Estimation of Total factor productivity by using Malmquist Total Factor Productivity Approach: Case of rice in India

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Introduction

The green revolution (GR) has significantly contributed in achieving the self-sufficiency of foodgrain production in India, primarily through increased production of rice and wheat. This remarkable achievement has been brought out through faster spread of modern varieties (MVs) and input intensification. The yield increase in case of rice during the initial phase of MV introduction was not as miraculous as has happened in case of wheat. This was on account of the fact that the diffusion of MVs in case of rice was not at a fast rate as happened elsewhere. This can be better gauged by the fact that by around mid-1980s, some Asian countries like Indonesia and The Philippines and reached the ceiling for MV adoption of 70-90 per cent; while that in case of India, was around 30 per cent during the same time (Otsuka, 2000). However, the diffusion of MVs continuously improved over years.

However, some researchers noted that the MVs introduced during the green revolution period has quickly exhausted the yield potential, not only in India, but across globe (Hayami and Kikuchi, 1999). Also, some symptoms of unsustainability of the modern cultivation practices emerged in due course of time. Some visible symptoms of this unsustainability were nutrient imbalances, depletion of soil micro-nutrients, over-exploitation of the ground water, land degradation, more frequent emergence of pests and diseases, and, diminishing returns to inputs (Chand *et al*, 2011). This has created apprehension about the ability of the approach to ensure the future food security. In this context an important debate emerged in policy circles- whether the slowdown of agricultural performance is due to technology fatigue or policy fatigue (Planning Commission, 2007; Narayanamoorthy, 2007). One major bottom-line of the debate was that given the high impacts of agricultural income in eliminating the rural poverty, ensuring TFP growth is critical to reduce rural poverty. In this context the present paper is undertaken with the objectives of examining the TFP growth in rice cultivation in India taking into consideration the change in the technical change and efficiency. In the light of the results the study also discusses whether the slowdown in the yield growth is due to technology fatigue or sluggishness in input intensification.

TFP studies in in India and in other developing countries

The TFP has attracted attention of many scholars in India and in other developing countries. One common generalisation that can be gauged from these studies is that the TFP has been deteriorating even during the heyday of green revolution in developing countries. For example, Kawagoe *et al* (1985) estimated the cross country production functions for 22 less developed countries and 21 developed countries using data for two decades between 1960 and 1980. They reported technological deterioration for developing countries and progress for the developed countries. Using cross-country analysis, some other studies as well reported negative productivity growth for the developing country agriculture since 1960s and 1970s (Chaudhary, 2012). Nkamleu *et al* (2003), analysing data set for 10 Sub-Saharan African countries for the period of 1972-1999 reported a deterioration of TFP growth. This deterioration was identified to be more on account of regress in technical change. As far as Chinese Agriculture is concerned, Li *et al* (2011) noted significant productivity growth since 1980s, although the growth rates varied considerably among the subsectors. The productivity growth emancipated from either technological progress or efficiency gains, not from both of them simultaneously.

In an early study on the TFP in India, Kumar and Mruthyunjaya (1992) reported growth in TFP of wheat in India during 1970-89 to be to the tune of 1.9 per cent in Punjab, 2.7 per cent in Haryana and Rajasthan, 2.6 per cent in Uttar Pradesh and 0.4 per cent in Madhya Pradesh. Kalirajan and Shand (1997) has noticed declining trend of TFP growth in agriculture by the end of 1980s. Joshi *et al* (2003) and Kumar and Mittal (2006) reported positive TFP growth for both rice and wheat during the period of 1980-2000, but the TFP growth posted reduction during the second decade compared to the first decade. In a study of various crops and states for the period of 1975-2005, Chand *et al* (2011) have observed that the TFP growth has shown considerable variation across crops and regions. During the entire period under analysis, rice has posted a TFP growth of 0.67 per cent, while that of wheat has been at the rate of 1.92 per cent.

Data and Methods

Malmquist productivity index

The improvement in the crop productivity can largely be attributed to growth in input use or growth in the TFP. While partial factor productivity measures the productivity pertaining to any specified input, the TFP provides a measure of productivity considering all the inputs went gone into the production process. The TFP index can be constructed by dividing the index of total output with an index of total inputs. In that sense, a growth in the TFP can be attributed to that part of the growth which is not accounted for by the growth in the input use. The most popular form of estimating TFP in the past is the Tornquist- Theil Index method. This index estimates the TFP growth based on information concerning price, and uses cost/ revenue shares as weights to aggregate inputs/ outputs (Bhushan, 2005). However, this method has one inherent weakness that it assumes the observed outputs as frontier outputs. One important consequence of this assumption is that the decomposition of the TFP growth into its constituent components, viz. movement towards a production frontier and shift in the production frontier cannot be carried out. The Tornquist- Theil Index attributes the TFP growth entirely to the technical change. The Malmquist productivity index (MPI) overcomes some of these problems.

