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Research Article

# IS CHANGE IN CONSUMPTION PATTERN TOWARDS HIGH-VALUE COMMODITIES DRIVING PRODUCTION DIVERSIFICATION IN INDIA?

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**Abstract-** This paper examines both consumption and production diversification towards high value commodities (HVCs) in India. A clear structural shift in consumption from food grains, particularly cereals, to high-value commodities (HVCs) comprising mainly livestock based foods, horticulture products, and beverages is witnessed in both rural and urban India. Similarly, the increasing share of HVCs accounting for more than half of the total agricultural value of output in the recent decade provides ample evidence of production diversification towards HVCs. Thus, a perceptible positive relationship between the rise in consumption expenditure on HVCs and their production (value of output) is discernible. The determinants of diversification towards HVC estimated through a pooled WLS regression analysis further provided the empirical evidence that changing consumption pattern towards HVCs is distinctly driving production diversification at the national level. Additionally, the structural changes in terms of development of markets, road network, irrigation, technology, urbanization and growing income levels have positively influenced agricultural diversification towards HVCs.

**Keywords**- Consumption pattern, monthly per capita expenditure, value of output, production diversification, high-value commodities, consumption elasticity.

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## Introduction

It is often indicated that Indian agriculture is in transition from a supply-push to a demand-driven situation. Economic growth, rapid urbanization, an increase in disposable income, and changes in tastes and preferences have resulted in a shift in consumption pattern from traditional food items to high-value food commodities, especially during the past two decades [1]. Across rural areas, the change in consumption pattern from traditional to high-value commodities (HVCs) is more in those regions that are experiencing a better development in infrastructure [2]. There is evidence of a commensurate decline in per capita household demand for food grains [3]. This change in consumption of food commodities is mainly because of a shift in consumption away from cereals to high-value food commodities such as milk and milk products, meat, eggs and fish, vegetables, and fruits [3,4], while projecting the demand for food commodities in India by 2020, anticipated diversification in the consumption pattern toward high-value agricultural products. Income growth and urbanization [5,6] further accelerated such diversification. Both demand for and supplies of these HVCs have grown much faster than those of food grains, with the shift being more pronounced in the past two decades [7]. The rapidly expanding demand for HVCs incentivizes farmers to diversify their production portfolio toward these commodities that have strong potential to bring higher returns to land, labor, and capital resources [8].

Traditionally, agricultural diversification is referred to as commercial farming wherein farmers cultivate a variety of HVCs on a piece of land, undertaking several enterprises with complementing effect on their farm portfolio, thus sustaining farm income. Concern for income security is valued more than household food security in commercial agriculture. In recent years, agricultural diversification is increasingly being considered to mitigate risk against uncertainties. While vegetables and livestock products among HVCs provide sustained and continuous income flows, perennials such as fruits and spices are also promising. At the macro level, HVCs contribute to the growth of the national economy, given their ability to accrue more income to producers, though such a development is not without problems such as market fluctuations that make producers vulnerable, besides the need of higher investments for growing HVCs [9,10]. At the farm level, HVCs increase household income. At the country level, these can boost growth of the agricultural sector.

Several studies have considered HVCs to comprise a few enterprise groups such as fruits, vegetables, and livestock products [3, 9, 11-13] have added processed products to the segment. The classification of commodities as HVCs is a matter of debate as a few crop groups such as floriculture, spices and condiments, beverages, etc., which qualify to be of "high value," have often been excluded. Our study considered those enterprises based on definitions provided by the National Academy of Agricultural Sciences [14] and [15][1] as

[1] The National Academy of Agricultural Sciences (NAAS), India defined high-value crops (HVCs) as those yielding significantly higher value productivity or net income per unit of resource used for their production compared to other competing activities. Gulati et al (2005) defined HVCs as agriculture goods with high economic value per kilogram, per hectare, per calorie, including fruits, vegetables, meat, eggs, and fish.

HVCs. HVCs are important for small producers who are under pressure to increase their revenues from their limited landholdings but are often excluded from the diversification process [9]. Although vegetable production is being undertaken by small farmers, they seem to be less enthusiastic to grow fruits because these are capital-intensive and relatively riskier. Contract farming concentrating on HVCs has been found to benefit growers, but it is non-inclusive of small farmers [16]. Keeping these issues in view, this study has examined how change in food consumption is driving production diversification toward HVCs in the agricultural sector in India.

**Methodology**

The changes in food consumption pattern were estimated using secondary data on monthly per capita consumption expenditure (MPCE) of different commodity groups collected from the survey reports of the National Sample Survey Organization (NSSO) relating to the 55th (1999-2000), 61st (2004-05), 66th (2009-10) and 68th (2011-12) rounds. The changes in food consumption expenditure were estimated for seven commodity groups: (1) food grains (cereals and pulses have been considered separately in some places); (2) edible oils; (3) milk and milk products (MMP); (4) meat, fish, and eggs (MFE); (5) fruits and vegetables (F&V); (6) sugars and spices; and (7) beverages.[2] The year-to-year data are made comparable by deflating the values using consumer price index (agricultural laborers for rural and industrial workers for urban consumers) at 1999-2000 constant prices. Production diversification toward HVCs was analyzed using the data on value of output (VoP) of various commodities (spliced to 1999-2000 constant prices), compiled by the Central Statistical Organization (CSO), government of India. In order to even out year-to-year differences in production and prices, the triennium averages (TE) of VoPs were computed. The study has captured the changes in VoP in the recent decade (between TE 1999-2000 and TE 2010-11). The HVCs group comprised horticulture, condiments and spices, beverages and narcotics (only coffee, tea, and tobacco), livestock products (only milk, meat, and eggs), cotton, sugarcane and gur, and fishery.

