

**STRUCTURAL TRANSFORMATION IN THE PRODUCTION
AND CONSUMPTION OF AGRICULTURAL COMMODITIES
IN HIMACHAL PRADESH: IMPLICATIONS ON FOOD
AND NUTRITIONAL SECURITY**

काशी हिन्दू
विश्वविद्यालय



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**Doctor of Philosophy
in
Agricultural Economics**

**Submitted by
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[See clause XIII.2 (b) (iii)]

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**STRUCTURAL TRANSFORMATION IN THE PRODUCTION
AND CONSUMPTION OF AGRICULTURAL COMMODITIES IN
HIMACHAL PRADESH: IMPLICATIONS ON FOOD AND
NUTRITIONAL SECURITY**

**Thesis submitted to Department of Agricultural Economics, Institute of
Agricultural Sciences, Banaras Hindu University, Varanasi in partial fulfilment
of the requirements for the degree of**

**DOCTOR OF PHILOSOPHY
IN
AGRICULTURAL ECONOMICS
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ABBREVIATIONS

Abbreviation	Meaning
%	Per cent
/	Per
et al.	et alii (and others)
Fig.	Figure
Rs.	Rupees
etc.	et cetera (and other things)
()	Parenthesis
Kg	Kilogram
g	Gram
TE	Triennium ending
pcpm	Per capita per month
pcpd	Per capita per day
MT	Metric tonnes
Kcal	Kilocalorie
Sq km	Square Kilometre
ha	Hectare
MPCE	Monthly per capita consumption expenditure
EFM	Egg fish meat
MMP	Milk and milk products
HVC	High value commodities
HVAC	High value agricultural commodities
pp	Pages

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PREFACE

Economic growth, increased urbanization, growth in the per capita income, changes in taste and preferences, diversity in the food basket and choice of the food in the market have shifted the consumption pattern of cereal-based items towards high-value commodities. Himachal Pradesh has made a tremendous achievement in terms of economic growth among all hilly states. The economy of the state has transformed from the primary sector towards the secondary and tertiary sector which led to the increase in per capita income and urbanization in the state, which further led to the shift in the consumption pattern of the households. The diversification of agriculture towards high-value agricultural commodities in the state has also added to this shift in consumption pattern. The present study entitled “**Structural Transformation in the Production and Consumption of Agricultural Commodities in Himachal Pradesh: Implications on Food and Nutritional Security**” was conducted to know the regional variations in the production pattern of the agricultural commodities and the shift in the consumption pattern of households in Himachal Pradesh. The study also projects the future households demand for food commodities in the state under different scenarios and changes in the nutrient intake to provide feedback for restructuring production pattern to ensure food and nutritional security in the state.

The work in the study was carried out in the period August 2015 to February 2021 at Banaras Hindu University as a part of a Doctoral Thesis under the supervision of Dr. H. P. Singh, Professor, Department of Agricultural Economics, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi and co-supervision of Dr. O. P. Singh, Associate Professor, Department of Agricultural Economics, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi.

The entire study was presented in five chapters; Chapter I highlights the general background and overview of the research study along with the justification for choosing this research topic and the objectives of the research work. Chapter II deals with the important work done in the past which provides a conceptual framework for carrying out as well as understanding the outcome of present work. Chapter III explains the methodology adopted for achieving the objectives of the study. Chapter IV gives the details of the study area and describes the geography, climatic conditions, demographic information, etc. of Himachal Pradesh. In Chapter V, results about production pattern, consumption pattern, demand estimation, future demand projection and change in nutritional intake are discussed. Chapter VI summarizes the entire study and brings out the policy implications. Lastly, the bibliography includes the list of references in alphabetical order which has been consulted during investigation and cited in the text.

(Jyoti Chaudhary)

INTRODUCTION

Structural transformation is defined as the reallocation of economic activity across broad sectors like agriculture, manufacturing, and services. The employment shares, value-added shares, and final consumption expenditure shares are the three most common measures of economic activity at the sectoral level. Various dimensions in which their structure can be analysed include sectors and product groups, space-wise rural and urban and interregional, distribution across the size of production units, income groups and consumption expenditure classes of households, technological and productivity variations across sectors and activities, skills, gender, and social groups. The economic transformation of a developing nation like India vitally depends upon the performance of its agricultural and the allied sectors. Since this sector plays a significant role in rural livelihood, employment and national food security. But, over the past few decades, the Indian economy has undergone a significant structural transformation away from the agricultural and towards the non-agricultural sectors. The share of agriculture in the country's gross domestic product (GDP) has consistently declined from 1950-51 (51.81 %) by many folds and recently gradually declined from 18.2 per cent in 2014-15 to 17.76 per cent in 2019-20, reflecting the development process and the structural transformation taking place in the economy (Economic Survey, 2020-21).

Looking at the performance of the Indian economy reveals that during the period spanning from 1947 to the early 1980s, it responded poorly to various policies and grew at a lower rate of 3.5 per cent per year, but as the 1980s unfolded India started emerging out of the slow growth and improved during 1980s and 1990s with a growth rate of 5.5 per cent due to the flourishing of the domestic business sector of the Indian economy (Erumban et al., 2019). During the early 1990s India witnessed, a severe Balance of Payment crisis and between the years 1991 and 1992 economy grew to just 3.2 per cent. As a consequence, the structural reforms introduced during the 1990s and the economy grew at 6 per cent per annum between 1992 and 2000. A survey by the

Government of India (2012) showed that between 1980 and 2010, India achieved an annual growth rate of 6.2 per cent, as compared to the whole world which registered a growth rate of 3.3 per cent. Resulting in the rise in India's share in global GDP more than double from 2.5 in 1980 to 5.5 per cent in 2010 (Heshmati et al., 2019). At present, the economy of the country is growing with an annual growth rate of 6.7 per cent per annum (Economic Survey, 2019-20).

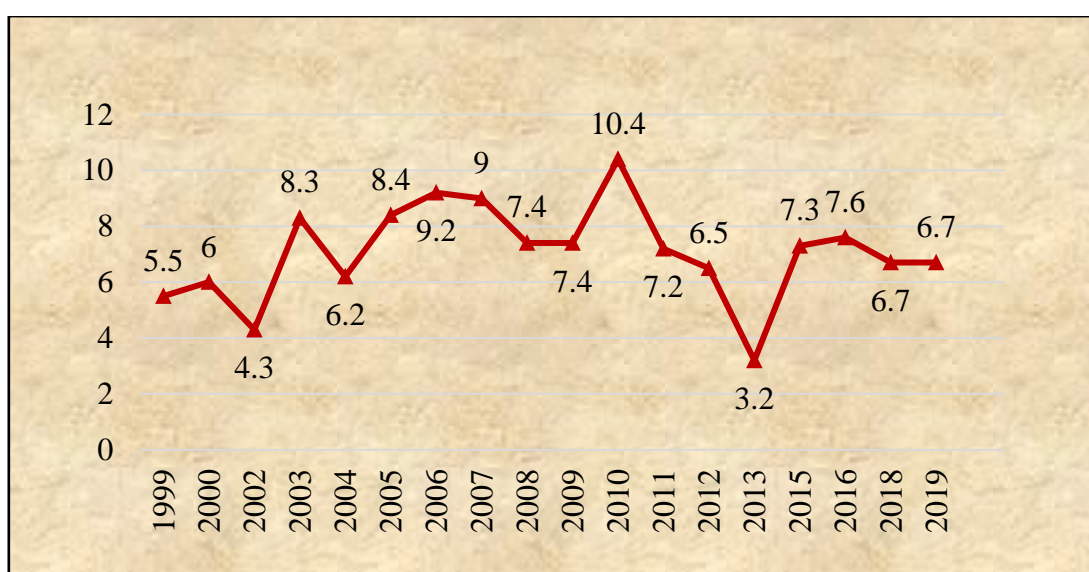
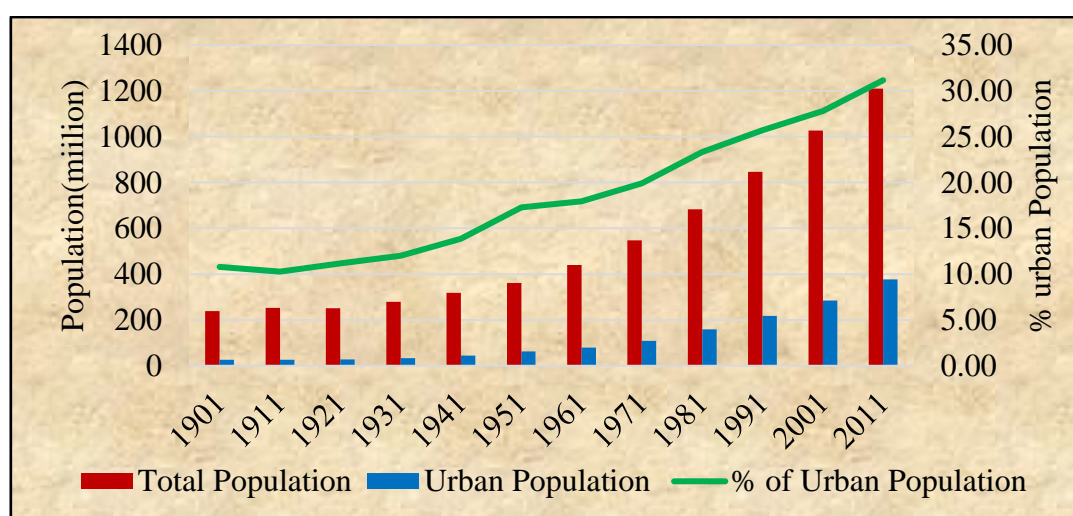


Fig 1.1: Annual growth rate of real GDP (per cent) of India (1999-2019)

Following major economic reforms initiated by the government in the early 1990s and social reforms, India has achieved an improved standard of living accompanied by rapid economic growth, increased agricultural production, improvement of private enterprises and the service sector (Hasan and Singh, 2017). One of the most significant trends accompanying this growth is dietary transition resulting in changes in food demand, food supply and composition and thus, the economy has shifted its consumption towards high-value crops. Despite the rapid fall of the agriculture sector in the share of GDP, it enjoys a significant part in the Indian economy because of its strategic importance in food and nutritional security, employment generation (direct and indirect) and poverty reduction. Also, the economic transformation of a developing country like India crucially depends upon the performance of the agricultural and allied sectors. The rise in population, increased income, urbanisation, technological revolution and liberalisation of international trade

further led to the structural transformation of the economy. Thus, this sustained economic growth, increased household income, globalisation, urbanisation, food availability and variety of food in the market places are the determinants for rapid growth in demand for high-value agricultural commodities in India.

Achieving food security and improvement of nutrition - the second sustainable Development Goal by 2030 of the United Nations is the most pressing development challenge in the world. Food security exists when people always have physical, social and economic access to sufficient, safe and nutritious food (FAO). Food security is adequate access to food in both quality and quantity. People experience moderate food insecurity when the quality and/or quantity of food they eat reduce and are uncertain they will be able to obtain food. Whereas, severe food insecurity is when people typically run out of food and, at worst, gone a day (or days) without eating.



Source: Government of India, Census (1901-2011)

Fig 1.2: Per cent urban population of India from 1901 to 2011

Thus, the starting point is the food production that determines the base of food availability. India which is an agrarian country, more than 60 per cent of the total population depends upon agriculture and allied activities for their livelihood and the count is as high as 70 per cent for rural households, with 82 per cent of farmers being small and marginal. Hence, the growth of this sector is a must for the overall economic growth of the nation. Over the years, the country has made rapid progress in the production of food as the annual growth rate of food including non-cereals production

increased from 2.1 per cent (1960s) to 3.0 per cent in the subsequent decades. The annual growth rate was 3.8 per cent during the 1980s. (Radhakrishna & Reddy, 2004). The production of the foodgrains has increased to 296.65 million tonnes during 2019-20 from 50.83 million tonnes during 1950-51 registering a compound annual growth rate of 2.38 percent per annum. Although, Indian agriculture has grown rapidly enough to move the country from the severe food crisis of the early 1960s to the food surpluses of the 1990s. The stress on food grain production during the green revolution and afterward provided a solid base for food security at the national level. India achieved self-sufficiency in food grains in the year 1978 and has sustained it since then (Radhakrishna, 2005).

