



ORIGINAL RESEARCH PAPER

Economics

SUSTAINABILITY ISSUES OF FOOD CROPS IN HIMACHAL PRADESH

KEY WORDS: Compound Growth Rate, Agriculture Crops, Production and Instability.

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ABSTRACT

The objective of the paper is the assessment of sustainable issues of food crops and sustainable development in Himachal Pradesh. The approaches for assessing the agriculture sustainability in terms of growth, instability and equity are generally the most listed indicators of agricultural Sustainability. Sustainable indicators are Quantifiable and measurable attributes of a system that are judged to be related to its sustainability. Sustainability indicators have multidimensional attributes- economic environmental and social. In this paper an attempt has made to estimate the relative shares of growth of area and yield to the growth of output of major food grains in Himachal Pradesh for the period 1980-81 to 2015-2016 and further it is split into two sub periods, period I 1980-81 to 1997-98, period II 1998-99 to 2015-2016. Further, Instability, in agricultural sector, which measures the range of variation in different dimensions; it may be in area of cultivation, yield or production. Here it has been shown, the range of instability in production among different crops in Himachal Pradesh. The result of instability analysis as per hectare yield of total food grains (3.017) showed higher instability in comparison to other crops in both the third sub – periods. Due to instability the rural inequalities are increasing and employment opportunities are shrinking. Therefore, Govt. policy should accord highest priority to take steps to make most efficient use of resources to deal with sustainability issues.

INTRODUCTION

The term "sustainable development" was popularized by the work of the world commission on environment and development in mid 1980s, but its origin dates back to the eighteenth centuries when foresters in Europe used the word "sustainable" to voice their concern for clear cutting method of logging. Environmental concerns gained international attention during the Brundtland Commission and a document emerged from the Brundtland Commission entitled "Our common Future" in 1987 in which sustainable development was defined as meeting the needs of the people today without jeopardizing the needs of future generations (WCED, 1987). The term sustainable development implies a long-term view of development and environment integrity.

Sustainable agriculture has been defined as "the successful management of resources for agriculture to satisfy changing human needs while maintain or enhancing the quality of environment and conserving natural resources." The agriculture in Himachal Pradesh has undergone some significant transformation in recent past. Agriculture sector has contributed 14.95 percent of the net state domestic product and helped the state economy to proposed the overall economic growth to 8.1 percent during 2015-16 (Government of Himachal Pradesh, 2018). As compared to the other states of India, Himachal Pradesh has very high proportion of workers (62.00) who directly depend on agriculture for their livelihood. The share of cultivator population has declined from 63.25 to 50.17 percent while that of agricultural labourer has increased from 3.30 per cent to 3.81 per cent between the period 1991 to 2011 (Government of Himachal Pradesh, 2016). Although there is a natural transfer of workers from agriculture sector to non-agriculture sectors taking place. High dependence of workers on this sector has resulted in lower labour productivity growth compared to no-agricultural sector. However, it is important to analyse the growth rates of selected crops and contribution to overall agricultural growth in Himachal Pradesh. Agricultural growth led by rise in yield is sustainable in the long term while too much of input intensification may affect the conditions of natural resources such as land and water.

Instability, in agricultural sector, which measures the range of variation in different dimensions; it may be in area of cultivation, yield or production. Here it has been shown, the range of instability in production among different crops in Himachal Pradesh. In other word, this study intend to measure the extent of

instability in the production of major crops in this state. There are many studies such as Rao (1975), Dharm Narain (1976), Mehra (1981), Hazell (1982), Rao et al (1988), etc, have pointed out that the new strategy of agri-cultural production based on high-yield varieties (HYV) seed-fertiliser technology has contributed to the growth in production and productivity. At the same time they have also pointed out that this growth has been accompanied with the increase in the output/yield variability (R.Shimar 2014).

In overall debates on the sustainable development, agriculture sector is often at the centre of discussion due to the obvious environmental problems associated with farming activities, Sustained growth in agriculture production and productivity is essential for overall stability of the economy. Sustainable agriculture is an elusive and difficult concept to define precisely. Sustainable agriculture has been defined as "the successful management of resources for agriculture to satisfy changing human needs while maintain or enhancing the quality of environment and conserving natural resources" (Food and agricultural Organization 1989).

