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(出版者 / Publisher)
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(雑誌名 / Journal or Publication Title)
Journal of International Economic Studies / Journal of International Economic Studies

(巻 / Volume)
20

(開始ページ / Start Page)
19

(終了ページ / End Page)
35

(発行年 / Year)
2006-03

(URL)
https://doi.org/10.15002/00001973

Journal of International Economic Studies (2006), No.20, 19–35

Long-term Agricultural Growth and Crop Shifts in India and Pakistan *

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Abstract

Based on a production dataset that corresponds to the current borders of India and Pakistan for the period c.1900-2000 and a district-level dataset from West Punjab for a similar period, this paper investigates the performance of agriculture in these regions. The growth records of agricultural production and shifts in crop mix indices show that changes in aggregate land productivity can be associated structurally with inter-crop and inter-district reallocations of land use. In the studied regions, cropping patterns of subsistence agriculture changed substantially, with a rising concentration of crop acreage in districts with higher productivity and shifts to more lucrative crops. These changes reflected comparative advantage and contributed to the improvement of aggregate land productivity. The crop concentration indices were at their highest levels in the early 2000s both in India and in Pakistan, showing the effects of agricultural liberalization policies and farmers' response to these policies.

1. Introduction

Agriculture plays an important role in economic development, through the provision of food to the nation, enlargement of exports, transfer of manpower to nonagricultural sectors, contribution to capital formation, and securing of markets for industrialization (Johnston and Mellor, 1961, pp. 571-581). Improving agricultural productivity is crucial for the realization of each of these roles. Historical records show that agricultural productivity has increased thanks to the introduction of modern technologies, the commercialization of agriculture, capital deepening, factor shifts from agriculture to nonagricultural sectors, etc. This overall process can be called "agricultural transformation," and the contribution of each of the factors has been quantified in the existing literature (Timmer, 1988). The traditional approach to quantification is through growth accounting, estimating the total factor productivity (TFP) as a residual after controlling for factor inputs (Timmer, 1988; Hayami and Ruttan, 1985).

As a complement to the TFP approach, this paper focuses on the role of resource reallo-

* The author is grateful for helpful comments to Konosuke Odaka, Kyoji Fukao, Ramesh Chand, and seminar participants at Hitotsubashi University (Tokyo), 5th GDN Conference (New Delhi), the Institute of Developing Economies (Chiba), the Indira Gandhi Institute of Development Research (Mumbai), the Agricultural Planning and Economic Research Institute (Tehran), and the Annual Meeting of the Agricultural Economics Society of Japan. Funding was provided through the Asian Historical Statistics Project by the Japanese Ministry of Education. Any remaining errors are the author's.

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cation within agriculture — across crops and across regions.[1] Unlike in manufacturing industries, the spatial allocation of land is critically important in agriculture due to high transaction costs including transportation costs (Takayama and Judge, 1971; Baulch, 1997). Because of this, farmers may optimally choose a crop mix that *does not* maximize expected profits evaluated at market prices but *does* maximize expected profits evaluated at farm-gate prices after adjusting for transaction costs (Omamo, 1998a; 1998b). In the growth accounting framework, a similar phenomenon is more often interpreted as a disequilibrium. If all producers do not choose activities based on the principle of comparative advantage, there is room for growth by reallocating resources in a way closer to the maximization of profits. In this case, output can increase without technological or price changes, yielding a so-called "disequilibrium" effect in the literature on inter-sectoral factor reallocation (Syrquin, 1984; 1988). Subjective equilibrium models for agricultural households provide other reasons for the divergence of decision prices by farmers from market prices. In the absence of labor markets, households need to be self-sufficient in farm labor (de Janvry et al., 1991). Also, farmers may consider production and consumption risk or the domestic needs of their families if insurance markets are incomplete (Kurosaki and Fafchamps, 2002). In these cases, their production choices can be expressed as a subjective equilibrium evaluated at household-level shadow prices.

During the initial phase of agricultural transformation, therefore, it is likely that the extent of diversification will be similar at the country level and the more micro levels because, given the lack of well-developed agricultural produce markets, farmers have to grow the crops they want to consume themselves (Timmer, 1997). As rural markets develop, however, the discrepancy between the market price of a commodity and the decision price at the farm level is reduced. In other words, the development of rural markets is a process which allows farmers to adopt production choices that reflect their comparative advantages more closely, and thus contributes to productivity improvement at the aggregate level evaluated at common, market prices. Therefore, the effect of crop shifts on productivity growth is a useful indicator of market development in developing countries.

With this motivation, Kurosaki (1999) and Kurosaki (2002) investigated the performance of agriculture in India and Pakistan for the period c.1900-2000, and found that it is associated with changes in cropping patterns. Kurosaki (2003) formally presented an accounting methodology, focusing on crop shifts, and empirically applied it to the case of West Punjab, which roughly corresponds to the area of Pakistan Punjab today, over a similar period. This paper combines the empirical findings of these papers with updated estimates for India and Pakistan. Datasets are newly compiled by the author, using government statistics. These regions are ideal for the objective of this paper, since they have experienced rapid agricultural production growth during this period and extensive statistics are available, although, on a global scale, the absolute income level of farmers still remains at the level of low-income countries.

The paper is organized as follows. The data used in the analysis are explained briefly in the next section. Section 3 presents empirical results using country-level data for India and Pakistan. The use of a very long time series corresponding to the current borders of India and

[1] Existing studies with motivations similar to this paper's include Huffman and Evenson (2001), who demonstrate the importance of crop specialization for productivity growth in U.S. agriculture, Sonobe and Otsuka (2001), who quantify the role of subsectoral resource reallocation in productivity growth in Taiwanese manufacturing industries, and Timmer and Szirmai (2000), who investigate the effects of labor shifts across the subsectors of manufacturing on labor productivity in Asia. This paper differs from those studies in that resource reallocation over space is explicitly investigated.

Pakistan distinguishes this paper from existing studies on South Asian agriculture.[2] The analysis in Section 4 is more disaggregated, using district-level data for West Punjab. Through these two sections, the effects of crop shifts on agricultural growth are quantified. Findings and policy implications of the investigation are summarized in Section 5.

2. Data

This paper employs an updated version of the country-level dataset compiled by the author for India and Pakistan (Kurosaki, 1999; 2002), covering a period from 1901/02 to 2003/04.[3] The inclusion of the late 1990s and early 2000s distinguishes this paper from previous studies (Kurosaki, 1999; 2002). The country-level data cover a geographic area corresponding to the current international borders of India and Pakistan. In 1947, what had been the Indian Empire under British rule was partitioned into India and Pakistan. The data compilation procedure for the colonial period is explained by Kurosaki (1999). Data on the areas that are currently in Pakistan and Bangladesh were subtracted from the database compiled by Sivasubramonian (1960, 1997). Information included in the district-level data in *Season and Crop Reports* from Punjab, Sind (or Bombay-Sind), the North-West Frontier Province, and Bengal was utilized in this exercise.

Using the same sources of information, district-level data were also compiled by the author (Kurosaki, 2003). By combining them with post-independence data from government statistics, balanced panel data for fifteen districts covering a period from 1901/02 to 1991/92 were constructed for West Punjab (the area corresponding to the major part of Pakistan Punjab after independence and the western half of the British Province of Punjab during the colonial period).[4]

Because historical data on agriculture are less detailed than current ones, it is not possible to compile production statistics for several crops. Therefore, this paper focuses on the production of principal crops that are important in contemporary India and Pakistan, and for which detailed data on production and prices are available from the British period. For India, eighteen crops are included: foodgrains (rice, wheat, barley, jowar (sorghum), bajra (pearl millet), maize, ragi (finger millet), and gram (chickpea)), oilseeds (linseed, sesamum, rapeseed & mustard, and groundnut), and other crops (sugarcane, tea, coffee, tobacco, cotton, and jute & mesta). These crops currently account for more than two thirds of the total output value from the crop sector and more than half of the total output from agriculture, and their contribution was higher in the colonial period. For Pakistan and West Punjab, twelve major crops are covered: foodgrains (rice, wheat, barley, jowar, bajra, maize, and gram), rapeseed & mustard, sesamum, sugarcane, tobacco, and cotton. These crops currently account for about 70% of value-added of all crops in Pakistan and about 40% of value-added of agriculture, and their share, similarly, was higher in the colonial period.