**Estimating food demand elasticities: two-stage budgeting framework with QUAIDS model**

The Almost Ideal Demand System (AIDS) is a popular method of estimating consumer demand systems and its upgraded versions such as linear approximate AIDS (LA/AIDS) and quadratic AIDS (QUAIDS) models prevail predominantly in most of the literature. This study used QUAIDS as it allows non-linear Engel curves (Banks et al., 1997) and tests the restriction of homogeneity and symmetry through restriction of fixed parameters [18]. Since there is a chance to have zero expenditure on some of the commodities, our study followed the two-step estimation procedure given [19] to estimate the demand elasticities of income and price. Accordingly, in the first stage, a probit function is used to capture the choices of income allocation to different kinds of food commodities that are available to households. In the second stage, the level of allocation of total food expenditure across different food groups is captured by using the QUAIDS demand model. The estimation procedure used in the two stages is as follows.

The first step involves estimating a probit regression function to estimate the probability of consumption of a particular food commodity and the function is expressed as follows:

$$d_{ih} = \alpha_0 + \sum_j \alpha_{ij} \ln p_j + \alpha_x \ln x_h + \alpha_1 HHS_h + \alpha_2 GEN_h + \mu_i \text{------- [1]}$$

where,

$d_{ih}$ = 1 if the h-th household consumes i-th food commodity and 0 if the household does not;

*ln* $p_j$ = are the prices of 12 food commodity groups [see Table-1 & 2];

*x* = monthly household expenditure on food articles;

*HHS* = household size in numbers; and

*GEN* = dummy variable for gender of the household head (1 = female; 0 = male).

Prior to executing the probit function, the total expenditure function was regressed on its determinants and a residual error term was obtained to solve the endogeneity problem of total expenditure variable in the estimation of the QUAIDS model. The exact function is as follows:

$$\ln x_h = \alpha_0 + \sum_j \alpha_{ij} \ln p_j + \alpha_1 HHS_h + \alpha_2 GEN_h + \mu_i \text{------- [2]}$$

The second step provides the estimated form of the Quadratic Almost Ideal Demand System (QUAIDS), which is represented as follows:

$$w_{ih} = \varphi(\hat{z}_{ih}\hat{\theta}_i)\left[\alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left(\frac{x_h}{a(p)}\right) + \left(\frac{k_i}{b(p)}\right)\left[\ln\left(\frac{x_h}{a(p)}\right)\right]^2 + \tau_i \hat{e}_h\right] + \delta_i \emptyset(z'_{ih}\hat{\theta}_i) + \omega_{ih} \text{------- [3]}$$

where,

$w_{ih} = \frac{P_{in}q_{in}}{x}$ = the i-th food product expenditure share for consumer h;

$p_i$ = the price of good i;

$q_i$ = quantity of good i;

*x* = monthly household expenditure on food articles;

$\hat{e}_h$ = the residual from the total expenditure regression; and

$\varphi(\hat{z}_{ih}\hat{\theta}_i)$ and $\delta_i \emptyset(z'_{ih}\hat{\theta}_i)$ are obtained from the first-stage probit regression.

The parameters of the QUAIDS model are estimated using Poi's STATA routine [20]. Adjustments are made to the original routine to include additional control variables in order to capture endogeneity and selectivity problems as appropriate Parameters for rural and urban regions were estimated separately by using the Seemingly Unrelated Regression Estimation (SURE) method with symmetry and homogeneity simultaneously imposed. The budget-share equation for edible oil was dropped to accommodate adding-up. The remaining eleven equations were estimated by an iterated, feasible, generalized nonlinear least square, which is equivalent to the maximum likelihood [20]. Estimates of the dropped budget share equation (edible oil) were recovered by exploiting the adding-up and homogeneity restrictions. All the analyses were done by using statistical software STATA 13 version.

**Measuring diversification**

Quite a few methods explain the specialization or diversification of commodities or activities in a given time and space by a single indicator. Considering our objective of assessing the extent of diversity in crop, livestock, and fishery activities, the Simpson Index of Diversity (SID) was calculated for each of the Indian states. This index ranges between 0 and 1; if complete specialization exists, the index tends toward 0. The index is computed as follows:

$$Simpson\ Index\ of\ Diversity\ (SID) = 1 - \sum_{i=1}^{n} P_i^2$$

where $P_i$ is the proportionate value of ith crop/livestock/fishery activity in the total value of output. Further, to estimate the pace of diversification in favor of high-value commodities, the share of high-value commodities in total value of agriculture of the state was calculated. The states were classified as low, moderate, and high pace categories based on "national mean ± ½ standard deviation" of this proportion.

Data on state income, irrigation, rainfall, and literacy were collected from the published reports of the Directorate of Economics and Statistics, government of India and the respective states. Export data were obtained from the Agricultural and Processed Food Products Export Development Authority (APEDA) and the respective commodity boards.

**Results and Discussion**

**Consumption diversification**

The monthly per capita consumption expenditure (MPCE) of household budget for different food commodity groups between the 55th (1999-2000) and 68th (2011-

[2]This group is also referred to as the "processed food" group. It includes tea, coffee, mineral water, soft drinks, fruit juices (not prepared at home), soda water, cocoa, biscuits, cakes, pastries, pickles, sauces, jams, jelly, and other salted refreshments and sweets not prepared at home.