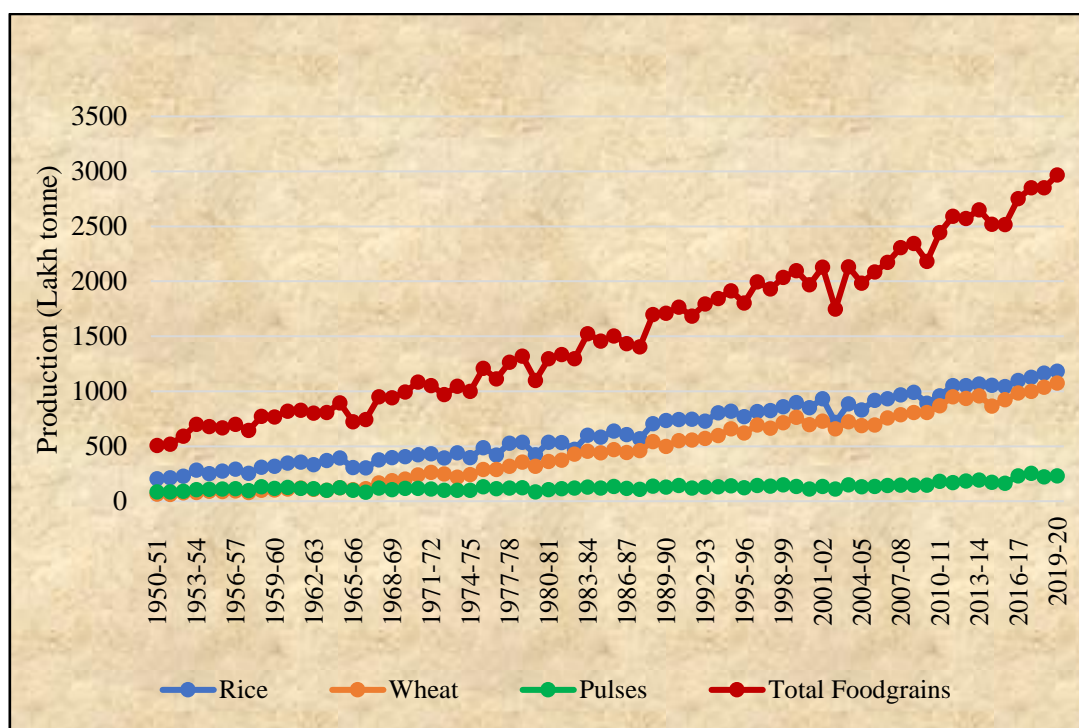


Fig 1.3: Trends in production of rice, wheat, pulses and total foodgrains in India (1950-51 to 2019-20)

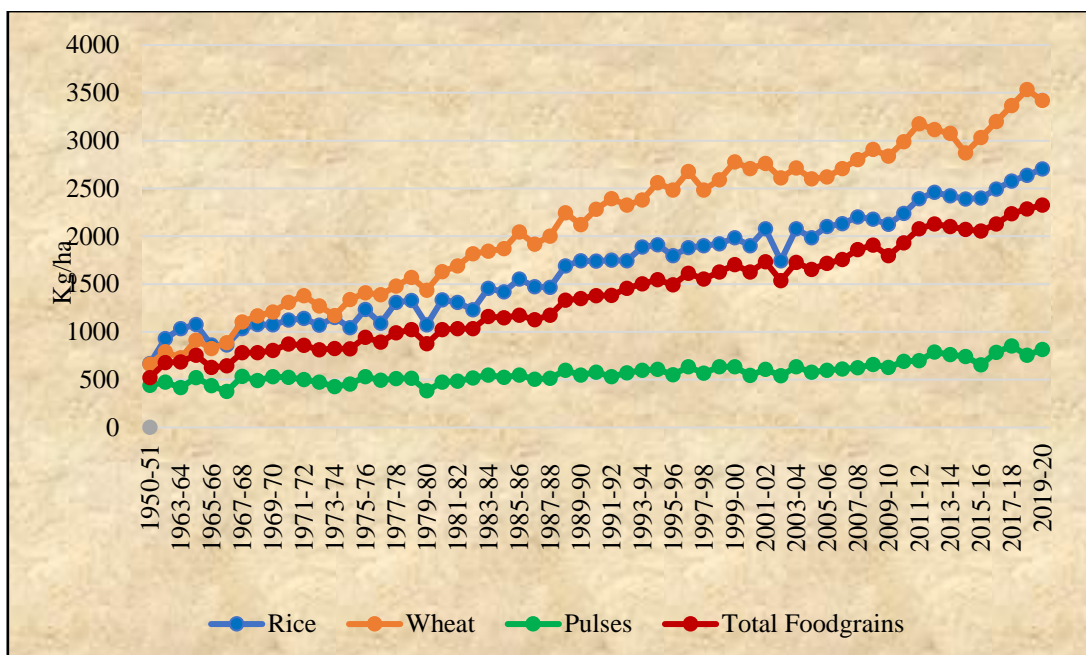


Fig 1.4: Trends in productivity of rice, wheat, pulses and total foodgrains in India (1950-51 to 2019-20)

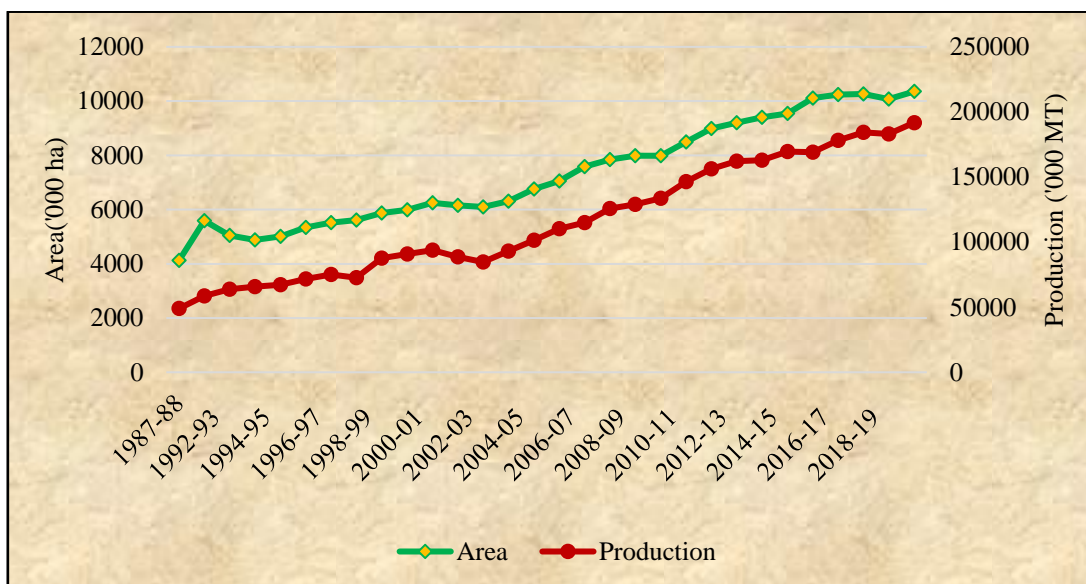


Fig 1.5: Trends in area and production of vegetables in India (1987-88 to 2019-20)

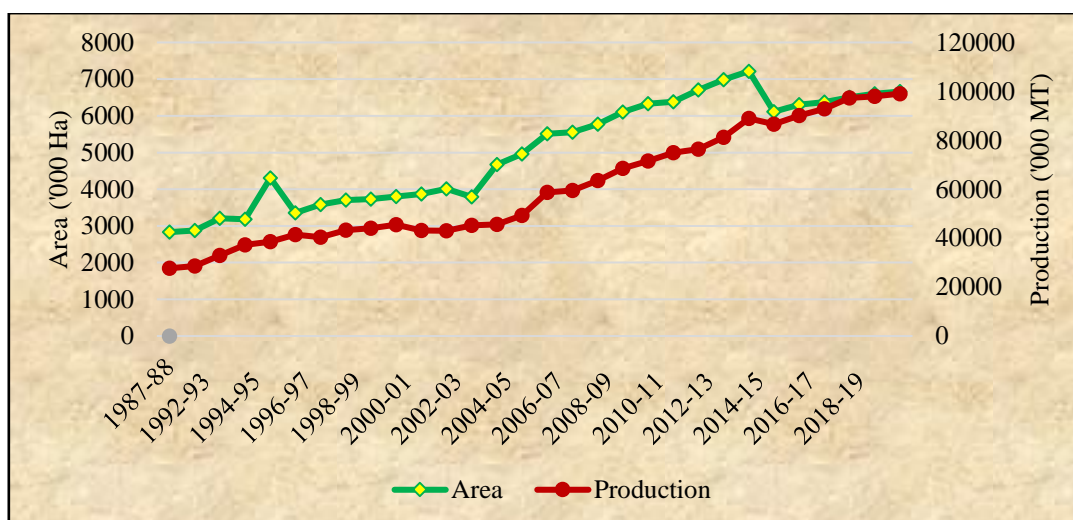


Fig 1.6: Trends in area and production of fruits in India (1987-88 to 2019-20)

According to Census 2011, GOI, around 31 per cent of India's population lives in the urban area and it has increased by 83 per cent over 60 years since 1951. According to UN world Urbanization Prospects, 2018 about 34 per cent of India's population now lives in urban areas which is a rise of about three per cent since the 2011 and will increase to approximately 40 per cent by 2030. Thus, the demand for various HVC is expected to double over the current levels. According to Swaminathan, given that India's population is likely to increase in the future by many folds, the challenge was to produce more and more from diminishing per capita arable land, irrigation resources and other factors like increasing abiotic and biotic stresses. Several Asian countries have used modernization in agriculture as a pathway for the growth of income and structural transformation of the economy. The green revolution during the 1960s had increased the food production of the staple foods – rice and wheat in the economies and crowded out the traditional micronutrient-rich food crops such as coarse grains, millets and pulses (Pingali, 2012). The per capita availability of the food grains has shifted from coarse cereals to super cereals such as rice and wheat and also from grain consumption to non-grain food and animal products consumption (Viswanathan, 2001). The per capita availability of food is a vital part of the debate on food security. The per capita net availability of food grains has increased by 25 per cent from 144.1 kg/year to 179.6 kg/year from 1951 to 2019 (Fig 1.7). It happened due to an increase in foodgrains production with the introduction of high-yielding varieties. But as far as pulses are concerned the per capita availability per annum has declined by 21 per cent

from 1951 and 2019. Several studies have been conducted to study the changing consumption pattern of food commodities. Radhakrishna (2005) observed a shift in the consumption from food to non-food items. Among food commodities from cereals towards non-cereals. Chopra (2015) observed the shift in the consumption pattern of households as the intake of the cereal and pulses decline while that of the consumption of the commodities like milk and milk products, egg, fish, meat, vegetables and fruits hover increased over the years. The shift in the consumption pattern from cereals especially coarse cereals intake to high-value commodities (fruits, vegetables and animal products) has been studied by Gupta and Mishra, 2014; Amarsinghe et al., 2007. According to Meenakshi (1996), the shift in the consumption pattern of households away from the traditional cereal-based consumption towards more expensive milk, non-vegetarian products (poultry and meat) is the consistent change associated with economic growth.

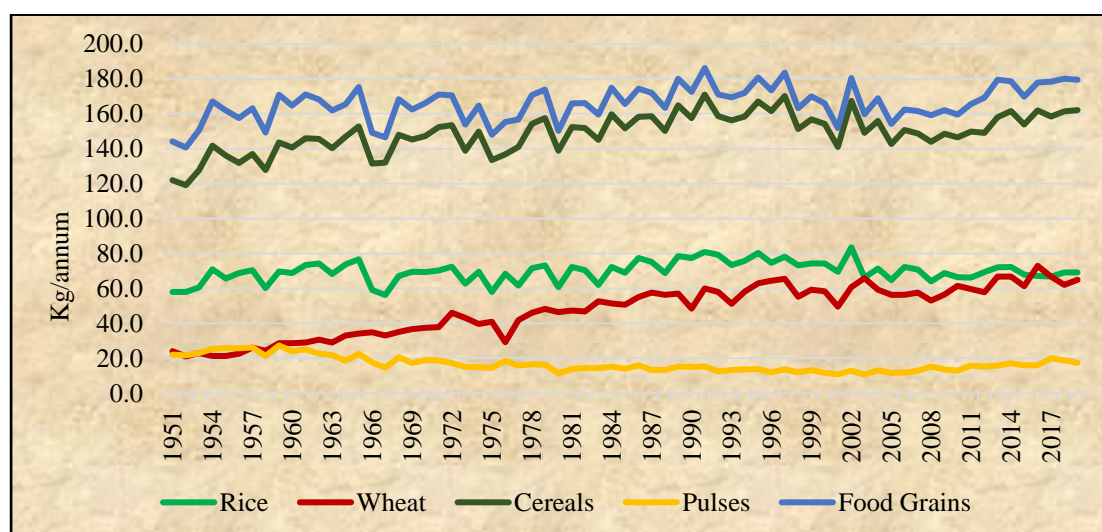


Fig 1.7: Trends in per capita per annum net availability of rice, wheat, cereals, pulses and foodgrains in India (1951-2019)

1.1 Future demand projection

Demand for food is projected to expand by 60 % as the global population increases to almost 9.7 Billion by 2050 (FAO). Further, as per Global Hunger Index (2020), India ranks 94th out of 107 qualifying countries. With a score of 27.2, it suffers from a level of hunger that is serious. With time the per capita income has been rising,

this would have led to some rise in per capita demand for foodgrains. The prices of foodgrains compared to the index of non-foodgrains prices have decreased over past few decades, which would have resulted in some increase in the foodgrains demand. If despite these factors favouring increased demand, the actual per capita demand for foodgrains has been declining, there must be powerful forces operating in the economic system which are dampening the demand for foodgrains. Radhakrishna and Ravi, 1992 and Radhakrishna and Murty, 1999 in their studies attributed this dampening demand to the changes in tastes and preferences of consumers away from foodgrains. There can, no doubt, be such changes in tastes and preferences (Rao, 2000).