The MPI was introduced by Caves *et al* (1982) based on distance functions. The output oriented Malmquist TFP index measures the maximum level of outputs that can be produced using a given level of input vector and a given production technology relative to the observed level of outputs (Coelli *et al*, 2005). It measures the radial distance of the observed output vectors in period t and t+1 relative to a reference technology. The Malmquist productivity index for the period t is represented by,

$$M^t = \frac{D_0^t\ (x^{t+1}, y^{t+1})}{D_0^t\ (x^t, y^t)} \quad \ldots \qquad (1)$$

which is defined as the ratio of two output distance functions with respect to reference technology at the period t. It is also possible construct another productivity index by using period t+1's technology as the reference technology, which can be depicted as,

$$M^{t+1} = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)} \quad \ldots \qquad (2)$$

Thus, there exists an arbitrariness in the choice of the benchmark technology depending on the time period t or t+1. Fare *et al* (1994) has attempted to remove this arbitrariness by specifying the MPI as the geometric mean of the two period indices, defined as:

$$M_0\ (x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_0^t\ (x^{t+1}, y^{t+1})}{D_0^t\ (x^t, y^t)}\right)\left(\frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)}\right)\right]^{\frac{1}{2}} \ldots \qquad (3)$$

where, the notations x and y represents the vector of inputs and outputs, D_0 representing the distances and M_0 representing the Malmquist index. Fare *et al* by using simple arithmetic manipulations has shown the MPI as the product of two distinct components, viz. technical change and efficiency change as indicated below:

$$M_0\ (x^{t+1}, y^{t+1}, x^t, y^t) \ = \ \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)} \left[\left(\frac{D_0^t\ (x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})}\right) \left(\frac{D_0^t\ (x^t, y^t)}{D_0^{t+1}(x^t, y^t)}\right)\right]^{\frac{1}{2}} \ldots \quad (4)$$

Where,

$$\text{Efficiency change} = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t\ (x^t, y^t)} \ldots \quad (5)$$

$$\text{Technical change} = \left[\left(\frac{D_0^t\ (x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})}\right) \left(\frac{D_0^t\ (x^t, y^t)}{D_0^{t+1}(x^t, y^t)}\right)\right] \ldots \quad (6)$$

The efficiency change can be further decomposed into pure efficiency change and scale efficiency change. A detailed account on the MPI can be had from Fare et al (1994), Coelli et al. (2005), Bhushan (2005) and Chaudhary (2012). Introduction of linear programming based Data Envelopment Analysis popularised the Malmquist index of productivity measurement. DEA involves construction of piece-wise linear frontier based on the distribution of the data of the input and outs of various entities/ decision making units (DMUs) using linear programming framework. This frontier constructs a piecewise surface over the data such that the observed data lies on or below the constructed production frontier (Coelli *et al*, 2005). The efficiency measure for each DMU is calculated relative to this production frontier. Fare *et al* (1994) identifies four important advantages of using Malmquist Productivity Index compared to other approaches. They include: (1) the approach requires data on only quantity, and not prices. Information on prices are generally not available for every input and output for many countries; (2) the linear programming based approach doesn't assume an underlying production function, and therefore the stochastic properties associated with the error term; (3) no prior assumption regarding the optimising behaviour of the DMUs; and, (4) Since the approach allows for both movement towards the frontier and shift in the frontier, it is possible to decompose the TFP into its components viz technical change and efficiency change.

Data

The basic input data for the estimation was collected from the reports of "Comprehensive Scheme for Cost of Cultivation of Principal Crops" carried out by the Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi. The data for the missing years were approximated by interpolations based on the trend growth. The output variable was yield per hectare (kg/ha) reported by Ministry of Agriculture. Six input variables were used in the analysis. They included usage in chemical nutrients (NPK, hg/ha), manure (q/ha), animal labour (pair hours/ha), human labour (man-hours/ha), and real costs of machine labour and irrigation[i]. The analysis was carried out for the overall period of 1080-81 to 2009-10. The overall period under analysis has been divided into two sub-periods of equal length of 15 years, 1980-81 to 1994-95 (period I) and 1995-96 to 2009-10 (period II). These periods broadly corresponds to the period before the macro-economic reforms and post-reform period as well, respectively. In order to avoid extreme variations triennial ending averages were used. The analysis has been carried out by using the software DEAP 2.1 (Coelli, 1996).