The gross output values of these crops are aggregated using 1960 prices and shown in

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[2] See references in Kurosaki (1999) for existing works.

[3] In this paper, "2003/04" refers to the agricultural year in India and Pakistan beginning on July 1, 2003 and ending on June 30, 2004. In figures with limited space, it is shown as "2004."

[4] This area accounted for approximately 90% of farmland in Pakistan Punjab in 1980/81. The 15 districts are Attock, D.G. Khan, Gujranwala, Gujrat, Jhang, Jhelum, Lahore, Lyallpur, Mianwali, Montgomery, Multan, Muzaffargarh, Rawalpindi, Shahpur, and Sialkot. For details of the adjustment for changes in district boundaries to make each district time-invariant throughout the study period, see Kurosaki (2003).

the Appendix Table. Ideally, the sum of the value-added evaluated at current prices and then deflated using a price index would be a better measure, but the sum of gross output values at constant prices is used as a proxy due to the absence of reliable data on input prices and quantities before independence. The results reported in this paper are insensitive to the choice of base year (1938/39 and 1980/81)[5]. The gross output value thus compiled is denoted by Q. As measures for partial productivity, Q is divided by L (the official population estimates of India and Pakistan) or by A (the sum of the acreage under the twelve or eighteen crops).

3. Agricultural Productivity and Crop Mix in India and Pakistan: Update

Using the dataset described above, the tables and figures reported in Kurosaki (1999, 2002) are updated. Since the data revisions for the earlier periods are minor, the discussion in this section focuses on the latest decade. Specifically, we investigate whether trends in agricultural productivity and the crop mix have changed during the 1990s and early 2000s.

3.1 Productivity

Growth performance in Indian agriculture is plotted in Figure 1. Table 1 shows statistical results quantifying the level of the growth rate, its significance, and its variability. To smooth out short-term fluctuations, a time series model for Y_t is estimated as

$$(1) \qquad \ln Y_t = a_0 + a_1 t + u_t ,$$

where t is measured in years and u_t is an i.i.d. error term. Equation (1) is estimated for the logarithm of Q, Q/L, and Q/A, by the ordinary least squares (OLS) method for each decade and

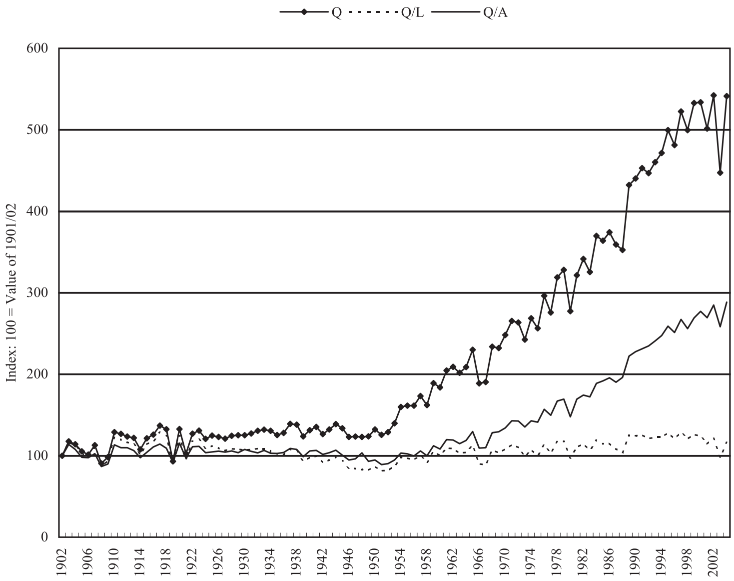

Figure 1. Agricultural Output in India, 1901/02-2003/04

[5] Misra and Rao (2003) reported that the agricultural growth rate in the 1990s was comparable to that in the 1980s if based on 1993/94 prices but lower than that in the 1980s if based on 1980/81 prices. Investigation using relative prices in the 1990s is left for further study.

Table 1: Growth Performance of Indian Agriculture

	Q (Total output value)		Q/L (Output per capita)		Q/A (Output per acre)	
Period	Growth rate	Coeff.var.	Growth rate	Coeff.var.	Growth rate	Coeff.var.
1901/02 - 1910/11	1.04%	11.8%	0.39%	11.8%	-0.26%	9.8%
1911/12 - 1920/21	-0.88%	13.0%	-0.97%	13.0%	-0.40%	8.0%
1921/22 - 1930/31	-0.08%	2.6%	-1.09% ***	2.6%	-0.41%	2.4%
1931/32 - 1940/41	0.24%	4.0%	-1.16% **	4.0%	0.10%	3.0%
1941/42 - 1950/51	-0.53%	4.2%	-1.78% ***	4.2%	-1.45% **	4.0%
1951/52 - 1960/61	4.24% ***	5.1%	2.28% ***	5.1%	2.34% ***	4.2%
1961/62 - 1970/71	2.53% **	8.8%	0.32%	8.8%	1.89% **	7.2%
1971/72 - 1980/81	2.62% **	7.1%	0.41%	7.1%	2.12% ***	5.6%
1981/82 - 1990/91	3.21% ***	6.2%	1.07%	6.2%	3.23% ***	3.7%
1991/92 - 2000/01	1.68% ***	3.5%	-0.27%	3.5%	1.62% ***	2.4%
1901/02 - 1946/47	0.48% ***	8.5%	-0.34% ***	9.6%	-0.01%	6.3%
1947/48 - 2003/04	2.72% ***	7.5%	0.60% ***	7.6%	2.19% ***	6.3%

Source: Kurosaki (1999) and update estimates by the author.
Note: "Growth rate" provides a parameter estimate for the slope of the log of Q (or Q/L or Q/A) on a time trend, estimated by OLS (see equation (1)). The parameter estimate is statistically significant at 1% ***, 5% **, or 10% * (two sided t-test). "Coeff.var" shows the coefficient of variation approximated by the standard error of the OLS regression.

then for the periods before and after independence. The first column of Table 1 gives coefficient estimates for a_1 (the exponential growth rate). The total output value (*Q*) grew very little in the period before independence in 1947 and then grew steadily afterward. The growth rate in the 1990s was 1.7%, a rate lower than the post-independence average of 2.7%[6]. The column for "Variability" shows the level of variability of the output around the fitted values in terms

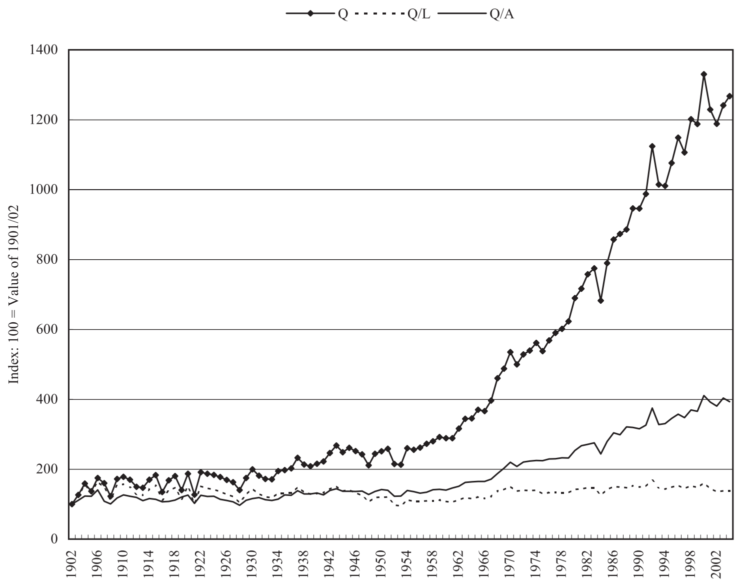

Figure 2. Agricultural Output in Pakistan, 1901/02-2003/04

[6] Our measure of output growth in the 1990s is an underestimate for the total crop sector because growth in non-traditional crops such as vegetables or horticultural crops was one of the main factors of growth in this period (Chand, 1999; 2004).

