Ind. Jn. of Agri. Econ.
Vol. 62, No.2, April-June 2007

How Sustainable is the Total Factor Productivity of Oilseeds in India?

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I

INTRODUCTION

The increased oilseed production and productivity in India has not helped out our country, in any way, to mitigate its substantial dependence on imports of edible oils. The edible oils are the most dominant item of agricultural imports. It has been accounting for almost half of the total agricultural imports in the recent years. It increased from mere 26 per cent in 1990-91 as per data from Ministry of Agriculture and Co-operation, Government of India. A naive explanation to this, keeping aside the other factors of import liberalisation and low international prices, could be faster increase in demand for edible oils than the increase in its production. Per capita consumption of edible oils in the country increased about seven times from 1.5 kg in 1965-70 to 10.2 kg in 1999-2002 (Dohlman *et al.*, 2003) while the production of oilseeds just tripled during the same period. However, it is complex to answer the next question, which intuitively arises, why doesn't production match? The answer to this question emanates from the study of sustainability of production and productivity of oilseeds, its technological improvement, profitability, inputs' growth and their efficient use. All these parameters are interdependent and ultimately decide the level of public and private investment on oilseeds and their production.

In the event of rare possibility to augment area, the growth in oilseeds production or of any other crop, for that matter, depends upon growth of inputs and the increased efficiency in input use. The area under six edible oilseed crops, namely, rapeseed and mustard (RSM), groundnut (GNUT), sunflower (SUNF), soybean (SOYA) and safflower (SAFF), which accounts for 80 per cent of the country's consumption, increased hardly at the rate of 3 per cent in the last two decades ending 2000 (CMIE, 2000). Per hectare production of these crops increased from 580 kg to 880 kg, which is still 50 to 60 per cent lower than the world averages varying from crop to crop,

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The paper is based on data and analysis conducted in a research project completed by the author on 'Impact Assessment of Oilseeds Research in India' at National Academy of Agricultural Research Management, Hyderabad (Andhra Pradesh).

The author is grateful to the anonymous referee for his valuable comments and suggestions to improve the quality of the paper.

registered a growth rate of 2.2 per cent per annum. However, it is incorrect to analyse the present scenario of oilseeds in the country on the canvas of area and production only.

Economically, the partial productivity (production per unit of area), a parameter of growth in production, does not truly reflect whether it is because of more use of inputs or improvement in the efficiency of their use. It assumes that the supply of inputs used in the given level of production changed in fixed proportion, which does not hold good especially in growing economies like India. Thus, partial productivity neither takes into consideration change of all inputs nor reflects completely sustainability of growth. The best measure is the one that compares output with the combined use of all resources (Fabricant, 1959).

The oilseed production is required to be sustainable over a long run to meet the growing demand for edible oils and maintain its profitability to adequately support the farming community producing the crops. There are quite a large number of factors both internal and external, influencing oilseed production sustainability. This paper works on measuring sustainability of oilseed production using Total Factor Productivity approach.

II

MEASURING SUSTAINABILITY: TOTAL FACTOR PRODUCTIVITY

The partial productivity is an inadequate measure of sustainability because it ignores time, secondary products like straw, inputs use other than land and externalities, all of which should be included in a sustainability measurement (Barnett *et al.*, 1995). Dissatisfaction with the analytical defects of the partial productivity measure has led economists to evolve the Total Factor Productivity (TFP) measure. In this measure, a situation of divergent growth rates of different factors could be transformed into a composite index of aggregate or total factor quantity (TFQ) under some assumptions. Any excess of the observed growth rate of net output over the growth rate of TFQ is the contribution of TFP change. For operational purposes, sustainability might be assessed in relation to an index of total factor productivity (TFP) with due allowance for externalities such that a sustainable system has a non-negative trend in TFP over time (Lynam and Herdt, 1989). Hulten (1975) cautioned that the conventional measure of total factor productivity is correct for measuring changes in productive efficiency but the result should not be interpreted as attributing economic growth to technical progress and real factor inputs.

For any system under consistent management, the TFP index will consist of an underlying trend plus natural year-to-year fluctuations. It is said to be sustainable if it is growing or at least kept constant over time. There is a need to keep TFP to be growing in all sectors of the economy without any exception to agriculture. The gains in productivity is a necessary element (Mruthyunjaya, 1993) to increase production with the growth of economy. It is required for obtaining high wage rates and to maintain their continuous rise. It is also an important contributory factor to the large and growing employment. Given the rate of monetary expansion, growth of productivity (TFP) helps in keeping the prices low resulting into higher exports. Thus, the major objectives of the study are (1) to estimate total factor productivity of major oilseed crops; and (2) to determine sustainability of total factor productivity in oilseeds production.

