

ANALYSIS OF AGRICULTURAL RESEARCH EXPENDITURE IN NORTH INDIAN AGRICULTURAL UNIVERSITIES

Rakesh Sharma*

The present study examine the Agriculture Research and Development Expenditure of the North Indian Agriculture Universities(Punjab Agricultural University, Ludhiana, Chaudhary Charn Singh Haryana Agricultural University and Chaudhary Sarwan Kumar Himachal Pradesh Agriculture University, Palampur). The study reveals that after 1990-91 to 1999-00 the CSKHPAU, Palampur was highest growth rate in compare to other two state universities. The study highlighted that the CCSHAU has released highest varieties of Pulses. During the period 2000-01 to 2013-14 CSKHPAU, Palampur has 83.93 percent expenditure on agriculture research incurred from ICAR (Indian Council of Agriculture Research) funding as compare to PAU, Ludhiana and CCSHAU, Hisar.

Keywords: Agriculture, Innovation, Research, Expenditure.

INTRODUCTION

The model of public sector research organisation came in to exist are in many parts of the world during the second half of the 19th century (Santhakumar, 2011). The national system of innovation treats R&D as an innovation system in which both the producers and users are seen as parts of the same system and attempts to identify certain patterns in system relationships, governance, capacity building or learning, evolving roles and wider institutional contexts (Hall and Yoganand, 2002). New innovations and modern agricultural technologies are the prime of agricultural productivity and growth. The public sector has played a major role in funding R&D activities that have led to new agricultural innovations, especially innovations that are disembodied or embodied. The State Agriculture Universities (SAUs) are the major partner in growth and development of agricultural research and innovation system. The SAUs receive funding from their respective states but also from central government and other sources. At the national level research and innovation system of SAUs are coordinated by the ICAR (Indian Council of Agricultural Research) which is also a source of research funding for the SAUs. Innovation capacity is seen as dependent on the effective institutional linking of more than one domain in order to allow for information to follow as widely as possible (Clark, 2002).

In this chapter we discuss the agriculture innovation system of three north India's main SAUs of Punjab, Haryana and Himachal Pradesh. The Punjab Agricultural University was established in 1962 to serve the state of erstwhile Punjab. The university covers 1510 acres on its main campus and 4615 acres at regional research stations. The Chaudhary Charan Singh Haryana Agricultural University, Hisar (CCSHAU) was initially a campus of PAU, Ludhiana. After the formation of Haryana in

* Department of Economics, Sachdeva Girls College, Gharuan, Kharar, Mohali (Punjab), Sharma82rakesh@gmail.com, Mobile 9988119440

1966, it has become an autonomous university on 2 February, 1970 through a presidential ordinance. The university has 7219 acres of land at its main campus and 1426 acres as research stations. The Himachal Pradesh Agricultural University, Palampur was established on 1st November 1978. The university has 981 acres at main campus and 470 acres as research stations.

Apart of introduction, the chapter is divided into three main sections. The comparative analysis of the agricultural research and development expenditure and funding allocation of three state agricultural universities that is Punjab Agricultural University, Ludhiana (PAU), Chaudhry Charn Singh Haryana Agricultural University, Hisar (CCSHAU) and Chaudhry Sarwan Kumar Himachal Pradesh Agricultural University, Palampur (CSKHPAU) in section I. Section II analysis the seed varieties generated by the three universities to understand the progress in terms of output measures of innovations and the concluding remarks are presented in section III.

Data Source and Methodology

The study is entirely based on secondary data. The state agricultural universities (Punjab Agricultural University, Ludhiana, Chaudhry Charn Singh Haryana Agricultural University, Hisar and Chaudhry Sarwan Kumar Himachal Pradesh Agricultural University, Palampur) data for agricultural R&D expenditure, allocation of funding are compiled from annual budgets and audited annual statements (various issues) of respective university from the period 1980-81 to 2013-14. The study used annual average growth rates by using the exponential function of the following form:

$$Y = ab^t \dots\dots\dots(1)$$

Taking log both the sides equation (1) can be written as follows:

$$\text{Log } Y = \log a + t \log b \dots\dots\dots(2)$$

After estimating the equation (2) with the help of ordinary least square, the coefficient of $\log b$ is estimated. The trend growth rate (g) derived as follows:

$$g = [\text{Antilog}(\log b) - 1] \times 100$$

Comparative Analysis of Three States SAU's Agricultural R&D Expenditure

The agricultural research investment had considerable impact on release of crop varieties and other technologies, which led to improvement in productivity of the crops in the state (Ananth, Chengappa and Janalah, 2008). The agricultural research expenditure by the three agricultural universities that is PAU, CCSHAU and CSKHPAU universities presented in table 1. During the period 1980-81 to 1989-90 the annual average growth rate of PAU, Ludhiana was higher in comparison to CCSHAU, Hisar and CSKHPAU, Palampur which has recorded negative growth rates. But during the period 1990-91 to 1999-00, the CSKHPAU, Palampur has highest annual average growth rate, that is 10.45 percent followed by PAU, Ludhiana (5.91 percent) and CCSHAU, Hisar (4.01 percent). The overall growth rate of PAU, Ludhiana during the period 1980-81 to 2013-14, was 6.03 percent per annum. However in the case of CCSHAU, Hisar and CSKHPAU, Palampur these growth rates were 2.75 percent and 1.9 percent per annum respectively.

