

## Growth of Primary Sector in Himachal Pradesh

Manoj Kumar\* and K C Sharma\*\*

\*Govt. College Chowari, Distt.Chamba

\*\* HPU Centre for Evening Studies, Shimla

### Abstract

*The present empirical study deals with the measurement of growth of the primary sector in Himachal Pradesh. For this purpose, we have compiled information on gross state domestic product for the primary sector (at constant prices) at aggregated and disaggregated levels, available for the period from 1980-81 to 2015-16. For measuring the growth of primary sector and its sub-sectors, we made use of alternative growth rates, to justify the equation of best fit into eleven different types of growth rates i.e. simple linear (SLR); parabolic (PRB); cubic (CUB); log-linear (LLN); log-parabolic (LPB); log-cubic (LCB); geometric (GEO); hyperbolic (HYP); modified exponential (MEX); gompertz (GOM) and logistic (LGS), were tested for state gross domestic product (SGDP) for primary sector at aggregated/disaggregated level. From results we concluded that income has exhibited a U shaped growth pattern for fishing (FSNG), during the entire study span. The inverted U shaped growth patterns observed for forestry and logging (FRLG), primary sector (PRMR). During the entire study period the mining and quarrying (MNQR), displayed an increasing trend in relative share, while the relative share of agriculture and animal husbandry (AGRL), forestry and logging (FRLG), and fishing (FSNG), sub-sector displayed a declining trend.*

**Keywords:** Growth, Himachal Pradesh, Primary, Sector

**JEL Classification:** C82, E01, O13, R11

### Introduction

Himachal Pradesh is a small hilly state, performing well as compared to adjoining states like Punjab and Haryana. The state gross domestic product growth rate may be stated the backbone of any economy. According to the ministry of statistics and programme implementation (GOI) for the year 2018-19 the SGDP growth rate of Himachal Pradesh was 7.34 percent, Punjab 6.37 percent, Haryana 8.19 percent and all India 6.81 percent. To understand the economy better economist like Colin Clark (1951) and Fisher (1935) have divided the economy into three sectors - primary sector, secondary sector and tertiary sector. The primary sector includes agriculture, fishing, farming and mining. Amongst the primary sector, agriculture is the predominant occupation and has the largest share in national income. The economy of Himachal Pradesh is predominantly dependent upon agriculture and in the

absence of a strong industrial base, any fluctuations in the agricultural or horticultural production effects the economic growth of the State. During 2017-18 about 8.84 percent of State income has been contributed by agriculture sector alone (Anonymous, 2018-19). The sectoral analysis reveals that during 2017-18, the percentage contribution of primary sector to total GSDP of the State is 13.73 percent (Anonymous, 2018-19). The primary sector, which includes agriculture, forestry, fishing, mining and quarrying, during 2017-18, witnessed negative growth of 1.0 percent due to decrease in agriculture and apple production in the state by 2.04 and 4.61 percent respectively, as compared to 2016-17 (Anonymous, 2019). The share of primary sector which include agriculture, forestry, fishing and mining & quarrying has declined from 35.52 percent in 1990-91 to 13.73 percent during 2017-18. (Anonymous 2019). The growth rates of the primary sector and its sub-sectors are more instable when compared to secondary or tertiary sectors due to the more dependence

of this sector on weather. So an attempt has been made in this study to find and compare the growth rates of primary sector and its sub-sectors in Himachal Pradesh.

### Data Sources and Methodology

The present study is quantitative research and based on secondary data collected from the various reports of economic and statistical department of Himachal Pradesh. There are certain tools and technique which have been used to achieve different objectives of the present study. The results in the present study have been calculated by applying the following statistical tools:

### Akaike Information Criterion (1973)

$$AIC = 2k - 2 \ln(\hat{L})$$

Where:

$k$  is the number of estimated parameters in the model.  
 $\hat{L}$  is the maximum value of the likelihood function for the model

### Long-term Trend Analysis

For estimating long-term behavioural growth paths, traced by each of the components of a particular study variable (say, gross domestic product), an attempt was made to search out the curves of the best fit from amongst the following 11 distinct trend relationship in time variable  $t$ :

