



Sectoral Public Expenditure And Agricultural Production In Himachal Pradesh: A Time-Series Analysis Using ARDL Methodology.

¹ Dr. Kishor Kumar, ² Divya Shelly,
¹ Assistant Professor, ² Research Scholar
¹ Department of Economics,
¹ HPURC Dharamshala, Himachal Pradesh

Abstract: This paper examines the relationship between public expenditure on agriculture and agricultural output or production in Himachal Pradesh from 1993-94 to 2022-23. The objective of this study is to investigate the relationship between public expenditure on agriculture and agricultural output in Himachal Pradesh by ARDL and ECM model. Descriptive and analytical research design has been used by using secondary data. The data relating to Public Expenditure have been collected from the Himachal Statistical Organization, Reserve Bank of India (RBI) Publications, state budget paper for the various years under consideration. The purpose of public expenditure is to provide for the socioeconomic well-being of citizens through government spending at federal, state, and local levels. This encompasses the operational costs of governance, investments in economic and social progress, and potentially, international aid. As the scope of government operations broadens, it becomes increasingly difficult to determine the optimal allocation of public funds between maintaining essential government functions and driving societal and economic development. The ARDL model F-Bounds test shows significant long-term relationships between agricultural output and public expenditure on agriculture, education, medical and public health, rural development, transportation, and communication. The finding suggests that government investment plays a pivotal role in enhancing agricultural productivity.

Key words: Public Expenditure, Agriculture output, Gross Domestic Product, ARDL, ECM and bound test

I. Introduction

Agriculture sector of Himachal Pradesh is a significant contributor to the economy of state, accounting for 45% of its GDP. It primarily involves the cultivation of cash crops like wheat, maize, rice, and barley, as well as valuable produce like ginger, seed potatoes, vegetables, and fruits. Around 71% of the working population engages in agricultural activities, and agriculture and its associated industries account for 22.5% of the state's gross national product. With a large agricultural area of 9.99 million hectares, 8.63 million farmers work in this sector. The entire population of the state more or less depends directly upon the agriculture of Himachal Pradesh. Around 84.5% of the total land held by the farming community of Himachal Pradesh are owned by the small and marginal farmers. ¹Agriculture is a critical sector of Indian economy and it forms the backbone of the economic development of the country. However, the share of agriculture and allied services in overall GDP of the country has fallen from about 23 percent in 2000-01 to less than 18 percent in 2010-11. The reason could be the growth of population coupled with many other factors leading to a change in the land use and cropping pattern of the country as a whole and the northern states of the country are following the same trend. Agriculture in these states has been facing a downfall from the past many years as the development of secondary or tertiary activities provide better employment opportunities. Also decrease in the share of agriculture share towards GDP, decrease in the area under agriculture, changed climatic conditions etc. have added to this downfall. ² Public expenditure is crucial in enhancing the agricultural sector by addressing infrastructure gaps and market failures. Investments in irrigation, rural roads, and storage facilities improve

farm productivity and reduce post-harvest losses. Government spending on agricultural research and extension services empowers farmers with knowledge to increase yields and adapt to changing climate conditions. Subsidies and price support programs stabilize farm incomes, mitigating market volatility risks and encouraging sustained agricultural activity. Strategic allocation of public funds fosters agricultural growth, food security, and economic development. The agricultural development had to rely heavily on government finance since the inception of first Five Year plan (FYP) period. However, there has been declining share to agriculture from the public finance due to planned achievements in agriculture, industrialisation and economic reforms. This trend may have deleterious effect on the performance of agricultural sector.³

II. Review of literature:

Jairath (2008) examined the distribution of private and public investment in agricultural marketing infrastructure in India from 2004 to 2008, focusing on whether private investment drives public investment. The data was gathered from various sources, including the Office of the Directorate of Marketing and Inspection, the National Cooperative Development Corporation, and the National Bank for Agriculture and Rural Development. The results showed that private investment in agricultural marketing infrastructure was highest in Madhya Pradesh, followed by Tamil Nadu, Andhra Pradesh, Rajasthan, and Punjab. The study concluded that private investment incentivizes public investment, and suggested strategies to boost private investment include removing barriers, creating awareness at the grassroots level, establishing single window services, and establishing an 'Entrepreneurial Bank' for promoting agricultural marketing infrastructure units.⁴

Bathla (2014) has examined the trends of Public and Private Capital Formation and Agricultural Growth in India during 1980–81 to 1990–91 and from 1999–2000 to 2005–06 for the pre- and post-reform periods. The study was based on secondary data which was collected from National Accounts Statistics, Statistical Abstract of India, Fertilizer Statistics of India and State Finances. GDCF and SDP deflators were used to convert the nominal series on investment and state domestic product in agriculture and related activities (SDPA) into real prices at base 1999–2000. The study found that rural poverty is negatively linked to agriculture's high capital intensity. However, investment performance improved in all states except Gujarat and Odisha. Private investment in agriculture was influenced by institutional credit, demand for agricultural products, and public spending. The northern and central areas experienced increased agricultural investment, reducing poverty. The study recommends technology, irrigation, and partnerships between farmers and the food processing sector.⁵

