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Abstract

The growth story of Gujarat's agriculture has received significant recognition (with around 10 percent growth rate in recent years) and is often being hailed as a role model for other states to follow. In this context, it is important to examine the major factors contributing to this high growth performance of the state. This paper tries to address the issue in the light of decomposition analysis where price has been included as an important factor besides area, cropping pattern and yield as has been the usual practice. The decomposition analysis suggests that the individual effect of price alone has increased over time with the reduction in the yield effect. The price-area interaction effect which was negative during the 1990s turned out to be positive in the recent years. Similarly, the interaction of yield and price has become positive in the recent years. This implies that most of the crops for which there was substantial price increase, had shown favorable changes in yield and area.

Keywords : Agriculture decomposition, price factor

JEL Classification : O13, O41, R11

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Agricultural Growth and Decomposition of Crop Output in Gujarat: Recent Trends

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1. Introduction

Agriculture sector in Gujarat has witnessed a phenomenally high rate of growth of about 10 percent per annum during the last decade (Dholakia, 2007, Dholakia, 2010, Shah *et al*. 2009, Gulati*et al.* 2009). Till then the sector was being viewed as a relatively lagging and highly fluctuating segment of the state's economy. The growth performance is particularly significant as it has come at a time when agricultural growth in several other comparable states was found to be fairly low or moderate. The growth story of Gujarat's agriculture thus, has received significant recognition and is often being hailed as a role model for other states to follow. In this context, it is important to examine the major factors contributing to this high growth performance during the recent period. Since growth rate alone does not provide detail explanation for the performance of agricultural sector, the analysis of decomposition of output growth would help gauging the reliability of the growth model. In this context the present paper tries to: a) examine the trends in area, production and yield of major crops, thus looking into the pattern of growth in Gujarat's agriculture during the 1990s and 2000s; b) explore the sources of growth in agriculture by using decomposition analysis for two sub-periods covering the past two decades; and c) discuss the implications thereof.

The paper is organized into five sections including the introduction. The second section discusses the scope and methodology used for decomposition analysis. This is followed by an analysis of the growth performance of Gujarat's agriculture sector in the third section. The fourth section presents the results of the decomposition analysis and fifth section discusses the implications of the main findings.

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1.1 Gujarat's Agricultural Growth: Some Important Observations

A number of researchers have highlighted the high-growth experience in last decade, particularly during 2003-07 (Gulatiet al. 2009, Shah et al. 2009, Dholakia, 2010, Dholakia and Sapre, 2011, Arya and Mehta, 2011, Shah and Pattnaik, 2012). Some of the key drivers, noted by various researchers include: large scale adoption of GM-technology (for Bt-cotton), massive campaign for rain water harvesting, power sector reforms, lab-to-land extension program and market support including credit (Gulati, et al. 2009, Shah et al. 2009). Besides these, modernization of agricultural practice, crop diversification and better infrastructure facilities with proper marketing system also seem to have influenced the growth of agricultural sector in the recent period (Kumar et al. 2010). Increased use of inputs such as seeds of high yielding varieties (HYVs), fertilizer and irrigation along with rainfall continue to remain as important factors in explaining the growth in agricultural output in the state (Metha, 2012). Development of irrigation, especially under the Sardar Sarovar Project (SSP), augmentation of ground water, and a long stretch of favorable monsoon seem to have helped reducing uncertainty in agricultural production in the last decade. Together, these factors have further improved the conditions for growing high-value crops such as cotton, spices, fruits, vegetables and oilseeds.

It is however, not clear as to how far the growth process has reached out to the poorer sections of the society. The question is particularly relevant to the context, since, agricultural growth in the state is heavily tilted towards those having access to irrigation and has adopted Bt-cotton in addition to some high valued crops like spices etc. It is likely that high growth trajectory may have bypassed some of the weaker sections of the farming communities and regions and that there may be a significant disconnect between the high growth in agriculture and some of the important developmental indicators.

One of the plausible explanations for the alleged disconnect could be found in terms of the sources or major drivers of growth in agricultural output in the state, since the rural development depend upon the linkage between agriculture growth and rural non farm sector. However the relationship between agriculture growth and non farm sector has been weakened during the recent period. It was also observed that there was declining in the productivity led (through technology) agricultural growth in India during the recent decade (Sharma, 2011), implying decline in importance of the real

factors of production in agricultural growth. The pattern of agricultural growth was mainly driven by the price induced growth (Gupta et.al., 2011; Jha, 2011). Jha (2011) pointed out that, the 'price induced agricultural growth is not as strong as that of the technology induced growth in agriculture'. Thus he established the fact that the `growth in crop production in the recent period[1] (in India) was not duly supported by the growth of the real factors of production. However significant growth has been driven by prices rather than (mainly) productivity (p.29).

