*Special volume published March 2016 containing selected papers from the IAAE-ISAE Inter-Conference Symposium on Re-visiting Agricultural Policies in the Light of Globalisation Experience: The Indian Context. The symposium was held in Hyderabad, India, October 12-14, 2014.*

# RE-VISITING AGRICULTURAL POLICIES IN THE LIGHT OF GLOBALISATION EXPERIENCE: THE INDIAN CONTEXT

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Supported by
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# Sources of Growth in Indian Agriculture: Implications for Food Security and Poverty

## I

## INTRODUCTION

India's policymakers have been targeting 4 per cent growth for the agricultural sector ever since the 9th 5-year plan (1995/96-2000/2001); the target, however, has remained elusive. The sector grew at an annual rate of 3.2 per cent during 1980/81 to 1995/96, the peak of Green Revolution. However, it started showing signs of stress afterwards, with growth in it decelerating to less than 2 per cent during 1996/97 to 2004/05. The poor performance of agriculture was on account of numerous factors such as deceleration in yield growth of important crops such as rice and wheat, decline in public investment and increased frequency of extreme climate events, viz., droughts and floods. Subsequently, many corrective measures were taken to arrest the decline in agriculture and the growth recovered later on, reaching to 3.8 per cent during 2006/07-2011/12.

Agriculture remains a key sector of Indian economy because of its strategic importance to food security, employment generation and poverty reduction, despite a rapid decline in its income share to less than 15 per cent in 2012-13. Close to 70 per cent of India's population lives in rural areas and about 70 per cent of it depends on agriculture for its livelihood. By 2030 India's population will exceed 1.5 billion, and to feed this number the country will require approximately 320 million tonnes of food grains, 290 million tonnes of vegetables and fruits, 185 million tons of milk, 26 million tonnes of meat, eggs and fish and 23 million tonnes of edible oils (Joshi and Kumar, 2011). Balancing this demand with domestic supply, however, will not be an easy task. Agriculture will face a confluence of biotic and abiotic pressures. Land, water and energy will emerge as main limiting factors. India's net cropped area has been stagnating at around 140 million hectares; hence there is little scope to source growth through area expansion. Intensification of the existing production systems will be constrained by acute scarcity of water and energy. Moreover, climate change will pose a significant threat to the sustainable development of agriculture. Fostering rapid and sustainable growth in agriculture, thus, remains to be a major policy challenge.

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The paper is drawn from the author's unpublished work on 'Sources of Growth which was published as a Discussion Paper by International Food Policy Research Institute (IFPRI).

In this paper, we examine the sources of growth in Indian agriculture focusing on the crop sub-sector that accounts for two-third of the value of output of the agricultural production. A better understanding of the past sources of growth is essential to provide an empirical support to the policies and programmes as to address the emerging challenges and accelerate agricultural growth. Specifically, this paper (1) identifies and quantifies sources of growth in crop sub-sector in the past three decades; (2) discusses economic, institutional, and policy factors underlying these changes; and (3) examines implications for growth, food security and poverty.

Rest of the paper is organised as follows. In the next section, we describe the data and the analytical approach used to identify and quantify sources of agricultural growth. Section III discusses sources of growth. The likely impacts of changing sources of growth on food security, and poverty are discussed in section IV. Policy implications of the study are discussed in the final section.

## II

## ANALYTICAL APPROACH

The patterns and sources of agricultural growth are studied for the period 1980/81 to 2009/10. This period is further divided into three sub periods, 1980/81 to 1989/90 (the 1980s), 1990/91 to 1999/2000 (the 1990s), and 2000/01 to 2009/10 (the 2000s), so as to compare the transformation and sources of growth in response to various technological, institutional, and policy measures implemented during the different periods. In the 1980s, Green Revolution technologies had spread widely; hence, this period can be considered the "technological transformation phase" of Indian agriculture. The decade of the 1990s can be labeled as a period of "policy regime shift," when a number of economic reforms were undertaken focusing on macroeconomic policy, exchange rate and external trade, industrial licensing, privatisation, etc. Many of the reforms though did not have a direct focus on agriculture; some of these that indirectly impinged on it included deregulation of the agri-food industry, liberalisation of trade in agricultural commodities, and de-monopolisation of external trade from state control. The process of economic reforms continued beyond the 1990s, but with emphasis on "reforming domestic markets" in order to align these with the global markets. In the next decade, the reforms were strengthened to allow private investment in agricultural markets, direct transactions in agricultural commodities outside the state-regulated markets, and contract farming. Futures' trading was permitted, on and off, in agricultural commodities. The list of agricultural commodities reserved for cottage and small-scale industries was pruned to allow private investment for modernisation of food processing sector. The food industry was accorded the status of a priority sector for the purpose of institutional financing. Restrictions on interstate movement of agricultural commodities were removed to improve integration among spatially dispersed markets. This period was

also characterised by high frequency of extreme climatic events such as droughts and floods.

*Data*

In this paper we analyse sources of growth in the crop sector that accounts for close to two-third of the value of output of agricultural sector. For the purpose, we have used data on area, yields and prices of important crops, viz., cereals: rice, wheat, maize, sorghum, pearl millet, finger millet, barley, and small millets; pulses: chickpeas, pigeon peas, and other pulses; oilseeds: groundnut, sesame, rapeseed–mustard, soybean, linseed, sunflower, safflower, castor, and niger seed; fibers: cotton, jute, and sun hemp; spices: betel nut, cardamom, chilies, pepper, turmeric, ginger, garlic, and coriander; fruits: bananas, cashew nuts, and other fruits; vegetables: potatoes, sweet potatoes, onions, tapioca, and other vegetables; beverages: tea and coffee; and coconut, sugarcane, tobacco, rubber, and cluster bean. The selected crops account for more than 90 per cent of both the total cropped area and the value of the output of the crop sector.