1. Simple Linear (SLR) :  $Y_t = b_0 + b_1 t + u_t$
2. Parabolic (PRB) :  $Y_t = b_0 + b_1 t + b_2 t^2 + u_t$
3. Cubic (CUB) :  $Y_t = b_0 + b_1 t + b_2 t^2 + b_3 t^3 + u_t$
4. Log-Linear (LLN) :  $\ln Y_t = b_0 + b_1 t + u_t$
5. Log-Parabolic (LPB) :  $\ln Y_t = b_0 + b_1 t + b_2 t^2 + u_t$
6. Log-Cubic (LCB) :  $\ln Y_t = b_0 + b_1 t + b_2 t^2 + b_3 t^3 + u_t$
7. Geometric (GEO) :  $Y_t = b_0 b_1^t e^{u_t}$
8. Hyperbolic (HYP) :  $Y_t = \frac{t}{b_0 t + b_1 + t_u}$
9. Modified Exponential (MEX) :  $Y_t = k + b_0 b_1^t$
10. Gompertz (GOM) :  $Y_t = k b_0^t b_1^t$
11. Logistics (LGS) :  $Y_t = \frac{k}{1 + b_0 b_1^t}$

Where  $u_t$  stands for disturbance term at time  $t$ ;  $b_0$ ,  $b_1$ ,  $b_2$  and  $b_3$  represents the unknown coefficients which were estimated through the OLS technique.

### Relative Growth Rates

With the help of the best-fit functional form, relative growth rates (RGR<sub>t</sub>) in the time-series  $\{Y_t\}$  in respect of different components of gross domestic product were computed. As per Rudra (1970),  $RGR_t = Y_t/Y_{t-1}$  where  $Y_t = [dy/dt]$  represents the time derivation of  $Y_t$ .

For different functional forms, the derived expressions (by Sethi, 2009) for relative growth rates were:

1. SLR =  $\frac{b_1}{b_0 + b_1 t}$
2. PRB =  $\frac{b_1 + 2b_2 t}{b_0 + b_1 t + b_2 t^2}$
3. CUB =  $\frac{b_1 + 2b_2 t + 3b_3 t^2}{b_0 + b_1 t + b_2 t^2 + b_3 t^3}$
4. LLN =  $b_1$
5. LPB =  $b_1 + 2b_2 t$
6. LCB =  $b_1 + 2b_2 t + 3b_3 t^2$
7. GEO =  $\frac{b_1}{t}$
8. HYP =  $\frac{b_1}{(b_1 + b_0 t) t}$
9. MEX =  $\frac{(b_0 b_1 t) \ln b_1}{k + b_0 b_1^t}$
10. GOM =  $\ln b_0, \ln b_1, b_1$
11. LGS =  $\frac{-(b_0 b_1^t) \ln b_1}{1 + b_0 b_1^t}$

Such growth rates were computed at different points in time so as to examine of consistency, acceleration or deceleration regarding behavioural growth paths traced by the different components. For this purpose, the temporal changes in the relative growth rates were depicted against time graphically.

### Results and Discussion

Findings from the analysis have been discussed under the three broad heads: the first section is devoted to the equation of best: the second section analyses fit long-term trends in different components of domestic product from primary sector and sub-sectors in Himachal Pradesh economy; the third section is devoted to the Relative Growth Rates in Real domestic product from primary sector and sub-sectors of Himachal Pradesh economy, covering the period from 1980-81 to 2015-16.

**Table 1. Values of Akaike's Information Criterion (AIC) for Eleven Different Functional Forms in respect of the Indexes on Primary Sector and Sub-Sectors of Himachal Pradesh State (1980-81 to 2015-16)**

Sector/ Sub-Sector	Functional Form Estimated										
	SLR	PRB	CUB	LLN	LPB	LCB	GEO	HYP	MEX	GOM	LGS
AGRL	154.5	142.7	143.7	143.3	145.3	143.2	187.7	223.8	165.4	175.8	194.3
FRLG	169.5	149.5	147.4	160.6	154.7	149.7	197.3	221.7	160.2	161.3	162.3
FSNG	172.8	174.4	157.5	175.7	181.8	146.9	183.6	228.6	181.5	184.9	188.8
MNQR	197.6	185.9	185.3	185.0	185.7	196.4	211.9	241.8	205.6	221.1	291.9
PRMR	143.9	114.6	113.2	124.2	122.1	111.4	185.7	221.2	141.4	151.0	165.9

