Increased Funding for Decentralized Agricultural Research

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Increased funding, even with new norms for publications, patents or farmers participation will not help, given the major impediment of centralization and consolidation of the research norms, contents and structures. Increased State government ownership of and decentralization of agricultural research to ensure location specific knowledge generation, access and utilization is necessary

An increase in research funding, to "1 per cent of the agricultural GDP" is a major recommendation to enhance the effectiveness and efficiency of agricultural research in India (Committee on Agriculture, 2014, p. 111). The Committee also notes that less than 50 per cent of the budget sought by DARE was allocated to it in the XII Five Year Plan; 23.27 per cent of this massively reduced allocation was sanctioned in the first two years of the XII Plan. But less than 80 per cent of that has been utilized (ibid, p.109). This brief paper points out that with its current centralized structure and research contents that cater almost exclusively to past capital formation in irrigation and chemicals, the faith that increased funding will enhance effectiveness is misplaced. The evolution of agricultural research reveals how government strategy of centralized target and control mechanisms is detrimental to agricultural research. Decentralization of agricultural research is imperative.

India's first agricultural policy was formulated in the 21st century; the policy goal is 4 per cent growth rate per annum. The country has no policy or strategic framework for agricultural research or extension thus far. The National Agricultural Policy (Government of India, 2000), has been critiqued for insufficient attention to strategies to achieve the policy goal – including levels of investment, public and private sector roles, improved irrigation and participatory management of water, forests, common lands (Chand, 2004; NAAS, 2003; Dhoot, 2006). An important recommendation emerging from these critiques is for 'a technology policy that ensures both that appropriate technologies are generated and that they are effectively disseminated to their end users' (Chand, 2004).

India's successful green revolution of increasing productivity response to major agri-inputs, ended in the 1980s (Bhalla and Singh, 2010); the green revolution is now being replicated in the Eastern states, and recent achievements of record production of pulses, cotton, coarse cereals, horticultural crops, livestock and fisheries have been lauded (DES, 2012). Yet, agricultural research is questioned for the fatigue of irrigation-chemical intensive production technologies and their negative environmental consequences (IFPRI, 2002; Vaidyanathan, 2010; Planning Commission, 2008; 2011). The evidence that recent agricultural growth rates have been driven more by price increases and not by productivity increases (Chand, 2014), and questions about why past successes in production have not had an impact on nutrition levels in the country

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(Gillespie et al, 2012; Haddad, 2011; Deaton and Dreze, 2009) are serious concerns about the conduct and content of agricultural research. There are crucial concerns about modern technology based private corporate sector growth in agriculture, access to and effective utilization of credit, rapid depletion of groundwater which irrigates more than 70 per cent of the total irrigated area, and increasing farmers suicides. Often weak extension is blamed for poor adoption of these technologies (see NDC, 2007). There are also allegations of inadequate rural infrastructure, illiteracy and poor risk bearing capacities among the small holders in particular, who cultivate over 84 per cent of the operational holdings and over 48 per cent of the net area sown in the country (ibid, Planning Commission, 2011). Increasing impacts of climate variability and change demand far more decentralized and location-specific research and extension to ensure adaptive capacities necessary for climate resilient agriculture (Raina, 2012).

Agricultural R&D in context

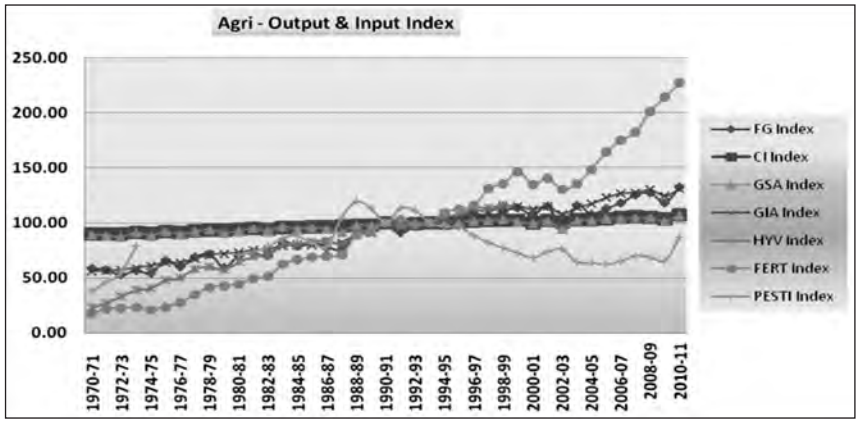
India's agricultural research system is almost entirely in the public sector. Functionally, the Union Government's Indian Council of Agricultural Research (ICAR) conducts research and some higher education and the State Governments' State Agricultural Universities (SAUs) undertake almost all the agricultural education, some research and extension education. Extension is located outside the formal research system, handled by the respective State Departments for agriculture, animal husbandry, dairy, fisheries, horticulture, and soil and water conservation. The SAUs are responsible for the conduct of research, education and extension education in an integrated fashion, to meet the knowledge and technology demands of each State. Given that extension in the SAUs is geared to imparting knowledge and technology to the extension staff of the Department of Agriculture, all the SAUs produce a 'Package of Practices' for all important crops in the State, with recommendations of appropriate embodied and disembodied technologies. Besides, there are Agricultural Technology Management Agencies (ATMAs) in every district, to manage and co-ordinate agricultural technologies and other information relevant to production problems.