The data on area, production, and yield of important crops were compiled from *Indian Agricultural Statistics* and *Agricultural Statistics at a Glance* published by the Ministry of Agriculture (India, Department of Agriculture and Cooperation, various years a, b), and , and *Indian Horticulture Database* (India, National Horticulture Board, various years). The data on value of main outputs of the selected crops (at their current prices) were compiled from the *Value of Output of Crop Sector* (India, Central Statistical Organization, various years, a, b). The farm harvest price of a commodity was estimated by dividing its value of output (at current prices) by its level of production.[1] The current prices were deflated by the general wholesale price index to convert them into real prices (at 1993/94 base). The time series on area, production, and prices were smoothed by applying Hodrick–Prescott (HP) filter.[2]

## III

## METHOD OF DECOMPOSITION OF GROWTH

To decompose agricultural growth by source and crop we followed the "growth accounting approach" as in Minot *et al.* (2006). According to this approach, the change in gross revenue from a single crop can be decomposed into (1) change in cropped area, (2) change in yield, (3) change in real price, and (4) a residual representing the interaction among the first three factors. The change in gross revenue from *n* crops can similarly be decomposed, except that there is one more source of change, the reallocation of area from lower-value to higher-value crops, based on comparative advantage.

If $A_i$ is area under crop $i$, $Y_i$ is its production per unit area, and $P_i$ is the real price per unit of production, then the gross revenue $R$ from $n$ crops can be written as

$$R = \sum_{i=1}^{n} A_i Y_i P_i. \quad \ldots.(1)$$

$A_i$ can be further expressed as the share of crop $i$ in the total cropped area, $a_i = \left(\frac{A_i}{\sum_i A_i}\right)$, and substituting this expression in equation (1) we get

$$R = \left(\sum_{i=1}^{n} a_i Y_i P_i\right) \sum_{i=1}^{n} A_i. \quad \ldots.(2)$$

Total derivative of both sides of equation (2) provide the absolute contribution of changes in these components to the change in gross revenue:

$$dR \cong \left(\sum_{i=1}^{n} a_i Y_i P_i\right) d\left(\sum_{i=1}^{n} A_i\right) + \left(\sum_{i=1}^{n} A_i\right) d\left(\sum_{i=1}^{n} a_i Y_i P_i\right). \quad \ldots.(3)$$

Equation (3) is only an approximation, since it excludes interaction term. The second term on the right-hand side of this equation can be further decomposed from a change in sums to the sum of changes, as follows:

$$dR \cong \left(\sum_{i=1}^{n} a_i Y_i P_i\right) d\left(\sum_{i=1}^{n} A_i\right) + \sum_{i=1}^{n} A_i \sum_{i=1}^{n} d(a_i Y_i P_i). \quad \ldots.(4)$$

Further expansion of the second term of equation (4) results in the following expression:

$$dR \cong \left(\sum_{i=1}^{n} a_i Y_i P_i\right) d\left(\sum_{i=1}^{n} A_i\right) + \sum_{i=1}^{n} A_i \sum_{i=1}^{n} (a_i Y_i dP_i) + \sum_{i=1}^{n} A_i \sum_{i=1}^{n} (a_i P_i dY_i) + \sum_{i=1}^{n} A_i \sum_{i=1}^{n} (Y_i P_i da_i) \quad \ldots..(5)$$

Equation (5) decomposes change in gross revenue due to change in (1) total cropped area, (2) crop yields or technology, (3) real prices, and (4) land reallocation or diversification. The first term on the right-hand side of this equation represents the change in gross revenue due to change in total cropped area. The second term on the right-hand side captures the change in gross revenue due to a change in the real prices of commodities. The third term measures the change in gross revenue due to changes in crop yields or technology. The fourth term represents the change in gross revenue associated with changes in crop composition. A positive fourth term indicates a reallocation of land from lower-value to higher-value crops. Dividing both sides of equation (5) by the overall change in gross revenue ($dR$) gives us the proportionate share of each source in the overall change in gross revenue or agricultural growth.

This methodology can be used to discern the contribution of each crop or crop group to overall growth of agriculture.

## IV

## SOURCES OF GROWTH

Cereals, mainly rice and wheat, dominate the cropping pattern in India, despite their declining share in the total cropped area and also in the total value of output

(Table 1). In the decade from 2000/01 to 2009/10, cereals accounted for 54 per cent of the gross cropped area and 37 per cent of the value of output. The second most important group of crops, in value terms, comprises the horticultural crops (fruits, vegetables, plantation crops, and spices and condiments). These crops contributed more than one-third to the value of output in the decade of 2000/01 to 2009/10, from an area share of less than 10 per cent. Further, their share in the area as well as value of output has increased considerably over the past two decades. Oilseeds accounted for 12 per cent of the gross value of output and 14 per cent of the gross cropped area during that decade. Sugarcane, cotton, and pulses were other important crops.