Krishnan and Sivagnanam (2015) have investigated the trend and composition of capital formation in the Indian economy and agriculture between 1980–1981 and 2010–2011. The trend and composition of capital formation were studied using National Accounts Statistics (NAS) from the Central Statistical Organization (CSO) which was based on secondary data. The Indian economy and agriculture experienced a decrease in GDP share from 35% in 1981–82 to 13.95% in 2012–13, with a decrease in net capital stock in agriculture, while forestry and logging saw an increase. The study suggests a need for substantial public investment in agriculture.⁶

Singh, Sharma and Mamta (2015) investigated issues regarding cropping pattern changes and growth sources in Haryana from 1980–81 to 2011–12. The study uses secondary data from the Ministry of Agriculture and Horticultural Department of Haryana to analyze the area under wheat-rice combination and vegetables. The study found that the assured Minimum Support Price (MSP) and price risk reduction have promoted the wheat-paddy combination. The area under vegetables has increased, with the Central zone contributing 35% and the Northern zone contributing 38%. Cucurbits, cabbage/cauliflower, radish, and leafy vegetables are on the rise, while potato and peas are decreasing.⁷

Apata, T. G. (2019) investigated Public Spending mechanisms and Gross Domestic Product (GDP) growth in the agricultural sector in China and Nigeria and draws up a model of Chinese development for Nigeria. Secondary data was used and were sourced from FAOSTAT and International Monetary Fund's Government-Finance Statistics from 1970–1979 to 2000–2016. Based upon this premise the study adopted a simple version of endogenous growth theory, production function and to estimate the strength of coefficients is Ordinary Least Squares (OLS). The study suggests Nigerians should focus on their own efforts and population creativity for structural transformation and agricultural growth, rather than relying on foreign aid. Public-spending policy and political will are crucial components of fiscal policy to achieve GDP growth in the agricultural

sector. However, if government spending patterns are not well-designed, they can negatively impact the economy, with society bearing the costs.⁸

Modi and Gopinath (2019) investigated the changes in cropping patterns in Rajasthan over the last sixty years (1957-67 to 2007-17) by looking at crop area, yield, high yielding varieties of seeds, and fertiliser use pattern. The study analyses the cropping pattern at the state level using time series data. The study analyzed secondary data from sources like the Rajasthan Government, Jaipur, and Ministry of Agriculture and Farmers Welfare, focusing on cropping patterns from July-June. Results showed a shift from low-value to high-value crops, with superior cereals like wheat and rice gaining area, while coarse cereals lost. Oilseeds increased from 5% to 17% of non-food grain area, while high-value horticulture crops increased. The government suggested offering a remunerative minimum support price to prevent foodgrain area reduction.⁹

Venkatesha (2019) has made an attempt to assess public and private investment in Indian agriculture. The temporal trends in Gross Capital Formation in Public & Private Sector in Agriculture were analyzed from 1990-1991 to 2015-2016. A study from the Directorate of Marketing & Inspection, Ministry of Agriculture, and Govt. of India found that the overall ratio between public and private investments in India is 1.51, with Rajasthan, Kerala, Punjab, Andhra Pradesh, and Tamil Nadu having higher ratios. The private sector has the potential to increase agricultural technologies and reach millions of farmers quickly. However, channeling these sources efficiently is crucial for both the profitability of the private sector and the farming community. Education and training are critical for boosting the growth of the agriculture sector. The study also found a shift in the relationship between private and state investment in the United States from 1990 to 2000.¹⁰

Kumar, Bathla, and Verma (2020) have investigated temporal trends in private fixed investment and rural household composition by using a 10-year study of debt and investment on a national level from 1981-82 to 2012-2013. The National Survey of Statistics (NSSO) analyzed data from 17 major Indian states over three decades, tracking changes in investment among rural households. The survey covered 3,000 villages and 30,000 households. The results showed that public investment in agriculture and irrigation positively impacted private investment in agriculture and allied sectors. Input subsidies were also important for farmers in middle- and low-income states. Terms of trade were crucial in determining farmers' investment choices. Geographical targeting of input subsidies and government investments in irrigation and agriculture is essential.¹¹

Shivaswamy, et al. (2020) have examined the impact of public expenditure on farm inputs and support services at the state and national levels in context of regions for 2006-07 to 2016-17. The study analyzed agricultural expenditures in six regions, including irrigation, infrastructure, research, education, extension, and training. The per-hectare public agriculture expenditure was calculated using the gross cropped area. The study found increasing trends in agricultural inputs and support services. Low spending on agriculture compared to industries was observed. Investing in R&D and infrastructure had the largest positive effect on growth and reducing rural poverty. Therefore, investing in these industries is a rural development strategy, and continued public investment growth is needed to support the country's agriculture industry.¹²

Muttalageri and Biradar (2021) examined the Impact of Agricultural Subsidies in Karnataka from 2015-16. This study was based on primary as well as secondary data. The districts of Bagalkot and Vijayapur were divided into three regions on the basis of levels of agricultural productivity. A study was conducted using a multi-stage proportionate random sampling technique, with 200 respondents from 4 taluka in 8 villages as the primary unit. A questionnaire was prepared to collect information about agricultural subsidies, and statistical tools like percentages were used. Secondary data sources included the Karnataka State Electricity Board, Statistical Abstract of Karnataka, Economic Survey of Karnataka, Karnataka Human Development Report, and the Karnataka State Electricity Regulatory Commission. The study found that indirect subsidies were used less by small, marginal, and SC/ST farmers than other castes and larger holdings. The study concluded that the current efforts have not been satisfactory due to poor farmers' lack of knowledge about subsidies and disinterest in financial institutions.¹³

III. Objective of the study

1. To investigate the relationship between public expenditure on agriculture and agricultural output in Himachal Pradesh.
2. To assess the impact of different sectors on agricultural output in Himachal Pradesh.