Source: Author's Computations

### Equation of Best Fit

Thirty-six years (1980-81 to 2015-16) data of Himachal Pradesh for primary sector including four sub-sectors viz., agriculture and animal husbandry (AGRL); forestry and logging (FRLG); fishing (FSNG); mining and quarrying (MNQR); primary sector (PRMR) as a whole was taken at constant prices with the base year 2011-12 which was again indexed for the base year 2011-12. To justify the equation of best fit eleven different types of growth rates SLR, PRB, CUB, LLN, LPB, LCB, GEO, HYP, MEX, GOM and LGS (Croxton and Crowden 1956) were tested for primary sector at

aggregated/disaggregated level. The choice for best-fit functional form was made based on the minimum value of Akaike's Information Criterion. Agriculture and animal husbandry sub-sector found the minimum value of Akaike's Information Criterion was 142.7 for the parabolic equation. Thus the parabolic growth rate equation was selected for this sub-sector. In the case of forestry and logging sub-sector, the minimum value of Akaike's Information Criterion was 147.4 for the cubic equation. Therefore the cubic growth rate equation was selected for this sub-sector. The fishing sub-sector found the minimum value of Akaike's Information Criterion

**Table 2. Best-Fit Functional Forms for indexed Primary Sector and Sub-sectors (At 2011-12 Constant Prices) in Himachal Pradesh at Disaggregated Level**

Sector/ Sub-Sector	Best fit Form	Values of the Coefficients	t-Values of the Coefficients	R <sup>2</sup>	Adjusted R <sup>2</sup>	F-value for R <sup>2</sup>	AIC
AGRL	PRB	$\beta_0 = 42.1261$ $\beta_1 = 0.4413$ $\beta_2 = 0.0474$	11.422*** 0.960 <sup>NS</sup> 0.012***	0.924	0.919	200.040	142.669
FRLG	CUB	$\beta_0 = 60.7549$ $\beta_1 = -3.1167$ $\beta_2 = 0.2214$ $\beta_3 = -0.0027$	11.120*** -2.471* 2.816** -1.952*	0.887	0.876	84.110	147.448
FSNG	LCB	$\beta_0 = 3.1320$ $\beta_1 = 0.1415$ $\beta_2 = -0.0057$ $\beta_3 = 8.9280 \times 10^{-5}$	36.419*** 7.125*** -4.646*** 4.056***	0.933	0.926	147.700	146.869
MNQR	LLN	$\beta_0 = 2.5896$ $\beta_1 = 0.0559$	25.680*** 11.770***	0.803	0.797	138.600	184.960
PRMR	LCB	$\beta_0 = 3.8660$ $\beta_1 = -0.0167$ $\beta_2 = 0.0024$ $\beta_3 = -3.5380 \times 10^{-5}$	75.419*** -1.419 <sup>NS</sup> 3.264** -2.699*	0.956	0.952	237.000	111.377

Source: Author's Computations

\*, \*\*, \*\*\* represents significance at 1%, 5% and 10% level of significance, ns means non significant

146.9 for the log-cubic equation. Hence log-cubic growth rate equation was selected for this sub-sector.

The minimum value of Akaike's Information Criterion was 185.0 for mining and quarrying sub-sector at the Log-Linear equation. Therefore the log-linear growth rate equation was selected for mining and quarrying sub-sector. The minimum value of Akaike's Information Criterion was 111.4 for the primary sector at the log-cubic equation. Therefore log-cubic growth rate equation was selected for the primary sector.

### Long-Term Trends in Different Components of SGDP from Primary Sector

A perusal at Table 2 reveals that the long-term growth pattern of gross state domestic product (GSDP) from agriculture and animal husbandry (AGRL) sub-sector of Himachal Pradesh most appropriately

modeled as parabolic (PRB), as it was associated with the minimum value (=142.669) of the Akaike's information criterion (AIC) among the eleven functional forms tried. Further, the equation had a reasonably high value for the line of best-fit ( $R^2=0.924$ ); a low value for adjusted  $R^2$  (=0.919) and F-value for  $R^2$  was 200.040. This indicated the equation of best-fit to the income from agriculture and animal husbandry of the Himachal Pradesh economy. Among the other three sub-sectors (viz., FRLG, FSNG, and MNQR) of the primary sector, a different type of pattern has been followed. In the case of forestry and logging cubic (CUB) turned out to be the equation of best-fit, for fishing log-cubic (LCB) and mining and quarrying log-linear (LLN) turned out to be the equation of best-fit.