Table 1: Annual Average Growth Rates of Agricultural Universities Research Budgets at 2004-05 Prices.

	Agriculture Research Expenditure					
	PAU, Ludhiana		CCSHAU, Hisar		CSKHPAU, Palampur*	
	Average (Lakhs)	AAGR (Percent)	Average (Lakhs)	AAGR (Percent)	Average (Lakhs)	AAGR (Percent)
1980-81 to 1989-90	2611.90	5.96	2064.58	-0.07	620.39	-2.900
1990-91 to 1999-00	4450.33	5.91	2255.21	4.01	492.28	10.455
2000-01 to 2013-14	9540.32	4.69	3879.06	-1.20	754.45	-17.46
1980-81 to 2013-14	6005.50	6.03	2867.79	2.75	657.24	1.87

Sources: Annual Budgets (various issues), PAU, Ludhiana

Annual Budgets(various issues), CCSHAU, Hisar

Audited Annual Statements (various issues), CSKHPAU, Palampur

Note:*Figures are from 1980-81 to 2012-13

In absolute terms, PAU, Ludhiana spent on an average Rs.2611.90 lakhs which were higher than CCSHAU, Hisar (Rs.2064.58 lakhs) and CSKHPAU, Palampur (Rs.620.39 lakhs).It is significant to note that SAU, Ludhiana continue to lead in terms of agriculture R&D spending throughout the period of the study compared with the other two state agriculture universities, that is Haryana and Himachal Pradesh. It is clear that the annual average growth rate of research expenditure by PAU, Ludhiana has almost same near about 6 percent over time, but the agriculture research expenditure has declined in the period 2000-01 to 2013-14,that is 4.69 percent. The CCSHAU, Hisar has negative growth rate of during the time periods 1980-81 to 1989-90 and 2000-01 to 2013-14, it was only positive at 4.01 percent growth rate in the time period 1990-91 to 1999-00.But same what similar trends are observed in the case of CSKHPAU, Palampur. From total budgetary situation, it is not clear how much actually it is devoted to R&D. Therefore, in the following table 4.2 we have examined the percent expenditure allocated to research.

Table 2 reveals the percentage share of agricultural research budgets as a percentage of total budgets of three agricultural universalities of Punjab, Haryana and Himachal Pradesh.

Table 2: Agricultural Research Expenditure by Agricultural Universities as a Percentage of Total Budgets.

	PAU, Ludhiana	CCSHAU, Hisar	CSKHPAU, Palampur
1980-81 to 1989-90	44.53	36.57	25.09
1990-91 to 1999-00	49.44	35.42	16.48
2000-01 to 2013-14	54.77	33.15	12.06
1980-81 to 2013-14	50.19	34.82	17.35

Source: As in table 1.

The analysis of table 2 reveals that the expenditure on agriculture research of PAU, Ludhiana was higher, that is 44.53 percent of the total budget compared with other two SAUs. During the period 1990-91 to 1999-00 the percentage of agriculture research was higher that is 49.44 percent of total budget of PAU, Ludhiana as compared to CCSHAU, Hisar(35.42 percent) and CSKHPAU, Palampur(16.48 percent). During the period 2000-01 to 2013-14 PAU, Ludhiana spent more than 54 percent of its budget on agriculture R&D. But during the same period, CCSHAU, Hisar and CSKHPAU, Palampur spent lowest share of budget on R&D. This table highlights that PAU, Ludhiana percent of agriculture research expenditure as a percentage of total budget has been increasing continuously but in the case of CCSHAU, Hisar and CSKHPAU, Palampur's percentage of agricultural research expenditure has been decreasing continually. The analysis of overall period from 1980-81 to 2013-14 shows that the PAU, Ludhiana has spent higher share 50.19 on agriculture research expenditure as a share of total budget in comparison to CCSHAU, Hisar (34.85 percent) and CSKHPAU, Palampur(17.35 percent).

Table 3: Funds Allocation under Non Plan Agricultural Schemes of Agricultural Universities for Agricultural Research.

Non Plan Research Expenditure						
	PAU, Ludhiana		CCSHAU, Hisar*		CSKHPAU, Palampur**	
	Average (Lakhs)	AAGR (Percent)	Average (Lakhs)	AAGR (Percent)	Average (Lakhs)	AAGR (Percent)
1980-81 to 1989-90	916.60	9.55	743.01	7.87	143.02	-4.33
1990-91 to 1999-00	1544.23	20.20	1228.04	8.34	143.56	16.37
2000-01 to 2013-14	5314.57	4.35	2383.67	0.06	138.46	-31.64
1980-81 to 2013-14	2921.13	8.54	1282.98	-8.62	141.91	-3.58

Source: As in table 1.