A similar phenomenon might hold true for Gujarat, especially in the light of the fact that Gujarat's agriculture has undergone a major shift towards high valued non-food crops as against food grains (Dixit, 2009, Patnaik and Pathak, 2012). However, this is not an entirely new phenomenon since, crop diversification or commercial orientation has been an important hallmark of Gujarat's agriculture over a long period of time. What seems to have happened is, a further strengthening of the process during the last decade. The questions arising from the recent experience are: Whether and to what extent the growth has been influenced by price? Whether the influence of price has increased during the recent period (particularly after 2003-04)?[2] This paper tries to address these questions in the light of decomposition analysis where price has been included as an important factor besides area, cropping pattern and yield as has been the usual practice. The analysis is placed in the backdrop of a brief profile of the pattern and performance of agriculture sector in the state by covering a fairly long time from 1990-91 to 2010-11.

2. Decomposition of Output Growth: Scope and Methodology

The analysis of the sources of growth by using decomposition method is not new in the research of understanding agricultural performance. The decomposition method of growth trend was first used by Minhas and Vaidyanathan (1965). They had estimated the change in value of agricultural output by segregating the changes in four major factors: area, yield, cropping pattern and the interactions among the three. They have used the additive

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[1] The growth rate of agricultural real GDP has increased to 2.62 percent during 2006-07 to 2010-11 compared to 2.08 percent growth rate during 1997-98 to 2004-05 (Chand, 2011).

[2] The likely implications of the growth model has been discussed in broder study by Shah and Pattnaik (2014).

method for working out the effects of the four factors. Deviating from the additive method, Parikh (1966) adopted multiplicative model for decomposition analysis. The major difference between the two is that the estimates in the additive method are based on absolute growth rates in outputs as against using relative growth rates in the case of multiplicative method. Moreover, the additive method explicitly includes residual impacts as 'interaction schemes', which is not the case for the other method.

Following the initial work, Minhas and Vaidyanathan (1966) expanded the four-factor model to seven factors model where they included area, yield, cropping pattern, area-yield, area-cropping pattern, yield-cropping pattern and overall interaction term. A similar model has been used by Mishra (1971) and by Sondhi and Singh (1975) for carrying out decomposition analysis in the case of Gujarat and component analysis of Indian foodgrain economy respectively.

In a major departure, Sagar (1977, 1980) tried to introduce current price as an additional factor for decomposition of agricultural growth by using eight components, i.e., four individual components (area, yield, price, cropping pattern) and four interaction terms (cropping pattern-yield, cropping pattern-price, yield-price and yield-crop pattern and price). Sagar, pointed out that price reflects the relative share of different crops in monetary terms, which might change over time due to change in taste and preference or due to the technical and physical constraint obtained in a region/economy. These aspects need to be captured independent of the impact of shift in cropping pattern, which is assumed to be driven mainly by relative profitability at given set of output prices. Jamal and Zaman (1992), has also attempted to decompose the conventional 'residual term' by using new indices like price, quantity and yield change. They have used the log-transformation to make the analysis convenient. However, their model did not have the residual term. Other major important contributions in terms of analyzing relative impact of area, yield and their interaction have come from Dashoraet al. (2000), and Sanker and Chakraborty (2002) who have used seven-factor additive method. Majumdar and Basu (2005), attempted to understand the change in the effects of different components on the absolute growth of output over the period 1970-71 to 1999-00. They have considered three components: area, yield and cropping pattern by using the additive method but without any residual terms.

Introduction of locational component in the decomposition method was yet another methodological development in the field. In his initial work Narain (1977) incorporated locational effect along with yield and cropping pattern as three main gross components. He postulated that a positive locational component implies shift of crop location from low productivity to high productivity area. The effort for further refinement of decomposition analysis has continued till recently. Among these, contribution by Kurosaki (2002) is noteworthy. He used a three-step process of decomposition by decomposing output into area and productivity and again decomposing the both individually. The static effect turns positive when area under crops whose yields were initially high increases relatively, whereas dynamic shift effect becomes positive when area under dynamic crops increases relatively to the area under non-dynamic crops.