The perusal of table 2 also reveals that the long-term growth pattern of gross state domestic product (GSDP)

**Table 3. Relative Growth Rates in Real GSDP of Primary Sector and Sub-Sectors of Himachal Pradesh**

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988
AGRL	1.258	1.460	1.654	1.838	2.011	2.173	2.324	2.464	2.593
FRLG	-4.636	-4.087	-3.492	-2.858	-2.198	-1.526	-0.856	-0.202	0.423
FSNG	13.023	11.953	10.937	9.974	9.065	8.209	7.407	6.659	5.964
MNQR	5.596	5.596	5.596	5.596	5.596	5.596	5.596	5.596	5.596
PRMR	-1.207	-0.758	-0.329	0.078	0.463	0.828	1.171	1.493	1.794
YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997
AGRL	2.710	2.816	2.911	2.996	3.071	3.137	3.194	3.242	3.283
FRLG	1.006	1.539	2.016	2.432	2.788	3.083	3.321	3.505	3.640
FSNG	5.322	4.735	4.200	3.720	3.293	2.919	2.599	2.333	2.12
MNQR	5.596	5.596	5.596	5.596	5.596	5.596	5.596	5.596	5.596
PRMR	2.074	2.332	2.569	2.785	2.980	3.153	3.306	3.437	3.546
YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGRL	3.317	3.344	3.364	3.380	3.390	3.395	3.396	3.394	3.388
FRLG	3.731	3.783	3.801	3.788	3.750	3.690	3.610	3.515	3.406
FSNG	1.961	1.855	1.803	1.805	1.860	1.968	2.131	2.346	2.616
MNQR	5.596	5.596	5.596	5.596	5.596	5.596	5.596	5.596	5.596
PRMR	3.635	3.702	3.748	3.773	3.777	3.759	3.720	3.660	3.579
YEAR	2007	2008	2009	2010	2011	2012	2013	2014	2015
AGRL	3.378	3.366	3.352	3.335	3.317	3.296	3.274	3.251	3.227
FRLG	3.285	3.155	3.015	2.869	2.715	2.556	2.392	2.222	2.047
FSNG	2.939	3.315	3.745	4.229	4.766	5.357	6.001	6.699	7.450
MNQR	5.596	5.596	5.596	5.596	5.596	5.596	5.596	5.596	5.596
PRMR	3.476	3.353	3.208	3.041	2.854	2.645	2.415	2.164	1.892

Source: Author's Computations

from primary (PRMR) sector of Himachal Pradesh was most appropriately modeled as log-cubic (LCB) as it was associated with the minimum value (=111.377) of the Akaike information criterion (AIC) among the eleven functional forms tried. Further, the equation had a reasonably high value for the line of best-fit ( $R^2=0.956$ ); a low value for adjusted  $R^2$  (=0.952) and F-value for  $R^2$  was 237.000. This indicated the equation of best-fit to the income from the primary sector of the Himachal Pradesh economy.

### Relative Growth Rates in Real GSDP of Primary Sectors and Sub-Sectors of Himachal Pradesh

The relative growth rates were worked out after identifying the most appropriate functional forms in respect of gross state domestic product in various sectors and sub-sectors of Himachal Pradesh economy with the help of the estimated values of the parameters of the equation of best-fit, to all data points for each of sectors and sub-sectors.

It may be emphasized, that exponential (EXP) failed to turn out to be the equation of best fit concerning various components of gross state domestic product while log-linear (LLN) used as the equation of best fit for only two places mining and quarrying (MNQR) sub-sector and for primary (PRMR) sector. Therefore, the majority of times, either deceleration or acceleration were prevalent in respect of growth in gross state domestic product in the economy of Himachal Pradesh at aggregated /disaggregated levels.