IV. Data Sources and Methodological Approach

The study based on secondary data which is collected from various government publications like Reserve Bank of India Publications, Directorate of Economics and Statistics and Finance Accounts of Government of Himachal Pradesh from 1993-94 to 2022-23. Annual time series data on GSDP are used as a proxy for economic growth and have been obtained from Economics and Statistics Department of the Himachal Pradesh and Data.gov.in & Census 2011, Govt. of India. ADF Unit Root Test, Correlation and Regression techniques have been applied.

Stationarity and unit roots tests

To avoid spurious regression in time series analysis, it's essential to determine the order of integration of each variable through stationarity tests, primarily using the Augmented Dickey-Fuller (ADF), Dickey-Fuller (DF), and Phillips-Perron (PP) tests. These tests assess whether a time series has a unit root, indicating non-stationarity, by estimating regression models that include lagged levels of the variable, and optionally, an intercept and a trend. Specifically, the ADF test involves regressing the first difference of the variable on its lagged level, lagged differences, and potentially a constant and a time trend, allowing for the determination of whether the coefficient of the lagged level is significantly different from zero, thus establishing the stationarity of the series. In this analysis, the Augmented Dickey-Fuller (ADF) test is employed to ascertain the stationarity of time series data by ensuring that the regression residuals are white noise. To detect the presence of a unit root, the following regression model is utilized:

$$\Delta Y_t = a_0 + a_1 Y_{t-1} + \sum_{j=1}^n a_{2j} \Delta Y_{t-j} + \mu_t \dots \dots \dots (1)$$

This regression is based on t-ratio. Where Δ is the first difference operator of the series y and n is lag, is constant, a_1 and a_2 are parameters and ' μ ' is a white noise error residual. According to the ADF test we usually use null and alternative hypothesis:

$H_0: a_1 = a_2 = 0$ (Series contains a unit root, nonstationary)

$H_1: a_1 \neq a_2 = 0$ (Series is stationary)

If the null hypothesis cannot be rejected, it indicates that the series contains a unit root and is therefore non-stationary. Conversely, if the null hypothesis is rejected, it suggests that the series is stationary, implying that its mean and variance remain constant over time.¹⁴

Model specification

We specify the following equation (2) to investigate the impact of public expenditure on agriculture output:

$$\ln(\text{Gsdpagri}) = \beta_0 + \beta_1 \ln(\text{Agriexp}) + \beta_2 \ln(\text{Edu}) + \beta_3 \ln(\text{Health}) + \beta_4 \ln(\text{Rudev}) + \beta_5 \ln(\text{Trans}) \dots \dots (2)$$

Where: Gsdpagri (agricultural GSDP) is the dependent variable which represents the agricultural output. Here Gsdpagri (proxied for agricultural output) represent the agricultural GSDP.

Independent variables are:

Agriexp = public expenditure on Agriculture and Allied Activities. This expenditure comprises of sub-sectors like Crop husbandry, Agricultural Research and Education, Fisheries, Animal Husbandry, Agricultural Finance Institutions and Other Agricultural Programmes.

Edu = Public expenditure on Education,

Health = Public expenditure on Medical and Public Health,

Rudev = Public expenditure on Rural Development and

Trans = Public expenditure on Transport and Communications., $\ln$ corresponds to natural logarithm form of the series. $\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 represents the long-term elasticities of agricultural GSDP with regard to public spending on Agriculture and Allied Activities, Education, Medical and Public Health, Rural Development and Transport and Communications respectively.

V Results and Discussion

Trends and Patterns of Public Expenditure in Himachal Pradesh

In this section, an attempt to examine the trends and patterns of public expenditure in Himachal Pradesh. The table 1 and figure 1 depicts the share of total expenditure (TE) spent on agricultural and related activities, education, medical and public health, rural

Table 1
Trends and Patterns of Public Expenditure in Himachal Pradesh (Rs. Lakh)