III

METHODOLOGY

The total factor productivity attempts to measure the amount of increase in total output, which is not accounted for by increase in total inputs. There is a large residual, measured by total factor productivity, which is the contribution of improvement of technology/knowledge, infrastructural development, human capital improvement and policy interventions. The total factor productivity index is computed as the ratio of aggregate output index to the aggregate input index.

In the calculation of output index and input index, Tornquist-Theil index was used for data on outputs and inputs of different oilseed crops in major oilseeds growing states of India. The Tornquist-Theil index is a superlative index, which is exact for the linear homogeneous translog production function (Diewart, 1976). The general formula used for construction of index is as follows:

$$I_t = I_{t-1}\, \Pi^{n(m)}_{j=1}\, (Q_{j,t}/\, Q_{j,t-1})^{1/2(Sj,t\, +\, Sj,t-1)} \qquad \text{where } S_{j,t} = Q_{j,t}{*}P_{j,t}/\, [\Sigma^{n(m)}_{j=1}\, Q_{j,t}{*}P_{j,t}]$$

Where, I_t is index value of output/input for current year 't'; I_{t-1} is index value of output/ input for the previous year 't-1'; $Q_{j,t}$ is quantity of j-th output/ input for the year 't', when 'j' varies from 1 to 'n' for outputs and 1 to 'm' for inputs used in the production of an oilseed crop; $Q_{j,t-1}$ is the quantity of j-th output/ input in the crop for the previous year 't-1'; $S_{j,t}$ is the share of j-th output value in total value of production (VOP) or j-th input in total cost; $P_{j,t}$ is the current price of j-th output/ input.

The additional advantage of this index is that it accounts for 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 (Capalbo and Vo, 1988). The Tornquist-Theil index provides consistent aggregation of inputs and outputs under the assumption of competitive behaviour, constant returns to scale, Hicks-neutral technical change and input-output separability.

If QI_t is the index for output in year 't' and XI_t is the index for inputs for the same year, the total factor productivity (TFP) index is equal to QI_t/XI_t.

TFP indices were calculated for six oilseed crops, namely, RSM, GNUT, SOYA, SUNF, SESA and SAFF for major oilseeds growing states for which data on outputs (grain and straw) produced and inputs used were available in the reports on Cost of

Cultivation of Important Crops in India (Directorate of Economics and Statistics, various issues).

Both grain and straw yields are included in output index of an individual crop. The shares in total revenue estimated using farm harvest prices were applied as the weights to aggregate the outputs. Inputs included in input index were land, seed, fertiliser, manure, insecticide/pesticide, human labour, animal labour, machine labour, capital (working and fixed) and irrigation. Inputs were aggregated using their shares in total cost of cultivation as weights. The output index was divided by input index to calculate TFP index for individual crop in a state. The output index and input index were aggregated across states and crops to find out the overall TFP using share in the respective and total oilseed production and area as weights.

The annual growth rates of output index and input index were calculated assuming exponential trend. Since, $\text{Ln TFP}_t = \text{Ln QI}_t - \text{Ln XI}_t$; its derivation with respect to time gives the growth rates, i.e., $\partial (\text{Ln TFP}_t)/dt = \partial (\text{Ln QI}_t)/\partial t - \partial (\text{Ln XI}_t)/\partial t$. Thus, growth in TFP index is equal to growth rate in output index *minus* growth rate in input index.

The TFP of production of a particular oilseed crop was considered sustainable in both the cases when its growth rates were either positive (CGR>0) or non-significantly negative.

IV

CROP-WISE SUSTAINABILITY OF TFP

In the subsequent paragraphs, the growth in TFP during past twenty years for six edible oilseed crops (rapeseed and mustard, groundnut, soybean, sunflower, sesamum and safflower) has been discussed in order to judge the long-term sustainability of the oilseeds production.

Rapeseed and Mustard

The total factor productivity of rapeseed and mustard (RSM) was estimated using data on cost of cultivation and production from seven states - Rajasthan, Punjab, Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat and Assam. These states account for 90 per cent of the area and 91 per cent of the production of the crop in India. The data available for Punjab were only after 1990 and for Madhya Pradesh and Gujarat, data were available only during last five years (1995-2000). The state-wise growth rate of output, input and TFP indexes are given in Table 1. Overall growth rate of 2.41 per cent showed that the production efficiencies of rapeseed and mustard have improved over time. The output index grew at much higher rate (13 per cent) than input index (10.59 per cent).