The brief review of literature on decomposition analysis in the Indian context thus suggests that although scholars have used different methods for decomposition of growth in agriculture output, there is no clear indication about superiority or suitability of one method over the other. However the additive method is a preferred one to the multiplicative method because the result obtained from the former could be interpreted in a straight forward manner compared to the latter (Mishra, 1971).

For the present analysis, we have tried to examine the component of production growth by considering price as a factor. The methodology adopted in the study is based on the decomposition analysis as used by Sagar (1977).This involved defining a price structure by comparing relative movements in prices (in real terms) of a specific group of agricultural commodities (e.g. oilseeds) with overall average prices of all commodities taken together. Taking all the prices in constant or real terms helps in obtaining the net change in prices of the specific commodity groups as well as for all commodities taken together. According to Sagar [1977; p.109] an analysis such as this could provide meaningful insights into the pattern of agricultural growth and has useful policy implications.

The equation used for the decomposition analysis is as fallows

$Q^1-Q^0 = (A^1-A^0)\ \Sigma_c\ a_c^0\ y_c^0\ p_c^0 + A^1\ \Sigma_c\ a_c^0\ y_c^0\ (p_c^1-p_c^0) + A^1\ \Sigma_c\ a_c^0\ p_c^0\ (y_c^1-y_c^0) + A^1\ \Sigma_c y_c^0\ p_c^0\ (a^1-a^0) + A^1\ \Sigma_c\ a_c^0\ (y_c^1-y_c^0)\ (p_c^1-p_c^0) + A^1\ \Sigma_c\ y_c^0\ (a_c^1-a_c^0)\ (p_c^1-p_c^0) + A^1\ \Sigma_c\ p_c^0\ (a_c^1-a_c^0)\ (y_c^1-y_c^0) + A^1\ \Sigma_c\ (a_c^1-a_c^0)\ (y_c^1-y_c^0)\ (p_c^1-p_c^0)$.

Where,

1 and 0 means the current period and base period respectively.

Q_c = physical quantity of the c^{th} crop, presented in the money value of the agricultural output

A_c = gross crop area under c^{th} crop

a_c= proportion of gross crop area under c^{th} crop.

y_c = yield of c^{th} crop.

p_c = deflated price of c^{th} crop. Deflated price (p_c) = Current price of c^{th} crop (Pcr)/ [Laspayer's index of agricultural prices during the i^{th} period/index at the base year].

As indicated in the equation, the total impact on value of agricultural production is to be captured through eight sets of effects consisting of four individual effects namely, cropping pattern (i.e., proportion of area under the selected crops), price, yield and area; and four interaction effects covering yield and price; yield and cropping pattern; cropping pattern and price; and second order interaction between yield, price and cropping pattern.

2.1 Sources of Data

The present analysis is based on information about fifteen major crops grown in Gujarat. These are: paddy, wheat, jowar, bajra, tur dal, groundnuts, castor, mustard, cotton, tobacco, sugarcane, chilies, potato, total fruits and spices. We have used prices of selected crops as proxy for calculating the contribution of fruits[3] and spices in Gujarat. Obtaining the data on prices

for all the fruits, vegetables and spices, produced in the state was very difficult. In order to address this limitation, we have considered proxy for each group. We have considered those crops from each category, which covers the maximum area under cultivation. Mango, a major fruit crop in Gujarat, constitutes around 36 percentage of the total area under fruit crops and 40 percentage of the total value of output. Thus we have considered price of mango as the proxy of the total fruits. Similarly, cumin is considered as the proxy variable which represents total spices[4]. It covers 63 percentage of the total area under spices in Gujarat and 60 percent of the value of output during 2008-09 (CSO, 2011).

Time series data for area, yield and production of the selected crops, covering the period 1990-91 to 2009-10 have been compiled from official sources. Wholesale price for the selected agricultural commodities have been used for calculating the value of output, and Laspayer's index was used for obtaining deflated prices of the crops selected for the study.

The present paper analyses the agricultural growth and decomposition of crop output for two periods i.e. 1990-99 and 2000-10. Gujarat's agriculture has witnessed a different growth trajectory, particularly after early 2000s. The Net State Domestic Product (NSDP) from agriculture in constant price (1999-00) shows a break after 2000. The year 2003-04 marked a significant departure from the past trend of growth in NSDP (Appendix: 1), thus suggesting a structural break in the growth (Shah and Pattnaik, 2012). The annual average growth rate for the period 2003-04 till 2010-11 was 9.97 percent as noted earlier (the growth rate for the period 2000-01 to 2010-11 was estimated as 10.75 percent)[5].