Today, Indian agriculture is governed by the two key domestic policy planks of output price support and input subsidies (Ray, 2007; Vaidyanathan, 2010). A few years after the launch of the green revolution, and public capital formation (over 90 per cent in irrigation), farmers responded to the national strategy formulated for agriculture (Subramaniam, 1972; Vaidyanathan, 2010). They changed land use patterns, increasing cropping intensity and devoting more land to the cultivation of irrigated rice and wheat. The mid-1980s witnessed increasing private investments in irrigation (tube wells expansion – with over 70 per cent of irrigated cereal production depending on groundwater irrigation by the end of the 1980s), accompanied by increasing subsidies for tube wells, agricultural chemicals – fertilizers and pesticides and seeds. The first phase of the green revolution ending around 1983 (Bhalla and Singh, 2010)[1] witnessed the end of the rapid expansion of public capital formation in agriculture. Overall, the share of gross capital formation (GCF) in agriculture, in total fell from 20 per cent in 1980-81 to 10 per cent in 1999-2000 and 6 per cent in 2007-08, rising marginally to 10 per cent in 2009-10 and 7.2 per cent in 2011-12.

As agricultural growth became dependent on capital investments for input production and supply (mainly since the 1970s), the index of input use rose rapidly compared to the index of food production or agricultural GDP. The index of chemical fertilizer use has far outstripped the index of cropping intensity, irrigation and food grain output (Figure 1). There is concern about declining incremental response to unit input use (both chemical fertilizer and irrigation) (ICAR, 1998; Vaidyanathan, 2000 and 2010), increasing input costs and steep hikes in the incremental capital output ratio (ICOR) (Golait and Lokare, 2008) which places a massive burden of production costs on the small farmer (Chand et al, 2011).

The agenda-setting power of the twin policy planks, and the irrigated chemical intensive production investments have led to the lament that agricultural research with an 'exclusive focus on irrigated chemical intensive production technologies

Figure 1: Agricultural Output and Inputs – Key Indices (1970-71 to 2011-12)
(1990-91=100)



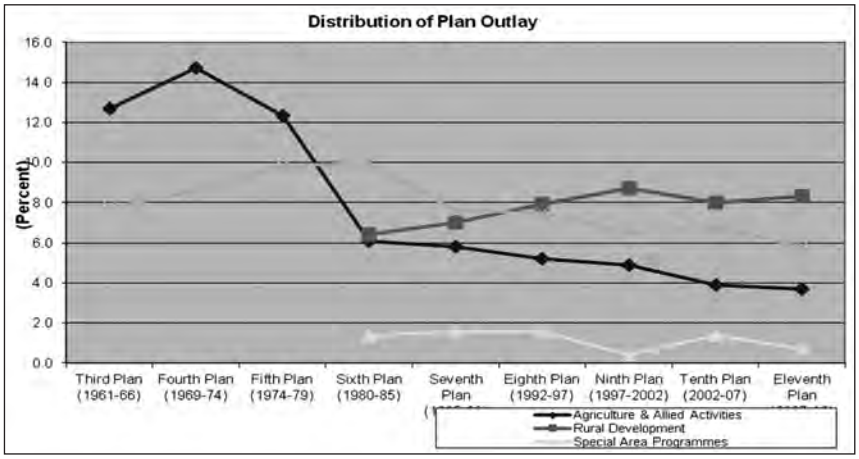
Source: estimated from DES various years

with no concern about environmental sustainability is a problem', and that 'attempts to reform agricultural research to address these problems have been inadequate' (Planning Commission, 2008, p. 13).

