decades. Compared with returns to other investments returns to agricultural research and development(R&D) have been one of the highest. Fan (2002) pointed out that with every one percent increase in agriculture research and development investment, urban poverty declines by 0.021 percent.

GLOBAL TRENDS IN AGRICULTURAL R&D

The economic studies done in the recent past show that both developed and developing countries in the world were investing large amount of money in public agricultural research which applies the importance of agricultural production in order to meet the challenges arising out of population growth. Even as agricultural research and development systems are faced very diverse conditions and difficult challenges their budgets are cut in many countries (Pardey and Beintema, 2001).On average developing countries spend about one and half of one percent of their agriculture

GDP on agricultural research and development (R&D), on the other hand developed countries spend two per cent of their agriculture GDP on agricultural R&D (Hazell and Haddad, 2001).

Table1.Global level Public Agriculture R&D Expenditure (millions 2000PPP dollers)

	Agricultural R&D Expenditure			Annual average growth rates(Per cent per year)		
	1981	1991	2000	1981	1991	2000
Developed Countries	8293 (54.57)	10534 (58.69)	10191 (44.29)	2.27	-0.58	1.10
Developing Countries	6904 (45.43)	9459 (47.31)	12819 (55.71)	3.20	3.09	3.14
Total	15197 (100)	19992 (100)	23010 (100)	2.63	1.20	2.11

Source:Pardey,Alston and Piggot 2006.

The table 1 shows that developed countries spend 54.71 per cent of total global public agricultural R&D in 1981 and increased 58.69 per cent in 1991 but decreased in 2000 as 44.29 per cent. On the other side developing countries contributed 45.43 per cent share of global total public agriculture R&D in 1981 and improved it in 47.31 per cent and 55.71 per cent in 2000 respectively. There was a notable reduction in publically funded agricultural R&D during the period 1990s in developed countries R&D spending grow at an average 2.27 percent in the 1980s and decreased by 0.58 percent per annum in 1990s.Developing countries average growth rate was near about 3 percent in three decades.

Table 2. Global level Public Agricultural R&D intensities ratio.

	Agricultural R&D Expenditure		
	1981	1991	2000
Developed Countries	1.41	2.38	2.36
Developing Countries	0.52	0.50	0.53

Source:Pardey,Alston and Piggot 2006.

The table 2 presented agricultural R&D spending providing by the agricultural intensities ratios. The agricultural research intensity ratios express agricultural research expenditure as percentage of agricultural GDP(gross domestic product).For every 100 dollars of agricultural GDP developed countries spent1.41 dollars in 1981 which was increased 2.36 dollars in 2000.Developning countries spent only 0.52 dollars in 1981 and 0.53 dollars in 2000.This fact highlighted the underinvestment in agricultural R&D in developing countries and the gap in generating new technology between rich and poor countries(Nin Pratt and Fan,2010).

Table 3.Private and Public agricultural R&D Investment 2000(million 2000 international $)

Region	Public	Private	Total
Developed Countries	10191 (44.8)	12577 (55.2)	22767 (100)
Developing Countries	12909 (91.6)	1108 (8.4)	14089 (100)
Total	23100 (62.7)	13756 (37.3)	36856 (100)

Source: same as table 1.

This table highlighted that in developing countries public funds are major source of agriculture R&D expenditure i.e. 91.6 percent of total agriculture R&D expenditure. But in developed countries the share of private sector (55.2 percent) was higher than public sector (44.8 percent).

AGRICULTURAL R&D INVESTMENT IN SOUTH ASIA

Whether directly or indirectly, the vast majority of Asia's rural population remains highly dependent on agriculture, forestry, and fisheries, but increasing population pressure, agricultural intensification, and inappropriate farming practices seriously threaten the rural environment, especially in South Asia (Rosegrant and Hazell 2000).The Asian region as a whole still houses over two-thirds of the world's poor people, representing 600 million people living on US$1 per day or less, and South Asia remains home to 38 percent of the global population of undernourished people (Von Braun 2007).To provide a pathway out of poverty for South Asia's rural poor and to tackle the widening rural urban gap, a revival of agriculture is urgently needed. There is empirical evidence which has demonstrated that agricultural R&D has been a major contributor to agricultural innovations, poverty reduction and productivity increase around the global over the past five decades (World Bank 2008, Fan 2010).