Table 2: Growth Performance of Pakistan Agriculture

	Q (Total output value)		Q/L (Output per capita)		Q/A (Output per acre)	
Period	Growth rate	Coeff.var.	Growth rate	Coeff.var.	Growth rate	Coeff.var.
1901/02 - 1910/11	4.32% **	15.1%	2.75%	15.1%	0.99%	10.9%
1911/12 - 1920/21	-0.33%	14.6%	-1.18%	14.6%	-0.19%	6.6%
1921/22 - 1930/31	-0.64%	10.3%	-1.73%	10.3%	-1.15%	7.4%
1931/32 - 1940/41	2.81% ***	5.8%	0.97%	5.8%	1.86% **	5.1%
1941/42 - 1950/51	0.05%	6.7%	-2.92% ***	6.7%	-0.19%	3.4%
1951/52 - 1960/61	3.44% ***	5.2%	1.00%	5.2%	1.66% ***	3.3%
1961/62 - 1970/71	5.85% ***	5.2%	2.99% ***	5.2%	3.93% ***	4.5%
1971/72 - 1980/81	3.24% ***	3.7%	0.09%	3.7%	1.75% ***	3.3%
1981/82 - 1990/91	3.50% ***	5.2%	0.85%	5.2%	2.65% ***	5.3%
1991/92 - 2000/01	2.30% ***	5.3%	-0.35%	5.3%	1.61% **	5.5%
1901/02 - 1946/47	1.30% ***	12.8%	-0.03%	11.9%	0.38% ***	8.6%
1947/48 - 2003/04	3.48% ***	8.2%	0.68% ***	7.7%	2.30% ***	6.4%

Source and notes: See Table 1.

of the coefficient of variation. The 1990s were associated with less variability. In the 1990s, output per capita (*Q/L*) did not grow while output per acre (*Q/A*) grew at a rate similar to that of *Q*. In other words, the source of growth in the 1990s in India was exclusively an improvement in aggregate land productivity.

Similar changes were observed in Pakistan but with higher growth rates throughout the period (Figure 2, Table 2). The growth rate of *Q* before independence in 1947 was smaller than the post-independence period but was still statistically significant at 1.3%. In the 1990s, the growth rate declined to 2.3% against the post-independence average of 3.5%, but its level was still higher than that of India. Unlike in India, the variability of *Q* was similar to the previous periods and the source of growth was not only an improvement in aggregate land productivity but also an expansion of total farmed acreage. The growth rate of output per acre (*Q/A*) in the 1990s was positive and significant but smaller than that of *Q*.

3.2 Crop Mix

An important aspect of agricultural transformation is changes in crop composition and specialization (Timmer, 1997). Even when there is no change in the land productivity of individual crops in each location, aggregate land productivity can grow through spatial shifts of crops reflecting the development of more efficient rural markets (Kurosaki, 2003). The spatial shifts are the result of farmers' attempts to diversify their farming activities towards non-traditional, high value-added crops such as fruits and vegetables and towards livestock activities (Chand, 1999).

To capture long-term changes in the crop mix, the Herfindahl Index of crop acreage was calculated. Let S_i be the share of crop i in the sum of the principal crops covered in this paper, in terms of acreage. Then the Herfindahl Index is defined as

(2) $$H \equiv \Sigma_i S_i^2 ,$$

which can be intuitively understood as the probability of hitting the same crop when two points are randomly chosen from all the land under consideration. Therefore, a higher H implies a greater concentration of acreage into a smaller number of crops.

As shown in Figure 3, the post-independence period was associated with increasing H

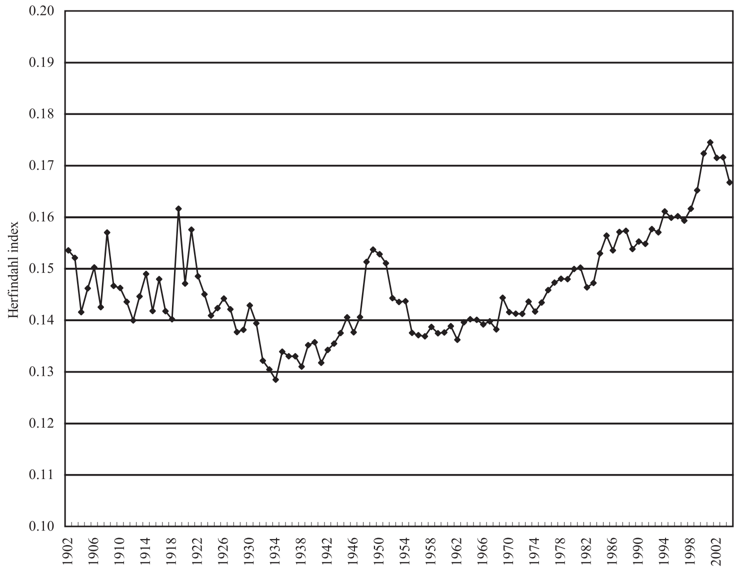

Figure 3. Crop Concentration in India, 1901/02-2003/04

over time in India. In the 1990s, this trend was accelerated. The level of concentration seems to have reached a plateau in the early 2000s.

To investigate whether these changes in crop mix were consistent with those indicated by comparative advantage and market development, changes in aggregate land productivity were decomposed into crop yield effects, static inter-crop shift effects, and dynamic inter-crop shift effects (Kurosaki, 2003). Let Y_t denote per-acre output in year t, i.e., Q/A plotted in Figures 1 and 2. Its growth rate from period 0 to period t can be decomposed as

$$(3) \qquad (Y_t - Y_0)/Y_0 = [\Sigma_i S_{i0}(Y_{it} - Y_{i0}) + \Sigma_i (S_{it} - S_{i0})Y_{i0} + \Sigma_i (S_{it} - S_{i0})(Y_{it} - Y_{i0})]/Y_0 ,$$

Table 3: Contribution of Crops Shifts to Land Productivity Growth in India

Period	Annural growth rates of land productivity (%)				Contribution share (%)		
	Pure yield effects	Static shift effects	Dynamic shift effects	Total	Pure yield effects	Static shift effects	Dynamic shift effects
1901/02 - 1911/12	0.90	0.00	-0.04	0.85	105.1	-0.1	-5.1
1911/12 - 1921/22	-0.35	-0.07	0.26	-0.17	209.5	43.8	-153.3
1921/22 - 1931/32	-0.34	0.14	0.05	-0.14	234.6	-97.2	-37.4
1931/32 - 1941/42	-0.36	0.30	-0.06	-0.12	290.9	-239.7	48.8
1941/42 - 1951/52	-1.48	0.30	-0.01	-1.20	124.0	-25.1	1.1
1951/52 - 1961/62	2.76	0.14	-0.01	2.89	95.3	5.0	-0.3
1961/62 - 1971/72	1.55	0.15	0.20	1.90	81.6	8.0	10.3
1971/72 - 1981/82	1.83	0.35	0.09	2.28	80.6	15.4	4.0
1981/82 - 1991/92	3.10	0.44	0.14	3.68	84.2	12.1	3.7
1991/92 - 2001/02	0.87	0.59	0.06	1.51	57.5	38.7	3.7
1901/02 - 1947/48	-0.24	-0.05	0.23	-0.06	423.5	82.2	-405.7
1947/48 - 2003/04	2.79	0.21	0.63	3.63	76.8	5.8	17.4

Source: Kurosaki (2002) and update estimates by the author.
Note: Annual growth rates were estimated using the method explained in the text (see equation (3)). Since both the estimate model and the data treatment for smoothing are different, the total growth rates of land productivity in this table are slightly different from those shown in Table 1.

where the subscript *i* denotes each crop so that Y_{it} stands for per-acre output of crop *i* in year *t*. The first term of equation (3) captures the contribution from the productivity growth of individual crops. The second term shows "static" crop shift effects, as it becomes more positive when the area under crops whose yields were initially high increases in relative terms. The third term shows "dynamic" crop shift effects, as it becomes more positive when the area under dynamic crops (i.e., crops whose yields are improving) increases relative to the area under non-dynamic crops.