Ideally, the demand for a national shift in research strategy from production enhancement to environmental and economic sustainability demands more plan investments in agriculture. Plan outlays have increased over time; but as capital formation tied to specific technologies became the norm, there was a gradual reduction in the share of plan expenditure devoted to agriculture (Figure 2). Non-plan investments are maintained, ensuring plan programme convergence with massive public investments made as capital formation *for* agriculture (Ministry of Agriculture, 2003). There is an erosion of capacities to conceive, design and implement policy instruments or programmes that address emerging environmental and production challenges.

Figure 2: Trends in Plan Outlay for Agriculture, Rural Development and other sub-sectors

(Percentage share of total plan outlay)



Source: Planning Commission and DES, various years, from Raina, 2014.

Centralization of Indian Agricultural Research

Recommendations to revisit the basic tenets of research for sustainable resource management and productivity enhancement based on a decentralized Agro-Ecological Knowledge Framework (Planning Commission, 2011a) demand an understanding of bio-physical and socio-economic contexts of agricultural systems. These capacities are distinct from the AEZs (Agro-Ecological Zones) classified based on bio-physical variables alone. They demand decentralized contextualised knowledge and application capacities. But centralized planning and execution is a feature of agricultural research structure and contents in India.

From less than Rs. 150 crores in 1960-61, the national public sector agricultural research spending (excluding education and extension expenses) has increased to over Rs. 3000 crores in 2009-10 (constant 2004-05 prices; Table 1). The agricultural production infrastructure and S&T systems till the 1960s, were predominantly handled by the State Governments.

Table 1: National Agricultural Research Expenditure (Constant price 2004-05)

(Rs. Crores)

Year	Total Union Government	Total State Governments and UTs	Total NARE
1960-61	56.27	86.77	143.04
1970-71	261.98	187.53	449.51
1980-81	470.65	239.63	710.28
1990-91	784.67	327.05	1111.72
2000-01	1443.95	512.55	1956.50
2009-10	2302.40	765.95	3068.35

Source: Estimated from CAG, various years (from Rajeswari, 1995 and Raina, 2014)

Note: Total CRE = RE from Ministry of Agriculture

RE from Ministry of Agriculture = ICAR research Payments + research account for agriculture + research account for animal husbandry.

Estimation of Union Research Expenditure, we have taken 97% of Union Government Expenditure on Agricultural Research and Education

Estimation of State Research Expenditure, we have taken 33% of State and UTs Government Expenditure on Agricultural Research and Education

National Agricultural Research Expenditure (NARE) = Total (97% of Union Government + 33% of State and UTs Government) Expenditure on Agricultural Research and Education

Table 2: Ratio of Union Government to State Governments and UTs Expenditure on Agricultural Research

Year	Ratio Union Government: State Governments+UTs
1960-61	39:61
1965-66	26:74
1974-75	59:41
1979-80	67:33
1990-91	71:29
1997-98	71:29
2006-07	75:25
2009-10	75:25

Source: Estimated from data same as above

Direct support from the Union Government for technology based programmes with public investments in irrigation (accounting for over 90 per cent), seeds, chemical fertilizers and agri-machinery also brought with it, an increasing centralization of S&T (Raina, 2011). The State Governments accounting for a major share in the 1960s dwindled to a minor share (less than a third) of the national agricultural research expenditure since the 1990s (Table 2).

In order to understand how this centralization has evolved, we classify the evolution of agricultural research according to major organizational and institutional changes in research at the Union and State Governments level (Table 3).

The ICAR was a Registered Society established in 1929. The need for modern technology to shift the production frontier, a felt need in the 1950s and 1960s, demanded that "far-reaching central authority and a clear line of command and execution alone could meet the challenge of growing more food" (The Agricultural Production Team, 1959, p. 6). Though there was a long history of diverse research organizations and interest groups, this 'pre-consolidation' phase was a process fraught with tensions, and a marked negative growth rate in research expenditure (Table 3)

The second phase starting in 1965 brought all research institutes under the Ministry, Commodity Committees, and some Provincial Governments under the consolidated control of the ICAR. It marked the end of the ICAR as a relatively autonomous entity and new powers for research funding and execution as a division within the Department of Agriculture of the Union Government. In 1975, with its new status as a full-fledged Department of Agricultural Research and Education (DARE), there was complete centralization of all aspects (funding and planning, execution, personnel recruitment and career advancement) of agricultural research. This included the protocols for research – as in the Co-ordinated Research Projects, purpose and content of agricultural science curricula taught in all SAUs and three deemed universities under the ICAR. This third phase continued well into the 1990s, and witnessed a steady expansion of research, though the growth rate of agricultural research expenditure remained lower than in the short transformative second phase (Table 3). The expansion phase continued unabated even when the scientific community realized that the green revolution gains were beginning to peter out (ICAR, 1998; Bhalla and Singh, 2010). It is the fourth phase of the consolidated, centralized NARS beginning in 1997), that continues till date. This phase saw establishment of the recent National Institute for Biotic and Abiotic Stress, with the onset of climate variability and change.