TABLE 1: STATE-WISE GROWTH RATES OF TFP OF RSM (1980-81 TO 1999-2000)

(per cent)

States (1)	Output Index (2)	Input Index (3)	TFP Index (4)
Rajasthan	14.61	11.17	3.44
Punjab	-5.61	-2.09	-3.59
Uttar Pradesh	-1.94	-1.86	-0.08
Haryana	8.98	9.91	-0.93
Madhya Pradesh	4.52	1.54	2.98
Gujarat	-1.89	-1.47	-0.42
Assam	0.33	1.14	-0.81
Overall	13.00	10.59	2.41

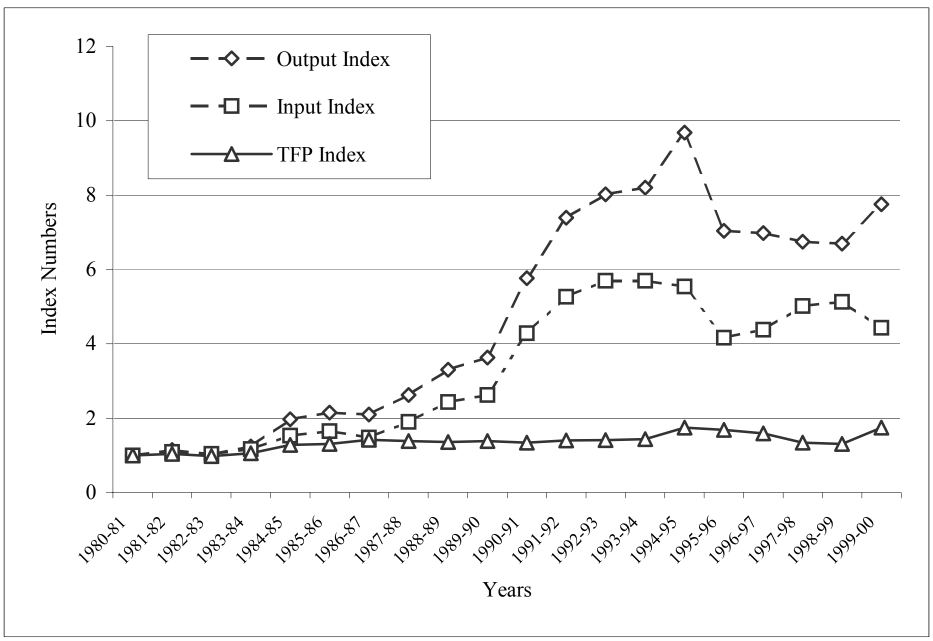

Figure 1: Yearly Fluctuations in Overall Output, Input and TFP Indexes of RSM

The scenario was not the same throughout the country as shown by wide variation in the results of TFP growth rates in different states. Among states, TFP declined in all states except in Rajasthan and Madhya Pradesh. Punjab registered the highest decline of -3.59 per cent. The major reasons for decline were the decrease in output of RSM in Punjab, Uttar Pradesh, Haryana and Gujarat, and the increased input use inefficiencies in Assam. Rajasthan was the only state, which registered growth rate in output, input and TFP indexes higher than the overall growth rates. Owing to improved efficiencies, there was remarkable growth in area and production of RSM in the state. The area under the crop increased more than seven times and the production more than ten times during 1981-2000. Presently, Rajasthan alone accounts for more than 45 per cent of the production of rapeseed and mustard in the country.

Groundnut

The total factor productivity in groundnut was estimated using data from six states - Andhra Pradesh, Gujarat, Karnataka, Tamil Nadu, Orissa and Maharashtra. These states account for 89 per cent area and 90 per cent production of groundnut in India. The data on output produced and inputs used were collected for twenty year period (1980-81 to 1999-2000) but the information was not available in some states during 1985-95 (Tamil Nadu), 1980-85 (Orissa and Maharashtra).

The state-wise growth rates in total factor productivity of groundnut are shown in Table 2. The overall trend in Figure 2 shows that TFP of groundnut which was high during late 1980s, reduced significantly during late 1990s and at the same time became unstable in comparison to the earlier period. The combined overall growth rate during last two decades was observed to be less than one (0.39 per cent) and was found statistically not significantly different than zero. The growth in output index of groundnut was mainly because of commensurate growth in input index, thus, very little was added by technological improvement and other external factors.

TABLE 2. STATE WISE GROWTH RATE IN TFP OF GROUNDNUT (1980-81 TO 1999-2000)

(per cent)

States (1)	Output index (2)	Input index (3)	TFP index (4)
Andhra Pradesh	4.73	3.66	1.07
Gujarat	1.18	1.32	-0.14
Karnataka	2.36	3.80	-1.44
Tamil Nadu	4.46	4.42	0.04
Orissa	-12.02	-11.32	-0.70
Maharashtra	2.05	0.43	1.62
Overall	2.95	2.56	0.39