12) rounds clearly indicated that the overall food consumption expenditure recorded an increase in both rural (`289 to `312) and urban (`411 to `531) areas considered in real terms (constant prices). Interestingly, a perceptible decline in the proportion of expenditure on food grains was witnessed in the past two decades in both rural and urban areas [Fig-1]. The decline was higher across rural households (`137 − `98) than urban households (`131 − `109) and was mainly due to the reduction in the proportion of expenditure on cereals: rural (37−25%) and urban (26−16%). Clearly, the composition of the food basket is changing; the share of expenditure on cereals in total household budget is declining. The consumption expenditure in real terms (at 1999-2000 prices) on pulses, milk and milk products, meat and meat products, vegetables, fruits, edible oils, and spices and sugars and beverages showed an increase. However, as per cent composition, only a marginal increase was found in fruits and vegetables and eggs, meat, and fish, except for beverages, which experienced a higher increase in the share of budget allocated in both rural and urban areas. The decline in consumption expenditure on cereals was mainly due to their low value and increase in the income levels of households [21]. Although the share of cereals in total food expenditure declined significantly, it still constituted a major item. It is important to note that, between the 55th and 68th rounds, there was a gradual increase in the consumption of HVCs. The proportion of HVCs across urban consumers was high since 1999-2000 (55th round), while in rural households it was witnessed since 2009-10 (66th round). Noted a similar trend in the long-term dietary pattern and food demand in Uttar Pradesh [22]. Thus irrespective of demographic (rural or urban) background, there is a clear shift in consumption pattern toward HVCs.

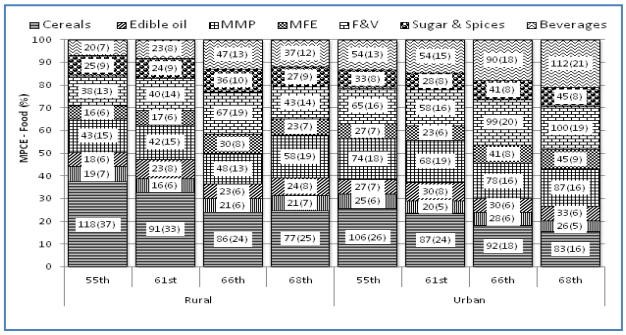


**Fig-1 Composition of monthly per capita consumption expenditure (MPCE) on different food commodity groups across rural and urban households in selected rounds of the NSSO survey (at 1999-2000 prices).**

*Note: MMP = milk and milk products, MFE = meat, fish, and eggs; F&V = fruits and vegetables. Values in the bar diagram indicate actual MPCE (in `) and the numbers in parentheses are percentages to total MPCE.*

*Source: Plotted by authors using the data compiled and computed from various rounds of NSSO reports*

The percentage changes in MPCE in different commodity groups during the previous decade, depicted in [Fig-2], indicate a higher increase in spending on HVCs by rural households than by urban households. The increase in MPCE in the case of pulses, milk and milk products, edible oils, and sugar and spices was moderate (<50%); whereas, in meat, fish, and eggs; fruits; vegetables; and beverages, it was high (>50%).

The perceptible shift in consumption toward HVCs at the national level encouraged us to find out whether such changes are happening at the state level also. The MPCE for some important Indian states is presented in [Fig-3] for rural households and in [Fig-4] for urban households. The MPCE of urban households on all the commodity groups was higher than that of rural households in all the states; the difference ranged from `200 to `700. For rural households, there is a considerable variation in MPCE across states, with the least spending recorded in Odisha state. The difference in MPCE across states in food grains (`159 to `272) and edible oils (`34 to `89) had a narrow range across states, which could be attributed to the distribution of subsidized food grains to BPL families. Along the same line, sugar, being a public distribution system commodity, did not show much variation in MPCE across states. There was considerable variation in MCPE for HVCs.

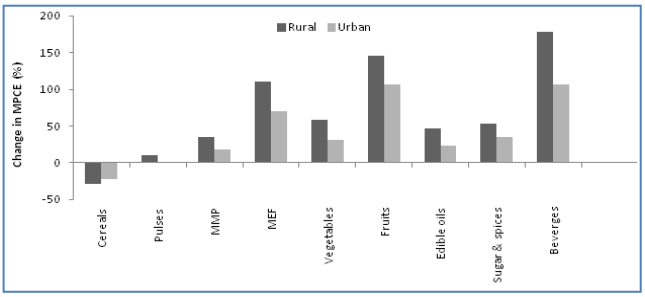


**Fig-2 Change in monthly per capita consumption expenditure (MPCE, in percent) in different food commodity groups during 1999-2000 and 2011-12 in rural and urban households (at 1999-2000 prices).**

*Note: MMP = milk and milk products, MFE = meat, fish, and eggs.*

*Source: Plotted by authors using the data compiled and computed from various rounds of NSSO reports.*

In many states, livestock-based foods attracted higher spending, while fruits and vegetables recorded higher MPCE in most others. Spices, being a minor consumption item, did not show much variation across states.