At the State level beginning with agricultural colleges and education of the colonial era, and intense debates about the nature of education for agrarian and rural India, the first phase saw the transfer of the Land Grant Model (in structure and not the philosophy of Land Grant, see Busch 1986), and the establishment of the first SAU in 1960. The Model Act for SAUs (1966) was implemented by the end of the 1960s with increasing State government and UT expenditure on research, but strengthening the ICAR's 'line of authority and control'. The second phase with the DARE deciding national co-ordination mechanisms, the central Norms and Accreditation Committee (NAAC) for curricula and guidelines for all SAUs, and uniform implementation of research and extension education, was

Table 3: Phases of growth of Agricultural Research Expenditure by Union and State Governments (% CAGR)

Important Phases	Year	CAGR
Union		
Pre- consolidation	1960-61 to 1965-66	-1.96
Pre- department (DARE) status	1966-67 to 1974-75	9.53
Centralized Consolidated Expansion phase	1975-76 to 1996-97	7.49
Centralized Consolidated phase	1997-98 to 2009-10	8.15
States		
Pre- Model Act & SAUs	1960-61 to 1969-70	7.69
Pre- NAAC & SAUs+ AICRP Phase	1970-71 to 1989-90	2.41
Centralization phase	1990-91 to 2009-10	4.58

Source: Estimated from data same as above

marked by a low growth rate of State level agricultural research expenditure (Table 3).

The third phase beginning in the early 1990s comes with a demand for attention to agro-ecological zone-specific research. But under the centralized research system 'the ICAR (has) systematically decimated research capacity in the States' (Jha, 2002). Even States like Maharashtra and Uttar Pradesh which till the late 1970s used to account for a significant share (almost half) of National Agricultural Research and Education expenditure and did conduct several experiments on local production systems, decided to shrink their allocations to agricultural research. The relatively uniform curriculum for the agricultural sciences continued in the 21st century, despite the recent tendency within States, to break up existing SAUs into separate universities for agriculture, horticulture, animal husbandry, and fisheries. Though this "siloisation" of education and research is a logical conclusion of excessive centralization and overall lack of relevance to local problem contexts, this marks the anti-thesis of agro-ecological zone based research, farmer participatory research, farming systems research, and most importantly, research for climate change adaptation and resilience.

Let us recall that in the 1960s, the consolidation and centralization of agricultural research was a necessity, a design demanded by the agricultural strategy and its production technology trajectory accepted scientifically and politically. In the 21st century, this technology driven centralized R&D is not held in high esteem or accorded increased investments. An indicator of the decline in esteem is the budget cuts that the ICAR has faced in recent years, against proposed and approved budget allocations in the annual plans. The growth rate of total ICAR budget (plan and non-plan) has fallen in recent years (-3.90 per cent for 2010-11 to 2013-14) compared to the previous decade (9.16 per cent for 2006-07 to 2010-11) (estimated from ICAR Annual Accounts data). The rapid growth of the period 2006-07 to 2010-11 following the implementation of the Sixth Pay Commission salary scales, has now petered out. In the Indian economy, agricultural research is still as insignificant as it was when the green revolution was launched – the national agricultural research expenditure (excluding education expenditure) has moved from 0.037 per cent (1965-66) to 0.068 per cent (2009-10) of national GDP (estimated from CAG data, used in Table1, and CSO data). In agricultural GDP, the share of agricultural research expenditure has increased from 0.094 per cent (1965-66) to 0.448 per cent (2009-10).

The current system has been built carefully since the mid-1960s, consolidated and centralized to deliver a set of pre-determined technologies in the context of the twin policy planks of commodity specific output price support and input subsidies. If the government needs production impacts and environmental impacts (Planning Commission, 2008), it has to enable capacities for decentralized planning and programme formulation –preferably at the Block level (Planning Commission, 2011a) or further lower levels of administration like the Mandal level (as in Andhra Pradesh).