Note : *Figures are from 1980-81 to 2009-10

**Figures are from 1980-81 to 2007-08

Allocation of Funding

There are various methods for allocation of funding for the state agricultural universities. Now we discuss the comparative analysis of funding allocation of three agriculture universities. The analysis of table 3 annual average growth rate and presenting average research expenditure of non plan agricultural research expenditure shows fluctuations in the trend. The non plan agriculture research expenditure has been used for the running and maintenance of the existing research activities. The research expenditure at 2004-05 prices of PAU, Ludhiana indicates a rising trend with ripples in between and reached to Rs.5314.57 lakhs in the period 2000-01 to 2013-14 from Rs.916.60 lakhs during the period 1980-81 to 1989-90. The non plan research expenditure growth rate of PAU, Ludhiana was higher 20.20 percent during the period 1990-91 to 1999-00 in compare to CCSHAU, Hisar(8.34 percent) and CSKHPAU, Palampur(16.37 percent). But during the period of 2000-01 to 2013-14 the annual average growth rate of PAU, Ludhiana was declined to as low as 4.35 percent per annum. The growth rate of CCSHAU, Hisar was only 0.06 percent which was still higher than

that of CSKHPAU, Palampur which recorded negative growth rate. If we compare overall non plan agriculture research expenditure growth rate from the period 1980-81 to 2013-14, the PAU, Ludhiana has impressive growth rate that is 8.54 percent per annum, but the CCSHAU, Hisar and CSKHPAU, Palampur has recorded negative growth rates.

Table 4: Fund Allocation under Non Plan Agricultural Research Expenditure by Agricultural Universities as a Percentage of Total Non Plan Expenditure

Time Period	PAU, Ludhiana	CCSHAU, Hisar*	CSKHPAU, Palampur**
1980-81 to 1989-90	29.58	23.50	26.77
1990-91 to 1999-00	34.80	29.86	17.32
2000-01 to 2013-14	46.89	21.44	9.67
1980-81 to 2013-14	38.24	24.52	18.52

Source: As in table 1.

*Figures are from 1980-81 to 2009-10

**Figures are from 1980-81 to 2007-08

The table 4 presented the percentage share of non plan expenditure as a percentage of total non plan budgets. During the period of 1980-81 to 1989-90, PAU, Ludhiana has spent more on agricultural research, that is, 29.58 percent of non plan budget as compare to CCSHAU, Hisar (23.50 percent) and CSKHPAU, Palampur (26.77 percent). The analysis of table shows that the non plan agricultural research expenditure was higher in the PAU, Ludhiana in the overall period of time but it was lower in CCSHAU, Hisar and CSKHPAU, Palampur. During the overall period 1980-81 to 2013-14 the PAU, Ludhiana has highest non plan agricultural expenditure than CCSHAU, Hisar (1980-81 to 2009-10) and CSKHPAU, Palampur (1980-81 to 2007-08).

Table 5: Funds Allocation under Plan Agricultural Schemes of Agricultural Universities for Agricultural Research at 2004-05 Prices.

Plan Schemes Agriculture Research Expenditure						
Time Period	PAU, Ludhiana		CCSHAU, Hisar		CSKHPAU, Palampur*	
	Average (Lakhs)	AAGR (Percent)	Average (Lakhs)	AAGR (Percent)	Average (Lakhs)	AAGR (Percent)
1980-81 to 1989-90	588.18	-4.39	519.77	-6.41	62.41	-5.59
1990-91 to 1999-00	923.30	4.72	315.11	-1.99	63.74	8.45
2000-01 to 2013-14	436.44	7.48**	1106.02	21.09	118.74	-7.74
1980-81 to 2013-14	624.27	-11.64	700.97	3.38	77.52	0.49

Source: As in table 1. Note * Figures are from 1980-81 to 2007-08

**Compound annual growth rate.

The perusal of table 5 indicates that the annual average growth rate of expenditure on plan agricultural schemes by the PAU, Ludhiana, CCSHAU, Hisar and CSKHPAU, Palampur has shown downward trends. During the time period 1980-81 to 1989-90 the annual average growth rate of three agricultural universities were negative. Under the plan component, the capital formation takes place and possibility of new infrastructure generation arises. In the time period 1990-91 to 1999-00 CSKHPAU, Palampur has spent higher share and growth rate was 8.45 percent on plan agricultural research expenditure .However PAU, Ludhiana recorded 4.72 percent growth rate which was lower than CSKHPAU. The CCSHAU, Hisar has recorded negative growth rate of agricultural research expenditure of plan schemes. But during the period 2000-01 to 2013-14 CCSHAU, Hisar has highest spending on plan agricultural research and expenditure was grown at 21.09 percent. But PAU, Ludhiana has recorded only 7.48 percent and CSKHPAU, Palampur recorded negative growth rates during the same period. There is an important result that emerges from the overall period 1980-81 to 2013-14 that is CCHAU, Hisar has spent higher amount on agriculture research and growth rate was 3.38 percent. The PAU, Ludhiana which has recorded negative growth rate and CSKHPAU, Palampur recorded only 0.49 percent annual growth rate.