Results and Discussion

Trend in the yield of paddy in India

The mean yield of paddy has registered significant improvement over years, from about 1.2 tonnes/ha in 1980-81 to 2.2 t/ha in 2009-10, at the rate of 1.9 per cent per year at national level (Table 1). There was high degree of variation across states and over two periods of time. While at national level, the yield increased at the rate of 3.1 per cent per year, the second period posted a growth rate of only 1.1 per cent during the first period. The states also shared the same trend with the exception of a few states like Punjab, broadly reflecting plateauing of yield during period II.

Table 1: Trend in yield of rice, across states, 1980-81 to 2009-10

States	Yield (TE average, kg/ha)			Growth rates (% per year)		
	1980-81	1994-95	2009-10	1980-81 to 1994-95	1995-96-2009-10	1980-81 to 2009-10
Andhra Pradesh	1872	2562	3217	2.11	1.87	1.78
Bihar	921	1234	1319	2.86	-0.97	1.56
Karnataka	2008	2371	2539	1.14	1.09	1.37
Madhya Pradesh	586	845	912	1.87	-0.11	1.24
Odisha	918	1364	2167	3.51	3.84	2.17
Punjab	2760	3428	4017	1.33	1.62	1.05
Tamil Nadu	1958	3145	2857	4.34	-0.78	1.23
Uttar Pradesh	869	1836	2106	5.75	0.13	2.65
West Bengal	1347	2069	2551	4.34	1.73	2.69
Overall	1245	1847	2168	3.08	1.33	1.87

Basic Data Source: Agricultural Statistics at a Glance, various issues

Trend in Total Factor Productivity

Following the methodology outlined earlier, we have estimated the trend in the Malmquist productivity index since 1980-81. Figure 1 illustrates the movement of the TFP, technical change and efficiency change since 1980-81. The figure clearly reveals that the movement of the TFP change is aligned more with the movement of the technical progress than with a change in the technical efficiency.

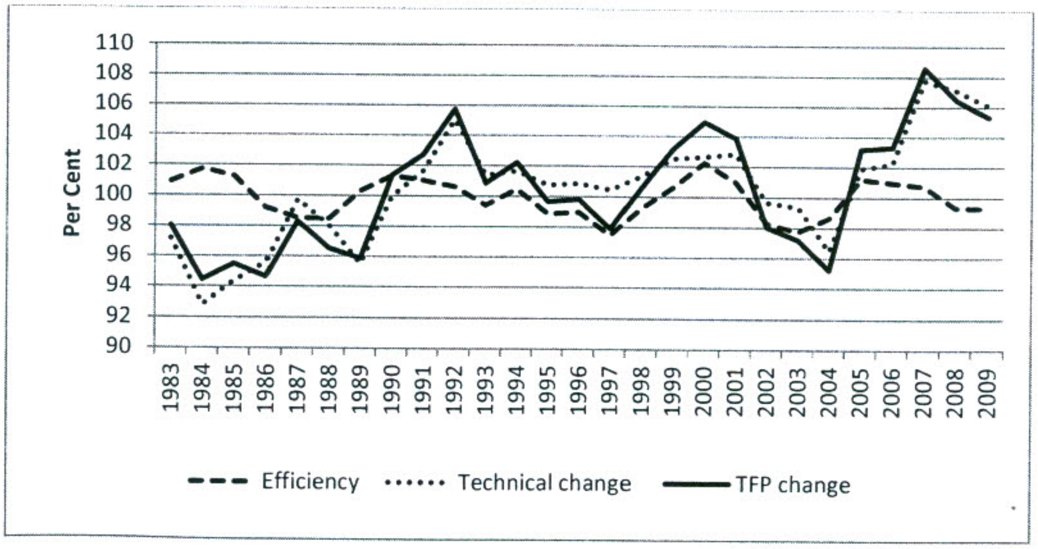

Figure 1:Movement of Malmquist, TFP and efficiency indices of paddy cultivation, 1980-81 to 2009- 2010

The result suggests that the mean TFP change for rice has been to the tune of 0.2 per cent per year during the overall period under consideration (Table 2). The decomposition of the TFP change indicated that the change in the TFP was associated with a technological progress of 0.3 per cent and a deterioration of the technical efficiency to the tune of -0.1 per cent. This underscores that fact that technical efficiency could not catch up with the technical progress, and is pulling down the TFP growth. In case of wheat in India for the period of 1982-83 to 1999-2000, Bhushan (2005) indicated that the major source of productivity growth was technical change than efficiency change. The efficiency change was not a major source of growth for rice in some other major rice technology development countries like The Philippines (Umetsu et al, 2003).

