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Total Factor Productivity Growth of Wheat in Madhya Pradesh

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ABSTRACT
The study was analyzed total factor productivity growth of wheat and growth in area, production and productivity of wheat crop in Madhya Pradesh. Time series secondary have been collected for the study. These data have been classified into three periods viz. Period-I (1982-1991), Period-II (1992-2001) and Period-II (2002-2011) along with overall period (1982-2011). At overall compound growth rate in area, production and productivity of wheat (0.49, 2.35 and 1.86%/year) was observed positively significant. The data shows that output index was positive and highly significant at overall level 4.029 per cent. Seed as a source of growth during 1992-2001 was highest (0.698). In case of fertilizer the source of growth was positive in all the period but as a source of growth was highest during 1982-91. Overall response of fertilizers as a source of growth was highest. Manure as source of growth shown positive in 1982-91 converted negative and less response during 1992 to 2011 because it's negligible use. Response of labour resources of TFP growth was higher during 1982-91 and 1992-2001 Similarly in the case of animal labour during all the period depict negative impact as source of growth. Input as a source of growth was tend to be declined in case of all the input, revealing that the ratio of output to input decline over the period of time but still fertilizer and seed are the major source of growth for wheat crop in Madhya Pradesh.
Keyword : *TFP, Wheat, Growth, Input and Output Index*

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INTRODUCTION

The Total Factor Productivity (TFP) approach is considered an appropriate tool to examine and understand the growth in agricultural productivity and to separate out the effect of inputs and other factors like technology, infrastructure, and farmers' knowledge on productivity growth. Quite a few studies on agricultural productivity have been undertaken in India during the past four decades or so, using TFP approach. They focus on estimating the effect of technological change on agriculture as a whole or total crop sector [3]**.** Due to non-availability of input allocation data at individual crop level, this may over- or under-estimate the TFP for the crop sector to the extent that rates of technological change differ across crops [1-2].

A rise in production can be attributed to input growth and total factor productivity growth. The level of Total Factor Productivity (TFP) can be measured by dividing total output by total inputs. When all inputs in the production process are accounted for, TFP growth can be thought of as the amount of growth in real output that is not accounted for by growth in inputs. Productivity is often defined as the efficiency with which output is produced by a given set of inputs. TFP is one of the most convenient indicators to evaluate economic performance as an ex- post facto. Earlier approaches to productivity measurement were based upon partial productivity indices, typically land or labour productivity only due to computational simplicity or feasibility. The source of TFP growth is not only technological progress but also progress in the quality of inputs or efficiency improvement depending on better organization or institutional restructuring. Growth rates of agricultural production simply depict performance of agriculture but does not revealed anything about efficiency of the performance [4-6]. However, factor productivity reveals efficiency with which the factors inputs are converted into output within production processes. Growth of total factor productivity (TFP) provides society with an opportunity to increase the welfare of people. Keeping in view the importance of agriculture in

the state economy quantitative assessment of the TFP and contribution of the various factors to TFP growth at the state level was undertaken with the following specific objectives. (1) To study the growth of Agriculture in Madhya Pradesh during the study period. (2) To find out estimate of Total Factor Productivity of Agriculture in the Madhya Pradesh.

MATERIAL AND METHODS

Time series secondary data have been collected for the study. These data have been classified into three periods viz. Period-I (1982-1991), Period-II (1992-2001) and Period-II (2002-2011) along with overall period (1982-2011). for the analyze of growth in area, production and productivity and TFP growth. An attempt has been made in the present study to analyze TFP growth in Madhya Pradesh using secondary data collected from different sources. The state has a diversified cropping pattern in different regions depending upon agro-climatic conditions and hence all the important cereals, pulses and oilseeds were selected for the present study.