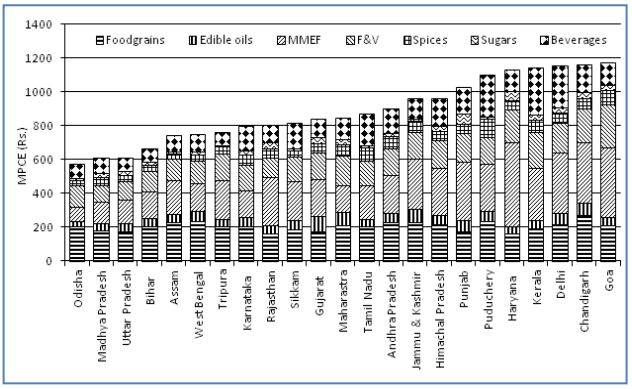


**Fig-3 State-wise MPCE on different food commodity groups in rural households: 2011-12.**

*Note: F&V = fruits and vegetables, MMEF = milk, meat, eggs, and fish.*

*Source: Plotted by authors using the data compiled and computed from various rounds of NSSO reports.*

The pattern in MPCE on different commodity groups among urban households followed almost a similar pattern as that of rural households [Fig-4].

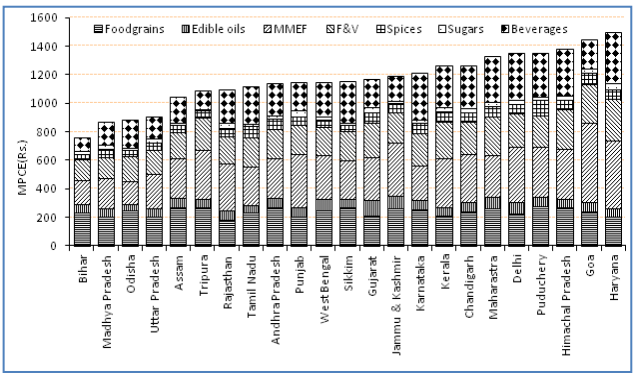


**Fig-4 State-wise MPCE on different food commodity groups in urban households: 2011-12.**

*Note: F&V = fruits and vegetables, MMEF = milk, meat, eggs, and fish.*

*Source: Plotted by authors using the data compiled and computed from various rounds of NSSO reports.*

The results of income and price elasticity of demand for different food item groups

for urban and rural households are presented separately in [Table-1]. In rural areas, the income elasticity of all food commodities is positive except for cereals in 2004-05 and eggs in 2011-12. The six-year span between 2004-05 and 2011-12 had a small variation of 1 to 3% in income elasticity value for the different food commodities. As expected, in rural areas, cereals (−0.35%, −0.45%) had negative income elasticity and beverages (3.7%, 4.1%), fruits (3.3%, 3.6%), and sugars (2.4%, 2.1%) evidenced positive income elasticity of relatively higher magnitude. Income elasticity for pulses changed from negative to positive between 2004-05 and 2011-12. In contrast, cereals and pulses had negative income elasticity in urban regions but the magnitude was smaller than with other commodities. The analysis revealed that family income plays a crucial role in determining changes in consumption pattern. The higher magnitude of income elasticity values for commodities other than food grains and oils indicates a consumption shift toward HVCs in both rural and urban areas. Vegetables seem to be an exception (elasticity below 1) as households seem to be consuming them in their regular diet.

**Table-1** *Expenditure (income) elasticity of food demand in rural and urban regions in 2004-05 and 2011-12.*

| | Expenditure (income) elasticity | | | |
|---|---|---|---|---|
| | Rural | | Urban | |
| | 2004-05 (61st round) | 2011-12 (68th round) | 2004-05 (61st round) | 2011-12 (68th round) |
| Cereals | −0.141** (0.026) | 0.535** (0.014) | −0.335** (0.039) | −0.435** (0.043) |
| Pulses | 0.565** (0.050) | 1.514** (0.022) | −0.266** (0.076) ) | 0.484** (0.062) |
| Sugar | 2.432** (0.069) | 1.040** (0.026) | 2.399** (0.059) | 2.148** (0.062) |
| Milk | 2.007** (0.059) | 1.151** (0.028) | 0.772** (0.089) | 1.260** (0.067) |
| Eggs | 1.758** (0.193) | −1.960** (0.086) | 2.900** (0.231) | 1.394** (0.223) |
| Fish and prawn | 3.888** (0.110) | 1.108** (0.028) | 3.457** (0.171) | 1.131** (0.184) |
| Meat | 1.563** (0.096) | 1.194** (0.018) | 0.135NS (0.156) | 0.307* (0.133) |
| Vegetables | 0.146** (0.029) | 0.748** (0.017) | 1.176** (0.059) | 0.599** (0.048) |
| Fruits | 3.466** (0.268) | 1.099** (0.017) | 3.268** (0.201) | 3.652** (0.157) |
| Beverages | 5.048** (0.254) | 1.708** (0.035) | 3.748** (0.138) | 4.713** (0.273) |
| Spices | 1.448** (0.045) | 1.306** (0.029) | 0.129 NS (0.070) | 0.417** (0.055) |
| Edible oil | 1.105** (0.043) | 2.031** (0.043) | 1.030** (0.075) | 0.415** (0.096) |

*Note: numbers in parentheses are significance values; ** = significant at the 1% level; NS = non-significant.*
*Source: Authors' calculations using the NSSO household level data; The model estimated using STATA software.*

It is interesting to note from [Table-2] that the food commodities, being necessities of life, were less sensitive to price changes (elasticity value near 0 and 1). The negative value of price elasticity for most food commodities could be explained by the demand theory. The exception was cereals, milk, and edible oil, which had positive elasticity, but could be interpreted as price inelastic as the value was close to zero.