The results of the decomposition for India are reported in Table 3. Throughout the post-independence period, there were substantial contributions from both static and dynamic crop shift effects. More interestingly, during the 1990s, the growth due to improvements in crop yields was reduced compared to the 1980s while the growth due to static crop shifts was higher. As a result, the relative contribution of static shift effects was as high as 39% in the 1990s. This is the highest figure among the post-independence decades. Therefore, it can be concluded that the changes in crop mix in the 1990s (the decade of economic liberalization in India) were indeed consistent with the comparative advantages of Indian agriculture so that the aggregate land productivity was improved.

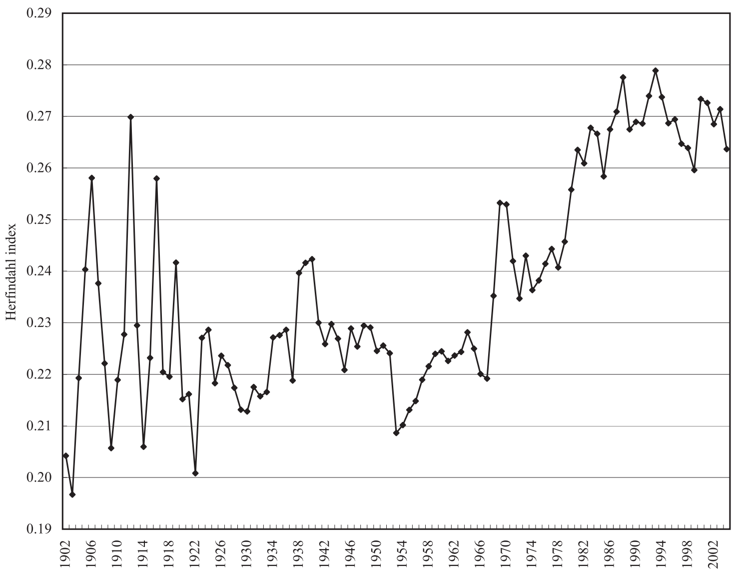

Figure 4. Crop Concentration in Pakistan, 1901/02-2003/04

In contrast, the crop concentration index in Pakistan did not accelerate in the 1990s (Figure 4). Rather it remained at the high level that had already been reached during the late 1980s or early 1990s. This seems to indicate that shifts in acreage toward crops with comparative advantages occurred earlier in Pakistan than in India, possibly reflecting Pakistan's attempt to liberalize agricultural marketing during the early 1980s. The results of the decomposition for Pakistan in Table 4 show that there were substantial contributions by both static and dynamic crop shift effects, and that their shares were larger than in India throughout the post-independence period. This indicates that crop shift effects are more important in a smaller economy. During the 1990s, the growth due to improvements in crop yields declined substantially while the growth due to static crop shifts recovered. As a result, the relative contribution of static shift effects was 16% in the 1990s, a level higher than the post-independence

Table 4: Contribution of Crops Shifts to Land Productivity Growth in Pakistan

Period	Annural growth rates of land productivity (%)				Contribution share (%)		
	Pure yield effects	Static shift effects	Dynamic shift effects	Total	Pure yield effects	Static shift effects	Dynamic shift effects
1901/02 - 1911/12	1.84	-0.19	0.09	1.74	105.4	-10.8	5.4
1911/12 - 1921/22	0.06	-0.05	0.02	0.02	254.3	-226.2	71.9
1921/22 - 1931/32	-0.35	0.03	0.02	-0.31	113.4	-8.5	-4.9
1931/32 - 1941/42	1.51	0.16	0.32	1.99	75.8	8.2	16.0
1941/42 - 1951/52	-0.80	0.18	0.03	-0.58	136.6	-30.6	-6.0
1951/52 - 1961/62	1.03	0.85	0.03	1.92	53.8	44.4	1.8
1961/62 - 1971/72	3.37	0.52	0.28	4.16	80.8	12.5	6.7
1971/72 - 1981/82	1.72	0.63	0.13	2.49	69.2	25.4	5.4
1981/82 - 1991/92	2.35	0.07	0.21	2.63	89.3	2.5	8.2
1991/92 - 2001/02	1.19	0.23	0.02	1.43	82.8	16.1	1.1
1901/02 - 1947/48	0.55	-0.03	0.22	0.74	74.5	-4.0	29.6
1947/48 - 2003/04	2.50	0.48	0.61	3.59	69.7	13.3	17.0

Source and notes: See Table 3.

average (13%). Here we find a similarity between India and Pakistan: in both economies, the crop shifts were an important source of land productivity growth in the post-independence period, and especially in the 1990s.

4. Agricultural Transformation and Crop Shifts in West Punjab: District-Level Analysis

The contribution of crop shifts to productivity growth can be analyzed in more detail using more geographically disaggregated data. Therefore, district-level panel data on agricultural production were compiled for fifteen districts in West Punjab. They are analyzed in this section.[7]

4.1 Productivity and Crop Mix

Aggregate farm output in West Punjab (Q) was about 7.5 times larger in the 1990s than in the early twentieth century (Figure 5). Partial productivity with respect to labor (Q/L) and land (Q/A) improved substantially as well, with levels in the 1990s more than double those in the early twentieth century. All three indices in Figure 5 show that the average annual growth rate was significantly higher after the mid 1950s. It should be noted that the acceleration of growth occurred *before* the introduction of Green Revolution technology, which enhanced the land productivity of wheat and rice dramatically beginning in the late 1960s. Before independence in 1947 as well, all three indices increased gradually, although the growth rates were lower than those after independence. The pattern shown in Figure 5 is very similar to that in Figure 2.

Another aspect of agricultural transformation in West Punjab is a change in the crop mix. As a counterpart to Figures 3 and 4, the Herfindahl Index for crop concentration was calculated for each district. Figure 6 plots the median, top quartile, and bottom quartile of H in each year for the fifteen districts, together with the same index at the province level for comparison. The exact districts ranked in each position are not the same throughout the period, but

[7] This section is subtracted from Kurosaki (2003).

