

Growth of Output and Productivity in Pakistan's Agriculture: Trends, Sources, and Policy Implications

M. GHAFFAR CHAUDHRY, GHULAM MUSTAFA CHAUDHRY and MUHAMMAD ALI QASIM

The paper aims to review the growth performance of Pakistan's agriculture from 1950 to 1995. The long-term growth rate of agriculture, although respectable, has exhibited considerable yearly fluctuations even between decades. The period of the fifties and early seventies lacked any growth. Accelerating and high growth rates marked the decade of the sixties but the performance has not been satisfactory since 1979-80 and average growth rates have barely exceeded the population growth rate, with widespread implications for growth of national economy, food security, and social welfare of the masses. Area, modern inputs, and technology have been the major determinants of growth but prices were equally important because of their incentive and disincentive effects. The agriculture price policies adopted during the 1980s are known to have had a negative effect on the development and use of technology in agriculture.

In order to boost agricultural productivity, a change in price policy is needed to ensure incentive prices. This could be done by setting agricultural commodity prices at par with corresponding import and export parity prices. A higher investment in research and development can hardly be overemphasised. There is an urgent need to remove the bottlenecks in agricultural input markets since these markets represent the typical monopoly position. To break up the monopoly of registered dealers and to promote competition, free sales in the open market by interested parties and individuals may be allowed.

1. INTRODUCTION

As agriculture is a sector of major proportions and is characterised by higher labour intensity relative to other productive sectors, rapid growth of agricultural output would be largely consistent with the improved welfare of the masses and achievement of major macroeconomic goals of the national economy [Mellor (1988)]. While agricultural output is the result of crop-livestock interactions, its growth can be decomposed into acreage and productivity increases. It may, however, be noted that crop-land increases, because of limited land availability, may not be a dependable source of future output increases. It, therefore, follows that any future increases in

M. Ghaffar Chaudhry is Joint Director. Ghulam Mustafa Chaudhry and Muhammad Ali Qasim are both Staff Economist at the Pakistan Institute of Development Economics, Islamabad.

agricultural output must largely spring from the growth of productivity in agriculture [Ahmed and Chaudhry (1987)].

In view of its significance, growth of output and productivity in Pakistan's agriculture since 1949-50 is the subject of discussion of the present paper with the following outline. While the current section is introductory, Section 2 looks at the trends of agricultural output at five year intervals. Section 3 deals with partial and total factor productivity trend and delineates at various growth sources. The policy implications of the discussion in Section 3 have been narrated in Section 4. The final Section 5 summarises the findings of the paper.

2. TRENDS AND GROWTH OF AGRICULTURAL OUTPUT

Agriculture sector in Pakistan consists of such subsectors as crops, livestock, forestry and fisheries. While crops and livestock subsectors account for a lions share of agricultural output, the contribution of forestry and fisheries does not exceed one percent [Government of Pakistan (1996)]. Being so, the emphasis of the current section is heavily centred on crop and livestock subsectors in addition to aggregate analysis of the agriculture sector. In order to look into the growth trends, the following Table 1 presents relevant data for the end and mid years of each decade.

Table 1

Indices and Annual Growth Rates in Agriculture from 1949-50 to 1994-95

Year	Indices of Value-added by			Annual Growth Rate (Percent) in		
	Agriculture Sector	Crops Sub-sector	Livestock Sub-sector	Agriculture Sector	Crop Sub-sector	Livestock Sub-sector
1949-50	100.00	100.00	100.00	–	–	–
1954-55	105.35	101.65	112.47	1.01	0.33	2.35
1959-60	116.92	112.33	124.98	2.10	1.91	2.18
1964-65	140.65	141.45	137.49	3.78	4.76	1.93
1969-70	190.66	209.79	151.54	6.26	8.18	1.96
1974-75	198.24	214.92	167.36	0.78	0.49	2.01
1979-80	239.97	263.32	194.62	3.91	4.15	3.06
1984-85	282.03	299.79	245.99	3.28	2.63	4.80
1989-90	352.68	359.88	330.97	4.57	3.70	5.93
1994-95	414.37	400.16	436.61	3.93	3.02	5.70

Source: [Government of Pakistan (1990, 1996)].