Table 4 Public Agricultural R&D Expenditure in South Asia (in million 2000 PPP $)

Countries	1996	2003	2009
Bangladesh	83	94	126
India	929	1497	2276
Nepal	18	20	22
Pakistan	201	176	172
Shri Lanka	40	42	38
Total	1271	1829	2638

Source: Stades and Rahija, 2012.

In 2009 public agricultural R&D investment in South Asia was totalled 2.6 billion dollars. This expenditure growth driven by the largest country, India. India's public sector spending

Total 0.9 billion dollars. After a period of strong growth in agricultural R&D expenditure in late 1990s, countries growth stagnated during 1999-2004, but after 2004 India's agricultural R&D spending strengthen due to enhancement government support such that by 2009 national investment totalled 2276 millions. India 'growth rate was higher (10.6 percent) in 1996-2001 and lower (4.2 percent) in 2001-2006.But after 2006 it was about 10 percent. Agricultural R&D spending year to year fluctuation. In 1966-2001 Nepal's agricultural R&D growth rate was 13 percent but in 2001-2006 it was negative growth rate i.e.- 12.8 percent After 2006 government increased support for agricultural research system, in 2009 the country spend 22 million $ on agricultural R&D. Public agricultural R&D expenditure fluctuate year to year. In 1996-2001 Pakistan's agricultural R&D was negative growth rate; in 2006-2009 this growth rate was 2 per cent per annam. In 2009 investment in public agricultural R&D totalled 172 $ million.

In late 1990's agricultural R&D spending of Shri Lanka's agricultural R&D spending level rose rapidly particularly focusing on plantation crops whose research was funded through commodity levies. In subsequent years revenue genera rated by these levies were gradually channelled away from research activities so the countries overall agricultural R&D expenditure was declined (Stades and Rahija 2012)

Table 5.Annual Growth in Public Agricultural R&D in South Asia

Countries	1996-2001	2001-2006	2006-2009
Bangladesh	10.2	3.4	2
India	10.6	4.2	9.9
Nepal	13	-12.8	9
Pakistan	-6.8	3.4	2
Shri Lanka	5.1	1.9	-7

Source: same as table 4

INDIA AND AGRICULTURAL RESEARCH SYSTEM

Agricultural research and extension services not only provided the critical base for India's green revolution but hold the key to future agricultural growth. India has one of the largest and most complex agricultural research systems in world with more than a century of organised application of science to agriculture. Investment in agricultural R&D has produced an institutionally diverse research system that has achieved the green revolution in 1960's and 1970's.This was the result that India has become a self sufficient in food production. Evension and Jha (1973) shown that the investment in agricultural research and extension is main source of growth in agricultural total factor productivity in India. Investment in agricultural R&D intensity ratio rose from 0.2 percent of agricultural GDP (Gross Domestic Product) during the early 1960s to about 0.5 percent in the 1990s (Jha and Pal 2003,Pal and Byerlee (2003).

Innovations in agriculture are main source of agricultural growth. Successful innovation in agriculture research depends on the provision of new and improved technologies that are well targeted and which in turn depend on efficient agricultural research system with appropriate capacity and infrastructure. There are several studies which have shown that irrigation, land reform, infrastructure development and technological change were the main source of agriculture growth (Desai 1997, Fan, Hazell and Thorat 1999). India's agriculture research system is mainly funded by the central government. The centre government provides about 60 percent of all funds for agricultural research, state government about 20 percent and private companies about 12 percent, foreign donors provide the rest (Ranjitha, 1996).Government's investment on agriculture R&D not only positive effect on rural poverty reduction, but also in urban poverty reduction. If government invest one percent on agriculture R&D, urban poverty declines by 0.021 percent (Fan 2002).