The result presented in table 6 indicates that the percentage share of agricultural research expenditure as the percentage of total plan expenditure was higher for the PAU, Ludhiana as compared to CCSHAU, Hisar (39.31 percent) and CSKHPAU, Palampur (11.87 percent).On the whole the PAU, Ludhiana has spent much amount on agriculture research than

Table 6: Fund allocation under Plan for Agricultural Research Expenditure by Agricultural Universities as a Percentage of Total Plan Expenditure

Time Period	PAU, Ludhiana	CCSHAU, Hisar	CSKHPAU, Palampur*
1980-81 to 1989-90	53.96	39.31	11.87
1990-91 to 1999-00	66.58	29.28	8.14
2000-01 to 2013-14	81.02	38.25	12.45
1980-81 to 2013-14	65.65	35.92	10.64

Source: As Source: As in table 1. *Figures are from 1980-81 to 2007-08

CCSHAU, Hisar and CSKHPAU, Palampur. The overall period from 1980-81 to 2013-14 analysis shows that the 65.65 percent funds of plan expenditure was spent on agriculture research by the PAU, Ludhiana which was highest in comparison to CCSHAU, Hisar(35.92 percent) and CSKHPAU, Palampur(10.64 percent).

Table 7: Funds Allocation under ICAR Schemes of Agricultural Universities for Agricultural Research.

Time Period	ICAR Schemes Agriculture Research Expenditure					
	PAU, Ludhiana		CCSHAU, Hisar		CSKHPAU*, Palampur	
	Average (Lakhs)	AAGR (Percent)	Average (Lakhs)	AAGR (Percent)	Average (Lakhs)	AAGR (Percent)
1980-81 to 1989-90	790.73	5.84	578.92	-7.29	206.39	3.92
1990-91 to 1999-00	955.94	1.85	546.19	0.05	261.48	2.12
2000-01 to 2013-14	1713.67	-2.07	794.93	-3.56	588.38	2.07
1980-81 to 2013-14	1219.35	3.33	658.24	1.61	373.56	5.14

Source: As in table 1. Note* Figures are from 1980-81 to 2012-13.

It is pertinent to add here that most of the financing of SAUs comes from apex body that is ICAR. Therefore, it is important to analyse the trends of financial resources flow to three universities of the north Indian states. In the table 4.7 present the average annual growth rate of research expenditure incurred from ICAR funding schemes by the PAU, Ludhiana, which was grown at a rate of 5.84 percent in comparison to CCSHAU, Hisar and CSKHPAU, Palampur. But in the period 1990-91 to 1999-00 the CCSHAU, Palampur has highest growth of agricultural research expenditure, that is, 2.12 percent per annum from total ICAR funds. There is another interesting finding that in 2000-01 to 2013-14 periods only CSKHPAU, Palampur has positive growth rate that is 2.07 percent of expenditure of ICAR funds, the CCSHAU, Hisar and CSKHPAU, Palampur recorded negative growth rates. The overall growth rate from 1980-81 to 2013-14 of CSKHPAU, Palampur was higher 5.14 percent per annum in comparison to PAU, Ludhiana(3.33 percent) and CCSHAU, Hisar(1.61 percent).The annual average of agricultural research expenditure of ICAR schemes were continuously increased by all the periods of three state agricultural universities. The share of PAU, Ludhiana in absolute terms was higher than other universities.

Table 8 : Fund Allocation under ICAR Schemes for Agricultural Research Expenditure by Agricultural Universities as a Percentage of Total ICAR Expenditure.

Time Periods	PAU, Ludhiana	CCSHAU, Hisar	CSKHPAU, Palampur*
1980-81 to 1989-90	74.05	67.12	59.36
1990-91 to 1999-00	76.45	75.11	67.73
2000-01 to 2013-14	69.75	67.11	83.93
1980-81 to 2013-14	72.99	69.47	71.58

Source: As in table 1. Note:*Figures are from 1980-81 to 2012-13

The table 8 presents the expenditure incurred on agriculture research from the funds allocated by the ICAR to SAUs of the three states. There is a high percentage of funds that have been spent by the three SAUs of north Indian states. During the period 1980-81 to 1989-90, the PAU, Ludhiana has

spent 74.05 percent of total ICAR fund spent on agricultural research whereas the CCSHAU, Hisar incurred 67.12 percent and CSKHPAU, Palampur incurred 59.36 percent. During the time period 1990-91 to 1999-00, the PAU, Ludhiana and CCSHAU, Hisar were almost spent equal percentage nearly 75 percent of ICAR funds on agricultural research, but the CSKHPAU, Palampur spent 67.63 percent which is lower than above mention two universities. But for the period 2000-01 to 2013-14, the CSKHPAU, Palampur spent highest that is, 83.93 percent of ICAR funds on agricultural research. On the other hand the PAU, Ludhiana spent 69.75 percent and CCSHAU, Hisar spend 67.11 percent on agricultural research. The analysis of overall period 1980-81 to 2013-14 shows that the CSKHPAU, Palampur has incurred highest expenditure on agricultural research of ICAR funds, that is, 71.58 percent as compared with PAU, Ludhiana which 72.99 percent and CCSHAU, Hisar 69.47 percent. So it can be concluded from the analysis of table 4.8 highlights that the state agricultural universities mostly spend ICAR funds for agricultural research and development.

Allocation of Funds in Veterinary Schemes

Animal husbandry is growing across north Indian states at a rapid rate. The share of animal husbandry in the state income has been the rise. Therefore, it is pertinent to examine the research support provided to this important sector of the state's economy. The data presented in the following tables and analysis brings out the various facets and direction of research in this aspect.

Table 9: Annual Average Growth rates of funds allocation under Non Plan Veterinary Schemes to PAU, Ludhiana for agricultural research.