Relative growth rates of the various sectors and sub-sectors shown in table 3. The relative growth rate shows the high performance of a sector or sub-sector concerning another sector or sub-sector. If a sector is showing a relatively high growth rate, again and again, we can state it as the driver of growth. The fishing sub-sector revealed a maximum growth rate (i.e. 13.023 %) in 1980, followed by mining and quarrying (i.e. 5.596%) and agriculture (i.e. 1.258 %), while the negative growth rate found in the forestry and logging (i.e. -4.636 %) and the primary sector (i.e. -1.207 %). The mining and quarrying sub-sector maintains the relatively higher growth rate (i.e. 5.596 %) in 1990, followed by fishing (i.e. 4.735 %) and agriculture (i.e. 2.816 %). The minimum growth rate was found in the primary sector as a whole (i.e. 2.332 %) and forestry and logging (i.e. 1.539 %). The mining and quarrying sub-sector maintains the relatively higher growth rate (i.e. 5.596 %)

in 2000, while the growth rate of forestry and logging, primary sector and agriculture sector were more or less same (i.e. 3.801, 3.748, and 3.364 % respectively). The minimum growth rate found in fishingsub-sector (i.e. 1.803%). The mining and quarrying sub-sector maintains the relatively higher growth rate (i.e. 5.596 %) in 2010, followed by fishing (i.e. 4.229 %) and agriculture (i.e. 3.335 %). The minimum growth rate was found in the primary sector (i.e. 3.041 %) and forestry and logging (i.e. 2.869 %). The fishing sub-sector maintains the relatively higher growth rate (i.e. 7.450 %) in 2015, followed by mining and quarrying sub-sector (i.e. 5.596 %) and agriculture (i.e. 3.227 %). The minimum growth rate found in forestry and logging (i.e. 2.047 %) and the primary sector (i.e. 1.892 %).

Figure I also represent the relative growth rates in respect of the different components of the domestic product from the primary sector in the Himachal Pradesh economy. As discernible from the figure, growth rate of agriculture and animal husbandry sub-sector has been following an increasing pattern up till 2004, and afterwards, it began to decline at a plodding pace. The maximum (i.e. 3.396 percent per annum) and minimum (i.e. 1.258 percent per annum) values of  $RGR_t$  were recorded during 2004 and 1980 respectively. As regards the forestry and logging sub-sector, has been following an increasing pattern up till 2000, and afterwards, it began to decline at a languid pace.

The maximum (i.e. 3.801 percent per annum) and minimum (i.e. -4.636 percent per annum) values of  $RGR_t$  were recorded during 2000 and 1980 respectively. The fishing sub-sector has been following a declining pattern up to 2000 after that shows an increasing pattern. The maximum (i.e. 13.023 percent per annum) and minimum (i.e. 1.803 percent per annum) values of  $RGR_t$  were recorded during 1980 and 2000 respectively. The mining and quarrying sub-sector shows a constant growth rate (i.e. 5.596 percent per annum) during the entire study period from 1980 to 2015. As for as the primary sector is concerned, the growth rate in this sector has witnessed an increasing pattern up to 2002, and afterwards, it began to decline. The growth rate in this primary sector is similar to that of the growth rate of agriculture and animal husbandry and forestry and logging. The maximum (i.e. 3.777 percent per annum) and minimum (-1.207 percent per annum) values of  $RGR_t$  were recorded during 2002 and 1980 respectively.