TABLE 1. CONTRIBUTION OF DIFFERENT CROPS TO AGRICULTURAL GROWTH, 1980/81–2009/10

| | Share in gross cropped area (per cent) | | | Share in real value of output (per cent) | | | Annual compound growth in real value of output (per cent) | | | Share in overall growth (per cent) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crop/crop group | 1980s | 1990s | 2000/01 - 2009/10 | 1980s | 1990s | 2000/01 - 2009/10 | 1980s | 1990s | 2000/01 - 2009/10 | 1980s | 1990s | 2000/01 - 2009/10 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Rice | 24.2 | 24.1 | 23.6 | 22.4 | 21.7 | 19.0 | 3.3 | 3.1 | -0.2 | 23.1 | 20.5 | -1.7 |
| Wheat | 14.2 | 14.6 | 15.1 | 12.0 | 12.7 | 12.6 | 2.4 | 5.5 | 1.2 | 10.2 | 20.7 | 4.6 |
| Maize | 3.5 | 3.4 | 4.1 | 2.1 | 1.9 | 2.1 | 0.5 | 3.1 | 5.0 | 0.7 | 1.9 | 3.2 |
| Other cereals | 20.0 | 14.6 | 11.6 | 5.8 | 4.1 | 3.2 | -2.7 | 0.4 | 1.3 | -3.2 | -0.2 | 0.9 |
| *All cereals* | 61.9 | 56.7 | 54.5 | 42.4 | 40.4 | 37.0 | 2.0 | 3.6 | 0.7 | 30.7 | 43.0 | 6.9 |
| Chickpeas | 4.5 | 4.0 | 3.9 | 2.8 | 2.4 | 2.4 | 1.2 | 2.4 | 5.2 | 0.7 | 1.1 | 3.6 |
| Pigeon peas | 1.9 | 2.0 | 2.0 | 1.5 | 1.4 | 1.0 | 3.5 | 1.7 | 2.6 | 1.4 | 0.1 | 0.9 |
| *All pulses* | 14.0 | 13.0 | 12.5 | 7.3 | 6.2 | 5.2 | 2.6 | 1.0 | 3.0 | 4.6 | 0.3 | 4.8 |
| Groundnut | 4.5 | 4.4 | 3.5 | 5.2 | 4.4 | 3.0 | 3.2 | -2.0 | 2.0 | 4.9 | -4.2 | 1.1 |
| Rapeseed & mustard | 2.0 | 3.3 | 3.2 | 2.4 | 3.1 | 2.7 | 9.0 | -1.5 | 6.1 | 6.9 | -1.7 | 4.3 |
| Soybean | 0.7 | 2.8 | 4.3 | 0.5 | 2.0 | 2.4 | 30.0 | 8.7 | 9.1 | 4.2 | 3.7 | 6.6 |
| Other oilseeds | 4.3 | 6.6 | 7.4 | 4.3 | 4.8 | 4.1 | 8.7 | -2.8 | 5.4 | 5.4 | -0.5 | 1.0 |
| *All oilseeds* | 10.8 | 14.2 | 14.0 | 12.4 | 14.1 | 12.1 | 6.9 | -0.7 | 5.4 | 21.4 | -2.6 | 13.0 |
| Cotton | 4.5 | 4.8 | 4.9 | 3.9 | 5.0 | 5.0 | 1.4 | 2.8 | 10.7 | 4.0 | 1.7 | 14.5 |
| Other fibers | 0.7 | 0.6 | 0.6 | 0.7 | 0.5 | 0.4 | 3.7 | 1.1 | 1.4 | 0.8 | 0.1 | 0.2 |
| *All fibers* | 5.2 | 5.4 | 5.5 | 4.7 | 5.5 | 5.4 | 1.7 | 2.6 | 9.9 | 4.8 | 1.8 | 14.7 |
| Plantation crops | 1.3 | 1.6 | 1.8 | 1.7 | 1.8 | 1.6 | 5.6 | 2.7 | 5.0 | 6.8 | 0.0 | 1.1 |
| Spices & condiments | 1.1 | 1.3 | 1.3 | 2.8 | 3.8 | 3.9 | 8.5 | 6.8 | 3.8 | 4.8 | 5.1 | 5.4 |
| Fruits | 1.4 | 1.9 | 2.7 | 9.4 | 10.6 | 14.2 | 4.4 | 6.2 | 5.5 | 11.3 | 20.4 | 24.6 |
| Vegetables | 2.1 | 2.9 | 3.8 | 9.8 | 11.5 | 13.5 | 3.6 | 6.8 | 6.7 | 11.0 | 19.1 | 28.9 |
| Horticultural crops | 5.9 | 7.7 | 9.6 | 23.7 | 27.7 | 33.2 | 4.6 | 6.3 | 5.8 | 33.9 | 44.6 | 60.0 |
| Sugarcane | 1.9 | 2.3 | 2.5 | 8.1 | 8.6 | 8.8 | 1.2 | 5.0 | 0.0 | 3.8 | 13.1 | -1.3 |
| Other crops | 1.6 | 1.5 | 1.9 | 1.0 | 0.9 | 0.9 | 0.9 | 1.0 | 6.8 | 0.8 | -0.1 | 2.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 3.1 | 3.7 | 3.3 | 100.0 | 100.0 | 100.0 |

*Source*: Estimated by authors

*Note*: Value of output does not include the value of crop by-products (straws and fodders). 2. Sub-total of each group of crops is in italics.

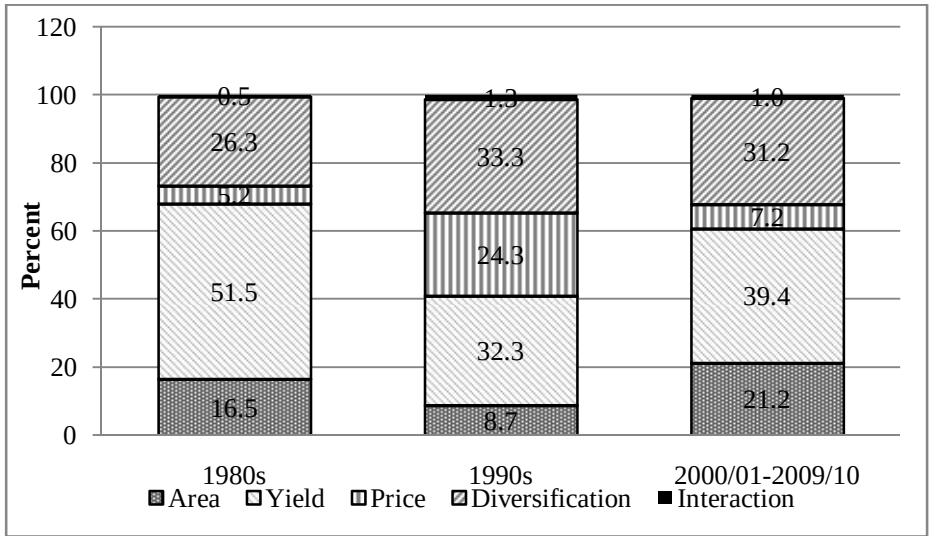
The crop sector grew at an annual rate of 3.1 per cent in the 1980s, which accelerated to 3.7 per cent in the 1990s. The rate of growth, however, decelerated marginally in the following decade. The growth patterns, however, are different for different crops or crop groups. Horticultural crops experienced a steady and relatively faster growth (around 6 per cent) in the 1990s and after as compared to a 4.6 per cent

growth in the 1980s. The value of output of oilseeds increased at a rate of more than 6 per cent a year in the 1980s. This momentum, however, could not be sustained in the 1990s, but it was followed by a strong recovery in the following decade. The value of output of wheat grew at an accelerated rate of 5.5 per cent a year in the 1990s, from 2.4 per cent in the 1980s. But, it decelerated significantly to 1.2 2000/01 to 2009/10. Rice, which has a higher share of the value of output than any other crop, experienced a strong decline in its growth. On the other hand, maize, cotton, and pulses experienced strong growth in this period.

Before presenting decomposition of growth by source we identify the crops or crop groups that have been important to overall growth of agriculture. The last three columns of Table 1 present the contribution of each crop or crop group to the overall growth of crop sector. In the 1980s, with a share of more than 21 per cent each, rice and oilseeds were the main contributors to agricultural growth, followed by fruits, vegetables and wheat (10 per cent). In the 1990s, wheat, sugarcane, fruits and vegetables gained in their shares of growth; rice lost marginally, and oilseeds ceased to be a driver of growth. In the following decade, the growth share of rice and wheat declined, leading to a drastic fall in the share of cereals. In contrast, fruits and vegetables emerged as important contributors to growth during 2000/01 to 2009/10; their combined share in overall growth increased to 53 per cent. Area under fruits and vegetables grew at an annual rate of more than 3 per cent in the 1990s and 4.5 per cent in the next decade. Oilseeds and cotton also emerged important contributors to overall growth during 2000/01-2009/10. These changes in the relative shares of crops provide a clear indication of the growing importance of high-value crops in Indian agriculture.