	AAGR (Percent)	Percentage of Total Budget	Average Agricultural Research Expenditure (in Rs.Lakhs)
1980-81 to 1989-90	33.28	23.64	79.98
1990-91 to 1999-00	3.68	27.24	142.78
2000-01 to 2007-08	3.60	36.11	437.91
1980-81 to 2007-08	11.54	28.49	204.67

Source: Annual Budgets, PAU.

The result presented in table 9 shows that annual average growth rate was higher 33.28 percent per annum during the period 1980-81 to 1989-90. But after the 90s its growth rate in agricultural research declined continuously that was 3.68 percent per annum in 1990-91 to 1999-00 and 3.60 percent per annum during the period 2000-01 to 2007-08. In the overall growth rate of agricultural research expenditure from the non plan veterinary schemes was 11.54 percent per annum during 1980-81 to 2007-08. The share of research expenditure to total expenditure has increased over time. It was 23.64 percent of total research expenditure during 1980-81 to 1989-90 which was increased 36.11 percent of total research expenditure of plan veterinary during the 2000-01 to 2007-08. This table shows that the research expenditure by PAU, Ludhiana under non plan veterinary scheme showed a rising trends in average agricultural research expenditure from 1980-81 to 1989-90 that is Rs.79.98 lakhs to Rs.437.91 lakhs in 2000-01 to 2007-08. Overall from the period 1980-81 to 2007-08 shows that the PAU, Ludhiana expenditure on agricultural research was Rs.204.67 lakhs under the non plan veterinary schemes.

Table 10: Annual Average Growth rates of funds allocation under Plan Veterinary Schemes to PAU for agricultural research.

	AAGR (Percent)	Percentage of Total Budget	Average Agricultural Research Budget (in Rs.Lakhs)
1980-81 to 1989-90	0.83	67.48	157.99
1990-91 to 1999-00	17.08	63.48	328.47
2000-01 to 2007-08	-16.50	49.21	135.46
1980-81 to 2007-08	-13.00	60.81	212.08

Source: As in table 9

Table 10 presents the expenditure of PAU, Ludhiana under plan schemes. The result shows that annual average growth rate for the period 1980-81 to 1989-90 was 0.83 percent per annum and annual average expenditure on research was Rs.157.99 lakhs. During the time period 1990-91 to 1999-00 the annual average growth rate turned to be very high that is, 17.08 percent per annum and the annual average expenditure on research also increased Rs.328.47 lakhs. But after this period, the growth rate of research was negative and the annual average expenditure was also decreased Rs.135.46 lakhs. The overall annual average growth rate was negative and annual expenditure on research was Rs.212.08 lakhs. The percentage of research expenditure as a percentage of total plan veterinary schemes declined during the period 1980-81 to 1989-90 from 67.48 percent to 49.21 percent in the 2000-01 to 2007-08 period. It may be noted that the veterinary college of PAU, Ludhiana converted into Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana with the act Punjab legislation No.16 of 2005. This university started functioning from April, 2006 for promoting livestock production and prevention of diseases through integrated teaching, research and extension. So the veterinary funds were transfer from PAU, Ludhiana to GADVASU, Ludhiana.

Table 11: Annual Average Growth Rates of Funds Allocation under Centrally Sponsored Schemes to PAU for Agricultural Research.

	AAGR (Percent)	Percentage of Total Budget	Average Agricultural Research Budget (in Rs. Lakhs)
1980-81 to 1989-90	18.03	93.21	113.30
1990-91 to 1999-00	8.90	79.55	64.25
2000-01 to 2013-14	10.88	89.52	322.21
1980-81 to 2013-14	6.37	87.67	184.90

Source: As in table 4.9

The table 11 indicates that the growth rate was higher at 18.03 percent per annum during the period 1980-81 to 1989-90. But after this period the annual average growth rate of research expenditure under centrally sponsored schemes was only 8.90 percent which was slightly improved at 10.88

percent during the period 2000-01 to 2013-14. The percentage expenditure on agricultural research as percentage of total centrally sponsored schemes funds was declined from 93.21 percent during the 1980-81 to 1989-90 to 79.55 percent in 1990-91 to 1999-00. It was improved at the rate of 89.52 percent in 2000-01 to 2013-14. Average expenditure on agricultural research under central sponsored schemes was Rs.113.30 lakhs during the period 1980-80 to 1989-90, which was declined at Rs.64.25 lakhs per annum in 1990-91 to 1999-00. The average expenditure on agricultural research was improved and highest at Rs.322.21 lakhs in 2000-01 to 2013-14. The analysis of the overall period from 1980-81 to 2013-14 annual average growth rate of agriculture research expenditure under central sponsored schemes was 6.37 percent per annum and average agricultural research expenditure was Rs.184.90 lakhs. The percentage of agricultural research expenditure as a percentage of total expenditure under central sponsored schemes was 87.67 percent.

The perusal of the table 12 shows research expenditure growth analysis under other schemes. Other schemes included schemes such as sponsored schemes, revolving funds, P.L.480 schemes and UGC schemes. The annual average growth rate of agricultural research expenditure under other schemes was 5.73 percent in the time period 1980-81 to 1989-90 increased 8.51 percent in 2000-01 to 2013-14. The result reveals that share of research expenditure to total expenditure has show declining trend that is 78.89 percent in 2000-01 to 2013-14 from 87.29 percent in

Table 12 : Annual Average Growth Rates of Funds Allocation under Others Schemes to PAU for Agricultural Research.