Table 2 also depitcts the growth in TFP and its constituent components across states for the overall period under analysis. The TFP change varied considerably across states, with four states (Andhra Pradesh, Punjab, Tamil Nadu and Uttar Pradesh) out of the total nine states under consideration posting positive trends and the remaining five states posting negative trends. The highest change in the TFP among states has been noted in case of Andhra Pradesh (5.1 per cent), followed by Punjab (4.6 per cent). On the other hand, the negative TFP growth ranged between -4.6 per cent in cases of Madhya Pradesh to -1.3 per cent in case of Karnataka. The table reveals that the TFP change is associated more with technical change than with efficiency change at state level also. A positive growth in both efficiency and technical change could be noted only in case of Andhra Pradesh and Uttar Pradesh. For Punjab, positive technical change was associated with no-change in efficiency, while for Tamil Nadu, technical change of 2.8 per cent is coupled with a efficiency change of -0.9 per cent. It is noteworthy that Karnataka and Madhya Pradesh posted a decline of technical change, efficiency change and TFP during the overall period. The change in efficiency has been decomposed into its components, viz. pure efficiency change and scale efficiency change as well. The pure efficiency has remained unchanged at national level and at most of the states, except in Andhra Pradesh and Tamil Nadu. An increase in pure efficiency has been observed in case of Andhra Pradesh and Uttar Pradesh. The results suggest that the agricultural development strategy has to pay increased attention towards the factors that could influence the efficiency as well along with the factors that results in a technical progress.

Table 2: Trend in the total factor productivity and it components, across states, 1980-81 to 2009-10

State	Efficiency change	Technical Change	Pure Efficiency Change	Scale Efficiency Change	TFP change
Andhra Pradesh	100.7	104.4	100.5	100.2	105.1
Bihar	100	97.7	100	100	97.7
Karnataka	99.9	98.8	100	99.9	98.7
Madhya Pradesh	98.7	96.7	100	98.7	95.4
Odisha	100	96.3	100	100	96.3
Punjab	100	104.6	100	100	104.6
Tamil Nadu	99.1	102.8	99.3	99.8	101.8
Uttar Pradesh	100.5	103.2	100	100.5	103.7
West Bengal	100	98.6	100	100	98.6
Mean	99.9	100.3	100	99.9	100.2

Trend in TFP during the sub-periods

The sub-period analysis throws up some interesting results (Table 3). It turned out that at national level, the mean TFP growth increased from -1.3 per cent in the period I (first period) to 1.8 per cent during period II (second period). This TFP change was associated with an improvement in the technical change (from -1.6 per cent to 2.1 per cent) and a decline in efficiency (from 0.3 per cent to -0.2 per cent). It is observed that some of the early green revolution states like Punjab, Tamil Nadu and Uttar Pradesh which posted high rate of TFP growth during the first period has exhibited a deterioration during the second period while states like Karnataka, Madhya Pradesh, Odisha and West Bengal where TFP trend was deteriorating during the first period has shown a revival. The results also suggest that during the two periods the TFP changes of the latter group of states were with high level of margins, the highest absolute increase being in case of Odisha (by 12.2 percentage points). The decline in the TFP of Punjab, Tamil Nadu and Uttar Pradesh was mainly due to a deterioration of the technical progress rate than a decline in the efficiency growth. The revival of the TFP growth in case of Karnataka, Madhya Pradesh, Odisha and West Bengal is due to high level of technological progress. A picture of contrasting performance has been noted in case of Andhra Pradesh and Bihar. In Andhra Pradesh an already increasing TFP growth has increased further during the second period (from 4.0 per cent to 7.5 per cent), while in Bihar the already deteriorating TFP growth during the first period has further deteriorated (from -0.7 per cent to -4.4 per cent). This contrasting performance of the two states owes it to the contrasting performance of technical progress of the two states. In case of Andhra Pradesh, the increase in the the technical progress from 2.5 per cent to 6.6 per cent could surpass the deterioration of the efficiency growth, effecting a positive TFP growth. On the other hand, the deterioration of the technical growth from -0.7 per cent to -4.4 per cent while the efficiency remaining unchanged has pulled down the TFP growth in case of Bihar. The increase in TFP growth with practically unaltered efficiency levels points to upward shift of the production frontier. In that sense, it can be presumed that the low performing states during the first period has been catching up with the already progressive states. On the otherhand results suggests that the rates of shift in the production frontier has been declining the already well performing states, except Andhra Pradesh.