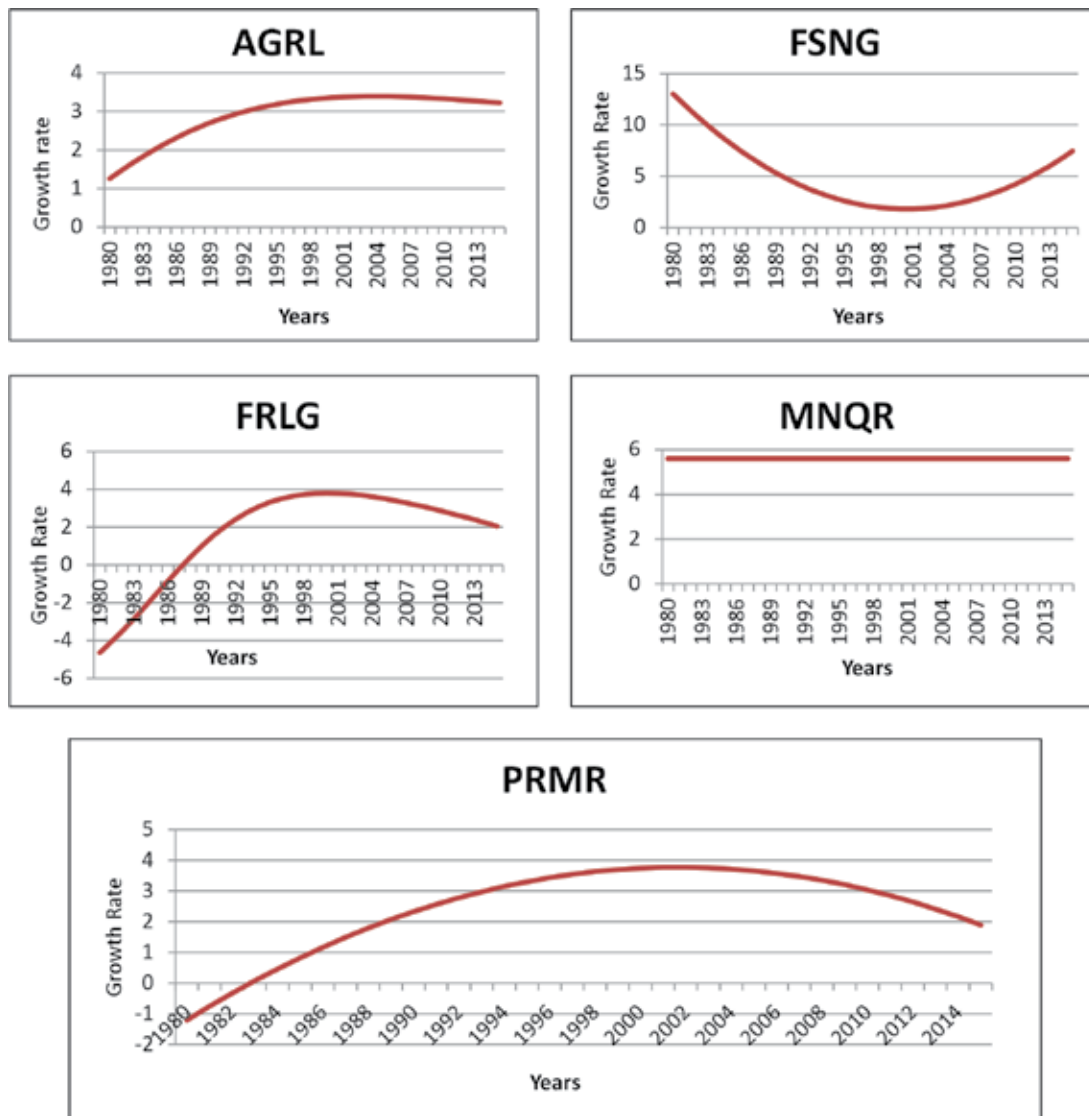


Figure I: Relative Growth Rates in Real GSDP from Primary Sector and Sub-Sectors of Himachal Pradesh

### Conclusion and Policy Implications

As regards the long-run growth performance, behavioural growth paths in respect of the various components of the domestic product from the primary sector were observed, in general, to be non-linear at aggregated/ disaggregated levels for the Himachal Pradesh economy. Moreover, the majority of the sectors followed third-degree trend path functions; that is, CUB and LCB turned out to be the best representatives in three cases. Specifically speaking, the equations viz., PRB, CUB, LCB, and LLN were observed to be of poorer-fit. The absence of an exponential growth rate equation indicates that none of the components of the

domestic product registered a constant rate of growth during the study period except mining and quarrying (MNQR) sub-sector where LLN equation found as the line of best fit. Notably, income has exhibited a U shaped growth pattern for fishing (FSNG), during the entire study span. The inverted U shaped growth patterns observed for forestry and logging (FRLG), primary sector (PRMR). During the entire study period the mining and quarrying (MNQR), displayed an increasing trend in relative share, while the relative share of agriculture and animal husbandry (AGRL), forestry and logging (FRLG), and fishing (FSNG), sub-sector displayed a declining trend.

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