Figure 1 shows the changes in share of the contribution of area expansion, price increases, yield improvements or technological change, and area reallocation or diversification to the growth of agriculture over the past three decades. Technological change had been the dominant source of growth in the 1980s, accounting for more than half of the overall growth in the crop sector. More than one-fourth of the growth during this period was associated with land reallocation from lower- to higher-value crops. Area expansion contributed about 17 per cent to overall growth, while prices did not have a significant influence on overall growth during this period.

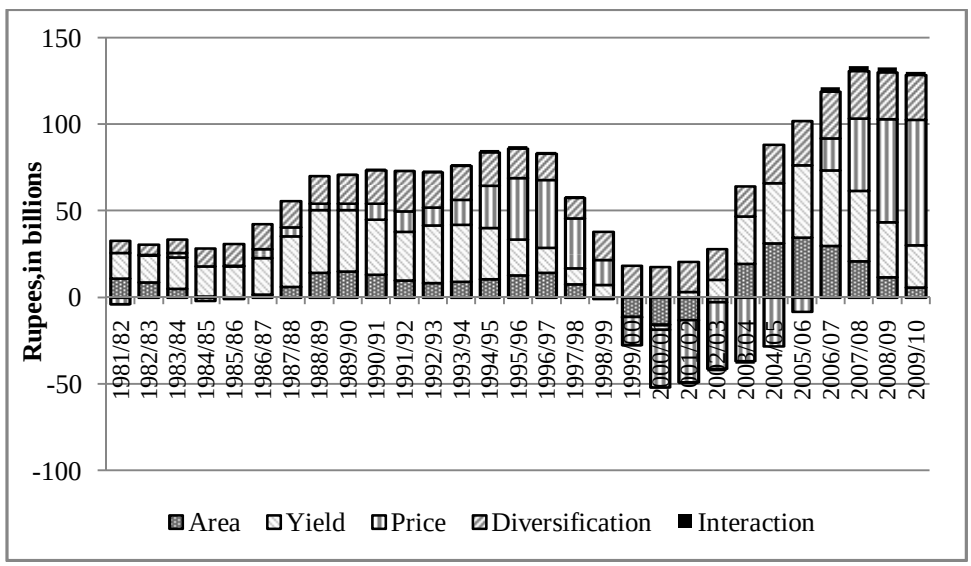
Sources of growth changed drastically in the 1990s. Effect of technology faded with its share in growth falling to one-third, while diversification consolidated its share equaling to that of technology. There was a drastic increase in the contribution of prices to 24.3 per cent in the 1990s, mainly due to a significant rise in the prices of rice and wheat. In the next decade, the contribution of technology improved, reaching to 39.4 per cent, while that of prices declined drastically to 7.2 per cent. During this period, the price effect on growth was driven by horticultural crops. Diversification maintained its share of around 30 per cent in the overall growth. Surprisingly, area expansion also turned out to be an important source of growth during this period.




*Source*: Estimated by authors

Figure 1. Contribution of Different Sources to Growth in the Crop Sector India, 1980/81–2009/10 (per cent).

For a deeper insight into the dynamics of growth sources, we now look at the year-over-year changes in their contribution to overall growth (Figure 2). The sum of these changes suggests that in the past three decades, agricultural growth behaved in




*Source*: Estimated by authors.

Figure 2. Annual Changes in Sources of Agricultural Growth, 1980/81–2009/10.

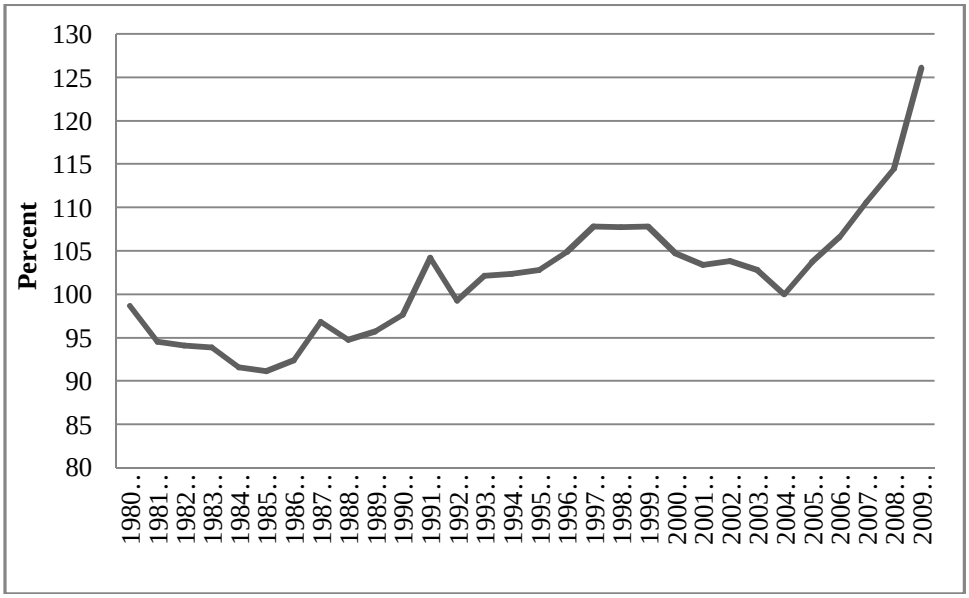
a cyclical manner, accelerating during 1980/81 to 1996/97, falling until 2001/02, and rising thereafter. Technology, as expected, had been the main source of growth until the mid-1990s. In the latter half of the 1990s, the growth became driven by prices, and the effect of technology started fading, having almost a negligible contribution between 1999/2000 and 2002/03. Later on, however, technology started regaining its lost position. Real prices of agricultural commodities declined in the first half of the decade 2000/01-2009/10, to the extent that these turned out to be a detractor of growth. However, in the second half of that decade, the prices of agricultural commodities started rising, which led to an improvement in their contribution to growth and also in overall growth. Interestingly, despite the erratic behavior of agricultural growth, diversification more or less maintained its share of growth throughout the past three decades, which leads us to conclude that diversification is a steady source of agricultural growth.