### Production diversification

In this section, production diversification has been analyzed to assess whether it is being driven by consumption diversification.

### Declining share of crop sector

Production diversification was analyzed by using value of output (VoP). The temporal composition of VoP across agriculture and allied sectors presented in [Fig-5] indicates the decreasing share of crop sector in the total VoP of agriculture over time. The share of crop sector declined from 69.4% in TE 1999-2000 to 65.4% in TE 2010-11 (a decline of 4% in share). During the same period, the share of the livestock sector increased in an almost commensurate proportion from 23% to 26.9%. A marginal decline in the share of forestry sector was witnessed while the share of the fishery sector remained stagnant at 4.4%. Overall, there has been a perceptible increase in the contribution of non-crop activities (livestock and fishery) during the decade to the total VoP of the agricultural sector in India.

**Table-2** *Own price elasticity of food commodity demand in rural and urban regions in 2004-05 and 2011-12.*

| | Own price elasticity | | | |
|---|---|---|---|---|
| | Rural | | Urban | |
| | 2004-05 (61st round) | 2011-12 (68th round) | 2004-05 (61st round) | (2011-12) ( 68th round) |
| Cereals | 0.068* (0.031) | −0.205** (0.015) | 0.022 NS (0.032) | 0.091** (0.024) |
| Pulses | −0.861** (0.019) | −0.493** (0.022) | −0.739** (0.036) | −0.342** (0.028) |
| Milk | −0.254** (0.048) | 0.184** (0.019) | −0.038 NS ((0.065) | 0.163** (0.018) |
| Sugar | -0.927** (0.031) | −0.402** (0.035) | −0.79** (0.025) | −0.35** (0.031) |
| Egg | -0.84** (0.151) | -1.099** (0.201) | −0.607** (0.202) | −0.066 NS (0.173) |
| Fish and prawn | −1.315** (0.06) | −0.506** (0.093) | −1.734** (0.096) | −0.617** (0.104) |
| Meat | −0.852** (0.043) | −0.525** (0.084) | −0.492** (0.07) | −0.255** (0.076) |
| Vegetables | −1.071** (0.011) | −0.799** (0.013) | −0.904** (0.024) | −0.721** (0.016) |
| Fruits | −0.804** (0.038) | −0.505** (0.043) | −0.560** (0.049) | −0.648** (0.033) |
| Beverages | −1.419** (0.068) | −1.141** (0.113) | −0.778** (0.049) | −0.820** (0.073) |
| Spices | −0.774** (0.012) | −0.618** (0.015) | −0.760** (0.029) | −0.717** (0.016) |
| Edible oil | −0.629** (0.027) | 0.208** (0.054) | −0.820** (0.038) | −0.085** (0.031) |

*Note: numbers in parentheses are significance values; ** = significant at 1% level; NS = nonsignificant*
*Source: Authors' computation using the NSSO household level data; The model estimated using STATA software.*

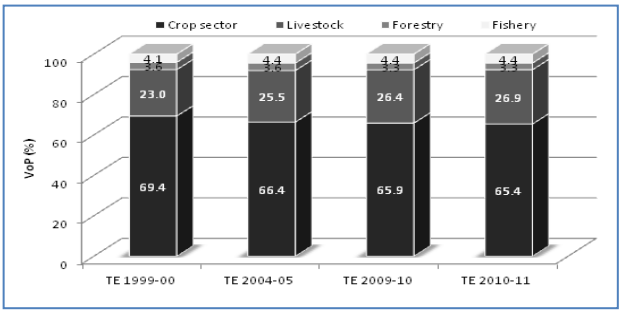


**Fig-5 Composition of real value of output of different commodity groups in terms of percentages (at 1999-2000 prices).**
*Source: Plotted by authors using the Value of Output (Agriculture subsectors) data compiled and computed from CSO database.*

### Livestock sector surpassing food grains

A closer look at the VoP of the crops and livestock sector revealed some interesting changes in the recent decade. The share of food grains recorded a downward trend, while the livestock sector continuously increased its share in the total VoP [Fig-6]. The value share of the livestock sector overtook the food grains value share in 2003-04. Currently (TE 2011-12), the share of livestock is around 28%. [23] have indicated the significant contribution of the livestock sector to the Indian agriculture. Similarly, the share of the horticulture sector has been increasing perceptibly in terms of its contribution to Indian agriculture over the years. There was not much change in the relative contribution of the other sectors,

as seen from the flat nature of the curves in [Fig-6].