	AAGR (Percent)	Percentage of Total Budget	Average Agricultural Research Budget (in Rs. Lakhs)
1980-81 to 1989-90	5.73	87.29	323.04
1990-91 to 1999-00	5.21	77.65	492.81
2000-01 to 2013-14	8.51	78.89	1224.48
1980-81 to 2013-14	5.14	80.99	744.15

Source: As in table 9

1980-81 to 1989-90. Average agricultural research expenditure has showed increased trend, that is, Rs.323.04 lakhs in 1980-80 to 1989-90 which was Rs.1224.48 lakhs during the period 2000-01 to 2013-14. The overall agriculture expenditure from 1980-81 to 2013-14 was 5.14 percent per annum and percentage of agricultural research as the percentage of total other schemes was 80.99 percent. The average research expenditure under other schemes funds was Rs.744.15 lakhs per annum.

CCSHAU, Hisar –Other Funding Allocation Schemes

The table 13 reveals that expenditure on agricultural research expenditure of central sponsored of CCSHAU, Hisar. The annual average growth rate was 0.38 percent during the period 1990-91 to 1999-00. The percentage of agricultural research expenditure as the percent of total central sponsored schemes of CCSHAU, Hisar was increased 90.38 percent in 1980-81 to 1989-90 which was further

97.81 percent in 2000-01 to 2013-14. The average agricultural research expenditure was increased Rs.70 lakhs in 2000-01 to 2013-14 from Rs.46.10 lakhs during the time period 1980-81 to 1989-90. Over all annual growth rate was 3.28 percent per annum and the percentage of research expenditure as percentage of total central sponsored schemes of CCSHAU, Hisar was 88.30 percent. The overall average expenditure on agricultural research was Rs.52.95 lakhs.

Table 13: Annual Average Growth Rates of Funds Allocation under Centrally Sponsored Schemes to Chaudhary Charn Singh Haryana Agricultural University (CCSHAU) Research Budget.

	AAGR (Percent)	Percentage of Total Budget	Average Agricultural Research Budget (in Rs.Lakhs)
1980-81 to 1989-90	-16.91	90.38	46.10
1990-91 to 1999-00	0.38	82.68	35.12
2000-01 to 2013-14	-10.08	97.81	70.00
1980-81 to 2013-14	3.28	88.30	52.95

Source: Annual Budgets (varies issues) CCSHAU, Hisar

Table 14: Annual Average Growth Rates of Funds Allocation under Others Schemes to Chaudhary Charn Singh Haryana Agricultural University (CCSHAU), Hisar Research Budget.

	AAGR (Percent)	Percentage of Total Budget	Average Agricultural Research Budget (in Rs.Lakhs)
1980-81 to 1989-90	3.19	98.96	51.67
1990-91 to 1999-00	-5.36	68.52	77.03
2000-01 to 2013-14	-12.55	42.62	125.85
1980-81 to 2013-14	1.13	66.81	89.68

Source: As in table 13.

An examination of table 14 shows that the research expenditure of CCSHAU, Hisar under other schemes (like revolving fund schemes, P.L.480 schemes and UGC schemes etc.). Annual average growth rate of agricultural research expenditure was 3.19 percent per annum during the period 1980-81 to 1989-90. After this period the annual average growth rate was negative. The overall annual average growth rate of agricultural research expenditure during the period 1980-81 to 2013-14, was 1.13 percent and percentage share of agricultural research as the percentage of total funds under other schemes was 66.81 percent. The annual average expenditure on agriculture research was Rs.89.68 lakhs.

VARIETIES OF CROPS RELEASED BY THE THREE STATE AGRICULTURAL UNIVERSITIES

The crop varieties developed and released by the three agricultural universities that is PAU, Ludhiana, CCSHAU, Hisar and CSKHPAU, Palampur are analysed in this section.

Table 15: Number of Varieties Developed and Released by Punjab Agriculture University (PAU), Ludhiana (1960 to 2014).

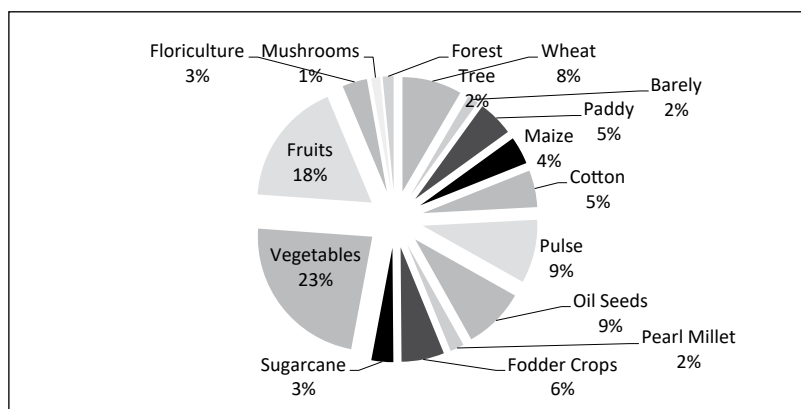
	1960-70	1970-80	1980-90	1990-00	2000-10	2010-14	Total
Wheat	6	7	16	11	13	7	60 (8.43)
Barely	2	2	1	2	4	-	11 (1.54)
Paddy	5	6	4	7	10	4	36 (5.06)
Maize	5	3	7	7	3	3	28 (3.93)
Cotton	2	3	6	9	13	4	37 (5.20)
Pulse	6	13	13	12	15	5	64 (8.99)
Oil Seeds	8	6	10	19	14	5	62 (8.71)
Pearl Millet	2	2	4	2	2	2	14 (1.97)
Fodder Crops	3	6	14	13	6	1	43 (6.04)
Sugarcane	6	4	7	5	-	-	22 (3.09)
Vegetables	55	22	26	29	26	3	165* (23.17)
Fruits	67	20	8	13	17	-	125 (17.56)
Floriculture	-	-	3	6	16	-	25 (3.51)
Mushrooms	-	4	3	-	2	-	9 (1.26)
Forest Tree	-	-	-	9	2	-	11 (1.54)
	167	98	122	144	143	38	712 (100)