With increasing income and urbanization, the non-grain crops (fruits, vegetables, etc.) and the animal products (dairy and poultry) will dominate the consumption basket by 2050 (Amarsinghe et al., 2007). As the future demand for food grains in India will not only come from an increase in population but also the increase in demand for animal feed and other indirect uses. The changing food consumption may lead to change in the future food demand and thus a concern for the food and nutritional security. Thus, the knowledge of the demand system and consumer behaviour is vital for a range of development policies related to nutritional status, subsidies in food, macroeconomic policies.

1.2 Nutritional Security

Despite all the definitions the nutrition always starts with what we eat, the products of the food and the agricultural sector. By paying attention to our food system the ways of production, collection, storage, transportation, transformation and food distribution we can improve our diets, our health and our impact on natural resources. Until about the middle of the 1960s, the nutrition problem was overlooked upon as a problem of protein deficiency and this, too, arising from a deficiency of quality protein from animal food, thus that was the time when P V Sukhatme carried work on nutritional intake and tried to disprove this myth. Later, the same facts have been supported by Gopalan (Dasgupta, 1983). After the study, it was taken for granted that the adequate intake of calories is a sufficient condition for the adequacy of necessary protein intake, and also a necessary condition for efficient utilisation of proteins on the human body.

The calorie intake puzzle was one of the most enduring puzzles related to economic development. The intake of calories has declined over years in India and the real consumption expenditures have increased (Chandrasekhar & Ghosh, 2003). The estimated average calorie intake in India in rural areas has declined by 10 per cent from 1983-84 to 2004-05, whereas, the real average monthly per capita expenditure has increased by about 22 per cent during the same period (Deaton and Dreze, 2009). The various challenges, such as climate change, rapid technological shifts and environmental sustainability are shifting food system and raising questions as to how to feed a rising world population in sustainable means. At the same time, uneven economic growth, social and economic transformations and other factors are shaping food systems and diets resulting in the increasing problem of overweight and other related non-communicable diseases while undernutrition and micronutrient deficiencies persist.

Over 800 Billion people are undernourished in the world and 98 per cent of the undernourished people live in developing countries. The food security linked to the nutritional security consumption of the food and nutrient intake is an outcome of the consumption behaviour. Hence, the quality and quantity of the food are a must for ensuring nutrition security. As per the availability of current statistics, there appears a confusing picture of India's progress on food and nutrition security. Both per capita food grains consumption and total calorie intake have declined in recent years among all levels of the population.

1.3 Himachal Pradesh

Out of about 13 hill states and regions of India, Himachal Pradesh is observed to be the most progressive state over the years which has made remarkable achievement in the socio-economic development of its people the state has created a new concept in the development of hill economy through transformation brought about in agriculture, horticulture and animal husbandry (Verma and Pratap, 1992). Himachal Pradesh, a hilly state, is one of the fastest-growing states in India. The Gross State Domestic Product at constant (2011-12) prices in 2018-19 is estimated at Rs. 1.53 lakh crore with an increase of 11.2 per cent over the year, whereas at current prices GDP in 2017-18 is estimated

at Rs. 1.37 lakh crore with an increase of 9.1 per cent during the year. The per capita income of the state increased by 11 per cent from Rs. 1,65,025 (2017-18) to Rs. 1,83,108 in 2018-19 and is estimated at Rs 1,95, 255 in 2019-20 (Economic Survey 2019-20, GoHP).

Agriculture is the primary occupation and the main source of employment in the state. An overwhelming portion of the state population more than 85 per cent lives in rural areas, indicating a massive dependence on agriculture and other related activities for their livelihood. But, land for agriculture constitutes only about one-tenth of the total geographical area of Himachal Pradesh. Despite the fall in the share of agriculture in the state economy, it has become a major source of income in the state because of the higher dependence of the rural workforce in this sector for employment. About two-thirds of the total population depends on agriculture including horticulture and provides direct employment to about 62 per cent of the total population (Kumar and Pattanaik, 2018). Given the mountainous topography, about 87 % of the farmers are small and marginal land-holders with merely one-fifth of the cultivable land under irrigation in the state, who largely favour subsistence economy, coupled with a limited scope of mechanised farming. The cropping patterns in Himachal Pradesh are quite different from other states of India, due to peculiar topographical and climatic conditions (Sharma, 2011). Earlier food grain crops dominated the cultivated area in Himachal Pradesh. But now, the state has realized the importance of commercial crops including off-season vegetables, potatoes and ginger (Thakur et al., 2014). Also due to the undulating physiographic land in the hilly areas it is more suitable for the cultivation of horticultural crops. The state is called as the “Fruit Bowl of Nation”. During 2017-18, the foodgrains production has decreased from 15.63 lakh MT to 15.31 lakh MT. The fruit production of the state was 5.65 lakh MT. Also, with the pickup in growing off-season vegetables, the total vegetable production was 16.92 lakh tonnes with annual growth of 2.8 per cent. The livestock is also an important integral to the sustainability of the state with the contribution of major products like 13.28 lakh tonnes of milk, 95.90 million eggs and 4406 tonnes of meat during 2016-17.

The structural composition of the state economy witnessed significant transformation during the decade. The economy has shifted from the agriculture sector

to industrial and service sector as the contribution of agriculture and allied sector in the total domestic product has declined from 57.9 per cent in 1950-51 to 26.5 per cent in 1990-91 and to 8.4 per cent in 2018-19. However, the declining share of agricultural sector does not affect the importance of this sector in the state economy. Though the relative contribution of agriculture to the national as well as state economy has changed, the basic characteristic of agriculture has not. It continues to be dominated by the small holders and the size of holdings reduced whereas the number of small holders increased.

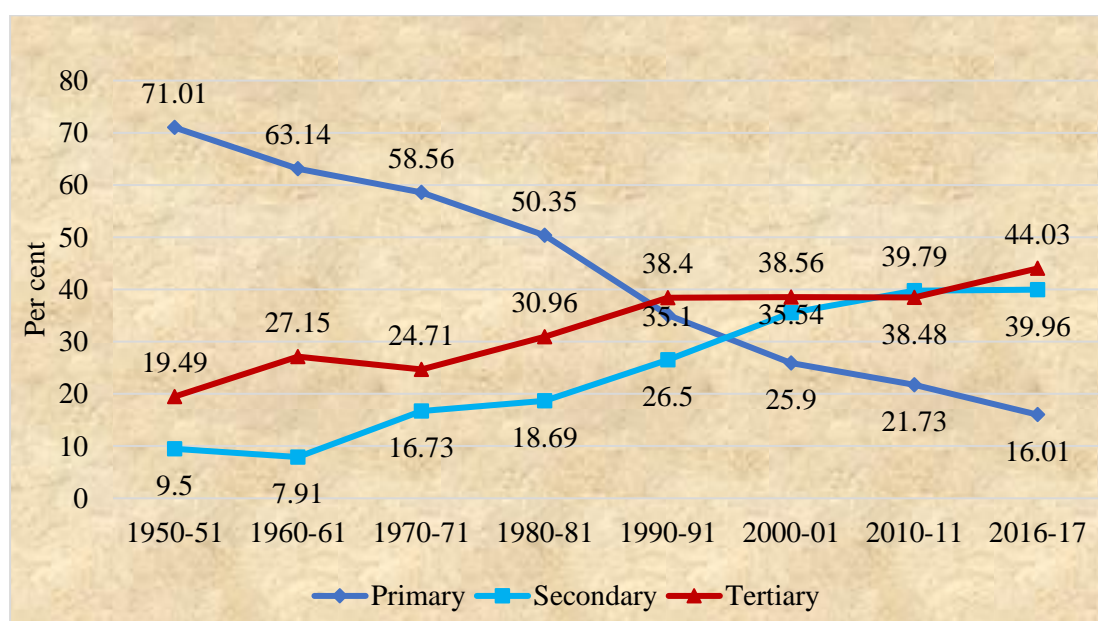


Fig 1.8: Trends in per cent contribution of primary, secondary and tertiary sectors to GDP in Himachal Pradesh

With the cultivation of high-value crops in some of the niches of the state, there has been an increase in income in the rural sector in the specific areas. Horticulture is considered to be the major mover of economic growth in the state and it has been recognised as significant for supplementing the otherwise major income of the people. The changing consumption pattern is both the cause and effect of the changing production structure of the food products in any economy. Thus, an increase in population, per capita income, etc. over the years put continuous pressure on food. As the share of agriculture in GDP continues to fall, the level of food consumption is expected to continue to rise with the shift towards high-value agricultural commodities (HVACs). This led to a change in consumption patterns and nutrient intake of

households in the state. Further, the consumption pattern of households also differs from region to region and in different income categories.

1.4 Need of the study

Not many studies have been conducted to track the variations and underlying changes in production performance of the agriculture sector at district and consumption pattern of food commodities in Himachal Pradesh. The analysis of consumption pattern is a pre-requisite of a planned economy to enable the planner to have precise knowledge of the future demand of different commodities and to match supply with changing pattern of demand. Based on the household expenditure data published in various rounds of National Sample Survey (NSS) reports, many studies have been conducted by different researchers. Mostly the studies were aimed at estimation of expenditure and income elasticities for food and non-food items at all India level and lack a specific regional approach. Hence the proposed study helped to explain the variations observed in production and consumption pattern in the rural and urban areas of Himachal Pradesh.

1.5 Objectives of the study

1. To examine the structural changes in production pattern of agricultural commodities.
2. To analyse change in consumption pattern.
3. To identify the factors affecting demand, to estimate demand elasticity of agricultural commodities and forecast their demand.
4. To examine the change in dietary intake of nutrients for rural and urban households.
5. To draw policy implications based on the study.

1.6 Plan of research work

The entire research study is presented in six chapters. The first chapter deals with the introduction and objectives of the research study. A comprehensive review of relevant studies is iterated in the second chapter. The third chapter incorporates

methodology and an analytical framework. In chapter fourth, a detailed description of the study area is given. In the fifth chapter, salient results obtained from the analysis of collected data are documented and discussed with logical reasoning duly supported by previous work. The summary and conclusions of the study is presented in the sixth chapter followed by the references.

1.7 Limitations of the study

A well thought and designed research study may not be free from limitations, hence the present methodology adopted for analysing data may have inherent limitations.

1. The data for consumption pattern for the recent years are not available and the latest available till 2011-12.
2. The study makes no distinction between calorie intake and calorie absorption, which again is a simplification that cannot be avoided in a socio-economic study. The intake norms for households vary depending on their family composition; number of adult men and women, male and female children of different age groups, as well as, infants. In this study, the average per capita calorie/ nutrient requirement was used.



REVIEW OF LITERATURE

The extensive reviewing of the fore conducted studies related to the present study has been considered important source to enrich the current understanding of the subject. It enlightens the researcher about the objectives that have been studied previously, methodology to achieve those objectives and the limitations faced by the researchers while conducting the research. The result and discussions of the studies conducted in past sometimes raise various questions hence, opens door to new research problems. A review of the available literature related to the scope of the study has been presented in the chapter before framing the problem of statement or methodology. The present chapter tries to compile some of the past relevant studies into following headings:

2.1 Studies related to production pattern

2.2 Studies related to change in consumption pattern of food commodity

2.3 Studies related to factors affecting food demand and projection of food demand

2.4 Studies related to nutrient intake

2.1 Studies related to production pattern

Kumar and Mittal (2003) conducted the study to examine the crop diversification in India by measuring the changes in cropping pattern during 1967-96 in terms of substitution and expansion effects on crop area. They found that the changes in the cropping pattern was the sum of the substitution and expansion effect which took place as a result of substitution from low productivity crops to high productivity crops. The area under coarse cereals and pulses have shown a steady decline. The states of the eastern and western regions have shown an increase in non-food crops while the area under coarse cereals has declined. Whereas, the northern region states have experienced a major decline in the area under coarse grains and pulses. The area under wheat and rice increased. Southern India experienced a major decline in the area under non-foodgrains. Among farm size, the Simpson

diversification index was found highest for sub-marginal (21 per cent) and marginal holdings (18 per cent), and the minimum was observed in the large holdings (8 per cent). The smallholdings made frequent changes in crop choices to increase their income and employment. Further, they suggested framing policies to help small farmers to diversify their activities towards both on-farm activities for enhanced sustainability and productivity.

Mahajan (2004) studied the crop diversification in the farm sector of Kangra district and investigated the empirical relationship between the magnitude of diversification and various socio-economic factors. The two-stage stratified random sampling was used to select two developed and two backward blocks. The crop diversification was studied using Herfindahl and Entropy indices, which were found higher in developed agriculture. The determinants like farm-size, tractor and bullock density, the extent of tenancy, farm income and non-farm income, and social factors like family size, age and education of the head of the family, distance from the town/metalled road are significant in crop diversification in the developed category in the district.