A number of policy and non-policy factors were responsible for the observed patterns of sources of growth. Demand-side factors played an important role. The observed changes in the production mix are consistent with changes in the consumption basket. Between 1983 and 2009, India's food basket underwent a significant transformation away from cereals and toward high-value commodities (Joshi and Kumar 2011). Export demand for fruits and vegetables also acted as a catalyst in the growth of high-value agriculture. India's exports of fruits and vegetables increased from US$202 million[3] in 1980–82 to $380 million in 1990–92 and took a drastic jump to $2.068 billion in 2008–10 (FAOSTAT: http://faostat.fao.org).

The demand-driven growth in the horticultural sector was facilitated by the improvements in roads, transportation, communication, and electricity (Joshi *et al*., 2004; Birthal *et al*., 2012) and development of retail chains (Birthal *et al*. 2005; Roy and Thorat 2008; Reardon and Minten, 2011).

In the 1990s, the terms of trade turned in favor of agriculture (Figure 3), which led to an increase in the contribution of prices to agricultural growth. The real prices of most agricultural commodities grew faster in the 1990s than in the 1980s. As a matter of policy most food grain crops in India are protected against price fluctuations through the policy of minimum support prices. The policy serves twin purposes as incentive to farmers to produce more and as a protection to the poor consumers against price volatility. The government procures huge quantities of rice and wheat for public distribution, welfare programmes, and buffer stocking at the minimum prices. In the 1990s, the wholesale prices of rice and wheat increased, respectively, at an annual rate of 1.3 per cent and 2.4 per cent in the 1990s, as compared with -0.3 per cent and -1.3 per cent in the 1980s. In the first decade of the 21st century, it was prices of wheat and rice that turned out to be the leading cause of erratic behaviour of agricultural growth. Starting in 2000/01, the prices of wheat (in real terms) declined continuously until 2005/06. The minimum support prices of both wheat and rice, however, were raised afterwards, when their international prices were

on the rising trend. But this could not compensate for the loss in their share of growth that occurred in first half of the decade.




*Source:* Estimated by authors using data from National Accounts Statistics

Figure 3. Terms of Trade for Indian Agriculture, 1980/81–2009/10

The declining share of technology in overall growth was due to the slowing down of growth in yield of most of crops in the 1990s and thereafter (Table 2). The yield of rice and wheat, which had been growing at an annual rate of more than 3 per cent in the 1980s, decelerated to less than 2 per cent during 2000/01-2009/10. The high-yielding seeds even though had spread widely by the mid-1990s, the growth in complementary inputs decelerated.[4]

TABLE 2. ANNUAL GROWTH IN YIELD OF IMPORTANT CROPS, 1980/81–2009/10

| Crop / crop group | 1980s | 1990s | 2000/2001–2009/2010 |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Rice | 3.15 | 1.21 | 1.42 |
| Wheat | 3.24 | 1.82 | 0.73 |
| Maize | 2.04 | 2.22 | 2.27 |
| Gram | 2.48 | 1.53 | 1.16 |
| Pigeon peas | 0.07 | 0.13 | 0.94 |
| Groundnut | 1.74 | 1.34 | 1.76 |
| Rapeseed & mustard | 3.00 | 0.38 | 2.13 |
| Soybean | 5.27 | 1.91 | 1.71 |
| Cotton | 4.21 | -1.40 | 10.29 |
| Sugarcane | 0.21 | 0.79 | 0.59 |
| Fruits | -2.21 | 1.81 | -1.48 |
| Vegetables | -2.46 | 0.38 | 1.31 |

*Source*: Estimated by authors.

A large share of oilseeds in the overall growth in the 1980s was due to favourable incentives and protection structures. The government launched the Technology Mission on Oilseeds (TMO) in 1986 that provided a package of improved technology, high-quality inputs, and extension services to farmers for encouraging cultivation of oilseed crops. These incentives were supported by high tariff and nontariff barriers on imports of edible oils. Cotton production increased impressively during 2000/01-2009/10 mainly due to introduction of Bt cotton in 2002/03, and in 2009/10 it occupied 90 per cent of the total cotton area.

Rise in the share of area expansion in overall growth during 2000/01 – 2009/10 was an outcome of increased weather uncertainty, which led to considerable contraction as well as expansion of the cropped area in some years, depending on the quantum and distribution of rainfall.

Diversification remained an important source of growth throughout the past three decades, but more so in the 1990s. Land reallocation took place from less profitable foodgrain crops like millets, sorghum, and pulses, and toward vegetables, fruits, and spices (see Annexure Table 1). Note that there has been little, if any, diversion of area from wheat and rice. Fruits and vegetables together accounted for more than three-fourths of the diversification-induced growth in agriculture and not much from yield improvements.

These findings clearly reveal that (i) given the fixed supply of land there is a limited scope to enhance agricultural growth through area expansion, (ii) prices do stimulate agricultural growth but cannot be a sustainable source of growth, and (iii) in the long-run, growth in agriculture has to come from technological change and diversification towards high-value crops.

## V

## CHANGING GROWTH SOURCES, FOOD SECURITY AND POVERTY

Indian agriculture is predominantly small-farm agriculture; landholdings measuring less than or equal to 1 hectare comprise two-thirds of the total holdings. The question is: How are smallholder farmers will be impacted by the changing sources of growth? The changing growth sources offer opportunities and pose challenges to small landholders. For instance, the demand-driven growth in high-value agriculture is an opportunity for smallholders to enhance their income and utilise their resources particularly the family labour efficiently by diversifying their production portfolio toward high-value crops, but access to markets both for outputs and inputs could be a major challenge.

First we examine the extent to which smallholder farmers can benefit from diversification. Table 3 presents net returns from high value crops vis-à-vis other crops on different farm categories. High-value crops generate more net revenue per unit of land than do most other crops, almost twice the mean revenue from other crops. Interestingly, the size–productivity relationship is also stronger in the case of

horticultural crops, except floriculture. For other crops, especially rice and wheat, there is no definite relationship between farm size and productivity. An important reason for this is the increasing mechanisation of field operations in these crops, and more so on larger farms, which has helped improve their production efficiency. On the other hand, there has been little, if any, mechanisation of field operations in horticultural crops because many of the activities cannot be accomplished by machines and require human and animal labor. Most high-value crops are highly responsive to constant and careful monitoring of plant health; careful weeding, pruning, and irrigation; harvesting based on assessments of when individual pieces of fruit and vegetables are ripe; and careful, efficient handling (Collins, 1995). These findings indicate that small farmers have comparative advantage in production of high-value crops.