To calculate input and output index, Tornqvist-Theil index was used for data on output and inputs of soybean crop. The Tornqvist index of TFP is the frequently used index to compute TFP growth. It does not require the assumption of neutral technical change and allows for variable elasticity of substitution [7]**.** Another advantage of this index is that it accounts for the change in quality of inputs because current factor prices are used in constructing the weights. The quality improvements in inputs are incorporated to the extent that these are reflected in higher wages and rental value [8]. The output and input indexes were calculated for the soybean crop in major states and at all-India level using TFPIP program developed by Coelli *et al.* [9, 10].

Total Output Index (TOI)

For construction of output index principal crops of the State were taken into account. The minimum support Price (MSP) was considered for converting physical values into monetary values. The physical quantities of production of all the crops for all the years were collected and multiplied with the respective Minimum Support Price (MSP) to get the value of the production. All these added to get the total value of production. The log of aggregated values of each year was taken to construct output index using Tornqvist-Theil (T-T) approximation to the Divisia index.

$$TOI_t / TOI_{t-1} = \prod_j (Q_{jt} / Q_{jt-1})^{(R_{jt}+R_{jt-1})^1/2} = A_t \quad \text{.....(1)}$$

Where,

R_{jt} is the share of j^{th} crop output in total revenue in the year t, Q_{jt} is the output of j^{th} crop in year t.

Total Inputs Index (TIT)

For construction of Input Index, following inputs - human labour, animal power, seed, fertilizers (NPK), manures have been taken. The per hectare expenditure on seeds, fertilizers (NPK), manures, human labour, animal power were used from the cost of cultivation data for principal crops in State. Tornqvist index have been used in the proposed study for computing the TFP for the crop sector.

$$TII_t / TII_{t-1} = \prod_i (X_{it} / X_{it-1})^{(S_{it}+S_{it-1})^1/2} = B_t \quad \text{.....(2)}$$

S_{it} is the share of input i in total input cost in year t, X_{it} is quantity of input i and p_{it} is price of input i in year t. In the case of TFP for a single crop, revenue share refers to the share of main product and by –product in total revenue from the crop, while a output includes main product and by-product. Total output index (TOI) and Total input index (TII) for the year "t" were computed from equations (1) and (2) as follows :

TOI (t) = A_1 A_2 .....A_t .....(3)

TII (t) = B_1 B_2 .....B_t .....(4)

This way, streams of total output index (TOI) and Total input index (TII) for different years (t) were computed from equations (1) and (2) respectively

Total factor productivity (TFP)

TFP is defined as the ratio of aggregate outputs to aggregate inputs used in the agricultural production process. As TFP index is a measure of growth the choice of index is important, as it will affected growth rates if the wrong procedure is chosen. Estimates of TFP indices have designed to provide an indication of the change in output per unit of total factor input. This index was computed as the ratio of an index of aggregate outputs to an index of aggregate inputs. Specifying the index equal to 100 in a particular year (1979-80 in the present study) and accumulating the measure based on above equation provides the TFP index. This index was

calculated for the crop sector as a whole. The **total factor productivity (TFP) index was computed from TOI and TII as under:** TFPt = {TOI(t)/TII(t)}
The TFP defined by above equations can be used as an approximation of technological progress, assuming that producers behave competitively, that the production technology is input-output separable, and that there is no technical inefficiency [11].

RESULTS AND DISCUSSION

Trend and Growth

The growth of area, production and productivity of wheat in Madhya Pradesh was analyzed during the study (Table 1). The data were divided into three period i.e. Period-I (1982-1991), Period-II (1992-2001) and Period-III (2002-2011) along with overall period (1982-2011).The area of wheat increased from 3559.67 thousand hectares in (1981-82) to 4134.03 thousand hectares in (2010-11), that shows a relative change of 16.14 per cent with fluctuation of 10.22 per cent during this period. Overall compound growth rate (0.49%/year) of wheat was observed positively significant. The growth of area of wheat was found positive and non-significant (0.34, 1.21 & 1.50%/year) in all the period. The higher relative change 11.15 per cent during the P-II period as compared to P-I (0.99) and P-II period (10.97) per cent with the fluctuation were also higher in P-II period as compared to P-I and P-III period.
The production of wheat increased from 3829.37 thousand ton in (1981-82) to 7519.68 thousand ton in (2010-11), that shows a relative change of 96.37 per cent with fluctuation of 26.07 per cent during this study. Overall compound growth rate (2.35%/year) of wheat was observed positively significant. The growth of production of wheat was found positive and significant (4.06%/year) in period -I and positive & non-significant in period-II (2.59%/year) & period-III (3.07%/year). The higher relative change 28.39 per cent during the period-I as compared to period-II (27.65) and period-III period (23.35) per cent with the fluctuation was higher in period-II (19.75%) as compared to period-I (15.55%) and period-III (15.26%) during the study.