Pochanna (2004) analysed the growth performance of agricultural output at the district and regional level and measured the fluctuations in food-grains output and yield during the period 1970-71 to 2000-01 in Andhra Pradesh. The study revealed that the pattern of agricultural development in Andhra Pradesh was characterized by inter-regional and intra-regional disparities. The analysis of cropping pattern concluded that the percentage of area under jowar crop had declined and there was a substantial increase in commercial crops areas like cotton and groundnut. Growth and instability analysis in crop production indicated that at the state level the yield growth performance had consistently improved and the yield instability was low in the coastal Andhra region where irrigation facilities were more. The increased use of modern inputs along with irrigation contributed the most in yield growth. The study suggested the need for an appropriate strategy for the development of lagging regions to minimize inter and intra-regional variations and also to avail the benefits of the increase in growth, agricultural diversification, and exports.

Lathika and Ajith Kumar (2005) studied the growth trends in the area, production, and productivity of coconut in India from 1950-51 to 2001-02 using semi-log, log-quadratic, and log-quadratic (modified) trend equations. The study was based on secondary data collected from the Coconut Development Board. They revealed that the major coconut producing states/UTs in India accounted for 90.5 percent of the Indian coconut area in 2002 (95.7 % in 1960) and 90.0 percent production for the same period. The trend in the area revealed that all the three models corresponding to all the regions found to be a good fit of \bar{R}^2 . Some of the states (Andhra Pradesh and Karnataka) were on vast area expansion under the crop, while some regions like Kerala, Tamil Nadu, and Andaman and Nicobar Islands experienced severe land pressure, had registered a sluggish growth in the area. They experienced that problems of growth stability in yield were trickier to tackle with than problem of stability in area growth.

Sharma (2005) studied the agricultural development and crop diversification in Himachal Pradesh using data of 225 farm households from three development blocks of Shimla, Sirmaur, and Mandi district. The Herfindahl Index for the determination of the diversification was used in the study. They have found that the agriculture in the state has shown fairly high growth as foodgrains production increased from 9.99 lakh tonnes to 14.11 lakh tonnes from 1974-75 to 1999-2000. The state agriculture over the years especially since the late eighties had been diversified towards fruits and off-season vegetables like peas, potato, cabbage, cauliflower, etc. Also, the net returns from the crops like garlic, ginger, cabbage, cauliflower, peas, and tomato were very high compared to traditional field crops, which increased income of households and further, enhances the standard of living of farmers.

Birthal et al. (2006) conducted study on agricultural diversification in the North Eastern Region of India. The diversification pattern was examined by the share of the high-value crops in the gross value of the output of agriculture. The agriculture sector contributed around 30 per cent of the agricultural GDP in these regions. Cereals mainly rice dominated agriculture occupying 67 percent of the gross cropped area. The share of high-value crops (fruits, vegetables, spices and condiments, drugs, and narcotics) increased significantly from TE-1982-83 to TE 2002-03. The favourable agroclimatic conditions for high-value commodities are constrained by the lack of the infrastructure

for production, marketing and processing. Further, the regular supply of irrigation water can improve the production and productivity of high-value crops as only 10 percent area in the region was irrigated. The local markets for the high-value crops were less and have poor cold storage and processing infrastructure.

Jha et al. (2006) conducted a study on the growth rates of area, production and productivity of chickpea in the state of Madhya Pradesh and found that the state registered a positive compound growth rate in the case of chickpea but a significant growth rate was observed only for the area under the crop. An inter-period analysis indicated that the state witnessed an insignificant growth rate of chickpea production during 1990-91 to 2000-01 instead of a significant positive growth rate during 1980-81 to 1989-90. The study revealed that half of the area under chickpea in the state suffered from a low growth rate in production.

Mathur et al. (2006) studied the trends in the growth of agriculture in India and identified the factors that affect agricultural growth. The study revealed that government expenditure in agriculture including public investment in fertilizers usage and electricity consumption for agriculture were the main factors affecting agriculture production in India. Agricultural prices had shown a positive relationship. The projection made for growth in agriculture (food and non-food items) sectors at all-India level, based on several assumptions as government expenditure, price behaviour, the input used, growth in population and rainfall suggest that there is a need for an increase in average growth of 10 to 15 per cent per annum in government expenditure with an appropriate increase in public expenditure. Also, they further suggested avoiding the stop and go type of government intervention in this sector.

Rao et. al (2006) conducted a study to examine the role of urbanization and infrastructure in the diversification towards high-value agricultural commodities. The study was based on secondary data on area, production and prices of agricultural commodities including livestock, products, etc. for the year 1980-98 for 492 districts covering 16 major states. The sustained economic growth and increasing urbanisation were fuelling rapid growth in the demand for high-value food commodities like fruits, vegetables, milk, meat, eggs, and fish. The intensive high-value agriculture is practiced

in about 11 percent of the area, mainly in the coastal and hill regions. On more than half of the area, high-value agriculture was extensive and confined mostly to the central and north-western regions. Fruits were found most important in intensive high-value agriculture followed by milk, vegetables, and poultry. In the extensive regions, milk was found a major commodity with vegetables, fruits and poultry being next in the order. In general, in areas with high rainfall, low levels of irrigation and mechanization, smaller land holdings and higher endowment of labour the high-value agriculture was prevalent. They observed urbanization to be an important determinant of intensification and growth of high-value agriculture and infrastructure facilities.

Singh et. al. (2006) schematized the diversification across states/crops in India and determined the determinants of diversification using the Simpson index of diversification. The diversification index varied from 0.47 (West Bengal) to 0.90 (Karnataka) in 1990-91 and from 0.40 (Orissa) to 0.92 (Karnataka) in 2000-01, this signified the shift towards non-food grain crops. The area under food grains in some states like Bihar, West Bengal and Maharashtra had declined and the area under finer cereals had increased but the increase in SID values shows the shift towards the non-food grain crops. As far as gross cropped area was concerned the share of foodgrains had declined virtually in all the states. For the cereals, the area had gone in favour of rice and wheat in non-traditional growing areas, due to the spread of technologies and adoption of HYV cultivars. Due to better market networks, price incentives and favourable climatic conditions, the area under fruits had increased in Andhra Pradesh, Gujarat, Himachal Pradesh, Orissa, Tamil Nadu and Bihar.

De and Chattopadhyay (2010) examined the crop diversification by poor peasants and the role of infrastructure in West Bengal using Herfindahl index, Simpson index, Entropy and Modified entropy index for all the districts of West Bengal for years 1970-73, 1979-1982, 1989-1992 and 2002-2005. The value of the diversification index had increased in the state but not at a very faster rate. The diversification in the relatively backward agricultural districts like Bankura, Midnapore had taken place at a relatively faster pace than other advanced districts like Burdwan, Hooghly, etc. as was observed by the decline in the coefficient of variation for diversification indices over years. Thus, the policies towards the expansion of infrastructure like road network,

irrigation facilities through different modes, marketing and storages facilities, power supply especially to the minor irrigation setups, availability of fertilisers and facilities or empowering those especially the poor farmers are the prerequisites for diversification of the crops across the districts.

Kannan (2011) analysed the trends in India's agricultural growth and its determinants. He found that a significant shift in the cropping pattern from the cultivation of foodgrains to commercial crops. The area for coarse cereals declined by 13.3 per cent between TE 1970-71 and TE 2007-08. The increase in the yield of the crop was one of the main factors in accelerating crop production in the country since the late 1960s. The factors like modern varieties, irrigation and fertilizers were the major factors contributed to higher growth in crop production. The crop output growth model results revealed that enhanced capital formation, better facilities for irrigation, normal rainfall and improved fertilizer consumption would help increase crop output in the country.

Kannan and Sundaram (2011) conducted a study to analyse the trends and patterns in agricultural growth at the national and sub-national levels in India. The analysis of data compiled on area, production, input use and value of output for the period 1967-68 to 2007-08 revealed that the cropping pattern in India had undergone significant changes over time. A marked shift has been found from the cultivation of food grains to commercial crops. The area under cereals declined by 13.3 per cent between 1970-71 and 2007-08. Similarly, the performance of pulses in terms of area and output was also not impressive. The factors like modern varieties, fertilizers and irrigation important that ensured higher growth in crop production. The results of the crop output growth model indicated that the enhanced capital formation, better irrigation facilities, normal rainfall and improved fertilizer consumption helped to improve crop output in the country.

Sharma (2011) conducted a study on crop diversification in Himachal Pradesh. He found that areas under rice, wheat, and other cereals and pulsed had declined and the area under fruit crops and vegetable crops had increased over the period. The area under vegetable crops increased from 23.13 thousand hectares in the triennium ending

1992-93 to 49.37 thousand hectares in the triennium ending 2006-07 with a compound growth rate of 6 per cent per annum and the production registered the growth of 7 per cent per annum for the same period.

Acharya et al. (2012) examined the growth in the area, production and productivity of major crops in Karnataka during the year 1982-82 to 2007-08 using the compound growth function. A significant positive growth in the area under pulses, vegetables, and spices and fruits and nuts was observed, while cereals showed significant negative growth. A substantial annual fall has been seen in the area under other cereals like jowar, bajra, ragi and minor millets. But the area under rice has shown a mild annual increment. A significant positive growth was found in production of cereals, pulses, vegetables and fruits. While the production of oilseeds and commercial crops registered insignificant positive growth. The productivity of cereals, pulses and fruits have registered significant growth and commercial crops registered insignificant growth. However, for vegetables, the productivity growth was insignificant and negative.

Pal and Kar (2012) studied the implications of the methods of agricultural diversification in Malda district. The crop diversification was calculated using different methods like Bhatia's method, Jashbir Singh's method, Herfindahl Index (HI), Transformed Herfindahl Index (THI), Ogive Index (OI), Entropy Index (EI), Modified Entropy Index (MEI), Composite Entropy Index (CEI), Gini's Coefficient (Gi) and Simpson index (SI). The HI and SI were widely used measures of crop diversification, but as per the output scale of resolution, Gi, MEI and OI were found more effective. In Malda district, the status of crop diversification was found to be better than that of the state and block level. The area under aman and boro paddy, potato and mustard together increased from about 64 % of GCA in 1970-73 to about 77 % in 2002-2005 despite some inter-district variations. The peasants still cultivated cereals instead of high-value crops.

Binswanger-Mkhize (2013) examined the stunted structural transformation of the Indian economy and they found that the Indian economy had accelerated sharply since the last 1980s, but the share of the agriculture in the GDP had declined while that

of industrial and services had shown increasing trends. The 1980_s were the golden years of Indian agriculture when the growth of agriculture (3.3%), labour productivity (2.3%) and total factor productivity (TFP) growth (2.7%) were at their peak. The structural transformation from agricultural production and employment towards non-agriculture appeared to be a consequence of rising urbanisation compared to rural non-farm self-employment, and this had reduced divergence in poverty rates, incomes and consumption.

Kumar et al. (2013) studied crop diversification in Himachal with special reference to Una using the Herfindahl index during 1997-98 the major crops grown in district Una were rice, wheat, maize, pulses, potato, oilseed, sesamum and sugarcane. The share of rice had fallen over the years (1997-2007), whereas a marginal increase in area for wheat and maize was noticed. The irrigated area under rice and wheat has increased from 6.44 and 17.35 percent to 7.33 and 23.55 percent, respectively from the year 1997-98 to 2007-08.

Birthal et al. (2014) studied the changing sources of growth in Indian agriculture using data on area, yields, and prices of important crops from 20 major Indian states. The Indian agriculture was transformed from a cereal-based production system toward high-value crops during the 1990_s. Technology played a major role in the transformation of agriculture during the past three decades (1980 to 2010), during that period the agriculture grew at an annual rate of more than 3 percent. Technology was considered the main source of development during the 1980_s, followed by crop diversification gained momentum in the 1990_s, and had almost the same contribution as technology in the agricultural development of the technology. The increase investment in agricultural research to sustain agricultural growth was suggested in the study.

Krishan (2014) studied the crop diversification and its determinants in Himachal Pradesh. The district-wise data on area, production and productivity for the year 1980-81 to 2004-05 was collected from the Annual Season and Crop Report, published by the Directorate of Land Records. The findings indicated that diversification has taken place towards horticulture crops. The crop diversification was

high in almost all the districts during 1980. The districts under the plain area like Hamirpur, Bilaspur and Una were moving towards specialization in cereals. The area in these districts under cereals (wheat and maize) contributed more than 70 % and was increased over time. The districts in hilly areas namely Kinnaur, Lahaul and Spiti and Kullu were moving towards specialization in terms of horticultural crops. The components like road connectivity, rural electrification, availability of low-cost inputs, education facilities, irrigation facilities, and institutional arrangements played a major role in crop diversification in Himachal Pradesh.

Thakur et al. (2014) studied the dynamics of agricultural production in Himachal Pradesh during the period 1972 to 2006 using data from Annual Season Crop Report of Himachal Pradesh. The study revealed that although the food grain crops dominated the cropping pattern of Himachal Pradesh, the cultivated area began to comprise more and more of highly remunerative crops, like fruits, off-season vegetables, and exotic vegetables. The production and yield level of maize, wheat, and rice has increased considerably, while barley and pulses had experienced either stagnation or decline in the production and yield level during the study period. The significant growth in the production and yield level of fruits (e.g., apples) and vegetables was noticed during the period.