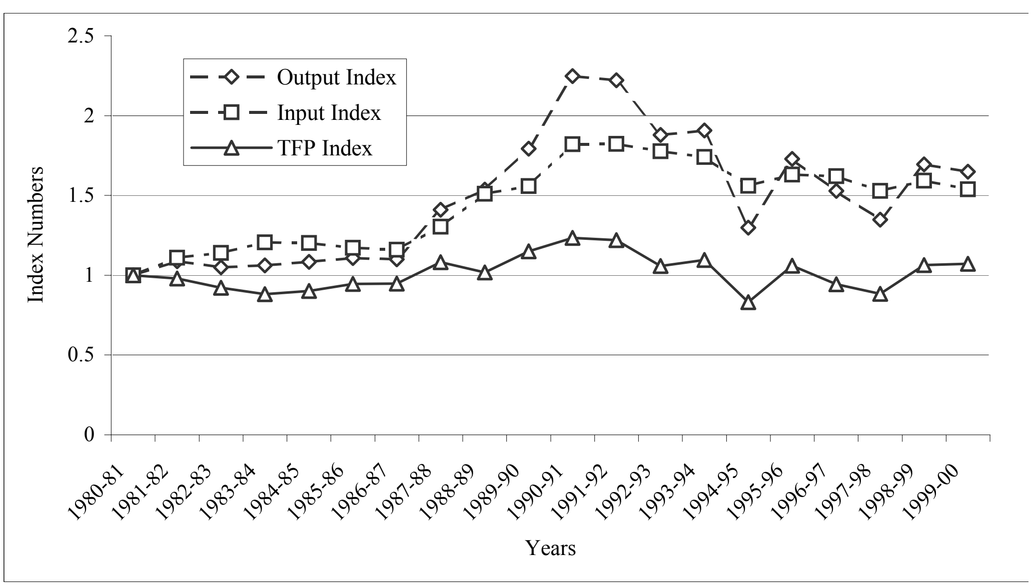

Figure 2. Yearly Fluctuations in Overall Output, Input and TFP Indexes of Groundnut

Among the states, TFP increased at a significant rate in Andhra Pradesh (1.07 per cent) and Maharashtra (1.62 per cent) while growth rate in Tamil Nadu (0.04 per cent) was just equivalent to zero though the increase in output and input indexes was more than four per cent. This reveals that output growth in Tamil Nadu is based on use of more area and inputs. The possible reason for this may be groundnut becoming a more suitable crop to the area due to lack of water. The technologies in groundnut are required to be refined for adoption in such areas. Ramasamy and Selveraj, 2002 reported that in case of oilseeds, more than 300 modern varieties and hybrid crops have been released to the farmers, but their adoption rates were poor due to their cultivation in rainfed areas. The decline in TFP in Gujarat though was non-significant but it could be a major area of concern to the researchers it being a major groundnut growing state. The intensive use of inputs seems to be the major reason for decline in TFP since input index grew at a rate (1.32 per cent) higher than growth rate of output index (1.18 per cent) revealing that groundnut production in Gujarat is becoming more input intensive than technology intensive. Both Andhra Pradesh and Maharashtra attained better technical efficiencies in groundnut production during last two decades, which will essentially promote cultivation of groundnut in future in these states.

From Figure 2, the sustainability of TFP during the period under study could be observed. The decrease in total factor productivity was quite apparent during early 1990s though it recovered slightly in the late 1990s with enhanced variability. The increase in output index was substantially high during 1985-90 (13.86 per cent), the period of Technology Mission on Oilseeds (TMO) intensifying oilseeds supporting programmes of the government.

Soybean

The data from two states - Madhya Pradesh and Uttar Pradesh, were used to calculate TFP. These states are the representative sample of soybean cultivation in India as they account for 85 per cent of the crop area in the country. The data on input use were not available for Uttar Pradesh during 1990-2000.

The state-wise growth rates and trend in TFP of soybean given in Table 3 show that the overall TFP of soybean declined marginally (-0.06 per cent) during last twenty years from 1980-81 to 1999-2000. The input index grew at a higher rate (18.29 per cent) than the output index (18.23 per cent).

TABLE 3. STATE-WISE GROWTH RATES IN TFP OF SOYBEAN (1980-81 TO 1999-2000)

(per cent)

States (1)	Output Index (2)	Input index (3)	TFP index (4)
Madhya Pradesh	17.64	18.00	-0.36
Uttar Pradesh	-28.86	-32.68	3.82
Overall	18.23	18.29	-0.06

The robust growth rate achieved in output was mainly because of increased input use, which brought inefficiencies in their use. The overall growth rates in indexes were mainly influenced by growth rates in Madhya Pradesh being the highest producer of and area under soybean in India. Though there was increase in output index of the state but TFP declined by 0.36 per cent, which is a matter of concern. In Uttar Pradesh, both output index and input index reduced at a very higher rate but the rate of decrease was more in input use than the decrease in output, thereby, showing improvement in TFP (3.82 per cent). The decline in production of soybean in Uttar Pradesh is attributed to increased cultivation of maize. The promotion of intercropping of soybean with maize may retain cultivation of soybean in an efficient way. A perusal of Figure 3 shows that the overall TFP remained almost stable over time with non-significant negative growth rate.