Many conclusions follow from the above table. Firstly, Pakistan's agricultural output exhibited an upward trend since 1949-50 and its production potential multiplied by a factor of four. The index of production in agriculture rose steadily although in the late Fifties and early Seventies it was less than one percent only. The same is true for the crop subsector and livestock subsector but with slower pace of rise in the former than that of livestock subsector. Secondly, the annual growth rates of crop subsector varied considerably from time to time but with the passage of time the value-added by livestock subsector witnessed systematic and accelerating growth rates. Thirdly, the crop-production subsector experienced the highest growth rates in the 1960s, as against the maximum growth rates of livestock subsector in the late Eighties and early Nineties. What shaped these trends, is of particular interest from policy perspective point of view. However, as the government intervenes little in the livestock subsector, market prices and technology are the main determining factor of changing production trends of this sector. By contrast, trends in crop-production are a function of a number of forces such as crop land, cropping patterns, agricultural productivities and technological changes which are shaped by the ongoing government policies. It is for this reason that the following section looks at various factors determining crop production trends.

3. PARTIAL AND TOTAL FACTOR PRODUCTIVITIES: THE CROPS SUB-SECTOR

A study of partial and total factor productivities permits decomposition of the growth process as contributions of various factors of production such as land, labour, capital and technological progress. It may, however, be recognised at the outset that because of the complementarity of agricultural outputs and embodiment of technological change in some of these inputs, precise calculation of the input contributions are hardly possible [Nadiri (1970)]. In the following pages, therefore, only estimates of the relative factor contributions are given. The estimated contributions have been based on methodologies developed and refined by some of the world-known economists such as Kendrick (1956); Solow (1957) and Denison (1967). In order to provide a bird's eye view of productivity trends in the crop-production subsector, the following Table 2 reports on growth rates of crop-production, cropland, partial productivity of land and total factor productivity.

The above Table 2 indicates that area increases accounted for nearly 40 percent of the total increase in crop output and the rest is due to increases in output per acre. However, growth rates of area and productivity have varied from time to time. The growth of per acre value-added by crops was negative during the decade of the Fifties and early Seventies. Any growth in crop output will have therefore to be attributed to area increases. The growth rates resumed acceleration in the 1960s and reached a maximum level of 7.55 percent per annum during the second half of Sixties. Although

Table 2
Growth of Partial and Total Factor Productivities in Crops
Sub-sector 1949-50 to 1994-95

Time Period	Annual Growth Rates of				
	Crop Production	Crop Land	Productivity per Acre	Aggregate Inputs	Total Factor Productivity
1950-55	0.33	1.24	-0.91	1.64	-1.31
1955-60	1.91	2.05	-0.14	2.40	-0.49
1960-65	4.74	2.03	2.73	2.20	2.56
1965-70	8.18	0.63	7.55	2.36	5.82
1970-75	0.48	0.70	-0.22	2.59	-2.11
1975-80	4.15	1.58	2.57	3.16	0.99
1980-85	2.63	0.15	2.48	3.32	-0.69
1985-90	3.70	1.50	2.10	2.83	0.87
1990-95	3.17	0.62	2.55	1.70	1.47
1949-95	3.02	1.31	1.71	2.54	0.48

Source: [Government of Pakistan (1990, 1996) and Kemal (1992)].

the per acre partial productivity index declined during the early 1970s, it took a significant positive turn during 1975-80 period. The growth rates of crop output per acre since 1975-80, were although positive, they have witnessed deceleration and have slightly declined from 2.57 percent per annum in 1975-80 to 2.55 percent per annum during 1990-95. Consequently, the contribution of areas to crop output witnessed an increase relative to partial productivity.

By contrast, total factor productivity relative to aggregate inputs made a smaller contribution to crop output. For example, for the period 1949-50 to 1994-95 factor productivity growth was only 0.48 percent per annum in contrast to annual growth rate of 2.54 percent of aggregate inputs. In other words this implies that the contribution of technology to crop-output in Pakistan was nearly 20 percent in contrast to 80 percent contribution of growth of aggregate inputs. However, the contribution of technology has varied considerably from time to time from negative rates in 1950s, early 1970s and 1980s to a maximum of more than 70 percent in the late Sixties. Like partial productivity index, the growth of total factor productivity has also been on the decline since 1970s.