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[3] In order to obtain the value of total fruits, we have used the wholesale price of Mango (one of the major fruits in Gujarat) as a proxy. Major fruits cultivated in Gujarat include, mango, chiku, citrus, banana, guava, pomegranate, papaya and custard apple. During 2008-09, total area under fruits was 339 thousand hectare, out of which mango constitute around 118 thousand hectare (CSO, 2011).

[4] The major spices cultivated in Gujarat, are Cumin, Fennel, Chilly, Ginger, Garlic, Turmeric, Isabgul and Suva. It was difficult to obtain the data on wholesale price of spices thus; we have considered the wholesale price of Cumin as the proxy for calculating the value of the spices in Gujarat.

[5] For details, see Shah and Pattnaik (2014).

3. Trend in Agricultural Productivity and Cropping Pattern in Gujarat

3.1 Cropping Pattern of Major Crops

The information presented in Table 1, clearly shows that there has been a major decline in the area cultivated under cereals and increase in the area cultivated under cotton and fruits and vegetables. During 1990-91, around 50 percent of the gross cropped area (GCA) in the state was under foodgrains (cereal and pulses), which has drastically dropped to 29 per cent in 2010-11. The major gainer in this category was cotton as its share has increased from 9.6 in 1990-91 to 20.7 percent in 2009-10 (Table: 1). Even though the area under groundnuts declined over the period, it still constituted around 15 percent of the total cropped area during 2010-11.

Table 1: Change in the Relative Shares of Major Crops in Gross Cropped Area (%)

Crops	**1990-91**	**1995-96**	**2000-01**	**2005-06**	**2010-11**
Paddy	6.5	9.5	6.6	6.4	5.7
Wheat	5.9	5.4	3.4	8.0	7.4
Jowar	6.8	4.5	2.3	1.3	1.4
Bajra	13.1	11.7	8.2	8.6	5.7
Tur	2.2	2.0	3.1	2.2	2.2
Groundnuts	16.7	16.5	17.5	17.4	15.3
Castor	3.4	3.7	4.2	3.0	3.5
Mustard	3.1	3.0	2.2	2.9	1.8
Cotton	9.6	13.4	16.1	18.1	20.7
Sugarcane	1.2	1.6	2.5	2.3	1.6
Tobacco	1.3	1.2	1.1	0.7	1.2
Chillies	0.2	0.2	0.1	0.1	0.1
Potato	0.5	0.4	0.3	0.4	0.5
Fruits and Vegetables	2.1	2.4	3.6	6.0	6.8
Spices	4.8	3.9	2.7	2.3	2.4
Total area	**77.4**	**79.6**	**75.9**	**79.7**	**76.3**
Total Cereals	41.7	32.7	28.2	28.9	24.8
Total Pulses	9.5	7.8	7.1	6.2	5.5
Total Oilseeds	25.7	26.5	27.5	24.9	21.8

Note: The data presented here pertains to the years that had experienced more or less normal rainfall.

Source: Compiled from various volumes of Statistical Abstract of Gujarat and Socio Economic Review. Data on Spices: National Horticulture Board.

The average area under wheat, tur, groundnut, castor, cotton, sugarcane, potato and fruits and vegetables has witnessed increase in the area cultivated during the recent period as compared to the 1990s. There was a major decline in the area cultivated under bajra, jowar and paddy (Table 2). Thus, there was a change in cropping pattern towards the cultivation of wheat, groundnut, cotton and fruits and vegetables and those are the major players of growth during the recent decade.

Table 2: Average Area under Major Crops in Gujarat

Crops	1990-99	2000-2010	% Change
Paddy	783	710	-9.3
Wheat	631	**810**	28.4
Jowar	597	174	-70.9
Bajra	1348	882	-34.6
Tur	235	**285**	21.3
Groundnut	1889	**1916**	1.4
Castor	353	**370**	4.8
Mustard	335	277	-17.3
Cotton	1391	**2039**	46.6
Sugarcane	171	**241**	40.9
Tobacco	121	90	-25.6
Chillies	8	9	12.5
Potato	41	**44**	7.3
Fruits and Vegetables	275	**511**	85.8
Spices	444	436	-1.8

Note: Area in 000 ha.