Bisnwnager-Mikhize and D'Souza (2015) examined the structural change and agricultural performance at the state level in India from 1980 to 2010 for 15 states. The economic reforms had led to a sharp rise in the growth rates across all states, along with the disappearance of the relationship between initial income and growth. The agricultural growth in the country was found disengaged from the rapid economic growth. The growth slowed down between the 1980s and the 1990s and didn't exceed 4 percent in the decade of the 2000s. The share of agriculture in the economy was highest in Punjab, followed by West Bengal and Madhya Pradesh, while it was lowest in Tamil Nadu, Kerala, Maharashtra and Gujarat. They found that the share of agriculture was heavily influenced by the other sectors. The sectoral composition of agriculture depicted both convergent and divergent trends. The share of the cereals was reduced and that of fruits and vegetables increased in the selected state. The income

elasticities of the cereals were low and for fruits and vegetables it was high. Except for Madhya Pradesh, the share of oilseeds and pulses had declined.

Kumar and Gupta (2015) examined the state-level trends and pattern in crop diversification in India for the period 1990-91 and 2011-12 using the Simpson Index of Diversification (SID) and panel regression analysis. The total food grain crops had experienced a negative growth rate in the area whereas, total fruits and vegetables experienced a positive and significant growth rate. At the state level the cropping pattern was shifting towards high-value crops from foodgrains. Also, the share of food grain crops in the gross cropped area was highest in east and northeast regions (76-78 %) followed by northwest region and southern region. The eastern and north-eastern region exhibits low crop diversification for food crops whereas, it was high in non-food crops. Kerala was the only state that exhibits a higher degree of crop diversification among food crops and non-food crops, Andhra Pradesh, Kerala, Gujarat, Maharashtra, Haryana, Bihar, West Bengal and Assam registered high level for diversification. The cropping intensity and annual rainfall had shown a positively significant impact on crop diversification. The study suggested the steps towards the reinforcement of link across production, processing, marketing and crop management.

Narayan and Kumar (2015) studied the constrained growth in the area, production and productivity of pulses in India for the year 1980-81 to 2010-11. The growth rate of pulses area and production was found negligible as compared to cereals like wheat and paddy. A wide variation was noticed in the yield of these cereals in different states of the country. The growth rate of the area was -0.09 percent, -0.60 percent and 1.62 percent and production was 1.52 percent, 0.59 percent and 3.35 percent during the 1980s, 1990s and 2000s, which further affected the per capita per day availability of pulses, which had shown a decline of 61 g to 32 g from 1951 to 2010. The gap of domestic demand and supply has sharpened, which was lessened by the liberalization and subsidization of different types of pulses items. They suggested to increase the source of production to solve problem of Indian pulses economy.

Nayak (2016) conducted study to examine the changing cropping pattern, agricultural diversification and productivity in Odisha during 1980-2005. The results

indicated that most of the districts in Odisha were experiencing a lateral movement towards crop specialization (rice) due to irrigation facilities and provision to minimum support price and crop diversification was found only in tribal-dominated / technologically less-developed districts. The reduction in inequality was found during the study period and had concluded that districts in Odisha were converging as far as agricultural productivity was concerned.

Singh (2016) studied the district wise agricultural diversification and contract farming in Punjab for the year 1970-71 to 2009-10 using the Simpson Index of diversification. The crop diversification in Punjab was high during the seventies and eighties but declined in the nineties which was further declined indicating monoculture of Punjab agriculture. During the early 1990s sunflower was the major crop of the state but its importance declined due to low returns as compared to wheat. The share of the fruits and vegetables in the cropping pattern was stagnant at less than one per cent and less than three per cent of the net sown area. The more irrigated area under horticultural crops has shown favour for agricultural diversification. Also, crop diversification and small landholders have shown a positive relationship. Finally, they found that the predominance of the wheat rice system had led to serious economic, social and ecological problems like a deceleration in productivity growth, over-exploitation of groundwater resources and decline in soil fertility in the state. Further, they have found that the contract farming was skewed towards the medium and large farmers. and it has brought to some extent crop diversification in the area.

Show (2017) analysed the changing cropping pattern and its impact on the agricultural income of West Bengal at the district level. The study indicated that the area under rice, wheat, cereals, sugarcane, potato, fruits, vegetables and oilseeds had increased whereas, the area under pulses, barley, mesta and jute crops had decreased from 1980-81 to 2013-14. The proportion of area under total cereals to total cropped area decreased from 86.89 percent in 1965-66 to 72.69 percent in 2013-14. The analysis of the cropping pattern revealed a change in blocks of Paschim Medinipur in favour of non-food grains during the period from 1995-96 to 2012-13. He found that crop diversification directly or indirectly increased the production of crops per hectare.

Tandane and Kaur (2020) studied the growth and instability in area, production and yield of tea in major tea growing states of India (Assam, West Bengal, Tamil Nadu, Kerala and Karnataka). The study based on the secondary data collected from Tea Board of India for the period 1990-2017. The compound annual growth rate and Cuddy Della Index was used to calculate the growth and instability in tea. Assam and West Bengal accounts for around 80 per cent of the tea production in the country. The compound annual growth rate of production in India was 2.23 per cent during 1990-2017. The area and productivity showed positive and significant growth rate of 1.44 per cent and 0.76 per cent, respectively. The instability in yield was high (6.42 %) and comparatively less in area (1.52 %). Assam, West Bengal, Tamil Nadu and Karnataka showed the positive growth in production of the tea, whereas, the production was positive but insignificant in Kerala state.

2.2 Studied related to change in consumption pattern of food commodity

Sarma and Gandhi (1990) studied the production and consumption of foodgrains in India and the implications of accelerated economic growth and poverty alleviation. The growth rate of foodgrains production declined from the pre-green revolution period (1949/50-1964/65) to the first half of the green-revolution (1967/68-1975/76), but during the second half (1975/76-1983/84) the growth rate showed a modest acceleration from 1.9 % to 2.5 %. The overall growth rate from 1949/50-1983/84 was around 2.6 %. The per capita availability of foodgrains had varied between 150-170 kg a year from the 1950s to the 1980s, which showed that food production was absorbed by population growth, reduction in imports and increase in stocks. The total expenditure of households had improved between 1977/78 to 1983 in both rural and urban areas. The overall income elasticities of foodgrains demand were 0.48, 0.23 and 0.42 for rural, urban and national respectively. The elasticities for the bottom quartiles were 1.0 and about 0.1 for the top quartiles. They projected that by 2000 the foodgrains production would be 220 million tons and the foodgrains consumption (demand) would vary from 206 to 240 million tons

Bhandari and Smith (2000) examined the relationship between education level and food consumption patterns in China by collected data from 3543 households. The

secondary data was collected from the 1991 administration of the China Health and Nutrition survey. They found that the education level has a differential impact on the food consumption pattern. Female education affected the consumption of nutritious and preferred food which was independent of the income effect. The education of males affected food consumption which was affected by income.

Rao (2000) conducted study to examine the declining demand for foodgrains in rural India during the period 1972-73 and 1993-94 and found that over the two decades, the per capita consumption of cereals declined (12 %) in rural areas than in urban areas (around 5%). Also, the per capita consumption of cereals was found higher in rural areas compared to urban areas. The states like Kerala and West Bengal had the per capita consumption of cereals in rural and urban areas below the national average in 1972-73, had further shown a significant increase during 1993-94. The per capita consumption in Haryana and Punjab was above the national average in 1972-73. For the poorest or the bottom 30 per cent population per capita consumption of cereals had increased while for the middle 40 per cent and top 30 per cent it was declined. The rural-urban difference between the top 30 per cent for per capita consumption was as high as 64 per cent in 1972-73 which was reduced to 40 per cent in 1993-94.

Giri (2006) analysed cereals consumption over time in the country and across the states using the data on consumption patterns and availability of food grains as available in various rounds of NSSO reports. Between the 50th round (1993-94) and 60th round the decline in consumption of coarse cereals (jowar, bajra, etc.) was more than rice and wheat in urban areas. The per capita consumption of cereals was 11.2 Kg during 1987-88 which declined to 9.8 kg during 2002 and further raised to 9.9 kg in 2003 and 10.0 kg in 2004. Similar trends were observed for rural areas. The lowest two MPCE classes both of rural and urban sectors had lower cereal consumption than the recommended one.

Golait and Pradhan (2006) analysed the changing food consumption pattern in rural India and observed a marked decline in the consumption of all the cereal items over the period 1987-88 through 2001-02 in almost all the states and both rural and urban areas. The reduction was sharp in the case of the smaller cereal items, like maize,

barley and cereal substitute (tapioca). A shift in preferences from cereals towards non-cereal items, such as meat/fish/eggs and fruits/vegetables were observed in the rural sector. Thus, the consumption pattern of the households in the rural India has shifted from the food grains towards the high value commodities.

Sharma et al. (2006) studied the changing consumption pattern in Himachal Pradesh and found that in rural areas the major portion of expenditure was spent on total food items which decreased from 66 percent in 1977-78 to 56 percent in 1999-00. The food expenditure was dominated by cereals followed by milk & milk products. The results for urban areas indicated that the expenditure on food items was highest and cereals accounted for the largest share. The expenditure on the non-food items was higher in the urban areas compared to the rural. The study suggested that to increase expenditure (income) in the rural sector there is a need to improve farm productivity through better infrastructural facilities in terms of input availability, marketing facilities, etc. according to diverse agro-climatic conditions of the regions, improvement in the non-farm sector, etc.

Shrivastava et al. (2006) studied the food security in India and examined the per capita availability of various food crops in India, and changing consumption pattern in India after Independence i.e., from 1950-51 to 2004-05. They found that increase in production over the years was more comparable to the increase in the population, which led to the increase in per capita availability of the foodgrains. A negative trend emerged for the pulses as production was decreased by 37 percent during the period of the study. The production of oilseed increased by 214 percent. The per capita availability of edible oils and vanaspati oil also increased by 139 and 101 percent, respectively. Similarly, the production and availability of milk and sugar also increased. They further suggested that various measures like rural infrastructure development, job creation and income security were the important tools for combating food insecurity and malnutrition in India.

Kumar et al. (2007) analysed the long-term change in the Indian food basket and nutrition using unit data on dietary patterns and consumer expenditures collected by the NSSO for 38th (1983-84) and 55th (1999-2000) round. The sample households

were divided into poor (lower) and non-poor (upper) classes. The consumption was diversifying towards high-value commodities. The nutritional status of the rural poor had worsened because of the decline in consumption of cereals. The per capita consumption of coarse cereals for both income groups had declined over the years. The decline in the consumption of the pulses by both income groups was due to a rise in its prices. The overall effect of the income and taste was found less in the urban areas. Among all the food commodities, the budgetary share of cereals was dominated the food expenditure in both rural and urban areas. The pattern of food consumption in poor states revealed that a high percentage of the population lives below the poverty line in Orissa (47.2 %), Bihar (42.6 %), Madhya Pradesh (37.4 %), Assam (36.1 %) and Uttar Pradesh (31.2 %). The nutritional status of poor was worsen over the time.

Ray (2007) analysed the changes in food consumption and the implications for food security and undernourishment in India during 1990s. The study documented the decline in the consumption of cereals especially in urban areas and prevalence of undernourishment over the period 1987/88 to 2001/2002. There was a significant number of households even in the top expenditure decile, were suffering from undernourishment. The study found that as a source of subsidized calories and as a poverty-reducing instrument, the PDS is of much greater importance to female-headed households than it was to the rest of the population. Despite the sharp decline in their expenditure share during the 1990s, rice and wheat continue to be the major source of calories, especially for the rural poor.

Dev and Sharma (2010) studied food security in India and examined the performance, challenges and policies in it in terms of availability, access, and absorption on nutrition and all three were inter-related. India is more or less sufficient in cereals but deficient in pulses and oilseeds. The change in consumption pattern had led to an increase in demand for fruits, vegetables, dairy, meat, poultry and fishery products. They suggested to increase the diversification and improve allied activities in the country. They further found that the increase in access to food can be achieved through employment due to growth in labour-intensive sectors and /or through social protection programs. The multi-disciplinary approach covering diet diversification including micronutrients, women's empowerment, education, health, safe drinking

water, sanitation and hygiene. The various social protection programs in India had improved incomes and protected the population especially the poor. But despite many policies and programmes food insecurity and malnutrition continued to be major. The problem with design and malnutrition continues to be high. Thus, appropriate institutions were needed for the better implementation of policies and programmes and people-centric programmes and institutions were needed for better implementation of all these programmes.

Godfray et al. (2010) conducted study on food security with the challenge of feeding 9 billion people and found that the continuous growth in population and consumption led to an increase in the global demand for the food for at least another 40 years. The increased competition for land, water and energy, and the overexploitation of fisheries had affected the food-producing ability. Also, climate change was another threat. There was a wide geographical variation in crop and livestock productivity, even across regions having similar climates. Therefore, a global strategy was required to ensure sustainable and equitable food security.