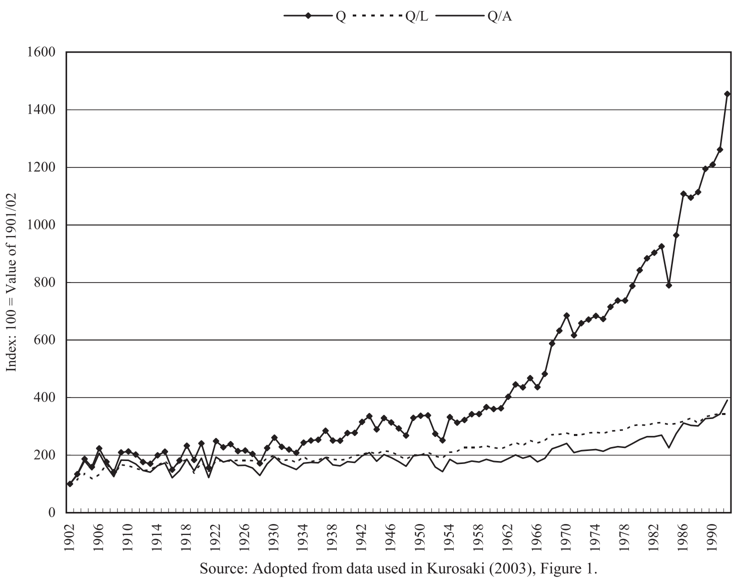

Figure 5. Agricultual Output in West Punjab, 1901/02-1991/92

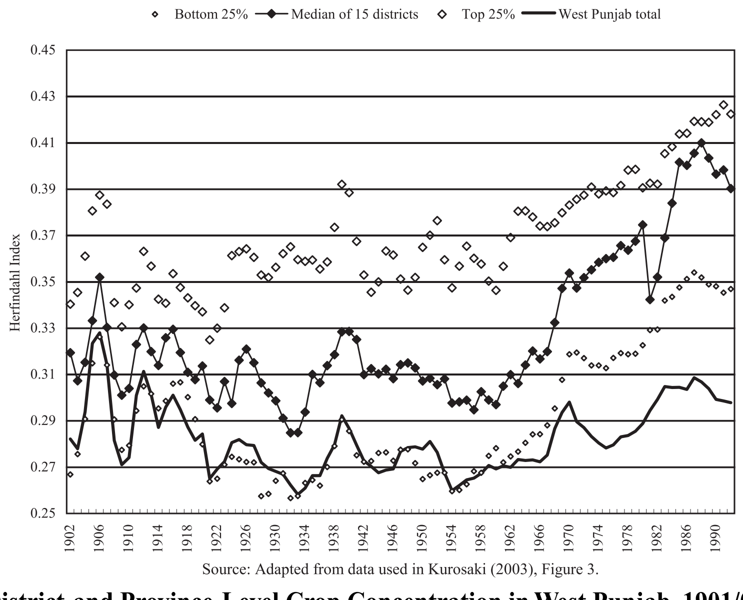

Figure 6. District-and Province-Level Crop Concentration in West Punjab, 1901/02-1991/92

there is no major churning among districts. The figure shows first that the crop mix is more diversified at the more aggregate level than at the district level throughout the period. Second, the concentration indices show an increase in the latter half of the study period. Thus, the acceleration of aggregate land productivity growth in Figure 5 since the mid-1950s is associated with an increasing concentration index in each district. Third, the difference between provincial and district-median indices widens in the latter half. Fourth, as shown by the top and bottom quartile plots, the dynamic paths differ widely from district to district.

Based on these records, Kurosaki (2003) hypothesized that the shift of cultivated areas from less lucrative to more lucrative crops and from less productive to more productive dis-

Table 5: Decomposition of Agricultural Growth in West Punjab, 1902/03-1991/92

	Average Annual Growth Rates (%)				
		Land Productivity Effects			
	Area effects	Subtotal	Aggregate crop yield effects	Inter-crop shift effects (static)	Inter-crop shift effects (dynamic)
1902/03 - 1951/52	1.43	0.58	0.33	0.06	0.19
	(71.2)	(28.8)			
		(100.0)	(56.5)	(10.1)	(33.5)
1951/52 - 1991/92	1.81	3.83	3.01	0.41	0.42
	(32.1)	(67.9)			
		(100.0)	(78.4)	(10.7)	(10.9)

Source: Kurosaki (2003), Table 2.
Notes: (1) Numbers in parentheses show relative contribution to growth (%).
(2) Average annual growth rates are calculated using simple interest.

tricts was an important source of agricultural growth in West Punjab. As evidence for this hypothesis, Kurosaki (2003) applied the decomposition of equation (3) to the district-level data in order to quantify the inter-crop shift effects on land productivity. The results are reproduced in Table 5.

In West Punjab, production increased at 2.0% per year in the first period until 1951/52[8] and accelerated to 5.6% in the second period. Area effects explain 71% of the first period growth, whereas land productivity effects account for 68% of the second period growth. Of this improvement in aggregate land productivity, growth in aggregate crop yield explains 57 and 78% respectively. The rest is explained by both static and dynamic shift effects. The absolute level of shift effects, both static and dynamic, is lower in the first period than in the second. In the first period, dynamic shift effects are more important than static shift effects, whereas in the second period, the relative contribution of dynamic shift effects is similar to that of static shift effects. These results show that inter-crop land reallocation was an important source of land productivity growth in West Punjab.

4.2 Effects of Inter-Spatial Crop Shifts on Productivity

To quantify the effect of inter-spatial crop shifts on land productivity, Kurosaki (2003) proposed a further decomposition of the aggregate crop yield effect for crop *i* in equation (3) as

$$(4) \qquad Y_{it} - Y_{i0} = \Sigma_h S_{hi0}(Y_{hit} - Y_{hi0}) + \Sigma_h (S_{hit} - S_{hi0})Y_{hi0} + \Sigma_h (S_{hit} - S_{hi0})(Y_{hit} - Y_{hi0}),$$

where S_{hit} is the share of district *h* in the cultivated area of crop *i* in year *t*. The three terms on the right hand side of equation (4) are interpreted similarly to the terms in equation (3): the first term shows the effects of the average crop yields in the district ("District crop yield effects" in Table 6), the second term indicates "*Inter-district* crop shift effects (static)" and the third term shows "*Inter-district* crop shift effects (dynamic)." An important aspect of equation (4) is that the effects of factor reallocation over space are incorporated explicitly into the decomposition. In other words, so-called "yield effects" in the existing literature based on

[8] Kurosaki (2003) estimated the timing of a breakdate in Figure 5 using a time-series model and chose the year 1951/52 as the breakdate.

Table 6: Contribution of Inter-District Crop Shifts to Growth in Aggregate Crop Yields

	Average Annual Growth Rates (%)			
	District crop yield effects	Inter-district crop shift effects (static)	Inter-district crop shift effects (dynamic)	Total
A. Wheat				
1911/12 - 1951/52	-0.03	0.02	0.06	0.04
	(-76.8)	(40.2)	(136.7)	(100.0)
1951/52 - 1991/92	2.69	0.08	0.10	2.86
	(93.9)	(2.8)	(3.3)	(100.0)
B. Rice				
1911/12 - 1951/52	-0.08	0.18	0.17	0.27
	(-27.4)	(64.0)	(63.4)	(100.0)
1951/52 - 1991/92	0.70	-0.03	-0.04	0.63
	(110.2)	(-4.2)	(-6.0)	(100.0)
C. Sugarcane				
1911/12 - 1951/52	2.44	0.13	-0.04	2.53
	(96.4)	(5.0)	(-1.5)	(100.0)
1951/52 - 1991/92	0.52	0.01	0.00	0.53
	(98.2)	(2.0)	(-0.2)	(100.0)
D. Cotton				
1911/12 - 1951/52	1.26	-0.04	0.44	1.66
	(75.9)	(-2.5)	(26.7)	(100.0)
1951/52 - 1991/92	4.22	0.01	1.72	5.96
	(70.8)	(0.2)	(28.9)	(100.0)

Source: Kurosaki (2003), Table 3.
Note: Numbers in parenthesis show relative contribution to growth (%).

macro data are often a mixture of pure yield effects (e.g., due to shifts in TFP in producing individual crops) and spatial crop shift effects.