TABLE 3. NET REVENUE PER HECTARE FROM DIFFERENT CROPS BY FARM SIZE IN 2002-03

(*Rs./ha*)

| Crops/crop groups | Marginal (≤1.0ha) | Small (1.0-2.0ha) | Medium (2.0-4.0ha) | Large (>4.0ha) | All |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Rice | 8594 | 8394 | 8919 | 9313 | 8734 |
| Wheat | 9497 | 9108 | 10614 | 9736 | 9711 |
| Maize | 4781 | 4769 | 4604 | 5140 | 4807 |
| Other cereals | 3375 | 3287 | 2415 | 2039 | 2611 |
| Total cereals | 7903 | 7298 | 7444 | 6611 | 7349 |
| Pulses | 5248 | 4393 | 5031 | 4187 | 4579 |
| Oilseeds | 8738 | 6759 | 6395 | 6150 | 6694 |
| Fiber crops | 7639 | 6999 | 7784 | 5731 | 6697 |
| Sugar crops | 22627 | 17780 | 23139 | 21279 | 21186 |
| Fruits | 32687 | 21004 | 19243 | 14881 | 21715 |
| Vegetables | 14182 | 12686 | 11752 | 12592 | 13103 |
| Spices | 21288 | 19340 | 18035 | 13061 | 17557 |
| Plantation | 23355 | 19678 | 18665 | 11449 | 19049 |
| Flowers | 20667 | 9508 | 10896 | 11585 | 13925 |
| Medicinal and narcotic plants | 13684 | 16822 | 14303 | 12351 | 14386 |
| High-value crops | 19220 | 16250 | 15699 | 13159 | 16444 |
| Other crops | 12421 | 10363 | 8622 | 4230 | 7350 |
| All crops | 9018 | 7944 | 8120 | 6668 | 7877 |

*Source*: India, National Sample Survey Organization (2005).

However, the capability of small farmers to grow high-value crops is often doubted on several counts. First, such farmers' average size of landholding is too small to permit them to divert more land out of staples at the cost of their household food grain security. Second, cultivation of high-value crops is capital-, and information-intensive,[5] which may restrict them to grow such crops. Third, most high-value crops are perishable and are prone to greater production and market risks, while small farmers are risk averse. Fourth, the marketable surplus of such crops may be too small to be remuneratively traded in the urban markets due to high transportation and transaction costs. Fifth, the modern marketing systems may exclude small farmers from the value chains because of their low marketable surplus and stricter food safety standards imposed by them.

The literature suggests that diversification of agriculture from lower- to higher-value crops offers significant opportunities to farmers to enhance their income and employment (Barghouti *et al*., 2005; Joshi *et al*., 2004; Weinberger and Lumpkin, 2007). Most high-value crops have short gestation periods, require low start-up capital, and generate a stream of outputs that can be easily liquidated for cash (Weinberger and Lumpkin 2007; Joshi *et al*., 2006). Thus, smallholder farmers are likely to benefit more from the diversification-led growth.

To assess the participation of smallholder farmers in high-value agriculture we compare area allocations to different crops by farm size (Table 4). Three important observations stand out prominently from this comparison. First, as compared with large farmers, smaller farmers allocate a larger proportion of their land to high-value crops. Second, smaller farms have a comparative advantage in production of vegetables over fruits and spices. This is expected, since vegetables generate quick and regular returns, and require more labour and less capital, which matches small-holders' resource endowments (Birthal *et al*., 2012). Further, most fruit crops and regular returns, and require more labour and less capital, which matches smallholders' resource endowments (Birthal *et al*., 2012). Further, most fruit crops and certain spices (betel nut and cardamom, for example) require more start-up capital and have longer gestation periods, which discourage small farmers from growing such crops. Third, compared with others, though the small farmers allocate a larger share of their area to high-value crops, they also allocate a larger proportion of their land to rice and wheat.

TABLE 4. AREA SHARE OF DIFFERENT CROPS BY FARM SIZE, 2002/03

(*per cent*)

| Crops/crop groups | Marginal | Small | Medium | Large | Total |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Rice | 38.09 | 31.14 | 24.76 | 15.13 | 26.67 |
| Wheat | 20.90 | 17.21 | 15.83 | 14.16 | 16.92 |
| Maize | 5.66 | 5.45 | 4.38 | 2.89 | 4.50 |
| Other cereals | 9.26 | 12.85 | 14.76 | 17.69 | 13.82 |
| Total cereals | 73.90 | 66.64 | 59.73 | 49.87 | 61.90 |
| Pulses | 6.58 | 9.53 | 10.96 | 16.01 | 11.04 |
| Oilseeds | 6.20 | 8.31 | 12.13 | 15.44 | 10.78 |
| Fiber crops | 2.01 | 3.64 | 5.05 | 6.87 | 4.51 |
| Sugar crops | 2.20 | 3.30 | 3.47 | 2.88 | 2.93 |
| Fruits | 1.12 | 1.20 | 1.37 | 1.06 | 1.18 |
| Vegetables | 4.03 | 3.08 | 2.06 | 1.24 | 2.54 |
| Spices | 1.05 | 1.00 | 1.24 | 1.13 | 1.11 |
| Plantation | 0.98 | 0.70 | 0.52 | 0.49 | 0.67 |
| Flowers | 0.09 | 0.05 | 0.13 | 0.03 | 0.07 |
| Medicinal and narcotic plants | 0.20 | 0.27 | 0.39 | 0.16 | 0.25 |
| High-value crops | 7.46 | 6.29 | 5.71 | 4.11 | 5.81 |
| Other crops | 1.65 | 2.28 | 2.96 | 4.82 | 3.03 |

*Source:* India, National Sample Survey Organisation 2005.

These findings have an important implication for food security. Contrary to the perception that small farm diversification is not compatible with household food

security (Vyas, 1996, Jha, 2001) the evidence suggests that smallholders do take care of their household cereal requirement while diversifying toward market-oriented high-value crops. This is also supported by results of the decomposition of growth where it emerged that diversification has occurred displacing less profitable crops rather rice and wheat. Singh and Kumar (2002) conclude that agricultural diversification helps achieve food security and improved human nutrition and increased rural employment.