Geetha (2011) examined the consumption pattern of rural and urban households in Coimbatore city. A village (Bolvampatti) and town (Ganapathy) in Thondamuthur panchayat were selected. A significant differential in consumption expenditure not only between the groups (rural and urban) but also within the groups was observed. A low expenditure elasticity for cereals and high expenditure elasticity for other food items revealed a shift in food consumption patterns in both rural and urban areas as income increases. In urban households, all commodities were treated as necessities as almost all expenditure elasticities for food items were near to one which was not the case in the rural area. Thus, for improvement in the consumption pattern of the household's especially rural households, there was a need for a judicious mix of beneficiary-oriented programmes, human resources and infrastructure development.

Caglayan and Astar (2012) analysed determinants of household consumption expenditure in Turkey for rural and urban areas. Quantile regression was used to examine the correlation of consumption at a different point on the distribution for both rural and urban areas. The consumption expenditures of men were lower than the

women at all the quantiles. Income was found to be significantly affecting the consumption expenditures. The relation between consumption expenditure and age was found positive and significant. Further, the consumption expenditure for the people with higher education was high as compared to the illiterate, primary and secondary education people. The households with mother father and children have higher consumption expenditure compared to single adults. Also, the expenditure of single household head was higher than married, widow and divorced households. The models estimated separately for rural and urban areas showed differences in the factors affecting the expenditure.

Gupta (2012) studied the food expenditure and intake in the NSS 66th round. She found some significant changes in the food consumption basket from 1993-94 to 2009-10. The average MPCE had increased from Rs. 281 in 1993-94 to Rs 928 in 2009-10 thus showing a growth rate of 7.7 per cent per annum, similarly, in urban areas, it had increased by 8.9 per cent per annum. Compared to overall expenditure the growth in food expenditure was significantly lower. There was the reallocation of consumer food expenditure away from cereals towards commodities such as egg, fish and meat, vegetables, milk and milk products, beverages, etc, in both rural and urban India. In pulses, all varieties (except gram and peas) have witnessed a drop in consumption, whereas the edible oils have shown a rise in consumption. Milk consumption increased both in rural and urban areas.

Nithya (2013) examined the changing trend of consumerism in Kerala. The process of urbanization had placed the state among the most urbanized places in India. The state ranks at the top among Indian states in per capita consumption expenditure, though the rank in the per capita Net State Domestic Product (NSDP) was relatively lower. With 3.4 per cent of the country's population, it accounted for 10 per cent of total consumption. During 2004-05 (NSS 61st round) the MPCE of Kerala for the rural and urban region was Rs. 1013 and Rs. 1290 respectively while for India it was Rs. 559 and Rs. 1052 respectively. Thus, the exposure of the state to the outer world, use of credit card, recent technology, advertisement, social prestige, globalization, etc have contributed to the changes in the consumption pattern of people.

Gupta and Mishra (2014) examined the food consumption pattern in rural India using the data from the National Sample Survey 66th round (2009-10). A multiple regression analysis was used to show the effect of the socio-economic and regional variables on the consumption of food items. They found that the bottom MPCE class, (20 % of rural population) consumed cereals less than the national average (11.73 Kg). The rich class enjoyed the consumption of all food items including cereals which declined with the increased income. Consumption of pulses, milk, fruits and vegetables increased with the increase in income. The cereals and milk consumption were more for self-employed in agriculture. Among religious groups, Christian households consume more rice in cereals (Jains, Buddhists and Sikhs consume more wheat). Hindu households included all types of cereals in their diet. Further, with the increase in the family size the consumption of food items especially cereals and milk declines in the diet, hence these families were at greater risk of nutrition deficiency. Among social groups, the likelihood of consuming all the food items was lower in scheduled tribes and scheduled caste households. The agro-climatic regions affected food consumption significantly.

Chopra (2015) analysed the changing pattern of consumption pattern and its implications for food security in India. The study was carried out to highlight the long-term change in consumption pattern in India for the years 1993-94 to 2009-10 using National Sample Survey Organization (NSSO). A sharp decline in the consumption of cereals was found. The study revealed the structural shift in consumption for the past two decades. Bennet's law of consumption was confirmed as there was a sharp decline in consumption of food commodities (cereals, pulses, edible oil, vegetables) and with increase in share of high-value agricultural commodities (milk and its products, egg, fish, meat and fruits) with the increased income. The study further showed that the states (Kerala, Maharashtra and Tamil Nadu) with high female literacy percent had a low share of consumption of expenditure on cereals, pulses, edible oil, vegetables and total food and a high share of consumption expenditure on high-value commodities (egg, fish, meat, fruits and non-food items).

More et al. (2015) studied the consumption pattern of rural and urban households in Amravati district. The study was based on primary data collected from

80 households for the year 2012-13. The socio-economic status revealed that the rural and urban households vary with the number of family members and educational status. The main food was cereals which accounted for 45 per cent, pulses > 6 per cent and vegetables about 10 per cent of total foodstuff by rural and urban households. The dietary consumption of foodstuffs except leafy vegetables and sugar was found significantly lower than the recommended dietary allowances (RDA) for both rural and urban households. In nutritional intake by rural and urban households, the deficiency was observed more in calories.

Umanath et al. (2015) studied the food consumption pattern and nutrient intake in rural and urban Karnataka. They estimated the income and price elasticities of demand for different food commodities and nutrients in the rural and urban regions using NSSO household consumer expenditure data on food commodities for the years 2004-05 and 2011-12. The Quadratic Almost Ideal Demand System was estimated in the study. The study revealed that except for fish, egg, and nuts in rural regions, all the food commodities were normal goods as income elasticities were positive and significant in both rural and urban regions. For rural regions, income elasticity was found more than one for rice, meat, fruits and spices and less than one for millets, wheat, pulses, milk. Edible oils and vegetables. The results revealed that urban households were more income responsive than rural households in consumption of most of the food commodities. The income elasticity of demand for rice was quite high in rural areas as compared to urban areas where it was inelastic, demonstrating that the rice was still a superior item of consumption in rural regions of Karnataka. The cross-price elasticity revealed strong substitutability between fish and vegetables. Further, the results showed that an increase in the per capita income of the households increased the intake of all the nutrients.

Kumar and Shah (2016) examined dairying as an instrument for ensuring socio-economic and nutritional security in India. Since dairy was considered one of the best poverty alleviation tools. The study was based on unit-level data from the Consumer Expenditure Survey, conducted by National Sample Survey Organisation. The households were divided into five categories based on the monthly per capita expenditure. They found that the households which were engaged in dairying were

comparatively better-off in financial and nutritional security as compared to those which were not. The producer household's intake of milk was more especially in lower categories than non-producers thus ensure nutritional security. Further, Lorenz curve distribution also showed that the producer household's income was more equitably distributed among the producer households than the non-producers, ensuring greater parity among the people. Hence, they suggested making dairying more popular among all- anti-poverty and social programmes initiated by the government and taking into account the state/regional level factors like socio-cultural practices, agro-climatic conditions, dietary intake pattern, etc.

Arun et al. (2017) conducted the study to examine the change in consumption pattern towards high-value commodities driving production diversification in India. They found in their study 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 in both rural and urban India. The study also revealed a perceptible positive relationship between the rise in consumption expenditure on HVCs and their production (value of output). The study indicated that a structural change in terms of the development of markets, roads network, irrigation, technology, urbanization and growing income levels have positively influenced agricultural diversification towards HVCs.

Hasan and Singh (2017) conducted a region-wise study to examine changing consumption pattern of agricultural commodities in Uttar Pradesh using data for two NSSO rounds (43rd and 66th) of consumption expenditure survey. The study revealed a structural shift towards high-value agricultural commodities like milk, fruits, vegetables and non-vegetarian products in the state. The results indicated that the share of the rural population in total food expenditure was higher than urban population although the absolute expenditure on food was higher in the urban area than the rural area in all the regions. The cereals and pulses, together constitute a major share in food basket and form a staple food group, registered a substantial decline in their share in food expenditure in all the regions and both the sectors between 1987-88 and 2009-10.

Thakur (2017) examined the changing consumption pattern in India during pre and post-reforms periods. The study found a decline of 3.3 percent in the food expenditure in the year 1987-88 and end of pre-reform period whereas, expenditure on non-food items fluctuated and steadily increased to 51.6 per cent during the same period. The economic growth during the past decades, India's average per capita calorie and protein intake had grown slightly, but the per capita fat consumption has registered higher growth. The inclusion of fruits/vegetables and animal-based food share increased calorie and protein intake whereas the intake of cereals and pulses declining. Thus, there was a need to include higher protein food such as pulses or protein-enriched cereals or cereal flours in the programmes. Also, there was a need to increase pulses production in the country as the international availability of pulses was limited. With the rising level of income, per capita, fat consumption was growing rapidly and the share of vegetable oil in the overall calorie intake increased necessitated large imports.

Carpena (2019) investigated the impact of drought on household food consumption and nutritional intake in rural India. The monthly total precipitation data were collected from 1900-2014. The consumer expenditure data was collected for rounds 60 to 64, 66 and 68. The nutrient conversion was done using a nutrient chart based on Gopalan, Sastri and Balasubhranian (1991) and various NSS Publications (NSS 2001,2003, 2007, 2012 and 2014) was used. The dry spells had a statistically significant and reverse effect on household nutrition. The households spent one percent lesser per capita per month on food and consume 1.4 percent fewer calories, proteins and fats. The dry shocks household rely more on cereals and purchase less high-value commodities i.e., vegetables, fruits, animal products. Rather than higher food prices, a fall in the household market and non-market income were the primary reasons for the lower household food consumption and nutrition during droughts.

Heshmati et. al (2019) conducted a study to analyse the determinants of household consumption expenditure and poverty in India using data from consumer expenditure surveys (50th, 55th, 61st and 66th rounds) by the National Sample Survey Organisation (NSSO). The impact of the characteristics (age, education level, marital status, and gender) and household characteristic (main occupation type, household size and social status) on monthly per capita consumption expenditure using conditional

mean least squares regressions and conditional quantile regressions was studied. The age's inverse U-shape's influence on consumption expenditure decreased as it moved up to the right side. The expenditure pattern of households revealed that single person had higher per capita expenditure levels than married and divorced/widowed people. The female-headed households had higher expenditure levels than male-headed households. Poverty alleviation had more prominent in urban than in rural areas in the last 20 years. They found that the backward classes and agricultural labour in rural areas, and casual labour in urban areas were vulnerable and required attention for poverty alleviation strategies.

2.3 Studies related to factors affecting food demand and projection of food demand

Meenakshi and Ray (1999) analysed India's food expenditure recognizing regional disparities in preferences and prices. The study attempted to provide evidence on disparities in expenditure patterns of India and estimation of demand using the Quadratic Almost Ideal Demand System. The study used the data from NSSO for 16 states for five rounds. The regional disparities in expenditure pattern implied that the nutrient enhancing programmes must recognise this diversity. The household size and composition, especially the number of children were the important determinants of household expenditure allocation among food items. Further, in policy application, the choices of the demand system were important in evaluating the impact of price and income changes on basic consumption and the formation of optimal tax systems.

Kumar and Dey (2004) conducted the study to examine the changes in fish consumption patterns in India. They had studied demand on a multi-stage budgeting framework and examined the demand elasticity for fish. In the first stage of the budgeting framework, households decided the allocation of total income on food commodities, conditionally on the consumption of non-food goods, household and demographic characteristics. In the second stage, the household allocated a portion of food expenditure to non-vegetarian food consumption. In the final stage, the household distributes total non-vegetarian food expenditure among fish, goat meat, poultry, eggs, etc. The responsiveness of demand for fish to changes in prices and income varied

across income classes, regions and with the level of urbanisation. The low expenditure groups were more sensitive to the price of fish than the higher expenditure (income) groups.

Kumar et al. (2005) analysed the demand for fish by species using the three-stage budgeting framework with the quadratic almost ideal demand system (QUAIDS). The study was carried out by conducting the household dietary-pattern survey in the states of Andhra Pradesh, Haryana, Karnataka, Uttar Pradesh, West Bengal and Orissa in the year 2002. The data on dietary pattern and fish consumption by species were collected from 591 and 569 fish-eating families in rural and urban areas respectively. The study showed that all the fish species under consideration had elastic demand and had positive income elasticity for all income levels, while the own-price elasticity was negative and unitary for all fish groups. The fish demand by 2015 was projected as 6.7-7.7 million tonnes and among all species, Indian Fish carps (IMC) dominated in meeting the fish demand.

Mittal (2006) studied the structural shift in demand for food with the projections for 2020 using data from consumer expenditure survey of the National Sample Survey rounds 38th, 43rd, 50th and 55th. The study showed that the lowest income group having expenditure below 75 per cent of the poverty line spent around two-thirds of their total expenditure on food and rich (above 150 per cent of the poverty line) around 50 per cent. The annual per capita consumption of foodgrains declined between 1983 and 2000 by 16.26 per cent. The consumption of vegetables and fruits, milk, meat, fish and eggs edible oil and sugar increased over the period.