years	Agriculture and Allied Activities in lakh	Education, Sports, Art and Culture in lakh	Medical and Public Health in lakh	Rural Development in lakh	Transport and Communication in lakh	Agriculture and Allied Activities (GDP) in lakh (H.P)
1993-94	311277	318019	172650	49221	833753	118702
1994-95	353689	363394	199330	45570	977417	118242
1995-96	376022	443195	219367	52295	1090863	123377
1996-97	410012	510770	257857	58006	1209474	124837
1997-98	463042	635992	208586	80519	1389907	125025
1998-99	565956	822117.9	352027	83238	1604051	129007
1999-00	416060	837090	245830	82870	457140	122475
2000-01	456510	904520	267590	138990	465720	132073
2001-02	456360	918720	245240	877530	448090	141929
2002-03	607610	957340	265210	90920	534290	140552
2003-04	418300	1007930	315590	94850	605260	158505
2004-05	401520	1077560	332690	98660	579890	174246
2005-06	479700	1213530	356110	110250	686120	191550
2006-07	445250	1362480	376650	149080	891350	646707
2007-08	671290	1636340	425720	188440	1034730	704787
2008-09	861930	2023380	501450	250770	1232020	698252
2009-10	1257420	2286580	610070	278060	1505850	620135
2010-11	1135630	2889140	746290	340220	1526140	734608
2011-12	1173470	3087880	755350	357530	1748620	709171
2012-13	1269880	3584320	882840	367310	1271170	731348
2013-14	1469440	3790910	159573	436940	1996810	896025
2014-15	1560270	4274830	1060630	896290	2245480	887491
2015-16	1602340	4431450	1129450	1009590	2806260	1394746
2016-17	177123	894866	471113	149769	1758818	1224060
2017-18	1859380	6040667	262865	924052	3508883	1441754
2018-19	2259657	6197728	1874959	1192908	3901878	1454726
2019-20	2229442	6422872	1893320	1212394	4344298	1526489
2020-21	5791454	6699996	2039278	1408403	4624128	1441203
2021-22	2568600	7197009	2202976	1324589	4727028	1563139
2022-23	3038930	9056740	3713100	2041340	5005300	1671742

Source: Computation from Reserve Bank of India Publication and Finance Accounts of Government of Himachal Pradesh (1993-94 to 2022-23).

development public health, rural development, transportation, and communication experienced significant fluctuations. Agriculture and Allied Activities experienced significant increases in the late 1990s and early 2000s, particularly from 2000-01 to 2006-07, but the allocation declined in 2010-11. The lowest point was reached in 2016-17, followed by a dramatic rise in 2017-18, indicating a renewed focus on agricultural development. The share fluctuated between 2019-20 and 2022-23, decreasing in 2019-20 and 2021-22, but increasing in 2022-23. Public expenditure on education has consistently grown over the years, with the highest allocation in 2017-18 and the lowest in 2016-17. However, there were slight falls in 2018-19 and 2022-23.

The share of Public Expenditure to medical and public health has seen a mixed pattern. However, the spending declined in early 1990s and reached a low point in 2013-14. Subsequently, there was a sharp increase in 2014-15, followed by another decline in 2016-17. The highest allocation was recorded in 2017-18, and keep on increasing till 2021-22 reflecting a potential emphasis on healthcare infrastructure and services. Rural development expenditure initially decreased in 1994-95, followed by a period of growth until 1998-99. Subsequently, spending increased significantly, reaching its highest in 2001-02. A decline in 2002-03 was followed by a sustained period of growth until 2015-16. However, a downturn occurred in 2021-22, with a subsequent upturn in 2022-23. The allocation to transportation and communication has generally increased over the years, lowest allocation was recorded in 1999-2000, while the highest was in 2017-18, followed by a slight decrease in 2018-19 but keep on increasing till 2022-23. The data overall reveals substantial fluctuations across different sectors between 1993-94 and 2022-23. The years 2014-15 and 2017-18 witnessed substantial growth across multiple sectors, signaling economic boom, whereas periods like 1999-00 and 2016-17 experienced declining growth rates, indicating economic slowdown or recession. Public expenditure on education in Himachal Pradesh has seen a significant increase, with an average growth rate of approximately 13.29% per annum from 2004-05 to 2020-21. This growth is attributed to various educational programs, such as the Mukhya Mantri Vidyarthi Protsahan Yojana, which provides education loans to economically weaker sections at minimal interest rates. The government has consistently allocated around 18.5% of total public expenditure to education, focusing on building more schools and upgrading existing facilities.¹⁵ Public expenditure on medical and public health and transportation and communication also shows consistent growth, with various schemes like the Ayushman Bharat scheme and health insurance initiatives enhancing public health infrastructure and services.¹⁶ However, public expenditure on agriculture and rural development shows greater variability due to climate change, irregular rainfall, and inadequate infrastructure. The Economic Survey for 2022-23 revealed that agricultural output has been negatively impacted by unprecedented rainfall and global events, leading to increased commodity prices and complicating budget allocations.¹⁷ The Himachal Pradesh MGNREGA and HPRLM have improved rural socio-economic status, with infrastructure investments boosting productivity. Initiatives like PMGSY have improved rural roads, facilitating smoother transportation of agricultural products, thereby contributing to income generation for farmers.¹⁸