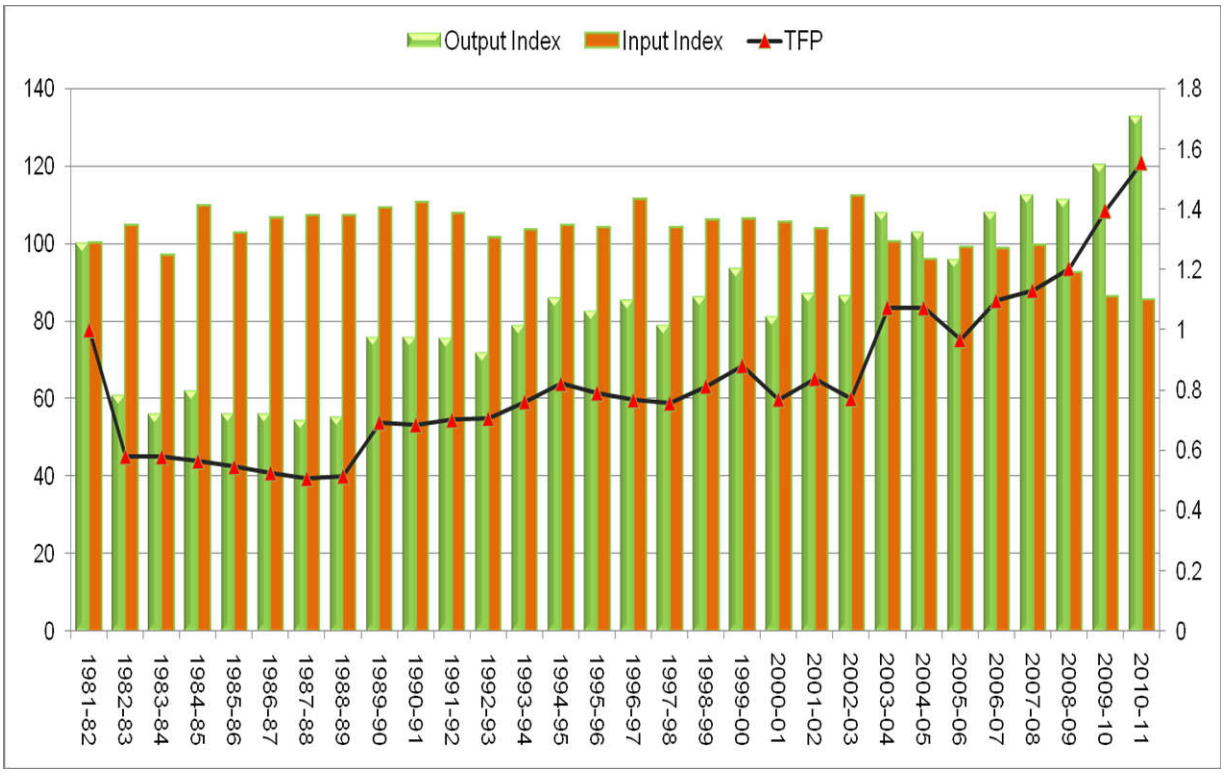

Fig 1: Input Index, Output Index and TFP of Wheat Crop in Madhya Pradesh during 1982 to 2011

Table 1: Growth of Area, Production and Productivity of Wheat in M.P.