4. EXPLAINING PRODUCTIVITY TRENDS

It follows from above that increases in aggregate input and technological changes have been at the heart of output increases in Pakistan's agriculture. The same forces could be used as the explanatory variables underlying the productivity increases.

As a first step, high productivity growth periods correspond with periods of rapid technological breakthroughs of biological chemical or mechanical technologies. For example, the rapid growth of productivity in Pakistan's agriculture in the Sixties corresponded with the onset and maturity of Green Revolution. It was initiated in the early Sixties with exploitation of underground water aquifer by rapid development of public and private tubewells. By mid-Sixties, the High Yielding Varieties (HYVs) of IRRI rice and wheat, with 2-3 times the yield potential of traditional varieties, became available and strengthened the productivity potential of Pakistan. The increased consumption of chemical fertiliser and pesticides throughout the decade were a source of chemical revolution. A departure from traditional cultural practices was filled by tractorisation. Even the second and third peaks in productivity growth corresponded with varietal breakthroughs and widespread adoption of newly evolved cotton varieties in the late Seventies to late Eighties. The negative or slow productivity growth periods corresponded either with nonavailability of modern technologies as was the case in the 1950s or their non-optimal use by farmers on technical or disincentive grounds as has been the case in early Seventies, Eighties and Nineties.

A second factor, in the productivity growth of Pakistan's agriculture, has to do with incentive and disincentive effects of price policy from time to time. There is convincing evidence in Pakistan that a shift from an unfavourable to favourable price policy for agriculture was the main motivating force behind the Green Revolution in Pakistan [Aresvik (1967)]. Beginning with 1979-80, however agricultural price policy turned increasingly hostile toward agriculture which resulted in immense resource transfers from agriculture [Chaudhry (1995); Faruqui (1995); Longmire and Debord (1993) and Mellor (1993)] and falling and even in negative rates of return in crop production [Afzal *et al.* (1992) and Ahmed (1987)]. Both the cases are known to have negative effect on the development and use of technology in agriculture. For example, resource transfers imping on savings investment potential in agriculture and reduce chances of accumulation of embodied technical change. The same would follow as a result of capital flight from agriculture if the rates of return in agriculture are abysmally low (as noted above) relative to industrial sector.

While technological developments are a function of investment in modern inputs, their use depends heavily on the price policy in vogue and profitability of agriculture. Many world-known agricultural economists have made convincing argument in this regard. For example, Bale and Lutz (1981) highlight the fact that the level of agricultural production depends not so much on technical considerations as in a large measure it depends on what governments do to agriculture. According to Schultz

(1978) whenever the farm product is underpriced, even though superior varieties are at hand, the adoption is at best partial. Arguing in the same vein, Johnston and Connie (1969) have remarked that the application of chemical fertilisers will undoubtedly increase output unless there is a marked deterioration of grain-fertiliser price ratios. With respect to institutional factors, Schultz (1965) categorically stated that when the price of fertiliser is far above the prices of farm products, no extension programme can induce farmers to use additional quantities of fertiliser.

Third and finally, agricultural production is a complex process combining a large number of traditional inputs, modern technologies and managerial skills. On top of that, natural hazards, insect pests and climate can have devastating effects on agricultural output and crop yields. Being uneducated, most of the farmers in Pakistan are not fully equipped with required technological skills for operating agriculture on modern lines. Under the global warming scenario, the existing cropping cycles have become increasingly susceptible to insect pests and temperatures. Instead of finding effective solutions to these problems, Pakistan has failed miserably to tackle these problems. One of the basic reasons for stagnating cotton yields in Pakistan since 1985-86 has to do with rising incidence of leaf curl virus and white fly which multiply under high temperatures and dry climate. The same holds good in the case of stagnation of wheat yields between 1985-86 and 1994-95 as rising temperatures in April head to strivelled maturity of grain. As such, there is little that could be done to improve the climatic conditions but efforts may be made to evolve early maturing wheat varieties. This has been done to a certain extent through the evolution of pest-resistant cotton varieties but a lot more needs to be done in the field of delivery of effective insecticides to wipe out the widespread incidence of major pest attacks.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

One of the major objectives of this paper has been to review the growth performance of Pakistan's agriculture. While the long term growth rate of agriculture has been respectable, it exhibited considerable fluctuations from year to year or even from decade to decade. For example, most of the Fifties and early Seventies are characterised by lack of growth. Acceleration and high growth rates marked the decade of the Sixties but things have not been satisfactory since 1979-80. The annual growth rate of agricultural output between 1979-80 and 1994-95 has heavily exceeded the population growth rate with widespread implications for growth of national economy, food security and social welfare of the masses.