Source: Compiled from various volumes of Statistical Abstract of Gujarat and Socio Economic Review. Data on Spices: National Horticulture Board.

3.2 Yield Performance of Major Crops

During the past decade, yield of most of the major crops, grown in the state has registered substantial increase [Table 3]. Among oilseeds, groundnut is a realtively major gainer in terms of yield during the period as compared to mustard and castor. Compared to cereals and oilseeds, cotton stands out as the best performing crop in terms of increase in yield; the average yield level increased significantly from 288 thousand bales during 1990s to 631 thousand bales during 2000-10. This suggests slightly more than two times

hike in average cotton yield, much of which is of bt-variety. With about one fourth of the area under cotton, a significant jump in the crop productivity, combined with somewhat superior quality and hence, better price realisation may have made a major contribution to the significant growth in agri-NSDP during the decade - a point already made by several scholars (Shah *et al*. 2009, Gulati *et al.* 2009, Dholakia, 2010).

Table 3: Average Yield of Major Crops

Major crops	1990-99	2000-10	% Change
Paddy	1543	**1682**	9.02
Wheat	2216	**2558**	15.4
Jowar	678	**1139**	67.9
Bajra	969	**1266**	30.6
Tur	777	576	-25.8
Groundnut	849	**1303**	53.4
Castor	1834	1706	-6.9
Mustard	1143	**1466**	28.2
Cotton	288	**631**	119.1
Sugarcane	7240	6534	-9.7
Tobacco	1759	1799	2.3
Chilies	4990	4687	-6.1
Potato	423	**483**	14.2

Source: Compiled from various volumes of Statistical Abstract of Gujarat and Socio Economic Review.

The increase in yield, as expected, is accompanied by higher levels of instability (measured by coefficient of variation) or variability over time. Table 4 depicts the changing scenario with respect to growth in yield and coefficient of variation (cv) over the two time periods. It may be noted that, whereas paddy, wheat, castor, mustard andtur were in the category of low growth in yield during 1990-99, they have shifted to the category of higher rate (between 3 to 10 percent) of growth in the subsequent period. Among the major crops which registered higher rates of growth in yield during 2000-10, cotton and tur outperform the rest of the crops. Of all the crops, cotton has attained a major shift from the growth rate ranging between 3-10 percent to the highest range of above 10 percent growth in yield during 2000-10.

Table 4: Growth Rate (Average Annual Growth Rate) and Instability of Yield per hectare in Gujarat

CV \ Growth rate	Below 3%	3%-10%	10%-above
1990-99			
Below 10%	Wheat, Potato, Tobacco, Sugarcane, Chilies	-	-
10%-20%	Paddy, Mustard, Castor, Tur	-	-
20%-30%	-	Cotton	Bajra, Jowar
30% above	-	-	Groundnut
2000-10			
Below 10%	Sugarcane, Chilies, Tobacco	-	-
10%-20%	Potato	Jowar, Wheat, Mustard, Castor	Paddy, Bajra
20%-30%	-	-	Tur
30% above	-	-	Cotton, Groundnut

Source: Compiled from various volumes of Statistical Abstract of Gujarat and Socio Economic Review.

The picture with respect to instability in yield as reflected by cv, is quite different as compared to the yield growth. It is interesting to note that whereas the number of crops having low cv (i.e. below 10) have decreased from five to three over the two sub-periods, what is particularly noteworthy is that the two crops viz, tur and cotton, having attained relatively higher increase in growth rates have also undergone corresponding shift with respect to the cv (Table 4). Conversely, jowar represents a case where both growth rate and cv were high during the first sub-period, but has slid down to low growth with a corresponding low cv in the second sub-period. Overall picture suggests that the number of crops with lowest growth rate has decreased whereas, that with the higher cv has increased. However, if we consider some of the major crops like cotton, groundnut, bajra, and tur with relatively higher growth rate (> 10 percent) during the second sub-period, we find them in the category of relatively higher instability of yield. The phenomenon thus raises the issue of sustainability of yield growth especially in the wake of fluctuating rainfall, which is an old feature of agriculture in the state.

3.3 Production of Major Crops in Gujarat

The production performance of the major crops in Gujarat for two periods are presented in Table 5. During 1990s, the growth rate of almost all the major crops was below 10 percent. Only groundnut witnessed annual average growth rate above 20 percent. Instability of most of the crops was below 30 percent, however, the production of cotton, tobacco and groundnut witnessed high instability. On the contrary, during 2000-10 the instability of all the crops had increased without significant increase in the rate of growth. Cotton, which is considered as one of the important drivers of agricultural growth, has witnessed an increase in both annual average growth rate as well as instability. During the recent period, the crops that have registered increase in growth rate compared to earlier period include tur, mustard, tobacco, wheat and cotton. However, the instability has also increased for these crops.