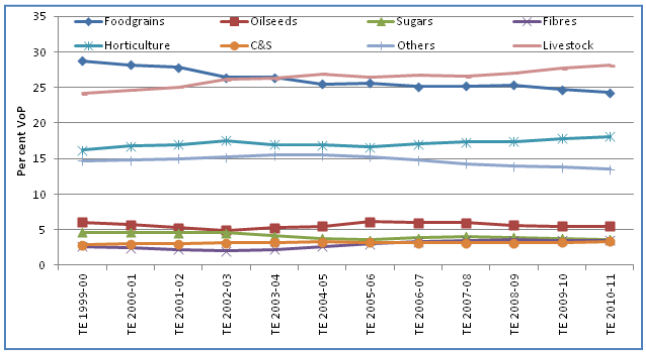


**Fig-6 Share of different commodity groups in the value of output in India (at 1999-2000 prices).**

*Source: Plotted by authors using the Value of Output (Agriculture subsectors) data compiled and computed from CSO database*

**Value composition of high-value commodities**

It is interesting to see the temporal changes in the relative composition of different commodity groups within HVCs during the recent period. The composition of VoP revealed a shift in production toward HVCs such as livestock products, horticulture, condiments, and spices, from the traditional cereals and pulses. The disaggregate analysis of VoP at four points during the decade, presented in [Fig-7], indicates that the livestock sector comprising milk, meat, and eggs (MME) accounted for a prominent share throughout the period, TE 1999-2000 to TE 2010-11. More than a 40% share of the HVC group is contributed by MME, with its value increasing from `1,095 billion to `1,703 billion during the 1999-2011 period. The proportion of horticulture remained at around 30%, but its actual value increased from `833 billion (TE 1999-2000) to `1,260 billion (TE 2010-11). The VoP of fisheries increased from `219 billion to `322 billion during this period, but the share remained at 8%. The share of cotton in recent years has increased from 4% to 5%, which has been attributed to the adoption of Bt cotton.

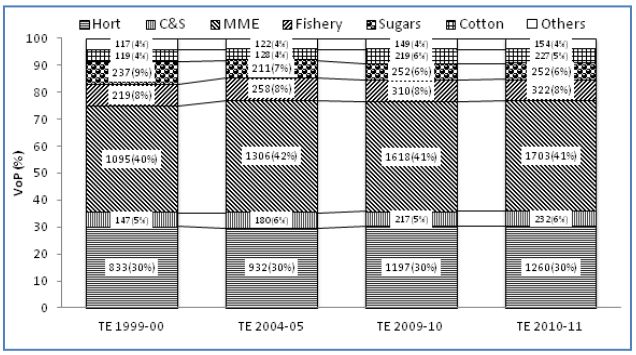


**Fig-7 Value composition of high-value commodities (at 1999-2000 prices).**

*Note: * Values in the bar diagram indicate actual VoP (in ` billion) and the numbers within parentheses are percentages to total HVC VoP; Hort = horticulture, which represents fruits, vegetables, and floriculture; C&S = condiments and spices; MME = milk, meat, and eggs; Others = drugs and narcotics and rubber.*

*Source: Plotted by authors using the Value of Output (Agriculture subsectors) data compiled and computed from CSO database*

**Contribution of high-value commodities to the total value of agricultural production**

The VoP of the HVC group increased considerably from `2,767 billion to `4,149 billion during the previous decade. In terms of share, the value contribution from the HVCs increased from 51% to 57% [Fig-8]. This transition occurred despite compulsions and incentives provided for the cultivation of food grains. The move toward such diversification is attributed to the fact that HVCs (comprising horticulture, sugarcane, cotton, tea, coffee, tobacco, rubber, and the major livestock products, such as milk, meat, eggs, and fisheries) are generating higher returns per unit of investment/production, thus motivating farmers to undertake these enterprises. The high-yielding varieties, particularly commercial crops, are capable of contributing more output per unit area and this has facilitated the shift of staple crop area to the HVCs [24].

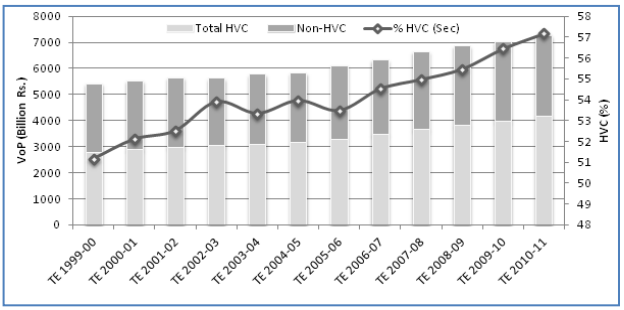


**Fig-8 Trend in the composition of value of output of HVCs and non-HVCs (at 1999-2000 prices).**

*Source: Plotted by authors using the Value of Output (Agriculture subsectors) data compiled and computed from CSO database*

To assess the level of diversification of different states, the Simpson Index has been calculated using the value contribution of different food groups to agriculture and allied sector VoP [Table-3]. In addition, to assess the level of diversification toward HVCs in particular, the contribution of the HVC group to the respective state agricultural VoP is also calculated. The Simpson Index of diversity presented in [Table-3] shows the higher value of diversification across all Indian states. This implies that a wide variety of crop enterprises is being undertaken in all states, with the values being lesser than 0.6 only for the states of Himachal Pradesh and Punjab during TE 1982-83. In the rest of the years, all states had an index value of more than 0.6. Though the index value shows the diversity of crop enterprises, it does not indicate whether the diversification is occurring toward any particular enterprise and its magnitude.