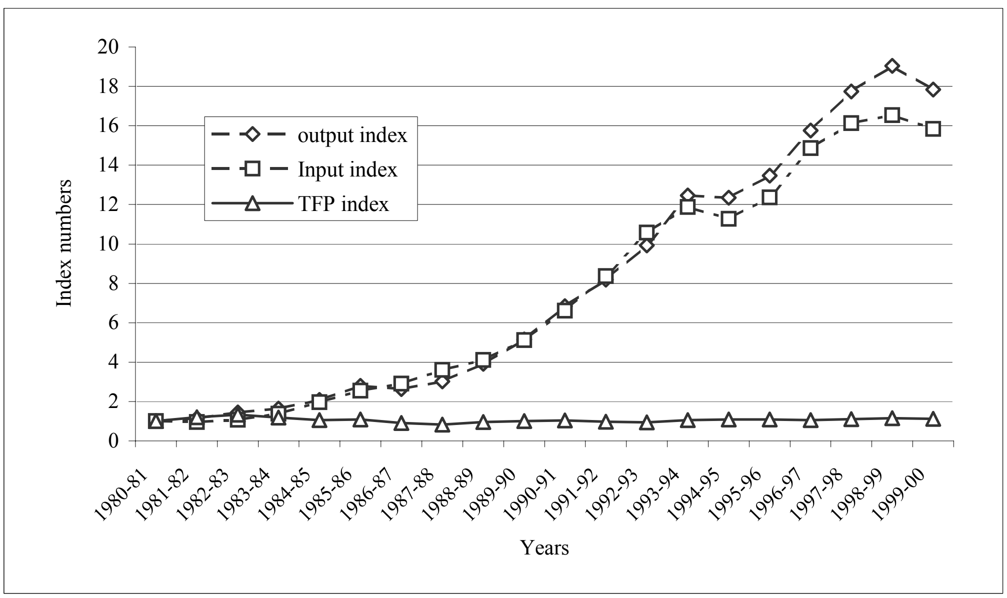

Figure 3: Yearly Fluctuations in Overall Output, Input and TFP Indexes of Soybean

Sunflower

The total factor productivity of sunflower has been calculated using data from Maharashtra and Karnataka. These are the two states, which represent 70 per cent of the area and 55 per cent of production of sunflower in India. The input-output data for sunflower were collected from 1980 onwards, however, it was not available for the state of Karnataka during 1980-85.

The state-wise growth rates in output, input and TFP indexes are presented in Table 4. Like groundnut, the overall TFP growth rate of sunflower (0.45 per cent) was found to be negligible. Nevertheless, rates of growth in output index and input index of sunflower were observed to be significantly high - output index (6.88 per cent) and input index (6.43 index) showing thereby a marginal improvement in TFP over the time period.

TABLE 4. STATE-WISE GROWTH RATES IN TFP OF SUNFLOWER (1980-81 TO 1999-2000)

(per cent)

States (1)	Output index (2)	Input index (3)	TFP index (4)
Maharashtra	10.38	10.45	-0.07
Karnataka	4.50	6.72	-2.22
Overall	6.88	6.43	0.45

The TFP declined in both the states at the rate of 0.07 per cent and 2.22 per cent, respectively. The decline in TFP was induced by higher rate of growth in input index than the rate of growth in output index. In Maharashtra, input index grew at the rate of 10.45 per cent while output index increased at the rate of 10.38 per cent. Similarly in Karnataka, the growth rate of input index was 6.72 per cent while output index grew only at the rate of 4.50 per cent. The presentation of overall indexes in Figure 4 shows that TFP in sunflower declined continuously in the last twenty years except for the period 1985-90.

In most of the oilseed crops, TFP grew at a significant rate immediately after the start of TMO but this growth rate could not sustain for a long time and during 1990s there were decline in TFP of most of the oilseed crops. The growth rates of output index and input index declined steadily over time showing receding sunflower cultivation in these states.