Though the 95 organizations under the ICAR are distributed across the country and many have regional stations in different agro-ecological zones, the central research agenda of irrigation-chemical intensive production is dominant (Government of India, 2008; Raina, 2011). This centralization of research design and the uniform dominant research content, meant to promote the Union government's strategy or policy framework for agriculture, ***contradicts the constitutional role*** assigned to Union and State Governments. 'Agriculture, including Agricultural Extension and Research, Protection against Pests and Prevention of Plant Diseases" is a Provincial subject (see Entry 14 of List II- Province List in the VII Schedule of the Constitution of India). Considering the Constitutional articulation and the excessive centralization of planned development (Ghosh, 1992), agricultural development schemes and programmes tuned to State level needs have been initiated and given some support during the XI Five Year Plan (2007-2012). The RKVY (Rashtriya Krishi Vikas Yojana) and the efforts to promote Comprehensive District Agricultural Plans (C-DAPs) are two promising policy reforms. But these need to be accompanied by decentralized, agro-ecological zone wise scientific research support, to understand and characterize the socio-technological production contexts and problems, ensure community participation to define problems, conduct participatory research and validate technologies to create locally responsive socio-technological systems.

Agricultural research that includes environmental impacts (Planning Commission, 2008) and economic and social impacts – especially household incomes and nutrition (Rao, 1982) and goes beyond narrow instrumental ends, demands changes in the structure, function and content of agricultural research. The current system has been built carefully since the mid-1960s, consolidated and centralized to deliver a set of pre-determined technologies in the context of the twin policy planks of commodity specific output price support and input subsidies. If the government needs production impacts and environmental impacts (Planning Commission, 2008), it has

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Table 4: Share of different regions in Total Agricultural Research and Education expenditure by State Governments from 1970-71 to 2010-11 (in Current Prices, Rs. Lakhs)

Year	South	North	West	East	Total
	per cent	per cent	per cent	per cent	(100 per cent)
1970-71	12	38	32	18	3493
1980-81	22	31	29	17	8814
1990-91	25	31	27	17	38684
2000-01	30	25	33	12	115322
2010-11	35	18	30	16	332644

Source: estimated from various issues of CAG reports

to enable capacities for decentralized planning and programme formulation –preferably at the Block level (Planning Commission, 2011a) or further lower levels of administration like the Mandal level (as in Andhra Pradesh).

Towards Decentralized Location Specific Research and Production Services

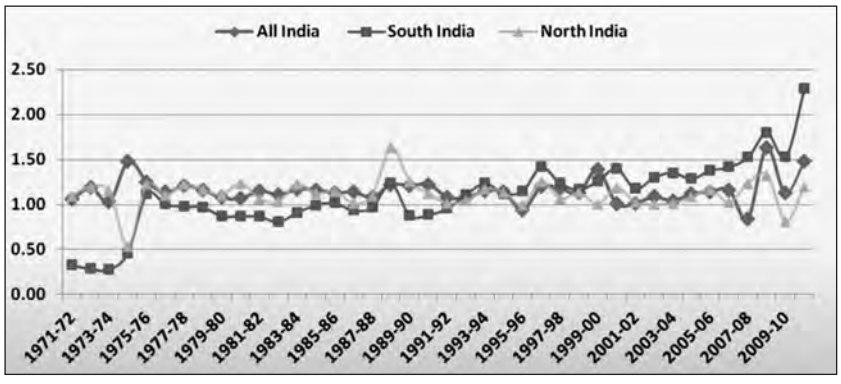
Centralization, meant to facilitate one research agenda, has been inimical to the advancement of knowledge, productivity growth rates, and further investments in research. Though the evolution of State level agricultural research (Table 3) happens in this context, the regions reveal differences in their support for agricultural R&D.

The Southern States now lead in their share in total agricultural research and education expenditure by State Governments in the country (Table 4). While the Eastern and Western regions have reduced their share in total State level research and education expenditure over time, the Northern States (accounting for over 70 per cent of the wheat production on average annually)[2] have seen a drastic reduction of their share in total State level agricultural research and education expenditure (down from a share of 38 per cent in 1970-71 to 18 per cent in 2010-11). Even within the ICAR, there is a depressing trend of less and less expenditure being devoted to actual research[3].