Source: Directorate of Research of PAU, Ludhiana.

Note:*Four varieties of vegetable (Potato) has not described year of releasing.

Figures in parenthesis are percentages.

Figure 1. Crop wise Distribution of Total Varieties Released by PAU, Ludhiana.



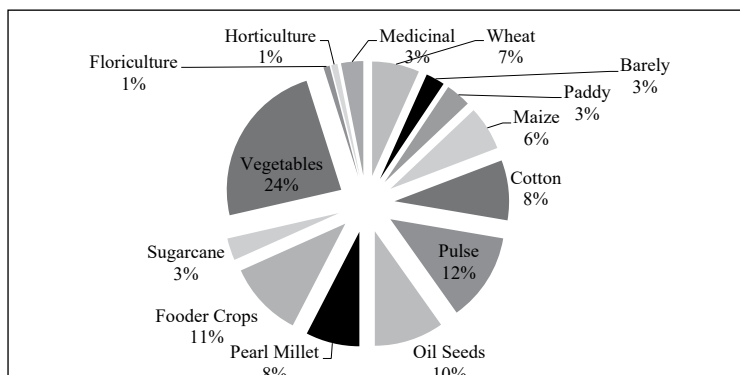
The table 15 presented the varieties of crops developed by the PAU, Ludhiana. Mostly, the varieties were developed during the period 1960-70. The PAU developed 167 varieties of crops out of which fruits(67) and vegetables(55). After this period the number of crop varieties was decreased. During the period 1970-80 the number of crop varieties was 98 which were lowest among all the time periods under consideration. The figure 1 shows that the share of vegetable varieties released were highest 23.17 percent among the other total crops varieties released by PAU, Ludhiana. The share of fruit varieties were second largest of the total crop varieties released that is 17.56 percent. The share of wheat, pulses and oil seeds varieties were nearby 9 percent of total crop varieties released by the PAU.

Table 16: Number of Varieties Developed and Released by Chaudhary Charan Singh Haryana Agriculture University (CCSHAU) (1970 to 2014).

	1970-80	1980-90	1990-00	2000-10	2010-14	Total
Wheat	2	3	4	3	3	15 (6.70)
Barely	2	1	-	2	1	6 (2.68)
Paddy	-	1	3	4	-	8 (3.57)
Maize	-	-	-	11	3	14 (6.25)
Cotton	2	3	6	8	-	19 (8.48)
Pulse	5	4	7	9	3	28 (12.50)
Oil Seeds	7	4	4	7	-	22 (9.82)
Pearl Millet	1	4	2	7	3	17 (7.59)
Fodder Crops	5	7	5	4	3	24 (10.71)
Sugarcane	2	3	1	1	-	7 (3.13)
Vegetables	8	1	24	20	-	53 (23.66)
Floriculture	-	-	-	2	-	2 (0.89)
Horticulture	-	-	2	-	-	2 (0.89)
Medicinal	-	3	2	2	-	7 (3.13)
	34	34	60	80	16	224 (100)

Source: Directorate of Research, CCSHAU, Hisar.

Note: Figures in parenthesis are percentages.

Figure. 2 : Crop wise Distribution of Total Varieties Released by CCSHAU, Hisar.

The table 16 highlights the varieties of different crops developed and released by the CCSHAU, Hisar. During the period 1970-80 and 1980-90 the total number of developed and released crop varieties was same, that is, 34 varieties. In 1970-80 the vegetables varieties (8) and oil seed varieties (7) was highest among other varieties. CCSHAU developed and released large number of fodder crops varieties, that is, 7 during the period 1980-81. The vegetables varieties were having highest share in development and released varieties among other varieties between 1990-00 to 2000-01. During 2010-14, there was 3 varieties developed in each crop of wheat, pulses, fodder crops and pearl millet.