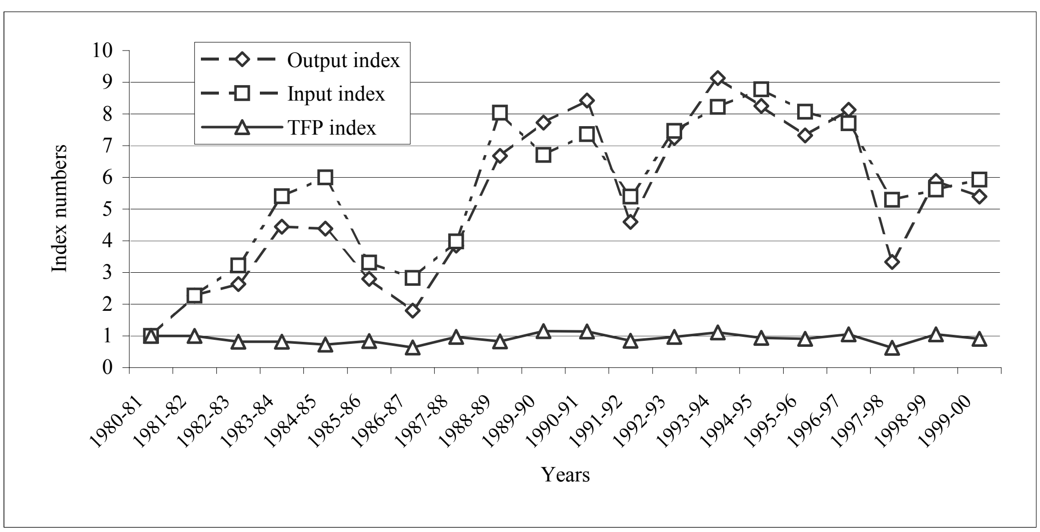

Figure 4: Yearly Fluctuations in Overall Output, Input and TFP Indexes of Sunflower

Sesamum

The data on cost of cultivation of sesamum were collected from Rajasthan and Uttar Pradesh to calculate TFP. The TFP for Rajasthan was estimated for the period 1985-2000 and for Uttar Pradesh from 1985-90. These are the states, which account for 25 per cent of the area and 10 per cent of the production of sesamum in India. The share of these states in area and production of sesamum has reduced from 45 per cent and 22 per cent, respectively in the early 1980s. The major sesamum growing states are Maharashtra, Karnataka and Orissa, for which the input and output data was not available.

The separate and overall growth rates of TFP in the states under study are given in Table 5. The TFP of sesamum declined significantly at the rate of 1.09 per cent per annum during the last twenty years. The decrease in output index was the major reason for decline in TFP. The output index reduced at the rate of 8.82 per cent and input index declined at the rate of 7.81 per cent. The overall trend was the same in Uttar Pradesh while the rate of reduction in input index in Rajasthan was higher than the output index and hence, TFP improved marginally at the rate of 0.10 per cent per annum.

TABLE 5. STATE-WISE GROWTH RATES IN TFP OF SESAMUM (1985-86 TO 1999-2000)

(per cent)

State (1)	Output index (2)	Input index (3)	TFP index (4)
Rajasthan	-4.70	-4.80	0.10
Uttar Pradesh	-10.53	-8.29	-2.24
Overall	-8.82	-7.81	-1.09

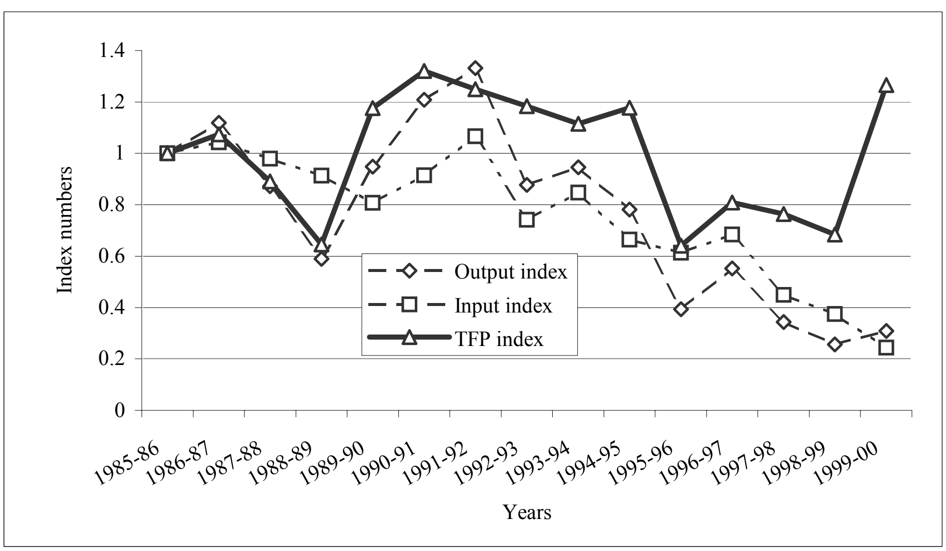

Figure 5: Yearly Fluctuations in Overall Output, Input and TFP Indexes of Sesamum

The plotting of yearly values of output, input and TFP indexes of sesamum in Figure 5 shows that TFP of sesamum increased in the last five years (1995-2000) after declining continuously in the first half of 1990s and the improvement has come mainly due to efficient use of inputs especially in the case of Rajasthan. During the period 1995-2000, for which the data were available for Rajasthan state only, the outcomes may not be generalised because its cultivation in the state has lot of variations. The decline in output index of sesamum during 1985-95 at a rate higher than input use led to decrease in TFP of sesamum for the period under reference.