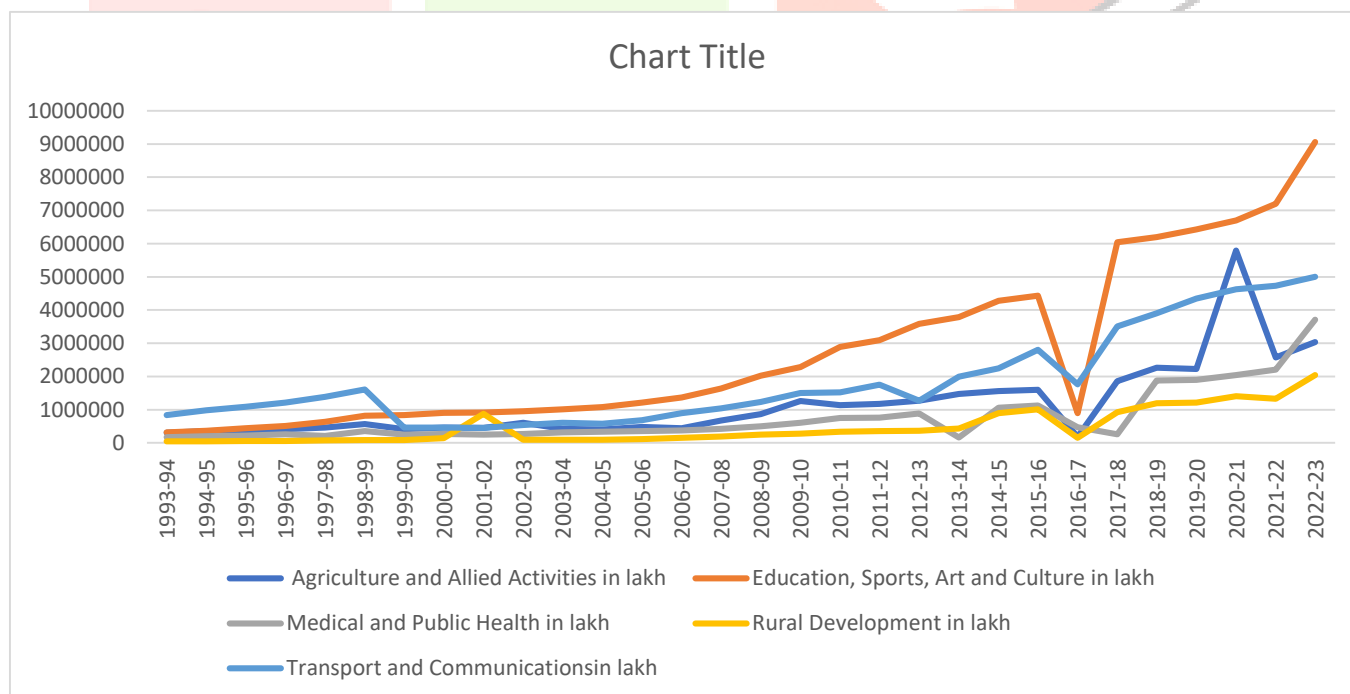


Figure 1 Share of Public Expenditure in Himachal Pradesh

Source: Computation from Reserve Bank of India Publication and Finance Accounts of Government of Himachal Pradesh (1993-94 to 2022-23).

Note: AA = Public expenditure on Agriculture and allied activities, Ed = Public expenditure on Education, health = Public expenditure on Medical and Public Health, Rural = Public expenditure on Rural

development, Transport = Public expenditure on Transportation and Communication and TE = Total Public Expenditure.

Unit Root Test

Results on the Impact of Public Expenditure on Agricultural Output

The Akaike Information Criterion (AIC) is used to assess the stationarity of time series variables in a regression analysis. The ARDL model is selected based on the Akaike Information Criterion and the Augmented Dickey-Fuller (ADF) test. The results show that public expenditure on Agriculture, Education, Medical and Public Health, Rural development, Transportation and Communication, and agricultural Gross State Domestic Product (GSDP) are less than the absolute critical values at level. The null hypothesis (H0) is accepted, indicating that the time series variables are not stationary at level. The Augmented Dickey Fuller (ADF) unit root test is employed to ensure all variables are stationary. Stationarity differencing is applied to remove non-stationary components, resulting in a stationary series. However, after taking first difference, the absolute value of ADF test statistics of the variables (Public

Table 2
Unit Root Test Results

	Level			First Difference			Second Difference		
Variable	ADF test statistic	Prob	Decision	ADF test statistic	Prob	Decision	ADF test statistic	Prob	Decision
Lnagriexp	-0.320	0.985	Not Stationary	-5.820	0.0004	Stationary	—	—	—
Lnedu	-2.859	0.189	Not Stationary	-6.021	0.0002	Stationary	—	—	—
Lnhealth	3.298	1.00	Not Stationary	-1.200	0.888	Not Stationary	10.963	0.0000	Stationary
Lnrurdev	-2.561	0.298	Not Stationary	-6.241	0.0001	Stationary	—	—	—
Lntransp	-0.780	0.955	Not Stationary	-7.806	0.0000	Stationary	—	—	—
Lngsdpagri	-2.618	0.275	Not Stationary	-7.490	0.0000	Stationary	—	—	—

Source: Computation from Reserve Bank of India Publication and Finance Accounts of Government of Himachal Pradesh.

agriexp = Public expenditure on Agriculture and allied activities, edu = public expenditure on education, health = Public expenditure on Medical and Public Health, rurdev = Public expenditure on Rural development, Transp = Public expenditure on Transportation and Communication, gsdpagri = and agricultural Gross State Domestic Product (GSDP).

expenditure on Agriculture and allied activities, public expenditure on Education, Public expenditure on Rural development, Public expenditure on Transportation and Communication and agricultural Gross State Domestic Product (GSDP) are greater than the absolute critical values, and thus the null hypothesis (H0) is rejected which confirms that the first difference variables are stationary. However, Public expenditure on Medical and Public Health remained non-stationary even after first differencing. It became stationary only

after second differencing, leading to the rejection of the null hypothesis as the test statistic exceeded the critical values.