Table 5: Growth Rate (Average Annual Growth Rate) and Instability of Production in Gujarat

CV \ Growth rate	Below 3%	3%-10%	10%-above
1990-99			
Below 10%	Chilies, Potato	-	-
10%-20%	Tur	Paddy, Castor, Sugarcane	-
20%-30%	Jowar, Mustard	Bajra, Wheat	
30% above	Tobacco	Cotton	Groundnut
2000-10			
Below 10%	Chilies	-	-
10%-20%	Potato	Tur	-
20%-30%	Jowar,	Paddy, Bajra Mustard, Castor	-
30% above	Sugarcane	-	Groundnut, Wheat, Cotton, Tobacco

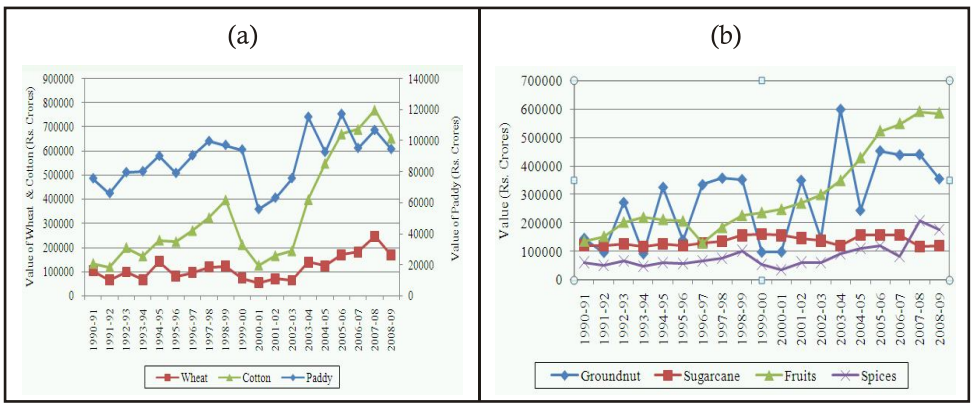
Source: Compiled from various volumes of Statistical Abstract of Gujarat and Socio Economic Review.

The above analysis presents a broad overview of the trends in area, cropping pattern, yield and production of major crops, taken into consideration for the two period analysis in Gujarat. The trend in crop productivity shows that output growth has been noticeably different in the two periods.

3.4 Value of Production

Figure 1 (a & b) presents trends in value of production of six (out of 15) major crops selected for the study. It is observed that whereas, groundnut and cotton have witnessed the highest increase in value of production, the value of groundnut is found to be most volatile among all the crops. Interestingly, both these crops have witnessed simultaneous increase in area, yield and prices. A similar pattern is also found in the case of fruits and vegetables that account for a fairly substantial share in the total value of agriculture production in the state. In fact most of the crops whose value of production has undergone substantial increase, have also witnessed increase in the area under cultivation. It may be noted that the prices of these three crops viz; cotton, groundnut and fruits and vegetables are generally higher than other crops that selected for the analysis. This may imply that the significant growth (close to 10 percent) achieved in agriculture NSDP during the past decade is contributed by only a few crops, especially cotton, thus suggesting a fairly limited base from which the growth has taken place in the crops sector; this of course leaves livestock sector which has also grown significantly during the past decade in the state (Shah and Pattnaik, 2012).

Figure 1 (a & b): Value of Production of Major Crops in Gujarat (In Rs. Crores)



Source: Compiled from MOSPI and Calculated by the Author

4. Decomposition of Output Growth in Gujarat

This section presents the results of the decomposition analysis based on fifteen major crops, accounting for about 75 to 80 percent of the gross cropped area as noted earlier. These crops account for about 84 percent of

the total value (at 1990-91 prices) of all crops grown in the state. Table 6 presents percentage share of each of the 15 crops in terms of the total value of these crops. The idea is to see the changes in relative share of each crop over time by keeping the price factor constant.