STRUCTURE OF INDIAN AGRICULTURE RESEARCH SYSTEM

India has a world's largest agriculture research system. Since independence, the national agricultural research system (NARS) has grown a few central institutes, regional centres, commodity boards and agricultural colleges addressing regional problems. At that time the functioning of the system in close association with education and extension systems is seen to have contributed to the rapid growth of agricultural production since independence (Paroda and Mouthyanjaya, 1999). Since independence the NARS has grown considerably .The NARS led by Indian Council of Agriculture Research(ICAR),now has 4 multi displinary national institutes(universities),49 central research institutes, 17 national research centres,4 bureaus,23 project directorates,60 All India Coordinated Research Projects(AICRPs),18 network projects and 10 other projects/programs in public sector(ICAR 2014). In addition there are 56 state Agricultural

Universities and 4 Central Agricultural Universities (DARE/ ICAR Annual Report 2013-14).

The Coordinated Projects are the main link between ICAR and the SAUs. The total number of centres involved in the these projects is about 1300 with about 900 being agricultural university based, 200ICAR institute based, and 200 based elsewhere. The National Academy of Agricultural Research Management is yet another unique institution under ICAR to conduct research and training in agricultural research management. In addition, general universities (about 23 are involved in agricultural research), scientific organizations (such as the Council of Scientific and Industrial Research and the Bhabha Atomic Research Centre), other government departments(the Department of Science and Technology, and the Department of Biotechnology),private and voluntary organizations(more than 35), and Scientific Societies (more than 105) are involved in agricultural research and form part of the NARS (Mruthyunjaya and Ranjitha1998).

GOVERNMENT EXPENDITURE ON AGRICULTURAL R&D

The agricultural R&D expenditure is a good indicator of technological capacitates within the national innovation system. Agricultural R&D expenditure is mainly under the government. The union and the state governments are both involved in agricultural R&D investments and funding.

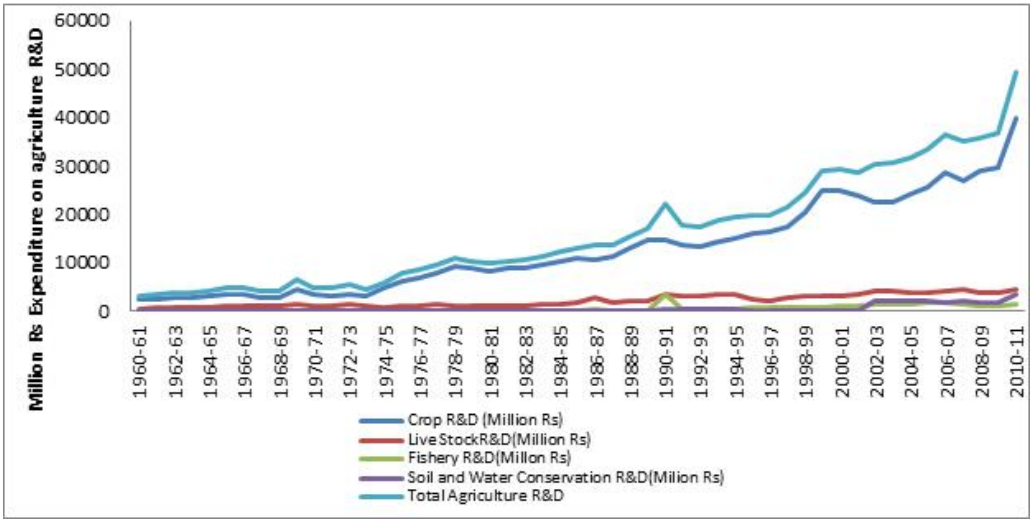
Table 6.Trend growth rates of India's agriculture research and development (R&D) expenditure (percent) (2004-05 prices)