The paper is organized in five sections. The first section provides introduction of the state. The second section provides objectives, data and methodology. In the third section presented result and discussion and along with the trends in agricultural growth in area yield and output in Himachal Pradesh. The fourth section discusses instability of agriculture crops and rural equity. Concluding remarks are made in the last section of the study.

II. Objectives of the Study

- 1 To study the crops pattern in selected food crops Himachal Pradesh
2. To estimate the compound growth rates of area, production and yield of major crops in Himachal Pradesh.
3. To analyse the instability for major crops in Himachal Pradesh.

Data Sources

The study entirely based on the secondary data compiled from various published sources of Govt. of Himachal Pradesh, Directorate of Land Records and Economic and Statistics Department. The state has a diversified cropping pattern in different regions depending upon agro-climatic conditions and hence all the major crops and crop groups have been selected for the present analysis. The selection of crops and crop groups for the study is dictated by the availability of data. The present study is conducted for whole Himachal Pradesh for the period 1980-81

to 2016-17. The entire study is split into two sub periods, period I: 1980-81 to 1997-98; period II 1999-99 to 2015-15 and overall period: 1980-81 to 2015-16.

METHODOLOGY

Growth rate Trend:

Agriculture development of a region can be determined through measuring the growth in area, output and productivity of the particular region. In the present analysis, compound growth rates of area, output and yield of the major crops and crop groups for each period is measured. If the time-series data are available at discrete points of time (as is usual in economic time series) it is than possible to determine growth rate by using the compound interest rate formula:

$$Y = \log a + t \log b \quad \text{CGR} = (\text{antilog } b - 1) \times 100$$

$$\text{or } r = [(\text{antilog } b - 1) * 100] = \text{Compound growth rate (in per cent)}$$

This may be expressed in percentage term by multiplying r by 100.

Where, CGR = Compound growth rate

Y = time series data of area/production/yield of crop concerned in the year

a = intercept

b = 1 + r/100

r = refers to percentage rate of compound growth rate of area/production/yield of crop per annum

t = time period in year

To test whether „r” differs from zero significantly, its standard error has been calculated using

SE(r) =

$$\frac{100 / \text{Loge} 10 \sum_{t=1}^n \frac{(\sum_{t=1}^n \log Y_t) - (\log B) 2 \sum_{t=1}^n (t-t)^2}{n} - (\log B) 2 \sum_{t=1}^n (t-t)^2}{(n-2) \sum_{t=1}^n (t-t)^2}$$

Where „t” follows student “t”-distribution with (n-2) degrees of freedom.

INSTABILITY

The agricultural instability can be measured by different methods, such as the coefficient of variation (CV), dispersion, Cuddy Della Valle Index (CDI), etc. The present study applies the for measuring the instability as an exponential index. IXEXP is obtained, by fitting an exponential time trend to the crops output, yield and Area. The equation of the exponential trended is written as:

$$Y_t = a_i e^{b_{it}} u_{it}$$

$$\text{Log}(Y_{it}) = \log a_i + b_{it} + \log u_{it} \quad (i = 1, \dots, n)$$

Where (Y_{it}) is the crop output of period - I in time t, t represents time, and u_{it} is the distribution term. Ordinary Least Squares is then used to estimate the equations. IXEXP measures deviations from a constant growth rate trendline.

Table. 1 Share of Area under major crops in India (Area in hectare)

Crops	1990-93		2000-03		% change over 1990-93 to 2000-03	2010-13		% change over 2000-03 to 2010-13
	Actual	Percent	Actual	Percent		Actual	Percent	
Wheat	378947	38.71	362879	38.21	-4.24	357155	37.92	-1.58
Maize	314427	32.11	299712	31.56	-4.68	297517	31.59	-0.73
Rice	83343	8.51	81767	8.61	1.89	76857	8.16	-6.00
Barely	28133	2.87	25419	2.68	-9.65	22021	2.34	-13.68
Total cereal	825802	84.34	783536	82.52	-5.12	762765	80.99	-2.65
Total pulses	41210	4.21	30260	3.19	26.57	31601	3.35	4.43
Total food grain	863898	88.23	813796	85.71	-5.80	794386	84.35	-2.38
Total vegetables and fruits	71034	7.25	96056	10.12	35.22	109134	11.59	13.61
Total food crops	946498	96.67	918584	96.74	-2.95	912888	96.93	-0.62
Total nonfood crops	35449	3.62	30912	3.25	-12.80	28863	3.06	-6.63
Gross cropped Area	979034	100.00	949496	100.00	-3.01	941751	100.00	-0.81

$$IXEXP = 100 / \bar{Y} [\sum_{t=1}^n (Y_{it} - \bar{a} e^{b_{it}})^2 / n - 2]^{1/2}$$