Autoregressive Distributed Lag (ARDL) Bounds Test

ARDL model is use to check the existence of a co-integrating relationship between Public expenditure on Agriculture and allied activities, public expenditure on Education, Public expenditure on Medical and Public Health, Public expenditure on Rural development, Public expenditure on Transportation and Communication and agricultural Gross State Domestic Product (GSDP) in 1993-1994 to 2022-2023. The bounds testing procedure provides a robust way to test for cointegration, even in the presence of mixed orders of integration. For this purpose, bound test is applied and the result is presented in table 2.2. The F-statistic test is used to determine the existence of this long-run relationship. If the calculated F-statistic is greater than the upper critical value at a specific significance level (usually 1%, 5%, or 10%), we reject the null hypothesis of no cointegration. This indicates that there is a long-run equilibrium relationship between the variables. If the computed F-statistics exceeds the upper critical bound value, then the null hypothesis of no co-integration will be rejected. If the F statistic falls into the bounds, then the test becomes inconclusive. If the F-statistic lies below the lower critical bounds value it implies no co-integration. The result of the Bounds test presented in table 2.2 shows that the calculated F-statistic is 3.15 higher than the 10 per cent level of significance of the Pesaran et al. (2001) upper bound values. The study applied a well-known approach by Pesaran et al. (2001) called the autoregressive distributed lag (ARDL) approach. The ARDL model is considered as the best econometric method compared to others in a case when the variables are stationary at I(0) or integrated of order I(1). Based on the study objectives, it is a better model than others to check for short-run and long-run impact of independent variables.¹⁹ Therefore, the findings lead to the conclusion that there is long run relationship between Public expenditure on Agriculture and allied activities, public expenditure on Education, Public expenditure on Medical and Public Health, Public expenditure on Rural development, Public expenditure on Transportation and Communication and agricultural Gross State Domestic Product (GSDP).

Table 2.2
Autoregressive Distributed Lag Bounds Test

Sample: 1994 2023 Included observations: 24		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	k
F-statistic	3.15	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.08	3
5%	2.39	3.38
2.5%	2.70	3.37
1%	3.06	4.15
R-squared = 0.931		Mean dependent var = 5.83
Adjusted R-squared = 0.857		S.D. dependent var = 199.44
		Durbin-Watson stat = 1.97

Source: Computation from Reserve Bank of India Publication and Finance Accounts of Government of Himachal Pradesh (1993-94 to 2022-23).

Public Expenditure and Agricultural Output in the Long run

The table 2.3 has depicted the long-run results of selected ARDL (5, 2, 2, 0, 2, 2) Model. The long run results in table 2.3 shows both positive and negative relationship between all public expenditure variables and Agricultural Output. In the long run, the overall

Table 2.3
Long run Co-efficients of ARDL (5, 2, 2, 0, 2, 2) Model
Dependent Variable: LNGSDPAGRI

Variable	Coefficient	Std. Error	t-Stat	Prob.
LNGSDPAGRI (-1)	-0.201	0.335	-0.600	0.574*
LNGSDPAGRI (-2)	-0.025	0.251	-0.102	0.922*
LNGSDPAGRI (-3)	-0.005	0.265	-0.021	0.983*
LNGSDPAGRI (-4)	0.403	0.300	1.343	0.236**
LNGSDPAGRI (-5)	-0.218	0.293	-0.745	0.489**
LNAGRIEXP	-0.073	0.130	-0.564	0.596*
LNAGRIEXP (-1)	-0.176	0.132	-1.335	0.239**
LNAGRIEXP (-2)	-0.119	0.111	-1.064	0.335**
LNEDU	0.374	0.131	2.847	0.035**
LNEDU (-1)	-0.469	0.252	-1.863	0.121**
LNEDU (-2)	0.217	0.190	1.140	0.305**
LNHEALTH	-0.514	0.209	-2.451	0.057*
LNRURDEV	0.174	0.177	0.984	0.370**
LNRURDEV (-1)	-0.175	0.155	-1.126	0.311**
LNRURDEV (-2)	0.185	0.254	1.009	0.358**
LNTRANSP	0.311	0.254	1.223	0.275**
LNTRANSP (-1)	-0.229	0.204	-1.123	0.312**
LNTRANSP (-2)	-0.376	0.226	-1.658	0.158**
C	1695.95	403.91	4.198	0.008

Source: Computation from Reserve Bank of India Publication and Finance Accounts of Government of Himachal Pradesh (1993-94 to 2022-23).

Note: *, **, * indicate the level of significance at 1%, 5% and 10% respectively. GSDPAGRI =Agricultural Output (agri GSDP), AGRIEXP = public expenditure on agriculture & allied activities, EDU = public expenditure on education, HEALTH = public expenditure on health, RURDEV = public expenditure on rural development, TRANSP = public expenditure on transportation and communication.**

effect of public expenditure on agriculture and allied activities on the agricultural output shows negative coefficient which indicates 1 unit increase in agriculture and allied activities leads to 0.073 units decrease in agricultural output in current period. Observably the impact of both lagged values of public expenditure on agriculture and allied activities is negative and was found not to be statistically significant. The coefficients of have revealed the mixed results, the current period and two-period lagged coefficient indicate a positive and significant relationship between public expenditure on education and agricultural output while one-period lagged coefficient implies a negative relationship between the both but statistically significant in the current period and one-period lagged. Moreover, Public expenditure on Medical and Public Health was found to be negatively related to Agricultural Output in current year, however it was found to be statistically significant. This might be Increased public health spending may divert resources from agricultural investments, such as research and development and irrigation. This could hinder the growth of the agricultural sector. Similarly, Public expenditure on Rural development was found to be positively related to Agricultural Output exchange rate in current period and two lagged period and negatively related to one lagged period 1% fall in increase in public expenditure on Rural development will reduce Agricultural output to 0.175 in one lagged period although the relationship is statistically insignificant.