Table 3: The trend in technical change, efficiency change and total factor productivity change between two periods, across states

State	Efficiency		Technical Change		TFP change	
	Period I	Period II	Period I	Period II	Period I	Period II
Andhra Pradesh	101.5	100.8	102.5	106.6	104.0	104.4
Bihar	100.0	100.0	99.3	95.6	99.3	97.7
Karnataka	100.0	100.3	95.3	102.1	95.3	98.8
Madhya Pradesh	99.7	98.8	91.4	101.8	91.2	96.7
Odisha	100.0	100.0	90.0	102.2	90.0	96.3
Punjab	100.0	100.0	105.6	104.0	105.6	104.6
Tamil Nadu	100.0	98.0	103.6	102.3	103.6	102.8
Uttar Pradesh	101.1	100.0	103.4	103.2	104.6	103.2
West Bengal	100.0	100.0	96.0	101.1	96.0	98.6
Mean	100.3	99.8	98.4	102.1	98.7	100.3

Technology fatigue or sluggishness in input intensification?

The above results help to shed light on the debates of on whether the declining productivity is due to technology fatigue of policy fatigue. The forgone analysis has clearly shown that TFP growth in rice has acquired greater geographical spread during recent periods. In this context, it would be worthwhile to analyse the trend in use of inputs in rice cultivation. Table 4 provides the trend growth of application of four major inputs, viz. irrigation, fertilizer, manures and human labour. It clearly indicates that the rate of use of inputs has declined in most of the states, with a few exceptions. The decline has been sharp in the case of labour, fertilizer and manure. All the states with the exception of Punjab posted a decline in the rate of application of fertilizers. In case of labour, all the states except Odisha and West Bengal have posted negative growths. This trend has been broadly reflected in the cost of cultivation as well (Appendix I). At national level, the cost of cultivation increased at the rate of 9.2 per cent per year during the overall period under analysis. On a disaggregated analysis the second period exhibited a growth rate of 7.3 per cent per year, compared to 10.9 during the first period. This decline in expenditure growth (despite a higher level of input price during the second period) might be out of reduced rates of input application.

Table 4: Growth in use of irrigation (real price), fertilzer nutrients (kg/ha) and human labour (labour hours) in paddy cultivation across states, between two periods (% per year)

States	Irrigation		Fertilizer		Labour	
	Period I	Period II	Period I	Period II	Period I	Period II
Andhra Pradesh	4.81	-13.70	2.73	1.88	-0.29	-2.29
Bihar	-7.22	23.04	7.63	1.30	-0.10	-0.74
Karnataka	9.75	-4.78	6.40	2.12	0.05	-0.28
Madhya Pradesh	19.02	1.12	8.74	-0.92	0.81	-1.99
Odisha	7.03	3.28	13.61	2.30	0.48	0.36
Punjab	1.39	-5.24	1.04	1.11	-3.25	-1.23
Tamil Nadu	5.79	-4.03	-1.36	1.85	-5.10	-2.79
Uttar Pradesh	11.30	2.74	7.99	2.76	-0.73	0.20
West Bengal	14.44	-5.09	10.23	4.11	1.20	0.42

The above trend is vividly reflected in the change in the cost structure and factor shares (Table 5). For analytical purpose the entire expenditure of rice cultivation has been clubbed grouped into four input groups, viz. current inputs, capital inputs, labour and land[ii]. The table provides three specific information- share of inputs in total cost of cultivation (cost share), trend growth of (nominal) expenditure of these input groups, and their share in total value of output (factor share). The expenditure of the current inputs has grown at the rate of 8.0 per cent per year, capital inputs at the rate of 8.8, labour at the rate of 10.5 and land at the rate of 8.5 per cent for the overall period under analysis. The period II has depicted a reduction in the expenditure growth for all the input groups, most noticeably in case of current inputs (from 9.7 per cent to 5.4 per cent). The use of capital inputs, which more or less reflects long term farm-investment, has reduced from 10.3 per cent to 7.2 per cent. This is a cause for concern, as the reduction in capital investment has long term implications farm income growth. Corresponding to the relative growth of expenditure, the structure of the costs also has depicted sharp change over time. While the share of the current cost, capital costs and labour in cost of cultivation has registered an decline over years, that of labour has increased by 13 per cent points between 1980-81 to 2009-10. The spurt in the expenditure has to be explained in the light of high rate of increase in agricultural wage in recent times than a physical increase in the labour absorption in rice cultivation. The results broadly suggest that it is the sluggishness in input intensification that is resulting in the yield decline than a reduction of TFP or technical change. This indicates that the farm policies should favour sustainable intensification of inputs so as to increase the yield. The trend in the cost share has been broadly reflected in the factor share as well. While the share of current and capital inputs declined over years, the share of labour and land has increased. A close observation also reveals that the technical change in the rice cultivation has not made a significant percolation of benefits to the enterpreuner / farmer in the form of increased share in the value of output, during the second period under analysis.