Table 6, reproduced from Kurosaki (2003), shows the decomposition results for four major crops in West Punjab. For wheat and sugarcane, the aggregate yields improved mainly through improvements in crop yields at the district level. In contrast, inter-district crops shift effects were the major source of improvement in the aggregate yields for rice and cotton. In the first period, when aggregate rice yields grew at 0.27% (statistically significant at the 1% level), the major source of yield growth was crop shifts across districts — more than 60% of yield growth was attributable to static and dynamic crop shift effects in each case (the effects of rice yield growth at the district level are negative). In the case of cotton, dynamic crop shift effects were important in both periods. They explain more than one fourth of the aggregate yield growth for cotton. On the other hand, static crop shift effects were nil. This implies that the improvement of cotton yields in the province was facilitated by the shifting of cotton areas from districts with stagnating or decreasing productivity to districts with increasing productivity. Because the districts with more rapid growth in cotton yields were those with low yields in the initial years, the static effects did not contribute to yield growth at the aggregate level. The expansion of cotton production for both domestic and foreign markets was the most important development in Punjab's agriculture during the colonial period. Still today, Pakistan's economy remains heavily dependent on cotton production in Punjab. The analysis here shows that the land productivity of cotton improved not only through improvements of crop yields at the district level but also through a reallocation of cultivated land to districts experiencing rapid improvements in cotton yields.

The evidence presented in Table 6 shows the importance of inter-district crop shifts for cash crops such as rice and cotton in facilitating yield growth at the province level. Combining this finding with those in the previous subsection, it can be concluded that the historical change in West Punjab in the study period is consistent with crop shifts reflecting static and dynamic comparative advantage, a finding consistent with the country-level analysis for India and Pakistan presented in Section 3.

5. Conclusion

Based on a production dataset that corresponds to the current borders of India and Pakistan for the period c.1900-2000 and a district-level dataset from West Punjab for a similar period, this paper investigated the performance of agriculture in these regions and associated it with crop shifts. The empirical results showed a discontinuity between the pre- and the post-independence periods, both in India and in Pakistan, and in West Punjab and its districts. Total output growth rates rose from zero or very low figures to significantly positive levels, which were sustained throughout the post-independence period; the crop mix changed with increasing concentration beginning in the mid 1950s. This paper quantified the effects of inter-crop and inter-district crop shifts, a previously unnoticed source of productivity growth, on land productivity. We found that the crop shifts contributed substantially to the productivity growth, especially during the periods with limited technological breakthroughs.

Underlying these effects were the responses of farmers to changes in market conditions and agricultural policies. Agriculture in these regions has experienced a consistent concentration of crops since the mid 1950s, when agricultural transformation in terms of output per agricultural worker was proceeding. These trends continued until the early 1990s in Pakistan and West Punjab and until the early 2000s in India. The performance in the latest periods suggests that agriculture in these regions seems to have entered a new phase of diversified production and consumption at the country level (Timmer, 1997). Although whether the trends will reverse remains to be investigated when more recent data become available, it is of interest to note that the concentration trended to reach a plateau earlier in Pakistan than in India. This contrast can be attributed to the earlier adoption of economic liberalization policies in Pakistan in the early 1980s. Pakistani farmers were exposed to international prices relatively earlier than their Indian counterparts.

The comparison of our results with those reported by Misra and Rao (2003) is also interesting. They showed that agricultural exports were the main source of growth for Indian agriculture in the 1990s, and that they were facilitated by trade liberalization policies and the devaluation of the Indian rupee. Their finding is reinforced by this paper, which shows that crop shifts were an important source of productivity growth in the 1990s, since our results are consistent with a shift to export crops.

Although this paper has shown the importance of crop shifts in improving aggregate land productivity, the overall impact is underestimated, because only major crops were covered. Incorporating non-traditional crops (Chand, 1999; 2004) into the framework of this paper would be highly desirable. To quantify the structural determinants of these changes and their net effects on the welfare of rural population, further research is needed, such as an analysis of production costs, investigation of minor crops and livestock activities, etc. These are left for future study. Instead, implications for agricultural policies in the 21st century are explored as the conclusion of this paper.

First, it appears likely that institutional and policy changes have significant effects on agricultural production in India and Pakistan. This is confirmed by the fact that the sustained growth in the total output began just after independence in 1947, well before the introduction of the Green Revolution technology, and also by changes in these trends in the 1990s. The current controversies in India and Pakistan on contract farming, corporate farming, and land ceiling legislation should be viewed from this historical perspective.

Second, farmers in India and Pakistan have responded to the changes in market conditions, not only by adopting new technology with high-yield potential but also by adjusting their land allocation toward high value crops. The importance of the effects of land re-allocation should not be ignored. For example, the effects of reforms of the price support system for major crops cannot be isolated from their interactions with crops whose prices are not under the support price system.

Third, although not discussed fully in this paper, existing evidence suggests that public investment in agriculture and in rural areas has been cut back since the 1980s. This occurred both in India and Pakistan under the banner of "Economic Reforms" or "Structural Adjustment." It should be emphasized that the sustained growth during the post-independence period was achieved at a time when substantial public investment was being implemented.[9] With reduced public investment, in the absence of a simultaneous improvement in investment efficiency, the boom experienced during the 1990s in response to newly opened opportunities will not be sustained. The importance of production-oriented infrastructure in increasing productivity of agriculture and in reducing rural poverty cannot be overemphasized (Hayami, 2003). Considering the public-good nature of such investment, it becomes more important in the context of globalization and trade liberalization.

References

Baulch, B. (1997), Transfer Costs, Spatial Arbitrage, and Testing Food Market Integration, *American Journal of Agricultural Economics*, Vol. 79, pp. 477-487.

Chand, R. (1999), *Agricultural Diversification in India: Potentials and Prospects in Developed Region*, New Delhi: Mittal Publications.

—— (2004), *Impact of Trade Liberalization and Related Reforms on India's Agricultural Sector, Rural Food Security, Income and Poverty*, paper presented at the parallel session on Reform of the Agricultural Sector, 5th GDN Annual Conference, 28 January 2004, New Delhi.

de Janvry, A., M. Fafchamps, and E. Sadoulet (1991), Peasant Household Behavior with Missing Markets: Some Paradoxes Explained, *Economic Journal*, Vol.101, pp.1400-17.

Hayami, Y. (2003), From the Washington Consensus to the Post-Washington Consensus: Retrospect and Prospect, *Asian Development Review*, Vol. 20, pp. 40-65.

Hayami, Y., and V.W. Ruttan (1985), *Agricultural Development: An International Perspective*, revised and expanded ed. Baltimore: Johns Hopkins University Press.

Huffman, W.E., and R.E. Evenson (2001), Structural and Productivity Change in US Agriculture, 1950-1982, *Agricultural Economics*, Vol. 24, pp. 127-147.

Johnston, Bruce F. and J.W. Mellor (1961), The Role of Agriculture in Economic Development, *American Economic Review*, Vol. 51, pp. 566-593.

Kurosaki, T. (1999), Agriculture in India and Pakistan, 1900-95: Productivity and Crop Mix, *Economic and Political Weekly*, Vol. 34, pp. A160-A168.

[9] For instance, Kurosaki (2003) showed that shifts to high value-added crops in West Punjab were facilitated by investment into public irrigation.

–– (2002), Agriculture in India and Pakistan, 1900-95: A Further Note, *Economic and Political Weekly*, Vol. 37, pp. 3149-3152.

–– (2003), Specialization and Diversification in Agricultural Transformation: The Case of West Punjab, 1903-1992, *American Journal of Agricultural Economics*, Vol. 85, pp. 372-386.

Kurosaki, T., and M. Fafchamps (2002), Insurance Market Efficiency and Crop Choices in Pakistan, *Journal of Development Economics*, Vol. 67, pp. 419-453.

Misra, V.N. and M. Govind Rao (2003), Trade Policy, Agricultural Growth and Rural Poor: Indian Experience, 1978-79 to 1999-2000, *Economic and Political Weekly*, Vol. 38, pp. 4588-4603.

Omamo, S.W. (1998a), Transport Costs and Smallholder Cropping Choices: An Application to Siaya District, Kenya, *American Journal of Agricultural Economics*, Vol. 80, pp. 116-123.