**Table-3** *Temporal changes in crop diversification across Indian states (Simpson Index).*

| States | TE 1982-83 | TE 1992-93 | TE 2002-03 | TE 2010-11 |
|---|---|---|---|---|
| Andhra Pradesh | 0.77 | 0.83 | 0.82 | 0.81 |
| Assam | 0.75 | 0.79 | 0.82 | 0.84 |
| Bihar and Jharkhand | 0.67 | 0.74 | 0.74 | 0.72 |
| Gujarat | 0.85 | 0.87 | 0.85 | 0.83 |
| Haryana | 0.67 | 0.74 | 0.71 | 0.70 |
| Himachal Pradesh | 0.56 | 0.68 | 0.69 | 0.69 |
| Jammu and Kashmir | 0.69 | 0.76 | 0.68 | 0.71 |
| Karnataka | 0.82 | 0.83 | 0.84 | 0.86 |
| Kerala | 0.69 | 0.82 | 0.84 | 0.83 |
| Madhya Pradesh and Chattisgarh | 0.70 | 0.78 | 0.78 | 0.81 |
| Maharashtra | 0.81 | 0.84 | 0.83 | 0.86 |
| Orissa | 0.76 | 0.76 | 0.73 | 0.78 |
| Punjab | 0.59 | 0.66 | 0.65 | 0.64 |
| Rajasthan | 0.75 | 0.82 | 0.75 | 0.70 |
| Tamil Nadu | 0.75 | 0.81 | 0.82 | 0.79 |
| Uttar Pradesh and Uttaranchal | 0.74 | 0.77 | 0.77 | 0.77 |
| West Bengal | 0.64 | 0.74 | 0.78 | 0.80 |
| Northeastern states | 0.62 | 0.73 | 0.76 | 0.79 |
| Goa and UTs | 0.71 | 0.63 | 0.76 | 0.71 |

Note: Northeastern states = Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura; Goa, and UTs = Delhi, Andaman & Nicobar Islands, Dadra & Nagar Haveli, Daman & Diu, Lakshadweep, Pondicherry, and Chandigarh.

Source: Authors' calculations using the CSO data on the Value of Output from various agriculture sub-sectors, across states.

The analysis of production diversification toward HVCs across Indian states is presented in [Table-4] indicates that, during the period TE 1982-83 to TE 2010-11, more states have moved into the "high diversification" category. In all four periods, Kerala consistently remained in the "high diversification" category during the three decades, mainly because of the dominance of plantation crops such as tea,

rubber, coffee, and spices in its production system. Assam figured among the highly diversifying states in the first two decades but later moved to the moderate category, as the value of the contribution of tea, a major product of the state, stagnated for many reasons. Similarly, Karnataka figured on the list of highly diversified states for the first three periods and dropped to the "moderate" group in the last decade. In recent years, Andhra Pradesh, Tamil Nadu, and West Bengal have diversified more toward HVCs and are making considerable contributions to the nation's agricultural sector. Not surprisingly, states such as Punjab, Rajasthan, Haryana, and Madhya Pradesh continue to be classified under the "low diversification" category.

Punjab and Haryana are known for food grain production and Rajasthan and Madhya Pradesh are major oilseed producers. As such, the diversification to HVCs is low in these states. Interestingly, Maharashtra, Gujarat, and Bihar were consistently "moderate" diversifying states. Odisha state has made considerable progress in the production of HVCs and has moved from a low to moderate level of diversification in recent years. The other states depict a moderate level of diversification. However, it is worth mentioning that the HVC contribution of the states to their respective agricultural VoP for most states is increasing over time, indicating their move toward HVCs, though at a different pace. In a similar analysis, Joshi (2010) observed southern (7.7%) and eastern (5.8%) states achieving higher growth in HVCs (in value terms) than northern and western states during the 1980s, though western (7.2%) states took the lead, followed by the southern region (5.5%) during the 1990s.

Clearly, states such as Assam, Bihar, Odisha, North Eastern states, West Bengal, and Kerala recorded higher production diversification. It is important to note that some of the states produce commodities such as spices and condiments and beverages (coffee and tea) besides considerable quantities of fruits and vegetables, and livestock products which add to the contribution of HVCs. However, their consumption takes place throughout the country (in fact, the whole nation constitutes the market) and, as such, the consumption driving production diversification has to be seen at the national level rather than at the state level.

**Table-4** *Temporal changes in diversification toward high-value commodities across states in India (at 1999-2000 prices)(per cent to state total)*

| States/UT | TE 1982-83 | | TE 1992-93 | | TE 2002-03 | | TE 2010-11 | |
|---|---|---|---|---|---|---|---|---|
| Andhra Pradesh | 34.9 | ■ | 48.1 | ■ | 59.7 | ■ | 64.3 | ▲ |
| Assam | 50.0 | ▲ | 57.3 | ▲ | 59.7 | ■ | 57.1 | ■ |
| Bihar and Jharkhand | 26.6 | ■ | 48.6 | ■ | 55.5 | ■ | 54.2 | ■ |
| Gujarat | 34.1 | ■ | 47.9 | ■ | 58.1 | ■ | 59.0 | ■ |
| Haryana | 18.8 | ▼ | 40.9 | ▼ | 44.7 | ▼ | 44.0 | ▼ |
| Himachal Pradesh | 33.9 | ■ | 56.5 | ▲ | 58.0 | ■ | 53.3 | ■ |
| Jammu and Kashmir | 35.4 | ■ | 46.5 | ■ | 59.5 | ■ | 46.7 | ▼ |
| Karnataka | 46.9 | ▲ | 57.3 | ▲ | 64.5 | ▲ | 56.7 | ■ |
| Kerala | 70.6 | ▲ | 69.1 | ▲ | 70.9 | ▲ | 63.6 | ▲ |
| Madhya Pradesh and Chattisgarh | 13.6 | ▼ | 41.7 | ▼ | 44.9 | ▼ | 47.1 | ▼ |
| Maharashtra | 29.0 | ■ | 51.6 | ■ | 54.2 | ■ | 58.4 | ■ |
| Odisha | 32.1 | ■ | 37.9 | ▼ | 56.2 | ■ | 53.3 | ■ |
| Punjab | 15.9 | ▼ | 38.1 | ▼ | 40.5 | ▼ | 42.8 | ▼ |
| Rajasthan | 9.8 | ▼ | 27.9 | ▼ | 36.1 | ▼ | 41.1 | ▼ |
| Tamil Nadu | 35.0 | ■ | 49.7 | ■ | 63.6 | ▲ | 64.3 | ▲ |
| Uttar Pradesh and Uttaranchal | 28.3 | ■ | 43.4 | ▼ | 49.4 | ▼ | 49.9 | ▼ |
| West Bengal | 53.6 | ▲ | 50.4 | ■ | 61.9 | ▲ | 62.4 | ▲ |
| Northeastern states | 47.1 | ▲ | 57.3 | ▲ | 61.2 | ■ | 57.9 | ■ |
| Goa and Union Territories | 28.4 | ■ | 71.4 | ▲ | 77.5 | ▲ | 73.3 | ▲ |