It is apparent from the analysis of this paper that the agricultural price policy pursued in Pakistan in the recent years has adverse consequences for investment and technology, production, employment and income distribution and needs to be changed to ensure incentive prices by setting agricultural commodity prices on the basis of

corresponding import and export parity prices. Since parity prices tend to be higher than procurement prices, the favourable incentive effects of the policy on major macroeconomic aggregates can hardly be denied. However, as parity prices are likely to vary with highly volatile world price, trend lines of past parity prices can be used to ensure stability of domestic prices.

Secondly, while price incentives may be instrumental to ensure some progress on technological front, the need for stepped up investment on research and development can hardly be overemphasised. This follows not only from high rates of return on investment in research but also from unlikely contribution of cropland to agricultural production, rather than undertaking general research. The emphasis should shift to problem shooting research in the area of specific land areas and crops. For example, if the realisation of the yield potential of current wheat varieties is handicapped by rising high temperatures in April, the evolution of early maturing wheat varieties should have the emphasis of wheat breeding research.

Finally, most of the agricultural input markets are still in their infancy in Pakistan and suffer from even greater fundamental problems than the commodity markets. For example, they are typically characterised by monopoly positions of one kind or another, there is lack of quality control and almost any product is sold at the asking price. These problems are particularly acute in the modern input markets such as those dealing in seeds, insecticides and fertiliser, with only few exceptions in the irrigation water and credit markets. The passage of antitrust laws and legislation of severe penalties may be suggested to check illicit trade practices in seed agencies and the production and marketing of substandard, fictitious and underbagged fertilisers and insecticides. To break up the monopoly of registered dealers and to promote competition, free sales in the open market by interested parties and individuals may be allowed.

REFERENCES

- Afzal, Muhammad *et al.* (1992) Review of Prices of Agricultural Inputs and Outputs. *Pakistan Journal of Agricultural Economics* 1:2.
- Ahmad, Bashir, and M. Ali Chaudhry (1987) Profitability of Pakistan's Agriculture. *Pakistan Development Review* 26:4 457-467
- Aresvik, Odd Var (1967) Strategy and Outlook for Agricultural Development in West Pakistan. Paper prepared for the Symposium on Strategy of Agricultural Planning in Developing Countries held at University of Sindh. (Mimeographed.)
- Bale, Malcolm, and Ernst Lutz (1981) Price Distortions in Agriculture and their Effects: An International Comparison. *American Journal of Agricultural Economics* 63:1.
- Chaudhry, M. Ghaffar (1995) Recent Input-Output Price Policy in Pakistan's Agriculture: Effects on Producers and Consumers. *Pakistan Development Review* 34:1.

- Denison, Edward F. (1967) Sources of Postwar Growth in Nine Western Countries. *American Economic Review* 57:2.
- Faruqui, Rashid (1995) *Structural and Policy Reforms for Agricultural Growth: The Case of Pakistan*. Washington, D. C.: The World Bank.
- Johnston, B. F., and John Connie (1969) The Seed-Fertiliser Revolution and Labour Force Absorption. *American Economic Review* 59:4.
- Kemal, A. R., and S. Islam Ahmad (1992) *Final Report of the Sub-committee on Sources of Growth in Pakistan*. Islamabad: Pakistan Institute of Development Economics.
- Kendrick, John W. (1956) Productivity Trends; Capital and Labour. *Review of Economics and Statistics*.
- Longmire, Jim, and Pascale Debord (1993) Agricultural Pricing and Comparative Advantage in Pakistan: An Update to 1991-92. Report prepared for the South Asian Division of the World Bank, Washington, D. C.
- Mellor, John W. (1988) *Lectures on Agricultural Growth and Employment*. Islamabad: Pakistan Institute of Development Economics.
- Mellor, John W. (1993) Commodity Price Policy Priority for Change. In Pervaiz Amir and Mazhar Hussain (eds) *Summary Report: Seminars on Policy Issues for Enhancing Agricultural Productivity in Pakistan*. Islamabad: Asianics Agro-Dev International (Pvt) Ltd and Washington, D. C.: John Mellor Associates, Inc.
- Nadiri, M. Ishaq (1970) Some Approaches to the Theory and Measurement of Total Factor Productivity: A Survey. *Journal of Economic Literature* 85:4.
- Pakistan, Government of (1990) *Economic Survey 1989-90*. Islamabad: Finance Division, Economic Adviser's Wing.
- Pakistan, Government of (1996) *Economic Survey 1995-96*. Islamabad: Finance Division, Economic Adviser's Wing.
- Schultz, T. W. (1965) *Economic Crisis in World Agriculture*. Ann Arbor: University of Michigan Press.
- Schultz, T. W. (1978) Constraints on Agricultural Production. In T.W. Schultz (ed) *Distortions of Agricultural Incentives*. Bloomington: Indiana University Press.
- Solow, R. M. (1957) Technical Change and Aggregate Production Function. *Review of Economics and Statistics*.