Error Correction of Autoregressive Distributed Lag Model

The negative and significant ECT in Table 2.4 confirms that the variables are cointegrated which confirms that the variables are cointegrated, indicating a long-run equilibrium relationship between Agricultural GSDP and the other variables. The negative and significant coefficient on the ECM (-1) term further supports this long-run relationship, suggesting that the system tends to return to its equilibrium over time. The speed of adjustment toward long-run equilibrium is 104.70% annually, meaning the system corrects its previous period disequilibrium at this rate each year.

Table 2.4
Error Correction Representation of the Selected ARDL (5, 2,2,0,2,2)

Dependent Variable: LNGSDPAGRI				
Variable	Coefficient	Std. Error	t-Stat	Prob.
Δ (LNGSDPAGRI) (-1)	-0.153	0.182	-0.840	0.438**
Δ (LNGSDPAGRI) (-2)	-0.179	0.190	-0.943	0.388**
Δ (LNGSDPAGRI) (-3)	-0.185	0.161	-1.145	0.303**
Δ (LNGSDPAGRI) (-4)	0.218	0.146	1.492	0.195**
Δ (LNAGRIEXP)	-0.073	0.055	-1.334	0.239**
Δ (LNAGRIEXP) (-1)	0.119	0.049	2.403	0.061*
Δ (LNEDU)	0.374	0.074	5.023	0.004***
Δ (LNEDU) (-1)	-0.217	0.079	-2.741	0.040**
Δ (LNRUDEV)	0.174	0.078	2.233	0.075*
Δ (LNRUDEV) (-1)	-0.185	0.077	2.403	0.061*
Δ (LNTRANS)	0.311	0.110	2.825	0.036**
Δ (LNTRANS) (-1)	0.376	0.142	2.631	0.046**
ECT (-1)	-1.047	0.150	-6.698	0.000***

Source: Computation from Reserve Bank of India Publication and Finance Accounts of Government of Himachal Pradesh (1993-94 to 2022-23).

Diagnostic tests

i) Normality Tests:

H0: Residuals are normally distributed; H1: Residuals are not normally distributed

Jarque-Bera= 0.475; p = 0.788. Here, the Null Hypothesis (H0) cannot be rejected indicating that the residuals are normally distributed.

ii) Breusch-Godfrey Serial Correlation LM Test:

H0: Residuals are not serially correlated; H1: Residuals are serially correlated

Obs*R-squared = 0.536; p = 0.764. In this case, the Null Hypothesis (H0) cannot be rejected and hence the residuals are not serially correlated.

iii) Heteroskedasticity Test Breusch Pagan-Godfrey:

H0= Residuals are not heteroscedastic; H1: Residuals are heteroscedastic

Obs*R-squared=1.911; p = 0.948.

These tests revealed that the model is free from serial correlation and heteroskedasticity, ensuring that the estimated coefficients are unbiased and efficient. Moreover, the normality assumption is satisfied, which is essential for accurate inference and hypothesis testing.

VI. Conclusion

In conclusion, this section has examined impact of public expenditure on agricultural output, trends, and patterns in Himachal Pradesh. It reveals a dynamic pattern in public expenditure on agriculture, education, medical and public health, rural development, transportation, and communication. The Gross State Domestic Product (GSDP) of Himachal Pradesh has shown steady growth in recent years, supported by various development initiatives by the state government. Factors contributing to this growth include infrastructure development, agriculture, hydropower, manufacturing, and services sectors like IT, ITES, healthcare, education, and tourism. The government's focus on improving infrastructure, such as roads and electrification, has enhanced economic productivity and attracted investment. The steady growth of Himachal Pradesh's GSDP can be attributed to strong sectoral performance, effective government policies, skilled workforce, and ongoing infrastructure development. Crop production in Himachal Pradesh has also shown steady growth due to factors such as crop diversification, government support, infrastructure development, technological advancements, cooperative movements, horticulture focus, research and education, and climate adaptability. The Agriculture Gross State Domestic Product (GSDP) in Himachal Pradesh has been steadily increasing over the years due to various agricultural practices, government support, infrastructure development, technological advancements, effective market mechanisms, and favorable climatic conditions. Crop

production in Himachal Pradesh has shown a steady growth trend over the years due to various factors, including crop diversification, government support, infrastructure development, technological advancements, cooperative movements, horticulture focus, research and education, and climate adaptability. Farmers are moving beyond traditional cereal crops to cultivate high-value crops like fruits, vegetables, and pulses, maximizing land use and income which enhances agricultural productivity and sustainability.