*Note: ▲ = high, ■ = moderate, and ▼ = low level of diversification toward high-value commodities.*
*Source: Authors' calculations using the CSO data on the Value of Output from various agriculture sub-sectors, across states.*

**Determinants of diversification**

The determinants of diversification towards HVC production were estimated using the fixed-effect WLS regression model with the share of HVCs to state agricultural VoP as dependent variable. The cross-section data on consumption extracted for the two NSSO rounds *viz.*, 61st (2004-05) and 66th (2009-10) rounds were considered for pooled regression. The WLS model was selected to overcome the problem of heteroscedasticity. Though several variables were considered, the best model included, consumption of HVCs on the demand side, the infrastructure variables (irrigated area, number of agricultural markets and road length), socioeconomic factors (literacy, urbanization, state income, changing land holding pattern) and technology (fertilizer use) as explanatory variables. Several regression models were tried, the best suited model is presented in [Table-5]. In the selected model, seven variables turned out to be significant. Consumption expenditure on HVCs had a highest influence (72%) on HVC production diversification, followed by extent of small holdings (28%), irrigation infrastructure (26%) and the per capita income (15%). The importance of infrastructure on the diversification process is quite evident. Over 80% of Indian farmers being small and marginal holders, an increase in their numbers seem to have positively influenced the diversification process as the small farmers practice diversification to maximise their income to meet their family needs. In a similar study by [13] considered several variables and found urbanization, infrastructure, per capita income to be major variables influencing diversification.

**Table-5** *Determinants of agricultural diversification toward HVCs (panel data fixed-effect WLS regression model).Dependent variable: proportion of VoP of HVC to total VoP.*

| Variables | Coefficients |
|---|---|
| Irrigated area | 0.2640*** |
| Road length (Kms) | 0.0744* |
| Number of Markets | 0.0758*** |
| Marginal and small holdings (%) | 0.2839** |
| Literacy rate | −0.1195 |
| Urban population (%) | 0.0525 |
| Per capita net state domestic product | 0.1527*** |
| Per capita expenditure on HVCs | 0.7152*** |
| Fertilizer use (kgs/ha) | −0.2149*** |
| R-square | 0.8274 |
| Adjusted R-square | 0.7829 |

*Note: ***,** and * denotes statistical significance at 1%, 5% and 10% levels*
*Source: Authors' computation using the CSO data on the Value of Output from various agriculture sub-sectors. The panel data regression analysis done using SPSS software.*

**Conclusions**

In our study, the scenario of changing consumption and production diversification toward HVCs has been analyzed for the country as a whole as well as at the regional level (states). In addition, the relationship between the two parameters has been established through econometric analyses. The consumption pattern over the past decade showed that the proportion of budget allocated by households for cereals has decreased over time and there has been a gradual increase in budget allocated to HVCs. Even though the magnitude of spending by urban consumers on HVCs has been higher, a perceptible increase has been witnessed even in rural areas, only in the recent decade. There are variations in pattern of consumption across different states in the country. This change towards HVC consumption was found to be sensitive to income as indicated by higher income elasticity values for these commodities.

Analysis of VoP indicated notable change in the production composition, with the livestock sector surpassing that of food grains, while horticulture and fishery sectors maintained their relative shares. The increasing share of HVCs accounting for more than half the total agricultural value in the recent decade clearly provides evidence of production diversification towards HVCs. Evidently, India is meeting its changing consumption demands through production diversification with its large livestock and horticultural base—the largest producer of milk and second-largest producer of fruits and vegetables in the world. States such as Assam, Bihar, Odisha, North Eastern states, West Bengal, and Kerala have shown high production diversification toward HVCs, with other states closely following this trend.

Overall, the changing consumption pattern toward HVCs is distinctly driving production diversification at the national level. The cross-section regression analysis further provided the empirical evidence to support our argument that the consumption is strongly driving the changes in production diversification in the country. No doubt, the structural change is significantly influenced by development of markets, road network, irrigation and technology. Similarly, on the demand side, growing income levels has positively influenced diversification. There is a need to focus both on achieving a balanced growth of food grain production on the one hand and encouraging the growth of high-value agriculture on the other, to ensure food security and sustainability in the agricultural sector.

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**Author Contributions**: All author equally contributed

**Abbreviations**:

HVCs : high-value commodities

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