It may be noted that during 2000-10 the value of crops like groundnut, cotton and fruits and vegetables was higher than 10 percent. The value of wheat has increased during the recent phase compared to earlier. Together these four crops account for 70 percent of the total value of crop during 2010-11. It is observed that whereas paddy, wheat and fruits and vegetables have increased their relative share during the two sub-periods, cotton and jowar are the major gainers during the last period. Sugarcane and groundnut have different patterns as could be seen from the Table 6. The scenario however, is likely to be quite different, if the impact of relative price movements is included. The decomposition analysis in this section captures this effect.

Table 6: Share of Major Crops in the Total Value of Crop Output (at 1999-00 constant price)

Crops	1990-91	1999-00	2010-11
Paddy	6.1	5.2	3.8
Wheat	8.4	5.1	6.7
Jowar	1.7	0.9	0.4
Bajra	5.1	4.9	1.9
Tur	4.7	1.9	1.5
Groundnuts	11.7	9.2	14.1
Castor	11.7	7.8	4.5
Mustard	3.8	3.3	1.8
Cotton	10.8	11.9	25.9
Sugarcane	9.8	14.6	4.8
Tobacco	4.9	4.3	0.4
Chilies	1.0	0.7	0.2
Potato	1.0	2.1	2.0
Fruits and vegetables	10.9	23.1	23.3
Spices	5.0	3.3	7.0
Total	100.0	100.0	100.0

Note: i) The value of each crop is presented in constant term. Laspayer's index is used to convert the current value to constant.
ii) The highlighted figures indicate increase in the relative share with respect to the previous period.

Source: Complied from MOSPI and Calculated by the Author.

4.1 Contribution of Different Factors in the Growth of Production

An attempt has been made to identify the sources of production growth. It implies, to what extent a change in production is contributed by area, yield, price and cropping pattern. In order to evaluate the share of each factor in the change in production, a decomposition analysis has been carried out. The fifteen major crops that we have considered for the purpose of decomposition have covered around 75 to 80 percent of the total cropped area over the period 1990-91 to 2010-11. The value of the selected crops taken together, had grown at an average rate of 7.89 percent per annum during 2000-10, compared to the 5.54 percent growth rate during 1990-99. Considering value of those crops as 100 percent, the impact of area, yield and prices on the increase in production has been calculated. As mentioned above, the formula for calculation of the factors contributing to changes in output can be divided into eight parts. First four parts include the individual effects and the rest indicates the interaction effects. The decomposition of the total output has been calculated for the two phases. The aim is to understand whether the factors influencing growth in output has changed over the period or not. The decomposition analysis helps us to understand the growth pattern via its different component and their interaction effects. As noted by Sagar (1977:114): "*these component analysis besides providing estimates of growth contributed by these components, the analysis also help in deducing hypotheses on causes and effects of a specific growth pattern*".

Table 7 is self-explanatory. In both the phases yield has emerged as the single largest component of growth in the value of output. However, there are significant variations in the relative impacts of the other effects. For instance, during 1990s, cropping pattern was the second largest effect after yield; this has become negative during the 2000s. Against this, the price effect has increased from about 13 percent in the 1990s to 23 percent in the 2000s. The area effect has also increased, though marginally. It is pertinent to note that despite having the highest value during both periods, the yield effect has declined from about 56 to 52 percent between the two periods. A part of this could be due to increased impact of the price component.

Another interesting finding is that the two interaction effects that includes price (i.e., yield and price; and cropping pattern and price) have turned out to be positive during the 2000s as against their negative effects observed during the 1990s. This once again highlights the relative importance of

price effect – independent as well as interaction – during the latter period. The second order interaction term, taking yield, cropping pattern and price, remained negative in both the periods. The second order interaction effect however, is very small, i.e., less than one percent.

Table 7: Contributions of Factors on the Total Production for Period: 1990-99 and 2000-10

Effects of the components	**1990s**	**2000s**
Individual effects		
Area effect	16.39	17.41
Cropping pattern effect	27.20	-1.50
Price effect	13.09	23.36
Yield effect	56.27	51.93
Interaction effects		
Cropping pattern and yield effect	0.23	1.20
Yield and price structure effect	-5.19	7.04
Cropping pattern and price structure	-6.69	0.88
Yield, crop pattern and price structure effect	-0.95	-0.32
Total	100.0	100.0

Source: Authors' calculation.

It is also important to note that the individual effects during the 1990s were substantially higher as compared to the latter period. This is mainly due to the fact that the interaction effects during the first period were mainly negative; the effects that have turned positive during the next period have incorporated price as interactive components. The evidence therefore drives home the two main findings: a) the largest effect of yield though, with lower value in the second period; and b) substantial increase in price effect –individual as well as interaction – over time.