Table 5: Trend in the cost share, factor share and growth rate of various input groups in paddy cultivation, national level

Input groups	Cost Share (%)			Trend Growth rate (per cent per year)			Factor share (%)		
	1980-81	1994-95	2009-10	Period I	Period II	Overall	1980-81	1994-95	2009-10
Current	18.9	17.0	13.0	9.7	5.4	8.0	17.2	14.4	12.4
Capital	24.4	20.8	17.9	10.3	7.2	8.8	22.3	17.6	17.1
Labour	28.9	32.3	42.3	12.1	8.9	10.5	26.4	27.5	40.3
Land	27.8	29.9	26.8	11.1	6.2	8.7	25.4	25.4	25.6

Basic Data Source: Cost of cultivation reports of CACP

Conclusion and Policy Implications

The study has estimated the TFP growth for rice in India and in major states and has decomposed the TFP growth into its constituent components viz technical change and efficiency change. In the light of the above results the study has discussed whether the recent slowdown in yield growth is due to technology fatigue or sluggishness in the input intensification.

The study identifies that during the overall period under analysis, the TFP growth has been at a moderate rate of 0.2 per cent per year, with large inter-state variations. The positive change in the TFP has been associated with a mean technical change of 0.3 per cent and a deterioration of mean efficiency by -0.1 per cent. The technical change turned out to be the main driver of the TFP change. Among states Andhra Pradesh, Punjab, Tamil Nadu and Uttar Pradesh exhibited positive TFP change during the entire period under analysis. The sub-period analysis indicates that second period has witnessed a revival of the mean TFP to the level of 1.8 per cent per year, compared to a negative TFP change of -1.3 per cent during the previous period. This revival has been effected mainly by positive technical change during the second period. However, a matter of concern is the decline in the technical efficiency. It is also observed that the TFP growth has become more widespread with passage of time. The less progressive states with respect to TFP growth, viz. Karnataka, Madhya Pradesh, Odisha and West Bengal during the first period have caught up with the initially progressive states during the second period, mainly propelled by high rate of technical progress. Also, it is noted that the TFP growth of the progressive states, except AP, have deteriorated during the second period, mainly due to the regress in the technical change. One state, that needs special mention is Bihar, where both the technical change and efficiency change deteriorated over years.

The study throws up some important policy observations. It establishes that in case of rice, there is no conclusive evidence for a technology regress; rather there is evidence of technological progress over years. However, the rate of growth of input application has been declining over years. Therefore, rather than technological fatigue, it might be the sluggish input intensification that is contributing to the decline in yield growth of rice in recent periods. Therefore, farm policies need to be aligned towards sustainable resource intensification, notably capital inputs, as they have long term implications of farm income growth. Along with technical progress, the policies should be aligned to improve the technical efficiency of cultivation. In the light of the evidences existing on the positive role of research investment in technical progress and extension expenditure on efficiency change, the agrarian policies need to favour increased flow of resources towards the research and extension system so as to effect TFP growth through both technical and efficiency changes.

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Appendix 1: Trend growth in cost of cultivation and cost of production across states (nominal prices)

% per year

States	Period I	Period II	Overall
Andhra Pradesh	11.5	5.8	9.1
Bihar	9.7	5.3	7.9
Karnataka	10.6	5.6	9.9
Madhya Pradesh	11.4	4.6	9.3
Punjab	8.7	7.2	8.1
Tamil Nadu	10.5	4.5	6.6
Uttar Pradesh	10.9	7.2	9.1
West Bengal	11.0	10.1	10.6
Odisha	11.4	6.9	10.0
National	10.9	7.3	9.2

1. Basic Data Source: Cost of cultivation reports of CACP