Safflower

The total factor productivity in safflower has been estimated using data from Karnataka and Maharashtra. These are the states, which account for about 96 per cent of the area and production of safflower in the country. The input-output data for safflower, were available with gaps, i.e., during 1985-2000 for Maharashtra and during 1985-90 for Karnataka.

The growth rates given in Table 6 indicate that TFP of safflower declined significantly at the rate of 1.92 per cent per annum. The reduction in output index (-4.18 per cent) was the main reason for decline in total factor productivity because the input index declined at a lesser rate (-2.26 per cent). The TFP index reduced at a much higher rate in Karnataka (-9.43) than Maharashtra (-2.38 per cent). In both the states, the main reason for decline in TFP was the reduction in output index owing to about 30 per cent decrease in safflower production in these states over a period of twenty years. The decrease in area was lesser than the decline in production affecting productivity adversely.

TABLE 6. STATE-WISE GROWTH RATES IN TFP OF SAFFLOWER (1985-86 TO 1999-2000)

(per cent)

State (1)	Output index (2)	Input index (3)	TFP index (4)
Maharashtra	-4.51	-2.13	-2.38
Karnataka	-1.16	8.27	-9.43
Overall	-4.18	-2.26	-1.92

The situation is clearer from Figure 6 showing time series movement of output index, input index and TFP index for safflower. The TFP of safflower grew during 1985-90 though at a slower rate (0.27 per cent). The declining rate increased substantially during the following period, i.e., –0.55 per cent during 1990-95 and –25.23 per cent during 1995-2000. The study of growth rates of output index and input index gives a typical case of creeping inefficiencies that the input index increased on the contrary to decrease in output index. During 1990-95, the output index decreased at the rate of 0.15 per cent while input index increased at the rate of 0.40 per cent. Similarly, the rate of decline in output index was 17.01 per cent during

1995-2000 while input index grew at the rate of 8.22 per cent. Drastic reduction in TFP of safflower during 1995-2000 owing to decrease in output index and increase in input index need further investigation into causes and effects.

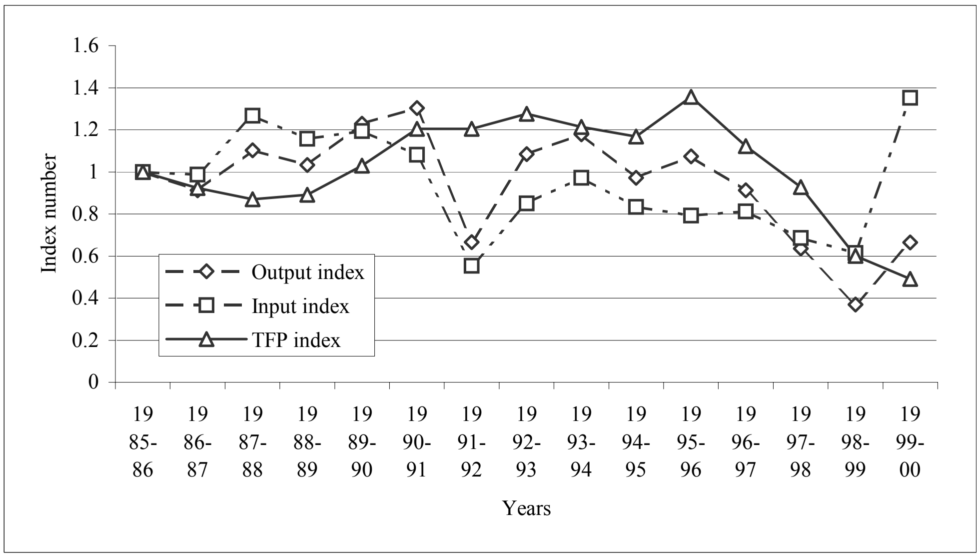

Figure 6.Yearly Fluctuations in Overall Output, Input and TFP Indexes of Safflower.

V

CROSS MATRIX (STATE AND CROP) OF TFP GROWTH RATES

Only those states were taken for discussion in which two or more oilseed crops were included for the estimation of TFP. These states were Rajasthan, Madhya Pradesh, Maharashtra, Karnataka, Uttar Pradesh and Gujarat. The growth rates of TFP in these states are given in Table 7.