Ȳ being the mean of Y_i

Since we wish principally to consider period wise variability in crop production yield and area. This estimation method has two advantages. Firstly, the error terms, expressed as natural logs, give a percentage estimate of the degree of instability. Secondly it helps in disaggregating the components of instability. If a growth curve is estimated for each components of particular aggregate variable, it can be seen that the weighted sum of the residuals closely approximates the residuals of the aggregate growth curve. These results it can be extremely useful in the analysis of the components of instability. Moreover, most of the policy decisions, on the long-term basis, are taken in terms of growth rates rather than in absolute increments.

Also, to test the change in variability of area, yield and output between the two periods, F-ratios are calculated using variances in period I and II calculated from n₁ and n₂ observations respectively. Then ratio:

$$F = \frac{\sigma^2}{\sigma^2}$$

Residual Sum of Squares

Where $\sigma^2 =$ -----

Degrees of Freedom

Is distribution as F - distribution with n₁-2 and n₂-2 degree of freedom.

RESULT AND DISCUSSION

CROPPING PATTREN IN HIMACHAL PRADESH

Agriculture is foundation of Himachal Pradesh. During the last three decades agricultural sector witnessed a transformation in favour of high value crops (Sharma 2005). One of dynamic factors contributing to structural changes is State Domestic Product (SDP) and employment is change in cropping pattern triggered by market opportunities and demand factors.

Source:

- 1) State Statistical Abstract of Himachal Pradesh, Department of Economics and Statistics.
- 2). Statistical Outline of Himachal Pradesh, Department of Economics and Statistics

Below table 1 revealed the decline of 2.65 per cent area under cereals over the period 2000-03. The Data exhibits that 84.35 per cent of gross cropped area in the state was under food grains in the year 2010-13. This indicates the dominance of food crops cultivation in the state. Wheat is the leading crop in the state occupying around 37.92 per cent of cropped area, followed by Maize (31.59), rice (8.16) per cent. The share of

pulses and total fruits and vegetables in cropped area are 3.35 percent and 11.59 per cent respectively.

Area under wheat, maize, rice and barley has shown decreasing trends whereas converse is true in case of pulses, fruits and vegetables. There has been a remarkable shift in area under fruit and vegetables. It has increased by 13.61 per cent during the period, thus increasing the proportion of fruits and vegetable to total cropped area from 10.12 per cent to 11.59 per cent.

Agriculture Crops Growth rates in Area, Yield and Production wise in Himachal Pradesh

Agriculture plays important role in the growth of the state economy in terms of employment generation to rural workforce. The growth rates of area, output and productivity of different crops in Himachal Pradesh over the two periods of time and overall period are presented in the following tables. Rice is an important kharif crop in the state occupying about 9.63 per cent of total food grains area and contributing about 7.95 per cent to total food grains output of the state during 2015-16 (Statistical Abstract of Himachal Pradesh 2016-17). The two most important rice growing districts of the state are Kangra and Mandi. The results reported in Table 2 showed that during the entire period (1980-81 to 2015-16) under study, the area under rice declined at the rate of negatively 0.79 per cent per annum while yield of the crop has increased significantly at the rate of positively 1.84 per cent per annum for the state as a whole.

Note:*, **, * indicates statistically significant at the 1, 5 and 10 percent confidence levels respectively.**

Source: Annual Season and Crop Reports of Himachal Pradesh, various publications.

Cereals dominates cropping pattern in Himachal Pradesh and covered 96.04 per cent of the state's total food grains area and contributes 95.24 per cent of total food grains production in the year 2015-16 (Statistical Outline of Himachal Pradesh, 2017-18). The state witnessed significantly positive output and yield growth during all the periods under study. There was decline in area of cereals under period II and overall period III.