Agricultural growth has been proven to be more pro-poor than the growth in other economic sectors (Ravallion and Datt, 1996; Warr, 2003). With higher returns per unit of land and greater area allocation to high-value crops on smaller farms the diversification-led growth is expected to empower smallholders to escape poverty. Table 5 compares poverty rates among growers and non-growers of high-value crops by farm size. In general, the incidence of poverty is higher among farm households towards the bottom of land distribution, but it is less among the growers of high-value crops (19.6 per cent) as compared to the non-growers (25.4 per cent). By farm size, it is less among the growers at all scales than among the non-growers. The poverty gap that measures depth of poverty (how far households are from the poverty line) and squared poverty gap that measures severity of poverty (besides poverty gap it takes into account the inequality among the poor are smaller for growers of high-value crops at all scales.

TABLE 5. POVERTY STATUS OF FARM HOUSEHOLDS 2002-03

| Farm class | Head count ratio | Poverty gap | Squared poverty gap |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Growers of high value crops | | | |
| Marginal (≤1ha) | 0.241 | 0.044 | 0.012 |
| Small (1-2ha) | 0.169 | 0.025 | 0.007 |
| Medium (2-4ha) | 0.109 | 0.016 | 0.004 |
| Large (>4ha) | 0.072 | 0.015 | 0.005 |
| All | 0.196 | 0.034 | 0.01 |
| Non growers of high value crops | | | |
| Marginal (≤1ha) | 0.302 | 0.056 | 0.016 |
| Small (1-2ha) | 0.203 | 0.035 | 0.009 |
| Medium (2-4ha) | 0.174 | 0.031 | 0.008 |
| Large (>4ha) | 0.105 | 0.017 | 0.005 |
| All | 0.254 | 0.046 | 0.013 |

*Source*: India, National Sample Survey Organization 2005.

These findings indicate that diversification toward high-value crops is more pro-poor. Though, in the short-run it may not help all the poor to come out of poverty, but may mitigate its severity and reduce the poverty gap. In the long-run given enabling policies, infrastructure and support services the growth in high-value agriculture will have a large positive impact on welfare of the farm households.

## VI

## POLICY IMPLICATIONS

Some important policy implications emerge from this study. First, prospects for growth through area expansion are limited. India's net cropped area has stagnated around 140 million ha. Competition for land is likely to intensify due to its increasing demand for residential and industrial purposes. The only possibility to expand cropped area is through intensification of the existing cropped land. This will require investment in irrigation and innovations in water management to improve water use efficiency.

Second, prices play an important role in stimulating agricultural growth; but price-led growth may not sustain for long. In India, the government sets a floor price (minimum support price) for most crops, but not for perishable high-value crops. A part of the price effect is due to changes in the administered prices, mainly of rice and wheat that the government procures for public distribution and buffer stocking. The administered price–led growth may widen interpersonal and regional disparities as the benefits of price increases accrue in proportion to the marketable surplus, which is obviously small for poor farmers and poorer states. This points towards the need for enhancing competition in the marketplace and improve market and transportation infrastructure to cut down marketing and transaction costs (Birthal *et al*., 2005) associated with small marketable surplus particularly of high-value crops.

Third, decline or stagnation in the relative contribution of technology to agricultural growth should be taken seriously. This could be due to factors, such as lack of investment in agriculture in general and agricultural research in particular, inefficiency in agricultural research, poor linkages between research and extension, weather uncertainty, etc. All these have implications for agricultural research and development. One such implication is the need to improve and sustain the level of public investment in agriculture that induces private investment also. Investment in agricultural research and extension is far from adequate. India spends only about 0.6 per cent of its agricultural gross domestic product on agricultural research and extension (Beintema *et al*., 2008). There is sufficient evidence to show that the payoff on investment in agricultural research is very attractive (Fan *et al*., 2007). A higher investment in agricultural research is, thus, required to keep yield frontiers upward or to reduce cost of production. Further, the agricultural research agenda needs to be revisited and prioritised as to tackle the emerging challenges of climate change, rising prices of agricultural commodities and energy inputs, increasing cost of production, labour shortages and degradation of natural resources, and also changing food preferences. While the focus of research is likely to remain on breeding for higher yields, the importance of research on management of biotic and abiotic stresses cannot be over emphasised. Research on horticultural crops also merits attention, since there have been few yield gains in most horticultural crops. Note that small farmers proportionally allocate more area to horticultural crops and also they are

more efficient in their production, investment in horticultural research would have a larger effect on income and poverty reduction. Finally, to harness benefits of research there is a need to effectively link with the technology and information dissemination systems, which otherwise would remain stunted.

Fourth, diversification toward high-value commodities is a sustainable source of growth and provides a cushion to agricultural growth. It also provides an opportunity to smallholders to enhance income and escape poverty as the demand for high-value food commodities is expected to accelerate. In the last few years, there has been some progress in dismantling policy and institutional barriers to the high-value agriculture and food industry, yet harnessing its potential of inclusive growth will require (1) increased investment in public infrastructure (roads, electricity, and communication) that reduces transportation and transaction costs and induces the private sector to invest in agro processing, cold storage facilities, refrigerated transportation, and retail chains to enhance efficiency of the value chains and minimise postharvest losses; (2) enhanced access of farmers to technology, credit, inputs, information, and services; and (3) appropriate policies that facilitate institutional arrangements like contract farming, producers' organisations, and cooperatives that provide farmers easy access to markets, distribute price risks, and reduce marketing and transaction costs.

## NOTES

1. The Central Statistical Organisation uses farm harvest prices and production of agricultural commodities supplied by the Directorates of Economics and Statistics and the Departments of Agriculture of different states to estimate their monetary values. Since information on farm harvest prices of all the commodities at state level was not readily available, we estimated these by dividing the value of output of different commodities by their respective levels of production.

2. Hodrick–Prescott filter is a data smoothing technique, commonly applied to remove short-term fluctuations from time series data. It generates a smoothed nonlinear representation of a time series. The adjustment of the sensitivity of the trend to short-term fluctuations is done by applying a suitable adjustment factor.

3. All dollar amounts are in US dollars

4. Growth in gross irrigated area and fertiliser use per hectare during the period 1996/97 to 2004/05 was 0.4 per cent and 1.9 per cent, respectively, as against 2.5 per cent and 5.9 per cent from 1980/81 to 1995/96.