–– (1998b), Farm-to-Market Transaction Costs and Specialisation in Small-Scale Agriculture: Explorations with a Non-separable Household Model, *Journal of Development Studies*, Vol. 35, pp. 152-163.

Sivasubramonian, S. (1960) Estimates of Gross Value of Output of Agriculture for Undivided India 1900-01 to 1946-47, in V. K. R. V. Rao et al. ed., *Papers on National Income and Allied Topics*, Volume I, New York: Asia Publishing House, pp. 231-251.

–– (1997) Revised Estimates of the National Income of India, 1900-01 to 1946-47, *Indian Economic and Social History Review*, Vol. 34, pp. 113-168.

Sonobe, T., and K. Otsuka (2001), A New Decomposition Approach to Growth Accounting: Derivation of the Formula and its Application to Prewar Japan, *Japan and the World Economy*, Vol. 13. pp. 1-14.

Syrquin, M. (1984), Resource Reallocation and Productivity Growth, in M. Syrquin, L. Taylor, and L.E. Westphal (eds.), *Economic Structure and Performance: Essays in Honor of Hollis B. Chenery*, New York: Academic Press, pp. 75-101.

–– (1988), Patterns of Structural Change, in H. Chenery and T.N. Srinivasan (eds.), *Handbook of Development Economics*, Vol. I, Amsterdam: Elsevier Science, pp. 203-273.

Takayama, A., and G. Judge (1971), *Spatial and Temporal Price and Allocation Models*, Amsterdam: North Holland.

Timmer, C.P. (1988), The Agricultural Transformation, in H. Chenery and T.N. Srinivasan (eds.), *Handbook of Development Economics*, Vol. I, Amsterdam: Elsevier Science, pp.275-331.

–– (1997), Farmers and Markets: The Political Economy of New Paradigms, *American Journal of Agricultural Economics*, Vol. 79, pp. 621-627.

Timmer, M.P., and A. Szirmai (2000), Productivity Growth in Asian Manufacturing: The Structural Bonus Hypothesis Examined, *Structural Change and Economic Dynamics*, Vol. 11, pp. 371-392.

Appendix Table: Time-Series Data of Agricultural Production in India and Pakistan

Agric.	Areas currently in India				Areas currently in Pakistan				15 West Punjab Districts			
Year	Q	Q/L	Q/A	H	Q	Q/L	Q/A	H	Q	Q/L	Q/A	H
1902	100.0	100.0	100.0	0.154	100.0	100.0	100.0	0.204	100.0	100.0	100.0	0.282
1903	117.5	116.8	113.8	0.152	126.5	124.5	111.2	0.197	134.1	113.9	131.5	0.278
1904	114.0	112.5	107.7	0.142	159.0	154.1	123.4	0.219	186.9	137.0	179.7	0.294
1905	105.3	103.2	98.1	0.146	137.1	130.8	122.8	0.240	158.5	117.7	149.5	0.323
1906	101.3	98.7	97.6	0.150	175.0	164.4	140.5	0.258	223.4	133.4	206.6	0.328
1907	112.8	109.2	102.4	0.143	159.8	147.7	108.3	0.238	176.9	167.5	160.4	0.314
1908	90.5	87.0	86.7	0.157	122.4	111.4	100.6	0.222	141.4	133.2	125.7	0.282
1909	98.4	94.0	89.8	0.147	171.9	154.1	117.4	0.206	209.4	166.8	182.6	0.271
1910	128.9	122.4	113.4	0.146	178.1	157.2	126.5	0.219	212.7	163.3	181.9	0.274
1911	126.9	119.7	109.7	0.144	169.9	147.6	122.7	0.228	202.2	155.0	169.5	0.301
1912	123.6	116.4	109.7	0.140	149.3	128.6	119.3	0.270	175.9	146.0	146.5	0.311
1913	121.8	114.6	106.2	0.145	146.5	125.2	110.1	0.229	170.1	149.4	140.7	0.301
1914	107.7	101.3	97.5	0.149	169.8	143.7	115.8	0.206	199.1	163.7	163.5	0.287
1915	121.4	114.1	104.2	0.142	183.0	153.7	113.8	0.223	212.1	179.4	172.9	0.296
1916	125.9	118.2	110.7	0.148	134.9	112.3	106.8	0.258	149.7	149.1	121.2	0.301
1917	137.0	128.5	114.2	0.142	168.1	138.8	107.6	0.220	181.6	175.6	146.0	0.295
1918	132.5	124.1	109.1	0.140	180.2	147.4	111.8	0.220	232.8	184.6	185.8	0.287
1919	93.2	87.3	91.7	0.162	140.1	113.6	120.2	0.242	183.4	138.8	145.4	0.282
1920	132.8	124.2	115.5	0.147	187.1	150.6	125.7	0.215	240.6	171.9	189.4	0.284
1921	102.5	95.8	96.9	0.158	126.9	101.2	102.3	0.216	156.1	145.0	122.0	0.265
1922	127.0	117.5	110.9	0.149	191.6	151.1	125.6	0.201	248.9	178.9	193.7	0.269
1923	130.8	119.8	111.5	0.145	187.0	146.0	122.3	0.227	227.2	181.6	175.9	0.272
1924	120.6	109.4	103.7	0.141	183.9	142.0	122.4	0.229	237.9	178.5	183.3	0.281
1925	124.7	112.0	104.7	0.142	177.6	135.6	114.0	0.218	213.8	182.7	163.9	0.282
1926	123.1	109.4	105.7	0.144	169.6	128.1	110.4	0.224	216.3	182.0	165.0	0.280
1927	120.9	106.3	104.5	0.142	162.9	121.7	106.9	0.222	204.4	180.7	155.2	0.279
1928	124.4	108.4	105.9	0.138	140.4	103.8	96.7	0.217	171.6	169.7	129.7	0.272
1929	125.1	107.9	103.7	0.138	174.6	127.7	110.8	0.213	224.9	190.2	169.1	0.269
1930	125.2	106.9	107.7	0.143	199.4	144.2	116.0	0.213	260.7	197.9	195.1	0.268
1931	127.2	107.5	105.4	0.139	181.3	129.6	118.8	0.218	228.9	179.9	170.5	0.267
1932	130.5	108.8	103.6	0.132	172.1	120.9	112.6	0.216	219.4	185.3	160.6	0.262
1933	132.0	108.5	106.5	0.130	171.1	118.0	110.8	0.217	208.2	173.9	150.0	0.258
1934	130.6	105.8	102.9	0.128	194.4	131.6	114.5	0.227	243.2	196.2	172.3	0.261
1935	125.3	100.1	102.9	0.134	197.5	131.3	126.6	0.228	250.6	177.7	174.5	0.266
1936	128.0	100.9	104.0	0.133	202.6	132.2	125.3	0.229	253.2	182.1	173.4	0.266
1937	139.1	108.1	108.8	0.133	232.4	148.9	138.5	0.219	285.1	193.8	192.0	0.274
1938	138.0	105.7	107.8	0.131	213.4	134.2	129.2	0.240	250.8	186.0	166.1	0.280
1939	123.7	93.5	98.8	0.135	208.6	128.8	129.2	0.242	250.2	182.5	162.9	0.292
1940	131.4	97.9	105.7	0.136	215.4	130.6	132.2	0.242	276.8	186.1	177.2	0.287
1941	135.3	99.4	106.4	0.132	222.2	132.3	126.7	0.230	277.7	198.7	174.9	0.280
1942	126.5	91.8	101.5	0.134	246.1	143.0	139.0	0.226	315.5	201.6	197.4	0.273
1943	132.2	94.7	103.6	0.135	268.0	151.9	144.1	0.230	335.3	211.5	208.5	0.270
1944	138.7	98.2	106.9	0.138	248.3	137.3	137.0	0.227	289.3	204.1	178.8	0.268
1945	133.6	93.4	100.7	0.141	261.3	141.0	137.1	0.221	328.8	215.5	201.9	0.269
1946	122.9	84.9	94.7	0.138	251.7	132.5	136.3	0.229	313.6	211.7	191.4	0.269
1947	123.4	84.1	96.1	0.141	242.5	124.6	137.2	0.225	292.9	198.9	177.7	0.277
1948	123.0	82.8	103.6	0.151	211.2	105.9	127.5	0.229	268.1	184.6	161.6	0.278
1949	123.7	82.3	93.1	0.154	243.9	119.3	136.4	0.229	329.6	201.4	197.4	0.279
1950	132.2	86.8	94.8	0.153	251.3	119.9	141.8	0.225	336.8	198.7	200.4	0.278
1951	125.6	81.5	89.0	0.151	258.6	120.4	139.4	0.226	338.1	210.7	199.9	0.281
1952	128.9	82.0	90.4	0.144	215.1	97.7	122.8	0.224	273.9	197.2	158.8	0.276
1953	139.8	87.2	94.7	0.144	212.8	94.4	123.4	0.209	251.7	189.4	143.1	0.267