Period	Mean	SD	BY	CY	AC	RC %	CV%	CGR
Area "000"ha								
P-I	3593.55	183.43	3559.67	3595.03	35.37	0.99	5.10	0.34
P-II	4113.09	477.14	3788.97	4211.40	422.43	11.15	11.60	1.21
P-II	3914.27	302.38	3725.50	4134.03	408.53	10.97	7.72	1.50
Overall	3873.64	396.06	3559.67	4134.03	574.37	16.14	10.22	0.49*
Production "000" ton								
P-I	4318.59	671.46	3829.37	4916.57	1087.2	28.39	15.55	4.06*
P-II	6799.38	1342.93	5715.73	7296.00	1580.27	27.65	19.75	2.59
P-II	6734.07	1027.72	6096.33	7519.68	1423.35	23.35	15.26	3.07
Overall	5950.68	1551.11	3829.37	7519.68	3690.31	96.37	26.07	2.35*
Productivity (kg/ha)								
P-I	1198.68	147.75	1072.40	1361.33	288.93	26.94	12.33	3.71*
P-II	1639.75	157.06	1502.53	1707.16	204.62	13.62	9.58	1.37
P-II	1711.83	143.06	1625.44	1815.61	190.17	11.70	8.36	1.54
Overall	1516.75	272.04	1072.40	1815.61	743.21	69.30	17.94	1.86*

* Significant at 5 % level

The productivity of wheat increased from 1072.40 kg/hectares in (1981-82) to 1815.61 kg/hectares in (2010-11), that shows a relative change of 69.30 per cent with fluctuation of 17.94 per cent during this period. Overall compound growth rate (1.86%/year) of wheat was observed positively significant. The growth of productivity was found positive and significant (3.71%/year) in period-I and positive & non-significant in period-II (1.37%/year) & period-III (1.54%/year). The higher relative change 26.94 per cent during the period-I as compared to period-II (13.62) and period-III period (11.7) per cent with the fluctuation was higher in period-II (12.33%) as compared to period-I (9.58%) and period-III (8.36%) during the study.

Total Factor Productivity

Growth rate of Input and Output Index and TFP

Total Factor Productivity of wheat and Input-Output Index for different period of time are given in Table 2. The data shows that output index was positive and highly significant at overall level (1982-2011) 4.029 per cent. The negative TFP growth during 1982-91 (2.494) was converted to positive significant TFP growth during 1992-2001 (1.467) and highly significant growth rate during 2002-2011.

Table 2: Growth rate of Input and Output Index and TFP of wheat in M.P.

Period	output	input	TFP
1982 to 1991	-1.313	0.998	-2.494
1992 to 2001	1.636	0.167	1.467*
2002 to 2011	4.029	-0.293	4.261**
1982 to 2011	2.379	0.260	2.907**

*Significant at 5% level and **Significant at 1% level

Source of Growth in TFP

The growth of TFP along with output and input index at overall level was recorded positive. The source of growth rate in Total Factor Productivity during different time period is worked out and presented in Table 3. The data presented in table depict that seed as a source of growth during 1992-2001 in wheat crop is highest (0.698), while during 2002-2011 it was lowest and negative (-0.041), this revealed that the quality seed distribution and seed replacement of wheat by new varieties over old varieties was higher during 1992-2001, while during 2002-2011 there was setback due to drought and because of that maximum input as a source of growth depict negative figure.

In case of fertilizer as a source of growth was highest during 1982-91 because during this period high yielding varieties (HYV) of wheat were introduced and adopted by the farmers of the Madhya Pradesh, which resulted more response to chemical fertilizer, previously there was less response of chemical fertilizer due to rain fed condition in most of growing area of the Madhya Pradesh. Overall response of fertilizers as a source of growth was highest among all the input considered in the study for the wheat crop.

Table 3: Source of Growth in TFP of Wheat in Madhya Pradesh.