Area under pulses in the state has been reported to decline at a high rate of negatively 2.21 per cent per annum during period III. While highly significant growth rate was found in case of yield of the magnitude of 2.06 per cent per annum and caused output growth to be positive of the magnitude of 4.82 per cent per annum for the whole state. During period I pulses witnessed negative trend in respect.

INSTABILITY ANALYSIS

For analysing instability question only major crops have been

taken up for discussion and analysis. To estimate the instability of agriculture sector in Himachal Pradesh, the study broadly covered the period of thirty-six year from 1980-81 to 2015-16 and further divided into two sub period i) pre-liberalization phase (1980-81 to 1997-98) and ii) post liberalization phase (1997-98 to 2015-16).

The instability in production of seven major crops including total cereal production are presented in table 3, the per hectare yield of barely, total cereals rice, maize and total food grains showed higher instability in comparison to other crops in both the two sub-periods.

Note: O-output, Y-Yield, A-Area *, ** indicates statistically significant at the 5 and 1 percent confidence levels

Source: Annual Season and Crop Reports of Himachal Pradesh, various publications.

In overall III period, the yield of total food grains (3.017 per cent), followed by rice (0.214 per cent), wheat (0.223 per cent) has registered the highest degree of instability. The instability in the production under rice, maize, pulses and cereal have increased in the second (II) sub-period and it increased further for maize, wheat and barley but it declined for the remaining crops. The instability in the area under rice, maize, cereal, pulses and total food grains have increased in the second sub-period. For all crops in the III period, there has been continuous decline in the instability over the period expect remaining Maize.

Instability drives poor people below the line of minimum subsistence in bad times as this reduces their ability to plan for the long term and leads them to assault environment. The extension of cultivation to areas with fragile environmental resources has further contributed to higher yield instability. In so far as instability is an attribute of unsustainable growth and this should be a cause of concern. It has been observed that the increased instability is not due to new technology itself but rather due to its application in less and less favourable conditions as it is extended from areas of assured irrigation to rain-fed areas.

RURAL EQUITY AND SUSTAINABILITY

Issue of inter-generational and intra-generational equity lie with some aspects of the one essential characteristics of sustainable agriculture and are generally found conflicting with the development strategies. Inter-generational equity is at the core of the definition of sustainability, whereas intra-generational inequality is the main force driving ecological degradation. Productivity and stability are pitted against each

Table 2. Compound Growth Rate of selected Food Crops in Area, Yield and Output Wise in Himachal Pradesh

Crops	Period-I(1980-81to1997-98)			Period-II(1998-99to2015-16)			Period -III (1980-81to2015-16)		
	A	O	Y	A	O	Y	A	O	Y
Wheat	-0.93	3.58	3.17***	-0.59	1.02	1.43**	0.24	2.15***	1.60***
Rice	-0.65	0.91	0.76*	-0.91	0.64	1.97**	-0.79	0.87*	1.84***
Maize	1.12***	2.93***	1.48***	-0.35	0.90	0.53	0.36*	1.71***	1.28***
Cereal	0.47	2.68***	1.25***	-0.53	0.82	2.02***	-0.10	1.58**	0.98
Barely	-2.09	-0.92	2.24***	-2.15	0.10	1.02	-2.21	-0.01	1.54
Total pulses	-2.61	-1.53	0.10	-1.40	6.25	7.47***	-2.26	2.06***	4.82***
Total Food grains	0.26*	2.59***	2.40***	-0.57	1.01	1.43***	-0.23	1.63**	1.78***

Table :3 Instability index of crops output in Himachal Pradesh

Crops	Period-I(1980-81to1997-98)			Period-II(1998-99to2015-16)			Period-III(1980-81to2015-16)		
	O	Y	A	O	Y	A	O	Y	A
Wheat	0.033	0.565	74.877**	0.035	0.283	18.842**	2.131**	0.223	1.053
Rice	0.028	0.533	0.014	0.132	1.175	2.075*	0.030	0.214	2.251*
Maize	1.977*	0.045	3.146**	3.159*	1.332	21.074**	2.162*	0.012	75.631**
Cereal	0.42	0.123	0.022	3.151*	0.551	16.799**	0.170	0.065	2.393*
Barely	1.62	0.037	2.293**	0.002	0.119	22.661**	2.415**	0.017	1.477
Total pulses	0.161	0.039	0.218	0.323	0.119	17.329**	0.078	0.065	0.0179
Total Food grains	0.028	0.027	1.681	0.023	0.977	22.726**	0.011	3.017**	1.185

other in order to achieve sustainability and equitability and vice-versa. Greenrevolution technologies helped in enhancing productivity, but they are associated with low sustainability and equitability.