TABLE 7. CROSS MATRIX OF GROWTH RATES OF TFP

(per cent)

States (1)	RSM (2)	GNUT (3)	SOYA (4)	SUNF (5)	SESA (6)	SAFF (7)	State-overall (10)
Rajasthan	3.44	-	-	-	0.10	-	3.39**
Madhya Pradesh	2.98	-	-0.36	-	-	-	-0.17
Maharashtra	-	1.62	-	-0.07	-	-2.38	-0.85
Karnataka	-	-1.44	-	-2.22	-	-9.43	-2.13**
Uttar Pradesh	-0.08	-	3.82	-	-2.24	-	1.03*
Gujarat	-0.42	-0.14	-	-	-	-	-0.001
Crop-overall	2.41**	0.39	-0.06	0.45	-1.09*	-1.92*	-1.21*

**and * Significant at 1and 5 per cent level of probability.

There were only two states (Rajasthan and Uttar Pradesh), which observed overall positive growth rate in TFP of oilseed crops. In the remaining states, the growth rate in TFP was observed to be negative but non-significant except in Karnataka. Among oilseed crops also, the growth rate of TFP was positive for rapeseed and mustard, groundnut and sunflower but non-significant except in rapeseed and mustard. The non-significant growth rates were taken equal to zero displaying no change in TFP. In other crops, the growth rate of TFP was negative but significant except in soybean. The overall growth rate of TFP for six edible oilseeds was found negative (-1.21) and significant, manifesting overall unsustainable behaviour of total factor productivity of oilseeds in India for the period under study. Due to non-availability of the required data, it was not possible to include in the analysis all edible oilseed crops and the states producing them. Nevertheless, the findings of the study reflect the picture for more than 80 per cent area and production of oilseeds in the country.

Among oilseed crops in the states, the total factor productivity in Gujarat and Karnataka reduced in case of all crops taken up for study. The states of Uttar Pradesh, Maharashtra and Madhya Pradesh registered positive growth rate in one crop only - RSM in Madhya Pradesh, GNUT in Maharashtra and SOYA in Uttar Pradesh. Rajasthan was found to be the only state where total factor productivity of both the studied crops (RSM and SESA) increased over time. This could be attributed to the oilseeds research and concerted efforts to support oilseeds production in the state.

The sustainability of TFP of oilseed crops in a particular state has direct bearing on allocation of area under the competing cereal crops. It has been observed in the study by Kumar and Mruthyunjaya (1992) on wheat in Rajasthan, a competing crop for RSM that the average annual growth rate of its TFP (2.7 per cent) during 1971-89 was lower than that of RSM led to fast shift in area from wheat to RSM in the state. Conversely, the lower growth rate in TFP of oilseeds may lead to shift in area and other resources in favour of competing non-oilseed crops. Thus, maintaining sustainable growth rate in TFP of oilseeds is important for continuous allocation of resources and making investment in their cultivation to increase production and productivity.

VI

CONCLUSIONS

Thus enhancing production and profitability of oilseeds is indispensable to stop the soaring import bill of edible oils. Both these indicators hinge on sustainability of total factor productivity of oilseeds. A sustainable production has a non-negative trend over time in total factor productivity. Working on this approach, the paper estimates TFP of six edible oilseed crops, namely, rapeseed and mustard (RSM), groundnut (GNUT), sunflower (SUNF), soybean (SOYA), sesamum (SESA) and safflower (SAFF) using Tornquist - Theil indices. The results analysed in terms of growth rate and trends in TFP showed erosion of sustainability in majority of the oilseeds in the past twenty years (1980-81 to 1999-2000) except in rapeseed and mustard. The TFP of rapeseed and mustard grew at a significant rate while it was close to zero in case of groundnut, sunflower and soybean. The TFP declined substantially in sesamum and safflower. The rate of increase in output index was higher than the input index of rapeseed and mustard, groundnut and sunflower, while in sesamum and safflower, the output index reduced at a rate higher than the input index causing TFP to decline in these crops. The commensuration of increase in input index with output index in soybean reflected production inefficiencies causing TFP to be almost stable.

Among states, Rajasthan registered the highest TFP growth rate for oilseeds production in the country followed by Uttar Pradesh. In the remaining states, overall TFP of oilseeds were observed to be stagnant except in Karnataka where it declined significantly. The overall growth rate of TFP for six edible oilseeds was found significantly negative (-1.21) manifesting overall unsustainable behaviour of total factor productivity of oilseeds in India. There is a need to reverse this trend.

Technology being a major contributing factor for TFP growth, greater R&D emphasis on oilseed crops is needed. Other factors, which could make a dent on the present unsustainable behaviour of TFP, are the price parity of oilseeds with competing cereal crops, market support and irrigation, with oilseeds being a rainfed crop. A growth in TFP will maintain relative profitability of oilseeds to ensure undisrupted flow of resources and investment in their cultivation.

Received December 2005. *Revision accepted April 2007.*

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