Appendix Table (continued)

Agric.	Areas currently in India				Areas currently in Pakistan				15 West Punjab Districts			
Year	Q	Q/L	Q/A	H	Q	Q/L	Q/A	H	Q	Q/L	Q/A	H
1954	159.9	97.8	103.3	0.144	260.3	112.6	138.9	0.210	332.3	210.1	185.1	0.260
1955	161.4	96.8	102.3	0.138	255.8	108.0	135.7	0.213	312.7	212.9	170.8	0.262
1956	161.4	94.9	99.7	0.137	261.5	107.8	131.2	0.215	322.3	225.9	172.6	0.264
1957	173.2	99.9	105.7	0.137	272.6	109.6	134.1	0.219	341.9	226.8	179.5	0.265
1958	162.2	91.7	100.0	0.139	280.0	109.9	141.2	0.222	342.7	226.9	176.3	0.267
1959	188.9	104.8	112.1	0.137	291.9	111.8	142.6	0.224	367.0	232.2	185.1	0.271
1960	183.9	100.0	108.1	0.138	288.8	107.9	140.1	0.224	360.0	226.0	178.0	0.269
1961	204.7	109.1	119.8	0.139	288.9	105.3	146.3	0.223	362.8	222.0	175.8	0.271
1962	208.9	109.0	119.1	0.136	316.1	112.0	151.2	0.224	402.6	231.5	188.3	0.270
1963	201.7	102.9	114.7	0.140	344.4	118.6	162.3	0.224	445.4	244.3	201.0	0.273
1964	208.8	104.2	118.8	0.140	345.5	115.6	164.1	0.228	435.5	232.8	189.7	0.273
1965	230.1	112.3	129.6	0.140	370.1	120.4	164.7	0.225	467.8	251.4	196.6	0.273
1966	188.8	90.1	109.3	0.139	366.4	115.8	165.2	0.220	436.4	242.0	177.0	0.272
1967	190.5	88.9	109.7	0.140	396.3	121.7	171.6	0.219	482.1	250.2	188.7	0.275
1968	233.8	106.8	128.2	0.138	460.2	137.3	187.8	0.235	587.7	270.8	221.9	0.287
1969	232.1	103.7	129.4	0.144	487.9	141.5	202.9	0.253	632.5	272.2	230.5	0.294
1970	248.1	108.4	134.1	0.142	535.0	150.7	219.8	0.253	685.3	277.0	241.0	0.298
1971	265.3	113.4	142.7	0.141	499.6	136.8	208.1	0.242	616.2	270.9	209.1	0.290
1972	263.4	110.1	142.5	0.141	528.6	140.2	220.5	0.235	657.9	270.9	215.4	0.287
1973	242.5	99.2	135.2	0.144	539.7	138.8	223.4	0.243	671.0	276.5	217.5	0.283
1974	268.7	107.5	142.8	0.142	561.6	139.9	224.9	0.236	683.7	279.6	219.4	0.280
1975	256.4	100.3	141.2	0.143	538.0	129.9	224.3	0.238	672.9	275.5	213.7	0.278
1976	296.2	113.4	156.9	0.146	568.8	133.0	229.5	0.241	714.8	283.1	224.8	0.280
1977	275.7	103.2	149.8	0.147	589.8	133.7	229.9	0.244	737.1	285.5	229.5	0.283
1978	318.9	116.8	167.0	0.148	601.7	132.2	232.5	0.241	736.8	288.6	227.1	0.284
1979	328.2	117.6	169.5	0.148	623.3	132.7	231.9	0.246	787.5	302.8	240.3	0.285
1980	277.4	97.2	147.7	0.150	689.4	142.2	253.6	0.256	842.4	305.6	254.4	0.289
1981	321.4	110.2	169.6	0.150	716.7	143.2	267.3	0.264	883.6	303.5	264.2	0.294
1982	341.4	114.5	174.5	0.146	757.7	147.4	271.3	0.261	902.9	311.5	264.4	0.299
1983	325.4	106.9	172.3	0.147	775.0	146.9	275.5	0.268	925.1	313.1	269.2	0.305
1984	369.8	118.9	188.8	0.153	682.3	125.9	243.6	0.267	789.4	306.0	225.7	0.304
1985	363.9	114.5	191.8	0.156	789.7	141.9	279.3	0.258	964.0	310.1	274.6	0.304
1986	374.3	115.3	195.7	0.154	857.0	150.0	304.0	0.267	1108.0	317.9	311.5	0.304
1987	359.3	108.3	190.2	0.157	873.2	148.8	298.3	0.271	1094.1	328.8	303.7	0.309
1988	352.6	104.0	196.1	0.157	885.7	147.0	321.3	0.278	1113.7	310.9	301.7	0.307
1989	432.3	124.9	222.2	0.154	946.4	152.9	319.3	0.267	1194.4	333.8	326.6	0.304
1990	440.1	124.4	227.6	0.155	946.0	148.8	315.7	0.269	1209.2	339.7	328.5	0.299
1991	452.9	125.3	231.2	0.155	987.7	151.3	326.2	0.269	1261.5	343.3	342.6	0.299
1992	446.8	121.2	234.7	0.158	1123.8	167.7	374.8	0.274	1454.5	343.4	390.8	0.298
1993	460.3	122.5	240.9	0.157	1014.8	147.4	327.9	0.279				
1994	471.6	123.1	247.4	0.161	1010.6	143.0	330.7	0.274				
1995	499.6	127.9	258.9	0.160	1075.9	148.2	345.6	0.269				
1996	481.3	120.8	251.2	0.160	1148.9	154.1	357.6	0.269				
1997	522.5	128.6	267.3	0.159	1106.3	144.5	347.8	0.265				
1998	499.6	120.6	255.9	0.162	1201.4	152.8	369.5	0.264				
1999	532.7	126.1	269.2	0.165	1187.9	147.2	365.6	0.260				
2000	533.7	123.9	277.2	0.172	1330.1	160.4	410.6	0.273				
2001	501.6	114.2	269.3	0.175	1229.0	144.4	392.1	0.273				
2002	542.2	121.1	284.9	0.171	1188.4	135.9	380.5	0.268				
2003	447.4	98.0	258.2	0.172	1241.0	138.2	403.5	0.271				
2004	541.3	116.2	288.5	0.167	1267.3	137.5	393.2	0.264				

Notes: "Agric.Year 1902" corresponds to the agricultural year 1901/02. Q: total output value, L: population, A: total acreage, H: Herfindahl Index. Q, Q/L, and Q/A show indices with the average of 1901/02 set at 100. See Section 2 for data sources.