A precedence approach seems to be the norm for maintaining research and education expenditure, irrespective of the diversity of regional agriculture. At the national level, the average annual growth rate of agricultural research and education expenditure (including Union and all State Governments and Union Territories) has been around 1 per cent to 1.4 per cent per annum over the past four decades and more. (Fig 3).The Southern States have maintained a steady growth in agricultural research and education expenditure; clocking above 1.5 per cent per annum in the late 2000s. The impact of the consolidation and centralization of agricultural research is most evident in the Northern States, with a growth rate hovering around 1 per cent over four decades.

Figure 3: Annual growth rate of agricultural research and education expenditure by Union Government and State Governments in Southern and Northern India

(Per cent)



Source: CAG, various years (from Reddy, 2014)

Changing research priorities, with massive increase in research on horticulture, fisheries and livestock, is a key driver in the South Indian States – areas of research that are relatively under-funded at the Union level. Even within the centralized system, some states have used research and extension to their local advantage. For instance, during the XI Five Year Plan, Rajasthan used its RKVY allocation for supplying Monsanto's hybrid corn with a subsidy. But Maharashtra used its RKVY allocation for Integrated Pest Management (IPM) for four major crops using 28 data collection and monitoring centres across the State in collaboration with the National Centre for Integrated Pest Management. In one, the state-science relationship was one of centralized supply of technologies or embodied inputs. In the other, it was one of enabling local social, financial and natural capital

to generate and ensure utilization of knowledge-based inputs.

Agriculture being a State subject, we must note that State Governments also invest differently in the social services (education and health care) and economic services (agriculture, rural development, and transport) among which are crucial production services and support for effective extension[4]. Going back to Maharashtra's work with NCIPM, the number of local jobs created for pest scouts, the co-evolution of local pest knowledge with modern genetics, agro-meteorology and insect physiology and the number of local enterprises established to cater to pest management inputs and advisories, are shaped by State level political and economic institutions. This goes unnoticed by parliamentarians, policy makers and scientists keen to increase funding for the centralized agricultural research system that has no wherewithal for linkages with or access to any such community support for research.

In conclusion, we ask if it is fair to blame agricultural research or any particular technology for the problems in agricultural production, productivity, malnutrition, environmental degradation, or overall technology fatigue (see, NDC, 2007; Planning Commission, 2008). The centralized research system must be congratulated for surviving against all odds. India's policy makers should celebrate the fact that it has continued to produce technologies for the supply driven ideology of the government. Our Parliamentarians, the Planning Commission and the State level Planning Boards do not ask *how* the resources are spent on agricultural research. The ICAR and SAUs have been designed and structurally fortified to spend their resources only on the dominant irrigation-chemical intensive production paradigm.[5] Increased funding, even with new norms for publications, patents or farmers participation will not help, given the major impediment of centralization and consolidation of the research norms, contents and structures. Increased State government ownership of and decentralization of agricultural research to ensure location specific knowledge generation, access and utilization is necessary.

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Endnotes

1 The phases of growth of agricultural output has been classified into three phases (i) initial period of the green revolution 1962-65 to 1980-83, (ii) the second phase of maturing of green revolution 1980-83 to 1990-93, and (iii) the post-liberalization period 1990-93 to 2003-06 (Bhalla and Singh, 2010) of expanding the same.

2 Note that rice, wheat, fruits and vegetables, pulses, cotton and sugarcane account for over 70 per cent of the research expenditure under the crop sciences. The crop sciences account for over 70 per cent of the research expenditure in SAUs and over 50 per cent of the research expenditure in the ICAR.(Bientemma et al, 2008).

3 The share of expenditure on salary and research under the ICAR is 55.5 per cent and 3.2 per cent respectively (ICAR budget book, 2012-13).

4 For instance, Sikkim, Goa and Puducherry spending between Rs.4000 to Rs. 8000 per capita for economic services (agriculture, rural development and transport) compared to Chattisgarh, Assam, West Bengal, Orissa, Punjab, Rajasthan, Madhya Pradesh, Jharkhand, Uttar Pradesh and Bihar spending far less than Rs. 1000 per capita on the same in 2011 (CAG, 2012). In the national revenue expenditure, economic services are crucial because they are predominantly rural and provide a range of production services crucial for agriculture.

5 A good example is the All India Coordinated Research Project (AICRP) on soil physics which was renamed AICRP on Soil Physical Constraints and Their Amelioration for Sustainable Crop Production (SCP), emphasizing its contributions to production. In 2001, the ICAR shut down this AICRP on SCP stating that it did not add to productivity (Raina et al 2006). That meso-level data on soil physical properties is crucial for climate adaptation and mitigation is now a painful realization. ❑

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