	Crop R&D	Live Stock R&D	Fishery R&D	Soil and water Conservation R&D	Total AgriR&D
1960-61 to1969-70	4.54	9.39	8.43	6.52	5.76
1970-71 to 1979-80	14.53	0.1	2.85	-4.19	11.03
1980-81 to 1989-90	5.59	7.73	6.81	6.45	5.94
1990-91 to 1999-2000	5.78	-2.24	14.21	-7.89	4.57
2000-01 to 2010-11	4.22	1.88	2.01	21.49	4.19
1960-61 to2010-11	5.56	3.83	6.55	6	5.35

Source: Combined finance and Revenue Accounts both Union and States, Comptroller and Auditor general of India (various issues)

The table 6 presented the growth rates of agricultural R&D expenditure in sector wise and total agriculture R&D expenditure. This table highlighted that in 1960-60 to 1969-70the agricultural R&D expenditure growth rate was 5.76 percent per year. In the time period 1970-70 to 1979-80 was the highest growth rate i.e.11.03 percent. This was the result of much investment of government on agricultural research system. Because of reorganisation of ICAR (Indian Council of Agricultural Research) in 1973 and substantial increase in the investment in the fifth plan (1974-78) set a sharp up trend in central funds (Pal and Alka 1997).But the growth rate in 2000-01 to 2010-11 slowdown at 4.19 percent per annam.The over all annual growth rate from 1960-61 to 2010-11 is only5.35 percent. The government expenditure on agricultural R&D has continued to move upward from Rs.3179 million in 1960-61 to Rs.49497 million in 2010-11(Figure.1).

Figure1. Trend growth rates of India's agriculture research and development (R&D) expenditure



Agriculture R&D Intensity Ratios

Research intensity measured as research and education as percentage of agricultural gross domestic product (AgGDP).

ARI= R&E/AgGDP*100

ARI=Agricultural Research Intensity

R&E=Research and Education

AgGDP=Agriculture Gross Domestic Product

Agricultural research intensity ratio that expresses the share of agricultural research and development expenditure in agricultural gross domestic product (GDP) was estimated 0.50

Table 7.Agricultural R&D intensity ratios in India, 1960-61 to 2010-11.

Years	Agricultural R&D intensity ratios
1960-61 to1969-70	0.20
1970-71 to 1979-80	0.27
1980-81 to 1989-90	0.36
1990-91 to 1999-2000	0.40
2000-01 to 2010-11	0.50
1960-61 to2010-11	0.39

Source: same as table1 and Economic Survey of India (various issues)

percent in the time period 2000-01 to 2010-11,showed a moderate improvement from 0.20 percent in the time period 1960-61 to 1969-70.This percentage is very low when we compared with the 2-4 percent share in developed countries and 0.75 percent average share for developing countries(Fan and Thorat 2007).India's agricultural R&D expenditure is mainly dependent on government sector, but in the developed counties half of total agricultural R&D expenditure come from private sector whereas in India most of it comes from government sector with private expenditure being marginal(15 percent of total)(Pal and Singh 1997).

CONCLUSION

The Indian agricultural research and development system is mainly dominated by government funded .All the centre, the ICAR and its research institutes are funded by the union government. The SAUs (state agricultural Universities) involved in research and education funded by state governments. Some funds are transfer from ICAR to SAUs in form of regular grants and schemes. The overall growth rate of agricultural R&D expenditure from 1960-61 to 2010-11 was only 5.35 percent per annum. The agricultural R&D intensity ratio is 0.39 percent which is very low in compare with developed countries i.e. 2-4 percent and developing countries which is 0.75 percent. The agricultural R&D expenditure has 43.16 percent share in total R&D expenditure in India in 1965-66 which is declined at 12.28 percent in 2010-11.India's total R&D expenditure's growth rate is 8.33 percent per annum but agricultural R&D expenditure's only growth rate 5.57 percent per annum. Therefore efforts should be made to explore strengthen the agricultural innovation system and improve the technology and keep cost of technology within the reach of small farmers which are increasing in numbers.

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