The findings, to a large extent, support the results of the studies by Sagar (1977; 1980). In turn, this may also reinforce the argument put forward by Jha (2011), indicating that price-led growth in agriculture may render limited welfare outcomes for the rural communities.

5. DISCUSSION

The foregoing analysis clearly demonstrated the changing profile of Gujarat's agriculture in the wake of high growth trajectory during the past decade. This was demonstrated by a shift in cropping pattern mainly towards cotton, fruits and vegetables, wheat and groundnut. Most of them are water intensive cops. The shift in area has also been accompanied by increased yield of the major crops with the exception of bajra, castor and the water intensive crop, sugarcane. Cotton and tur have outperformed most of the crops in terms of growth in yield, with cotton scoring very high in terms of growth rate. The high growth rate in value of agricultural output is contributed mainly by five crops, accounting for 71 percent of the total value. These crops also happen to be high valued crops such as cotton, groundnut, wheat, sugarcane, fruits and vegetables. What is however, concerning, is that the crops with better growth performance are also showing high variability in yield.

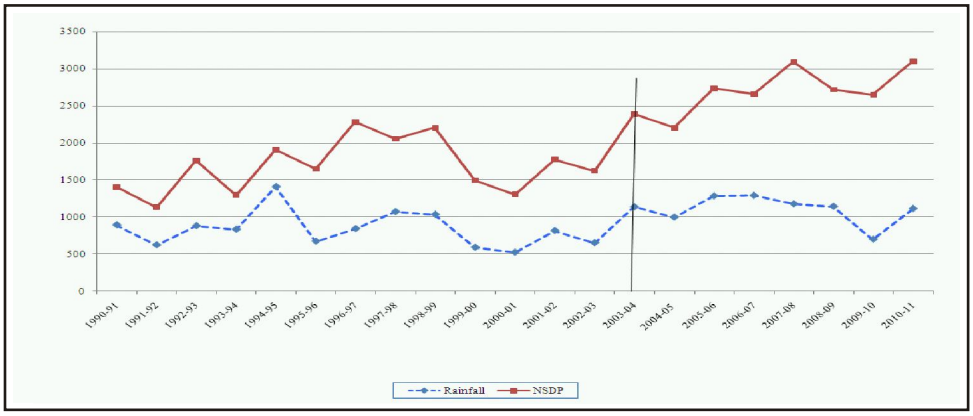
The above changes in cropping pattern and yield bring home the point that the recent growth experience in Gujarat's agriculture is characterized by limited crop base on the one hand and increased instability among the high performing crops on the other. Price factor may tend to further increase the variability over time as the top five major crops, by and large, are known to be high valued commercial crops (as noted above).

The decomposition analysis tried to examine the relative importance of four major factors, viz; area, cropping pattern, yield and prices. The analysis brought out two important findings: a) the largest effect of yield though, with lower value in the second period; and b) substantial increase in price effect –individual as well as interaction – over time. The results suggest that the individual effect of price alone has increased over time from 13 percent in the 1990s to 23 percent in the 2000s. This suggests increasing impact of price on the allocation of area under crops. This has been brought out by the fact that the price-area interaction effect which was negative during the 1990s turned out to be positive in the recent phase. Similarly, the interaction of yield and price has become positive in the recent phase. This implies most of the crops for which there was substantial price increase, shows favorable changes in yield and area during the recent phase. The present analysis clearly shows, with the increase in the growth of agricultural sector

in the recent decade there was decline in the yield effect and increase in the price effect.

Understanding of the present pattern of agricultural growth is essential for the next round of discussion of Gujarat agricultural development and can link with other developmental issues. This analysis provides a useful context for re-thinking agricultural development in the state of Gujarat.

Appendix 1: Trend of Agricultural- NSDP (Rs. Lakhs) and Rainfall (mm.) in Gujarat



Note: The vertical line represents the structural break point in Gujarat's agricultural-NSDP. The year 2003-04 was identified as the break point by considering the agricultural-NSDP series from 1960-61 till 2010-11. The authors have used the Bai-Perron method for calculating the structural break in NSDP. This method identifies the endogenous break point in a series by considering different regimes altogether. The Bai-Perron test helps to find out the change in both intercept and slope parameters (m). The model is considered as the pure structural break model (Dholakia and Sapre, 2011).

Source: Statistical Abstract of Gujarat, various issues.

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