5. We estimated cost of cultivation for horticultural crops as aggregate, and these were higher on smaller farms. The unit cost of production, measured as paid out cost (excluding imputed cost of the family labour) to produce one unit of output in monetary terms, was almost similar (Rs. 37-41 to produce output worth Rs 100) across farm types. The gross revenue per ha on smaller farms, however, was higher enough to offset the cost disadvantage. Higher gross revenue on smaller farms could be attributed to the higher endowments of family labor on smaller farms per unit of arable land.

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ANNEXURE TABLE 1. AVERAGE ANNUAL CHANGE IN THE SOURCES OF AGRICULTURAL GROWTH, NATIONAL LEVEL (IN MILLION RUPEES), 1980/81–2009/10

| Crop / crop group | 1980s | | | | | | 1990s | | | | | | 2000/2001–2009/2010 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | Y | P | D | I | T | A | Y | P | D | I | T | A | Y | P | D | I | T |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (16) | (17) | (18) | (19) | (20) |
| Rice | 1,714 | 9,205 | -171 | -81 | 30 | 1,0697 | 995 | 4,714 | 4,354 | 799 | 104 | 10,965 | 2,863 | 5,280 | -5,097 | -4,198 | -109 | -1,260 |
| Wheat | 919 | 5,285 | -1,511 | 51 | -29 | 4,715 | 518 | 4,012 | 4,235 | 2,134 | 194 | 11,093 | 1,896 | 2,179 | -852 | 45 | 92 | 3,361 |
| Maize | 163 | 741 | -345 | -240 | -10 | 308 | 85 | 809 | -185 | 329 | 0 | 1,039 | 327 | 997 | 0 | 974 | 31 | 2,328 |
| Other cereals | 437 | 1,408 | -1,349 | -1,954 | -46 | -1,505 | 221 | 855 | 1,229 | -2,331 | -58 | -85 | 491 | 1,121 | 1,022 | -1,933 | -67 | 635 |
| *All cereals* | 3,233 | 16,639 | -3,377 | -2,224 | -55 | 14,216 | 1,818 | 10,390 | 9,633 | 931 | 241 | 23,012 | 5,578 | 9,577 | -4,927 | -5,112 | -53 | 5,063 |
| Chickpeas | 215 | 704 | 228 | -777 | -54 | 316 | 120 | 568 | 207 | -309 | -2 | 585 | 361 | 751 | 226 | 1,249 | 49 | 2,636 |
| Pigeon peas | 114 | -64 | 258 | 337 | -10 | 634 | 67 | -32 | 130 | -123 | -3 | 39 | 146 | 131 | 513 | -154 | -6 | 630 |
| *All pulses* | 568 | 1,417 | 801 | -587 | -68 | 2,131 | 318 | -110 | 799 | -826 | -23 | 158 | 792 | 479 | 1,486 | 723 | 3 | 3,483 |
| Groundnut | 413 | 1,017 | 23 | 772 | 50 | 2,275 | 257 | 688 | -1,192 | -1,993 | 16 | -2,225 | 479 | 851 | 1,049 | -1,565 | -27 | 788 |
| Rapeseed & mustard | 208 | 895 | -555 | 2,627 | 32 | 3,208 | 171 | 406 | -1,491 | 25 | -26 | -915 | 445 | 1,379 | 1,092 | 220 | 21 | 3,157 |
| Soybean | 46 | 347 | 204 | 1,223 | 119 | 1,939 | 81 | 268 | -1,134 | 2,756 | 17 | 1,988 | 368 | 510 | 1,371 | 2,464 | 123 | 4,836 |
| Other | 196 | 727 | 751 | 810 | 24 | 2,507 | 144 | 277 | -451 | -248 | 14 | -264 | 327 | 639 | -310 | 71 | -31 | 695 |
| *All oilseeds* | 863 | 2,987 | 424 | 5,431 | 225 | 9,929 | 653 | 1,639 | -4,268 | 539 | 21 | -1,415 | 1,619 | 3,379 | 3,202 | 1,189 | 86 | 9,475 |
| Cotton | 303 | 2,228 | -67 | -628 | 37 | 1,873 | 265 | -1,507 | 728 | 1,242 | 158 | 886 | 766 | 8,797 | -283 | 1,293 | -2 | 10,571 |
| Other fibers | 45 | 251 | 256 | -199 | 6 | 360 | 26 | 130 | -178 | 82 | -5 | 56 | 68 | 168 | 108 | -173 | -7 | 163 |
| *All fibers* | 349 | 2,479 | 189 | -827 | 43 | 2,233 | 291 | -1,377 | 550 | 1,324 | 153 | 942 | 833 | 8,965 | -175 | 1,119 | -9 | 10,734 |
| Plantation | 278 | 1,114 | 691 | 1,027 | 40 | 3,150 | 192 | 857 | -2,241 | 1,225 | -59 | -25 | 434 | 23 | 141 | 180 | 27 | 804 |
| Spices & condiments | 170 | 872 | 848 | 297 | 40 | 2,226 | 115 | 1,503 | 706 | 356 | 23 | 2,703 | 468 | 2,084 | 1,303 | 76 | -7 | 3,923 |
| Fruits | 716 | -1,264 | 2,141 | 3,627 | 2 | 5,223 | 429 | 2,522 | 2,871 | 4,943 | 155 | 10,919 | 2,229 | -2,096 | 392 | 17,369 | 59 | 17,954 |
| Vegetables | 753 | -959 | 1,240 | 4,136 | -53 | 5,117 | 444 | 1,451 | 1,133 | 7,110 | 103 | 10,240 | 1,995 | 4,908 | 6,283 | 7,267 | 635 | 21,088 |
| Sugarcane | 639 | 260 | -747 | 1,564 | 40 | 1,756 | 365 | 405 | 3,907 | 2,274 | 79 | 7,029 | 1,412 | 819 | -2,724 | -376 | -51 | -921 |
| Other crops | 80 | 333 | 205 | -251 | 6 | 372 | 47 | 23 | -71 | -36 | -6 | -43 | 125 | 611 | 276 | 361 | 57 | 1,429 |
| Total | 7,648 | 23,878 | 2,417 | 1,2192 | 219 | 46,353 | 4,672 | 17,302 | 13,017 | 17,841 | 687 | 53,519 | 15,484 | 28,748 | 5,257 | 22,797 | 747 | 73,033 |

*Source*: Estimated by authors

*Notes*: A = area; Y = yield; P = price; D = diversification; I = interaction; T = technology. Subtotal of each group of commodities is in italics