The ARDL model F-Bounds test indicates that Agricultural Output have significant long-run relationships with Public expenditure on Agriculture and allied activities, public expenditure on Education, Public expenditure on Medical and Public Health, Public expenditure on Rural development, Public expenditure on Transportation and Communication. Also, negative and significant coefficient on the ECM (-1) term confirms this long-run relationship and indicates that the system tends to adjust back to its equilibrium over time. However, the F-Bounds test and ECM (-1) term suggests a long-run relationship, it is important to conduct further analysis, such as diagnostic tests to validate the results and ensure the robustness of the model. The CUSUM line remains within the control limits throughout the observed period. This suggests that the process is stable and in control. There is no evidence of a significant shift from the target value. The diagnostic test of the selected (5, 2,2,0,2,2) model has revealed that the selected model confirms the existence of normality and also confirms free from the serial correlation and heteroskedasticity. Hence, the results of the diagnostic test have indicated that the selected model has the desired econometric properties.

REFERENCES

1. Dhanbir Singh (2024) “*Changing and Issues of Agriculture in Himachal Pradesh*”, **International Journal of Creative Research Thoughts (IJCRT)**, Volume 12, Issue 5, pp 417-425.
2. Shilpa Devi and Navneet Kaur (2022) “*Agriculture in Himachal Pradesh and Its Neighbouring Himalayan States: The Present Scenario*” **Indian Journal of Hill Farming**, June 2022, Volume 35, Issue 1, Page 145-154.
3. K. N. Selvaraj (1993), “*Impact of Government Expenditure on Agriculture and Performance of Agricultural Sector in India*”, **Journal of Agricultural Economics**, XVI, 2 (December 1993) pp. 37-49.
4. Jairath M.S. (2008), “*Trends in Private and Public Investments in Agricultural Marketing Infrastructure in India*”, **Agricultural Economics Research Review**, Vol 21, pp- 371 to 376.
5. Seema Bathla (2014), “*Public and Private Capital Formation and Agricultural Growth in India: State Level Analysis of Inter-linkages during Pre- and Post-reform Periods*”, **Agricultural Economics, Research Review**, Volume 27, Pp-19-36.
6. Sara Gopal Krishnan and K. Jothi Sivagnanam (2015), “*Structural Changes within 'Agriculture and Allied' Sector in India*”, **Agriculture Situation in India**, May 2015, pp 25 to 32.
7. Singh, R.K Sharma and MS. Mamta (2015), “*Trends in Growth of Production, Crop Diversification, Productivity, Profitability and Cost Structure in Haryana Agriculture*”, **Agriculture Situation in India**, October 2015, pp 16 to 30.
8. Apata, T. G. (2019), “*Public spending mechanisms and gross domestic product (GDP) growth*”, **Bulletin of Geography**. Socio-economic Series, No. 44, pp- 57 to 72.
9. Anisha Modi and P. Gopinath (2019), “*Changes in Cropping Pattern in Rajasthan: 1957 to 2017*”, **Ind. Jn. of Agri. Econ.** Vol.74 (1), pp- 155 to 172.
10. Venkatesha, T. K. (2019), “*Public and private investment in Indian Agriculture – An analysis*”, **International Journal of Arts, Science and Humanities**, Vol 6, issue 3, pp _72- 79.
11. Anjani Kumar, Seema Bathla and Smriti Verma (2020) “*Revisiting the relationship between public and private capital formation in Indian agriculture: A disaggregated analysis*”, **International Food Policy Research Institute**, pp- 6 to 40.
12. Shivaswamy, G.P., Anuja, A.R., Singh, K.N., Shekhawat, R.S. and Harish Kumar H.V. (2020), “*Public expenditure on agricultural inputs and farm support services in India – An overview*”, **ICAR-Indian Agricultural Statistics Research Institute**, Vol. 41(4), pp 418 to 423.

13. Sunil K Muttalageri and Dr. R R Biradar (2021), “Agricultural Subsidies in Karnataka: An Analysis of Its Impact on Farmers”, **IJEDR**, Vol-9, Issue-1, pp 241 to 246.
14. Rashmi Gupta and Swati Shastri (2020) “Public Expenditure and Economic Growth in India: An Empirical Analysis Using Vector Autoregression (VAR) Model”, **Journal of Business and Economics Review**, vol 5, issue 2, pp. 45 – 58.
15. Prof. Aparna Negi and Mr. Gaurav Dutt (June 2023), “Growth of Public Expenditure on Education in Himachal Pradesh”, **International Journal of Economic Perspectives**,17(06) 295-312.
16. **Economic Survey of Himachal Pradesh 2022-23**. Economic and Statistics Department, Government of Himachal Pradesh
17. HT Correspondent, Dharamshala (2024, August 10) “Himachal to launch ₹150-crore scheme to boost natural farming”, **Hindustan Times**.
18. Dr. Vinod Kumar (2022) “Impact of Rural Development Programmes on the Rural Households in Himachal Pradesh”, **Journal of Arts, Humanities and Social Sciences**, Volume - 5, Issue – 4, pp- 28 to 32.
19. 11. M. Hashem Pesaran & Yongcheol Shin & Richard J. Smith (2001)“Bounds testing approaches to the analysis of level relationships,” **Journal of Applied Econometrics**, John Wiley & Sons, Ltd., vol. 16(3), pages 289-326.