Comments

Descriptive studies on trends of agricultural growth are many. On the other hand, rigorous studies on sources of productivity growth in agriculture are not numerous. Nevertheless, such analysis on growth sources provides rich policy implications. I, therefore, would like to greet this paper written by Dr M. Ghaffar Chaudhry and others as such a valuable attempt.

In this paper, the trends and sources of output and productivity growth are analysed for the case of Pakistan's agriculture. Productivity growth is first decomposed into land contribution and per-acre productivity contribution, and then decomposed into aggregate input contribution and total factor productivity (TFP) contribution. Since some of these exercises for the total agricultural sector were already included in Kemal and Ahmad (1992), "Sources of Growth in Pakistan", on which the methodology and data in this paper are based, this paper focuses on the crop sub-sector for the decomposition analysis.

Table 2 in their paper summarises findings from the growth source decomposition. The first decomposition confirms the widely held view in Pakistan: the crop growth was the highest in the second half of the 1960s, the period of Green Revolution; the contribution of land increases to growth has become less important in more recent periods; per-acre productivity gain was the strongest in the Green Revolution period, etc. Results from the second decomposition are more interesting: the TFP growth was not phenomenal overall, except for the Green Revolution period; the contribution of the TFP growth varied rapidly, etc.

The authors argue that these findings can be explained by three factors. The first is the availability of technological breakthroughs. The second factor is government price policy. This paper attributes the stagnant TFP growth in the 1980s to the price policies since 1980, which were unfavourable to the agricultural sector. The third factor is agronomic and climatic, including possible effects of global warming. From this interpretation, the authors derive policy implications with respect to pricing, R&D, and input distribution policies, all of which makes perfect sense.

I have three major comments. First, unfortunately, the decomposition exercise in this paper is too limited to support the authors' argument to relate the TFP growth pattern with the three factors. I would like to wait for the extension of this study to quantify the authors' argument. For instance of such an extension, the movement of the TFP growth in each year can be regressed on the movement of terms of trade or proxy variables for the price policies.

Second, as is stated in the paper correctly, the future contribution of crop-land increases is likely to be very limited in Pakistan's agriculture. Therefore, instead of defining the TFP in terms of value-added, it will be an exciting extension to re-

define the TFP in terms of per-acre value added. Since the data on the aggregate inputs can be decomposed into crop-land, labour, capital, and other inputs, we can re-estimate the TFP growth of per-acre productivity as a residual from the growth of the aggregate inputs of labour, capital, and other inputs per acre. This extension will offer rich insights to the sources of growth in Pakistan's agriculture.

Finally, rigorous studies on the possible effects of the global, climatic, or agronomic factor on the productivity growth deserve acute attention. This factor is suggested in the paper as the third factor to explain the TFP growth, but the discussion is not quantitative. Whether the current stagnation of crop value-added reflects long-term deterioration of biological environments is an urgent issue to be answered, for which interdisciplinary efforts are called for.

To sum up, this paper opens up the various directions for further research. The insights presented in this paper will serve as a reliable guide for such studies.

Takashi Kurosaki

Institute of Developing Economies,
Tokyo.