Amarasinghe et al. (2007) assessed the changing consumption pattern of India and its implications on total crop demand in the future for the years 2025 and 2050. The direct grain consumption was declining while the non-grain product consumption in the daily diet increased in both rural and urban areas. They projected the increase in demand for the non-grain crops and animal products (dairy and poultry) with the increase in income and urbanization by 2050. The contribution of the grain products to the total calorie supply was projected to decline from 65 per cent in 2000 to 55 per cent and 48 per cent by 2025 and 2050, respectively. The total calorie supply would increase to

about 2770 and 3000 Kcal/person/day by 2025 and 2050, respectively. The feed demand was projected to increase from 8 mMt to 38 and 117 mMt by 2025 and 2050. Further, the demand for oil crops, vegetables and fruits would increase several times. Their study showed the need for the diversification of future agricultural production, especially to high- value non-grains crops.

Chand (2007) estimated demand for foodgrains by taking into consideration account population growth, the composition of the rural and urban population, growth in per capita incomes in rural and urban areas and change in taste and for the year 2020-21. The estimation for food demand was based on foodgrains demand consumed by the household at home in various forms (direct demand) and foodgrains used as feed, seed, and in industry and the quantity that goes waste (indirect demand). The projected direct demand for all cereals for food was 166.6 million tonnes by 2020-21 and total foodgrains was 179 million tonnes by 2020-21. Despite the dietary diversification involving a sharp decline in per capita direct consumption of foodgrains, the demand for cereals and pulses was projected to grow at about 2 per cent per year on account of the increase in population and growth in indirect demand. The growth rate was four times the growth experienced in the domestic production of foodgrains during the last decade.

Chand (2009) examined the demand for foodgrains during the 11th plan and towards 2020 and pointed out despite dietary diversification, there was a sharp decline in the per capita direct consumption of the foodgrains and demand for livestock products and fruits and vegetables has been gone up. The demand for cereals and pulses was projected to grow at about 2 per cent per year on account of the increase in population and growth in indirect demand. The demand for foodgrains was projected to be 179 million tonnes by 2020-21. The growth rate in domestic production of foodgrains failed to rise to the desired level and led to a decline in the export of rice and eventually increased dependence on import of wheat and rice and pulses for meeting domestic demand for foodgrains would occur.

Kumar et al. (2009) projected the demand for foodgrains for India for the years 2011-12, 2016-17 and 2021-22 by considering the factors like urbanization, regional

variations in consumption pattern, transformation in dietary pattern and income distribution, required energy, a shift in taste and preferences of consumers for food varieties. the national level demand estimates were based on the food characteristic demand system (FCDS). The per capita consumption of cereals was projected to decline from 139.9 kg in 2004-05 to 125.3 kg in 2011-12 and 122.6 kg in 2021-22. The seed, feed, industrial usage and wastage were projected as 36.9 Mt in 2012-13, 39.0 Mt in 2016-17 and 41.1 Mt in 2021.22 which was about 16 per cent of total foodgrains production in the country. The home away demand was also assumed to increase by 5 per cent of the total direct demand. Finally, they estimated that to meet the future demand the yield must increase by a minimum of 2.65 t/ha rice, 3.38 t/ha wheat and 0.85 t/ha for pulses by 2021-22.

Kumar et al. (2011) estimated demand elasticity for food commodities in India in the context of the structural shift in the dietary pattern of its population. The study revealed that consumers have shifted their budgetary allocation from cereals-based food towards high-value commodities like fruits and vegetables, milk, fish, meat and meat products, etc. The demand elasticities, worked out using two alternative models, namely QUAIDS and FCDS, these models were used to explain the food demand behaviour of the people. The study revealed that demand elasticities vary widely across income groups and food commodities. The estimated income elasticities found to vary across income classes and were lowest for cereal groups and highest for horticultural and livestock products.

Ganesh-Kumar et al. (2012) projected the future supply and demand up to the year 2025 for rice and wheat, two main cereals cultivated and consumed in India. The quadratic almost ideal demand system (QUAIDS) was used to model household demand. The model was estimated with data on the consumption of 11 major agricultural commodities from the 61st round of the NSSO for the year 2004-05. The demand elasticity for total food expenditure was negative for rice, wheat, and pulses, which had given the observed fall in the consumption of these commodities on a per capita basis over a fairly long period even as income level rose in the country. The forecasted total demand in 2025 for rice was in the range of 104.7-108.6 and and wheat in was 91.4-101.7 million tons, respectively.

Parvathi and Arulselvam (2013) examined agricultural production and food security in India. They found that foodgrains production had increased 4.5 times, horticulture 8 times, milk 6 times and fish 9 times in 2009-10 compared with production in 1950-51. The total demand for cereals was projected to 218.9 million tonnes by the end of the eleventh plan and it would reach 261 million tonnes for the year 2020-21. The demand for the pulses for the same period would grow to 16.1 and 19.1 million tonnes. The foodgrains demand was expected to grow 280.6 million tonnes by end of 2020-21.

Singh (2013) projected the demand for food commodities using data consumer expenditure from various rounds i.e., 43rd (1987-88), 50th (1992-93) and 61st (2004-05) for the estimation of the demand elasticities and demand projections. A multistage budgeting framework was used for demand analysis of various food commodities. The LA-AIDS was used to estimate the demand for different pulses. The total expenditure elasticities of demand for all the cereals were positive but very low in all the regions. The projected total demand for the cereals was 172 MT for 2010 under business as usual (BAU) and 190-195 MT and 209-220 MT for 2015 and 2020, respectively. The demand in rural areas was found to be more than urban due to high per capita cereal consumption and large population in rural areas. The projection for food commodities revealed that the supply-demand gap would widen even under moderate growth, which might further deteriorate the nutritional balance of consumers.

Srivastava et al. (2013) empirically revealed the difference in the consumption pattern of rural and urban households of India among geographical regions and income categories. The findings confirmed with Engel's law and Bennett's law of consumption. The expenditure elasticities of food were calculated using the LA-AIDS demand system. The expenditure elasticities of high-value agricultural commodities were higher than staple food. The inelastic demand was exhibited by cereals, but the study suggested that its total demand would be high due to an increase in population and high indirect demand (seed, animal feed, industrial demand waste, etc.). The wide interregional variations in the household demand for food commodities were observed which necessitates matching the demand and supply at the disaggregated level and to remove the bottlenecks in the production of food commodities in the respective region to fulfil

the demand. Thus, a strong need to improve productivity, control prices and strengthen the public distribution system and supply chain at the disaggregated level to fulfil the future demand was suggested.

Gandhi and Zhou (2014) examined the rise and transformation of food demand and the food security challenges in two large emerging economies of India and China. The data was collected from consumer surveys of the government of India and similarly from China. They found the transition in consumption towards animal products, fruits & vegetables and reduction in cereals. High-income elasticities of demand were seen for commodities such as animal products, processed food, and eating out from home in both rural and urban sectors. The supply did not match with the demand which led to high price inflation. Similarly, in China also the demand for high-value commodities, such as meats, dairy products and aquatic products increased strongly. Urbanisation had a significant impact. The various challenges included not only in managing the supply but also the supply chain, marketing, food safety and food processing.

Akhil and Prasad (2015) studied the food consumption and nutritional intake in the rural area of major states during 1993-94 to 2011-12 using NSSO data. They found that the state like Assam, Uttar Pradesh, Orissa and West Bengal lagged in terms of income growth which can be substantiated by their higher expenditure on food. Though the share of high-value commodities had increased, the rate of increase was not sufficient to surrogate for the decline in cereal consumption. In case, of nutrient intake, the states such as Tamil Nadu, Assam, Orissa were labelled as the protein deprived states in rural India. During 2011-12, there was a remarkable income growth, which led to the growth in average consumption of both calories and proteins, particularly among the poor and middle expenditure classes.

Felix and Kumar (2020) analysed the food demand in rural and urban households of Tamil Nadu using data 68th round of NSSO. The income and cross price elasticities were derived from Quadratic Almost Ideal Demand System model. The results for income elasticity revealed that the milk and vegetables were the necessary goods and luxury goods in urban households but meat was luxury in rural and necessary in urban households. The demand was more responsive to the own price changes in

meat, edible oils, and nuts in rural households and in urban households the own price elasticity was more responsive for milk, egg, vegetables, fruits, nuts and oils. The uncompensated cross-price elasticity showed that the milk and beverages were substitutes in both rural and urban sectors, likewise meat and egg in rural, milk and egg, fruits and nuts in urban households were substitutes. For the compensated price elasticity, nuts and oils in rural and urban households, and milk egg, vegetables and fruits in urban households were elastic to the price changes.

2.4 Studies related to nutrient intake

Dasgupta (1983) estimated the nutritional intakes and found that until the mid-1960s the nutritional deficiency was considered as the protein deficiency, mainly the deficiency of quality and animal foods. The study was carried for the year 1961-62, 1971-72, 1972-73 and 1973-74. using data from NSSO (National Sample Survey Organisation) and NIN (National Institution of Nutrition). The cereals were found to be the main source of calories. Income happened to be the major factor influencing the intake of the various nutrient and intake of calories and protein increased with the size of landholdings.

Amar et al. (1996) studied household food security, food consumption patterns and the quality of children's diet in a rural northern Ghana community. The study was conducted on 20 households in the northern region of Ghana. They found the mean daily intake was over-dependent on cereals and minimal on high-value commodities like animal products. The consumption of the vegetables varied across seasons i.e., low during the pre-harvest season, high during the post-harvest season. The nutrients intake was low in the region compared to the recommended dietary allowances, high during the post-harvest season. Diet quality was adversely influenced by a low intake of micronutrients derived mainly from plant sources as well as by poor dietary habits. To alleviate malnutrition along with food security focus should be made on dietary quality in conjunction with promoting appropriate dietary behaviour and national policies.

Huang and Lin (2000) estimated the food demand and nutrient elasticities from household survey data for the years 1955, 1965-66, 1977-78 and 1987-88. The data have been used to describe the food-consumption behaviour pattern and to assess the

nutritional content of diets. The AIDS model was used for demand estimation and the results showed that most unit values of each food category had a positive effect on the budget shares within categories. The estimates were statistically significant. The budget share of each food category was also affected by changes in per capita food expenditure. The budget shares of beef, other meat, egg, cereals, and bread decreased as total food expenditure increased, while the budget shares of poultry, fruits, vegetables and juice increased with the rise in expenditure. The significant estimates of food quality effects generated in the study showed significant role of food quality in household budget allocation, and is an important factor in modelling a food demand system from household survey data.

Musebe and Kumar (2002) investigated the dietary pattern and nutritional status of rural Households in Maharashtra using rural household consumer expenditure data of the 50th round (1993-94) of the National Sample Survey. The influence of the socio-economic factors on food and nutrient intake was studied and target groups for prioritization for the improvement of nutritional status were identified. The cereals were found the major source of nutrients with the supply of 68 percent for both calories and protein and 19 percent for fats. Pulses were the second major source of protein followed by milk and milk products. The increase in the income, land size, literacy and possession of milch animals led to the increase in diet diversification. The undernourishment was more for the landless, illiterate heads of household, scheduled castes and tribes. The improvement in the household nutritional status could carry out by enhanced agricultural technologies, literacy, dairy enterprises and increasing purchasing power of the poor.

Radhakrishna and Reddy (2004) examined food security and nutrition vision 2020. Between 1970-71 and 1997-98, the per capita cereals consumption declined by 0.72 and 0.74 per cent per annum in the rural and urban areas, respectively. The decline was prominent in Punjab and Haryana. The per capita expenditure at constant (1990-91) prices steadily increased since 1970 both in rural and urban areas. The increase was 1.5 per cent per annum in both the areas during the 1970_s and 1980_s and around 1.2 per cent per annum in rural areas and 2.8 per cent per annum in urban areas during the 1990_s. There was a chronic under-nourishment in about half of the population,

particularly among the vulnerable groups (children, women and elderly women). The expenditure spend on food was slowly going down even in the households with chronic under-nourishment. The under-nourishment in the bottom 30 per cent of the expenditure class was alarming. With the recent shift to more market-oriented and outward-looking macro-policies, the poor were likely to be exposed to the resultant risk of market uncertainties.

Deaton and Dreze (2009) examined the evidence on food intake and nutrition in India using data from 38th, 43rd, 50th, 55th, 61st (thick rounds) and 56th, 57th, 58th, 59th and 60th (thin round). The per capita consumption of calories and protein fallen in rural India and no trend was observed in urban India. The decline in per capita calorie consumption was accompanied by an increase in real average household per capita expenditure. The expenditure elasticity of cereal calories was lower than the total expenditure elasticity of all calories, depicting, a higher fraction of each rupee is spent on non-farm cereal calories than on cereal calories. Richer households allocated food expenditure differently from poorer, switching from cereals to fattier and sweeter foods like edible oils, meat and sugar. The expenditure on the calories was more for the households who spent more on total food. The child nutrition indicators revealed that from 1975-79 to 2004-05 there was a reduction of around 50 per cent in the prevalence of severe undernutrition in India.