Period	Seed (kg)	Fertilizer (kg)	Manure (Quintal)	Human Labour (Hrs.)	Animal Labour (Pair Hrs.)
1982 to 1991	0.260	10.206	0.675	0.401	-3.812
1992 to 2001	0.698	3.279	-24.039	0.431	-6.204
2002 to 2011	-0.041	2.352	-28.114	-2.572	-12.330
1982 to 2011	0.372	4.043	-6.754	-0.501	-6.553

Manure as source of growth shown negative and less response in wheat crop because it's negligible use. Response of labour resources of TFP growth was higher during 1982-91 and 1992-2001 but latter on due to substitution of human labour by mechanical power specially for harvesting and threshing of wheat crop; its impact was negative as a source of growth. Similarly in the case of animal labour during all the period depict negative impact as source of growth and it shows increasing over the period of time reflecting that rate of substitution of animal labour by machinery power increased over the period of time at faster rate.

CONCLUSION

It is conclude that input as a source of growth for wheat crop was tend to be declined in case of all the input, revealing that the ratio of output to input decline over the period of time but still fertilizer and seed are the major source of growth for wheat crop in Madhya Pradesh. This indicates that in future more fertilizer responsive and development of varieties resistance to a-biotic and biotic stress will lead to the positive growth of wheat in Madhya Pradesh. The government initiated work on priority for completion of principal and minor irrigation projects, investment for electricity tariff subsidy, increased power supply to agriculture through feeder separation and number of temporary connection during rabi season etc. which ultimately resulted in enhancing use of purchase inputs like improved seed, fertilizer etc, for wheat production, despite of negative input growth, this reveal that over the period of time response of input is declined due to various reasons such as increasing price, detoriation in quality of input and other managerial factors.

REFERENCES

1. Himanshu, Lanjouw P., Mukhopadhyay A. and Murgai R. (2010) Non-farm Diversification and Rural Poverty Decline: A Perspective from Indian Sample Survey and Village Study Data. Working Paper 44. Asia Research Centre, London School of Economics and Political Science, London, UK.
2. GoI (2015b). Agricultural Statistics at a Glance 2014. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi.
3. Rosegrant, M.W. and Evenson, R. E., (1992). Total Factor Productivity and sources of long term growth in Indian agriculture. Paper presented for IFPRI/IARI workshop on Agricultural growth in India, May 1-6, New Delhi, India.
4. Planning Commission (2010). Mid-Term Appraisal of the Eleventh Plan, Chapter 4: Agriculture, Government of India, New Delhi.
5. Narayanamoorthy, A. (2007). Deceleration in agricultural growth: Technology or policy fatigue. Economic and Political Weekly, 42 (25):2375-79.
6. Chand, Ramesh; Kumar, Praduman and Kumar Sant (2012). Total Factor Productivity and Returns to Public Investment on Agricultural Research in India. Agricultural Economics Research Review, 25 (2) 181-194
7. Evenson, R.E., Pray, C. and Rosegrant, M.W. (1999). Agricultural Research and Productivity Growth in India. Research Report No. 109. International Food Policy Research Institute, Washington, D.C.
8. Capalbo, S.M. and Vo, T.T. (1988) A review of the evidence on agricultural productivity and aggregate technology. In: Agricultural Productivity: Measurement and Explanation, Resources for the Future, Eds: Susan M. Capalbo and John M. Antle. Washington, DC, USA.
9. Coelli, T., Rao, D.S.P. and Battese, G.E. (1998). Introduction to Efficiency and Productivity Analysis. Kluwer Academic Publishers, Boston.
10. Coelli, T.J., Rao, D.S.P., O'Donnell, C.J. and Battese, G.E. (2005). An Introduction to Productivity and Efficiency Analysis. Second Edition, Springer, USA.
11. Antle, J. & Capalbo, S. (1988). An introduction to recent development in production theory and productivity measurement. In: Capalbo s. Antle J. (eds) Agricultural productivity measurement and explanation resource for the future. Washington DC, pp 17-95.

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