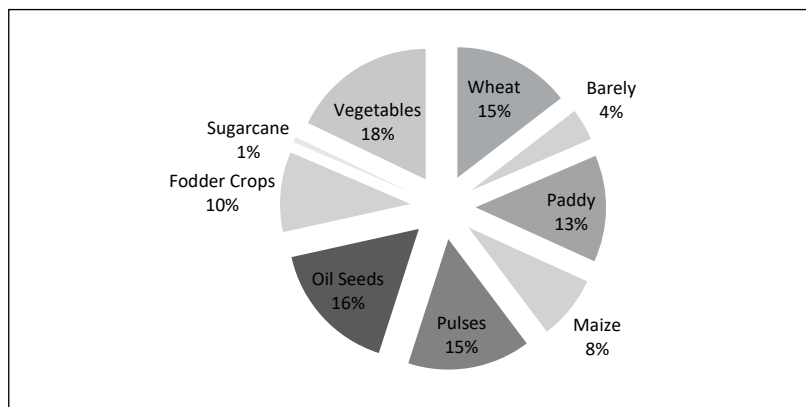
Table 17: Number of Varieties Developed and Released by Chaudhary Sarwan Kumar Himachal Pradesh Agricultural University, Palampur (CSKHPAU) (1978 to 2014)

	1970-80	1980-90	1990-00	2000-10	2010-15	Total
Wheat	3	8	9	2	-	22 (14.57)
Barely	-	1	3	2	-	6 (3.97)
Paddy	1	3	7	9	-	20 (13.25)
Maize	-	2	2	8	-	12 (7.95)
Pulse	-	3	9	10	1	23 (15.23)
Oil Seeds	-	4	8	10	3	25 (16.56)
Fodder Crops*	-	3	6	4	-	15 (9.93)
Sugarcane	-	-	1	-	-	1 (0.66)
Vegetables**	-	-	-	-	-	27(17.88)
	4	24	45	45	4	151 (100)

Source: Directorate of Research, CSKHPAU, Palampur.

Note:*Two Fodder Crops Varieties has not described year of releasing.

**All Vegetable Varieties has not described year of releasing.

Figure 3 : Crop wise Distribution of Total Varieties Resealed by CSKHPAU, Palampur.

The table 17 reveals that the analysis of varieties developed and released by the CSKHPAU for different crops. There is a limitation of data in the sense that the varieties of vegetable have not described the year of its release. The numbers of all the varieties were 151 in which the share of vegetable varieties were highest 17.88 percent of total varieties of crops developed and released by CSKHPAU. The other crops like wheat (14.57 percent), pulses (15.23 percent), oil seeds (16.56 percent) and paddy (13.25 percent) were developed by CSKHPAU. The figure 3 presented the percentage distribution of all crops released and developed by CSKHPAU.

CONCLUSION

From the detailed analysis of agriculture research expenditure, allocations of funds, crop varieties and patents of three state agricultural universities (PAU, Ludhiana, CCSHAU, Hisar and CSKHPAU, Palampur). The annual average growth rate of PAU, Ludhiana was higher than CCSHAU, Hisar and CSKHPAU, Palampur over the period of study except 1990-91 to 1999-00 when the CSKHPAU, Palampur recorded highest growth rate, that is, 10.45 percent per annum. The PAU, Ludhiana has spent more percentage on agriculture research as percentage of total budget, that is, 50.19 percent of overall period (1980-81 to 2013-14). The PAU, Ludhiana has 46.89 percent amount of non plan agricultural budget spent on agricultural research as compared with CCSHAU, Hisar (21.44 percent) and CSKHPAU, Palampur (9.67 percent). The PAU, Ludhiana has spent highest share of research expenditure that is 81.02 percent from plan agricultural funding schemes as compared to CCSHAU, Hisar and CSKHPAU, Palampur.

Another important finding emerging from the analysis is that during the period 2000-01 to 2013-14 CSKHPAU, Palampur has 83.93 percent expenditure on agricultural research incurred from ICAR funding schemes as compared to PAU, Ludhiana (69.75 percent) and CCSHAU, Hisar (67.11 percent). The PAU, Ludhiana and CCSHAU, Hisar has some other funding sources which provide funding for agriculture research, that is, non plan veterinary schemes, plan veterinary schemes, centrally sponsored schemes and other schemes. The three agricultural universities had released and developed vegetable varieties in large numbers. The percentage share of developed oil seeds and pulses varieties were highest in CSKHPAU, Palampur as a percentage of total developed crop varieties.

References

- Ananth,G.S.,P.G.Chengappa and Aldas Janalah(2008), “Research Investment on Technology Development in Peninsular India” in Keijiro Otsuka and Kaliappa Kalirajan (eds.),Sage Publication, New Delhi.
- Annual Budgets (various issues), CCSHAU, Hisar
- Clark, N (2002), “Innovation System, Institutional Change and the New Knowledge Market: Implications for third world agricultural development” *Economics of Innovation and New Technology*, Vol. 11(4), pp. 353-368.
- Audited Annual Statements (various issues), CSKHPAU, Palampur,
- Hall, A.J., B.Yoganand (2002), “New Innovation Arrangement in Agricultural R&D in Africa: Concepts and Case Studies”, in H.A. Freeman, DD Rohrbach and C.A.Ogutu (eds.), ‘Targeting Agricultural Research for Development in the Semi Arid Tropics of Sub Saharan Africa ’International Crops Research Institute for the Semi-Arid Tropics, Nairobi, Kenya.
- Annual Budgets (various issues), PAU, Ludhiana.
- Santhakumra, V.(2011), “Economic Analysis of Institutions-A Practical Guide”, Sage Publications, New Delhi.