The general measure of rural equity, the pattern in the distribution of land holding in Himachal Pradesh has been considered first because land, being the prime asset of an agriculturally dominated society, like rural Himachal Pradesh, is the major source of income for the rural people. More than nine lakh farmers of Himachal Pradesh cultivated about 9.55 lakh hectares of land with an average operational land holding of 0.99 hectares (Agriculture census 2010-11)

Himachal Pradesh agriculture is suffering from some structural deficiencies on the one hand and distortion in agrarian structure on the other. Inequality in asset distribution implies initially poverty for the deprived. In the table description the Marginal farmers constitute about 69.78 per cent in the farming community and operate up to 28.63 per cent of area. The increasing pressure of population on agriculture has resulted in phenomenal rise in the number of marginal and small holdings as increasing proportion of landless labour. Therefore, given the present agrarian structure, the high input agriculture also needs external intervention to achieve the objective of equitability. It is seen that inequality in the distribution of land ownership has increased from 0.55 in 1981-82 to 0.64 in 2003-04.

CONCLUSION

In this paper an attempt has been made to assess the sustainability of agricultural crops in Himachal Pradesh in terms of growth, instability and rural equity. The long-term growth of total cereal output has been about 1.00 percent per annum. There are clear indications of deceleration in growth rate in almost all the crops in period II. The foregoing analysis clearly demonstrated the declining trend in area for all crops is mainly attributable to the shifting of area in favour of fruits, floriculture and off-season vegetables which have become attractive and more remunerative alternatives for increasing income and generating employment in the temperate regions of the state of Himachal Pradesh. It is worth mentioning that a small shift in crop pattern to a suitable crop can lead to tremendous increase in output and income of the farmers. Increasing trend in yield is attributable to high yielding varieties, use of fertilizers; expansion of irrigation, modern farm practices coupled biological packages and state policy regarding agriculture sector.

The result of instability analysis indicated that the state level, period III showed higher magnitude of instability indexes particularly in respect of total food grains crops. Stability in production and yield for wheat and maize in the state after the adoption of new technology refuted the widely held belief that increased instability is a necessary consequence of higher growth. The above discussion has shown that rural inequalities are increasing and employment opportunities are shrinking. The high input base growth is not sustainable and is becoming more expensive and less efficient. Policy should accord highest

priority to take steps to make most efficient use of resources to deal with sustainability issues. Further there is need for identifying efficient means of dealing with the equity problem. Education and awareness may be used to make hill farmer more sensitive to the environmental impact of their operations. Marketed human input is a pre requisite of any sustainable system rather than just opting for yet more machine power. Therefore, human resource development should be at the top of agenda in the development planning.

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TABLE:4 DISTRIBUTION OF LAND OWNERSHIP IN HIMACHAL PRADESH 1990-91& 2010-11

Operational Farmsize (in Hecht.)	1990-91			2010-11		
	Percentage of operational Holding		Average operational Area (Hecht.)	Percentage of operational Holding		Average operational Area (Hecht.)
	Area	Area		Area	Area	
Marginal (Below 1.0)	63.82	21.26	0.40	69.78	28.63	0.41
Small (1.01-2.00)	19.96	23.29	1.41	18.17	25.55	1.40
Semi-medium (2.01-4.01)	12.26	25.51	2.74	8.83	24.14	2.71
medium ((4.01-10.00)	4.29	20.32	5.73	2.87	16.39	5.67
Large (10.01 and above)	0.67	9.61	17.65	0.34	5.29	15.45
All sizes	100.00	100.00	1.21	100.00	100.00	0.99

Source: Economic survey of Himachal Pradesh 2017-18, Department of Economics and Statistics Government of Himachal Pradesh