Jha et al. (2009) computed nutrient- income elasticities for two macronutrients (calories and protein) and five micronutrients (calcium, thiamine, riboflavin, carotene and iron) using data from National Council for Applied Economic Research (NCAER) for January to June 1994. The consumer choices varied according to the taste of variety, whereas, the increase in income would increase nutrient intake by different amounts, but calorie intake was low but significant. The higher income itself could not bring substantially higher calorie intake among low-income households and that price intervention may not be more effective in achieving the objective. Thus, subsidised food distribution targeted to the poor under the Public Distribution System would improve nutritional status.

Nasurudeen et al. (2006) studied the trend in food consumption and nutrition in food security concerns. Between 1972-73 and 1999-2000, the nutrient intake, except for fat did not improve in both the rural and urban areas. The per capita calorie intake was decreased by 5.24 per cent in rural areas whereas it increased by 2.39 per cent in the urban areas for the period from 1972-73 to 1999-2000. Inequality in the consumption of calories, protein and fats between states as well as income classes given by the Gini coefficient showed a continuously decreasing trend. The Gini Coefficient indicated the state-wise disparity in calorie intake declined by 12.5 per cent between the 38th and 50th round for rural India whereas it raised by 16 per cent for the urban population indicating an increased inequality in the calorie consumption for the urban population in different states in India. The thrust of market intervention policy must shift to accelerating the production of non-cereal food items and also making both cereals and non-cereals food items available to the poor by improving their income.

Basu and Basole (2012) studied the calorie consumption puzzle in India and they found that over the past decades the average per capita calorie intake had declined even though the per capita monthly expenditure had increased over time. The panel data set of 28 states and the capital city Delhi over four time periods (1993-94, 1999-00, 2004-05 and 2009-10) was used in the study. Many explanations were given for the declining trend of the calorie intake including movements in relative prices, impoverishment of a large section of rural India, diversification of food consumption, a decline in calorie need and a squeeze of the food budget. But they found that despite the rising incomes in past decades, a steady increase in non-food essential expenditures had squeezed the food budget keeping it from increasing in real terms, further, stagnant food budget, declining home-grown consumption and diversification has led to a steady reduction in average calorie intake over time.

Kiresur and Chourad (2015) analysed the food consumption pattern in the rural and urban areas of Koppal district of Karnataka. The secondary data was collected from various reports of NSSO from 1993-94 to 2009-10. They had found that the monthly per capita expenditure (MPCE) on both food and non-food items together has been found double in urban areas as compared to the rural areas. The expenditure on the food items in rural areas was more as compared to non-food items which were

reverse in the urban areas. The consumption of the cereals was less and pulses was more in urban areas. The expenditure on the non-food items namely education, healthcare, insurance was found less compare to the satisfactory. Further, at Rs. 45.18 per day per capita, the optimal plan ensured the dietary requirements in terms of energy (2425 kcal), protein (80.2 g), fats (61.5 g), carbohydrates (366.1 g), minerals (15.0 g), and fibers (26.6 g) through the consumption of jowar, green gram, groundnut, palm oil, sugar, milk, brinjal, methi, pomegranate, potato and dry chili. Also, food security varied significantly across income groups.

Joshi et al. (2016) investigated the dynamics of food consumption and nutrient insecurity in India over the past three decades using the data from the consumption expenditure survey of NSSO for 1983-84 and 2011-12. A shift in the consumption of the food commodities from foodgrains towards high-value commodities was observed in both rural and urban sectors of the households. The level of diversity was varied with time, as the Simpson Index of diversity was higher during 2011-12 than 1983-84 for all the income groups of the households. Further, the nutrients intake had varied across the rural-urban divide and income status of households. The intake of nutrients calories, proteins and iron declined over the years. The estimated gap between RDA and real-time intake of calories and nutrients revealed a prevalence of nutrient deficiency in the country. The lower-income households had a higher level of calorie-intake gaps. Similarly, gaps in intake of other nutrients like, proteins, calcium and vitamin A was observed over the years particularly for low-income rural households. However, the population with under-intake of nutrients like fats, Iron and zinc has reduced over time, thus depicting the enhancement in nutritional outcomes for these nutrients.

Sangeetha et al. (2017) assessed the food consumption pattern and dietary pattern in Baghpat district of Uttar Pradesh during 2014-15 using body mass index (BMI) as one of the indicators of nutrition status. About 10 per cent men, 20 per cent women, 30 per cent boys and 35 per cent girls were found underweight and the remaining were overweight. The women were well informed about the nutrient status compared to men and Anganwadi workers were the key informants. The actual consumption of food groups was about 50 per cent less than the recommended dietary allowance (RDA) across all the category and pulses were more deficient in their

consumption. The Individual Dietary Diversity Score (IDDS) ranged from 7.6 to 8.0, women dietary score was found slightly less than men, similar was the case for children. Thus, production diversity could be the right strategy for enhancing nutritional security in rural areas.

Shadap and Pala (2017) examined the nutritional intake and consumption pattern in the state of Himachal Pradesh and Meghalaya using the 68th round of NSSO on consumer expenditure conducted in 2011-12. The per capita per diem intake of calories and protein was reported lowest for Meghalaya whereas Himachal Pradesh reported the highest intake. In respect of fat intake, Meghalaya ranked fourth from the bottom and Himachal Pradesh occupied the fourth position from the top after Punjab, Haryana and Delhi. It was also found that Meghalaya spent a higher percentage on food than Himachal Pradesh and the rest of India.

Shah et al. (2017) examined the trends and patterns in nutritional intake in India during 2004-05 and 2011-12 using the NSSO data. They found a slow, but steady decline in the consumption of calories and proteins, but the consumption of fat had been increasing both in rural and urban India. The states belonging to the north eastern region seemed to be lagging in terms of nutritional intake when compared to the national average. For protein, a relatively lesser number of states in the country had exhibited a positive trend during 2004-05 and 2011-12. In terms of calorie intake, about 39 per cent of the country's population remained undernourished. As compared to the increased food expenditure among rural and urban masses in the country, there was less than a proportionate increase in calories, protein and fat intake. Yet, a relatively higher propensity was witnessed to consume more of fat with the rise in food expenditure.

Khed and Saravanakumar (2019) assessed the nutrient intake and dietary diversity of the rural and urban households of Karnataka state. A multistage sampling technique was used to select the 160 rural and urban households. They found around 80 per cent of the households were nutritionally insecure and the intake of the both micro and macro nutrients was below the Recommended Dietary Allowances. The average daily intake of food items was 729.52 gram per consumer unit per day in rural areas and 725.88 g per consumer unit per day in urban area. The average daily per capita energy intake was higher in the rural area (2163.13 Kcal) compared to the urban area

(2003.75 Kcal). The great variation was observed in the monthly consumption expenditure of households across low and high-income households. In the rural areas around 17.50 per cent are nutrient secure and 20 per cent in urban households. The regression analysis showed that age, education, production diversity, income and food expenditure of the households have a positive and significant impact on the dietary diversity of households. They suggested a distributing subsidized nutritive food commodity and generating awareness about nutrition, etc. to improve nutritional security of households.

Minocha et al. (2019) examined the supply and demand of high-quality protein food in India. Over the decades the Indian diets and subsidy programmes were biased towards cereals, and only limited quality protein were offered. The inter-regional variation in dietary patterns reflected the risk of quality protein deficiency varying from 19 per cent to 49 per cent amongst different Indian states. The production and consumption of high-quality foods rich in proteins were vital for India's attempt to enhance diet quality. The demand for pulses and proteins expected to rise over the years hence, the policy should be made to increase the supply of such commodities. The eggs, fish and meat demand would not increase significantly. The focus was required to be put on agricultural and other food policies to shift from cereals towards stronger investment in pulses, dairy and egg production.

2.5 Summary comments on studies reviewed

Examination of the past studies showed that there has been a gradual transformation in the production and consumption pattern of agricultural commodities. The studies so far conducted were mostly at the national level and dividing the nation into different regions. Some studies have been conducted for the particular states of the nation. Few studies have been conducted for the state of Himachal Pradesh also. However, no study has been conducted so far for the study in the shift of production and consumption pattern together. Hence, the present study is conducted to examine structural changes in production and consumption pattern of agricultural commodities in Himachal Pradesh.



RESEARCH METHODOLOGY

This chapter deals with the sampling procedure employed, the nature and source of data, and various tools and techniques employed to accomplish the objectives of the study. A few concepts are explained to facilitate a clear understanding of the terms with which the present study is concerned.

The methodology is presented under the following major heads:

- 3.1 Sampling procedure
- 3.2 Nature and sources of data
- 3.3 Analytical tools and techniques

3.1 Sampling procedure

3.1.1 Selection of the study area

The study was conducted in Himachal Pradesh. There are 12 districts in the state. The state is selected purposively as it exhibits a wide variation in agro-climatic conditions, resource endowment, and diverse consumption pattern of agricultural commodities due to regional disparities.

3.1.2 Selection of districts

All the 12 districts of the state namely; Bilaspur, Chamba, Hamirpur, Kangra, Kinnaur, Kullu, Lahaul and Spiti, Mandi, Shimla, Sirmaur, Solan, and Una were selected to study distinct inter-district variations in food production due to the extreme climatic conditions, varied topography, change in production pattern, etc. The consumption pattern was studied for the rural and urban areas of the state.

3.1.3 Selection of agricultural commodities

To study the production pattern of the state the major agricultural commodities like rice, wheat, maize, total cereals, pulses, total foodgrains, fruits and vegetables were selected.

The major food commodities like cereals, pulses, milk and milk products (MMP), edible oils, non-vegetarian products like egg, fish, meat (EFM), vegetables, fruits, and other foods were selected to study the change in consumption pattern in the state.

3.2 The nature of data and their source

For attaining the results from various objectives of the study, secondary data was collected. To examine the changing production pattern of agricultural commodities over time and across regions district-wise time series data on area, production and yield of crops for the period 1991-92 to 2019-20 was collected from the various published and unpublished sources, Annual season crop report of Directorate of Land Records, Department of Agriculture and Directorate of Horticulture, Shimla, Himachal Pradesh.

The consumption pattern of agricultural commodities and nutrient intake was analysed temporally and spatially using household-level consumption data from the consumption expenditure survey conducted by the National Sample Survey Organization (NSSO). To study the temporal changes in consumption pattern data was taken from four rounds given below in Table 3.2.1.

Table 3.2.1 List of NSSO rounds selected for the study

Sr. No.	Round	Year
1.	43	1987-88
2.	50	1993-94
3.	61	2004-05
4.	68	2011-12

3.3 Analytical tools and techniques

Keeping in view the specific objectives of the study, the collected data was analysed using descriptive statistics along with the following analytical tools:

3.3.1 Production pattern of agricultural commodities

3.3.1.1 Cropping intensity

3.3.1.2 Simpson index of diversification

3.3.1.3 Compound annual growth rate

3.3.1.4 Coefficient of variation

3.3.2 Consumption pattern of agricultural commodities

3.3.2.1 Monthly per capita consumption

3.3.2.2 Share of food groups in total consumption expenditure

3.3.2.3 Simpson index of dietary diversity

3.3.3 Factors affecting demand, estimation of elasticity of agricultural commodities

3.3.3.1 Quadratic Almost Ideal Demand System (QUAIDS)

3.3.3.2 Projections of the demand for food commodities.

3.3.4 Change in dietary intake of nutrients

3.3.4.1 Nutritional security status

3.3.1 Production pattern of agricultural commodities

The production pattern of crops was analysed by comparing the share of a crop's area in the gross cropped area. The cropping intensity, Simpson's index of diversification (SID), compound growth rate, and coefficient of variation was estimated for each district as follows:

3.3.1.1 Cropping intensity

Cropping intensity was measured by using the following formula:

$$\text{Cropping Intensity (CI)} = \frac{\text{Gross Cropped area}}{\text{Net cropped Area}} \times 100$$

3.3.1.2 Simpson index of diversification

The Simpson Index of Diversification was used to compute crop diversity in the districts and state as a whole. A zero value of SID indicates specialization and its value approaches one with an increase in the extent of diversification.

$$SID = 1 - \sum_{i=1}^n \left(\frac{A_i}{GCA} \right)^2$$

Where,

A_i = Area under i^{th} crop

GCA = Gross cropped area

3.3.1.3 Compound annual growth rates (CAGR)

The Compound annual growth rate of area, production, and yield of crops were estimated as:

$$Y_t = AB^t$$

Where,

Y_t = area/ production/ yield of major crops in t^{th} period

t = time variable (1,2,3,...,n)

A = constant,

$B = (1+r)$

r = compound growth rate

After log transformation and estimation of the above function as:

$$\ln Y_t = \ln A + t \ln B$$

Compound growth rate was estimated as:

$$r = (\text{Antilog } B - 1) \times 100$$

3.3.1.4 Coefficient of variation

Coefficient of variation (CV) was calculated using the formula,

$$CV = \frac{\sigma_x}{\bar{X}} \times 100$$

Where,

σ_x = standard deviation of X

\bar{X} = mean of X

X = area/ production/ yield

3.3.2 Consumption pattern of Agricultural commodities

The consumption pattern was analysed temporally and spatially in Himachal Pradesh. The spatial consumption pattern of Himachal Pradesh was studied for the rural and urban areas.

3.3.2.1 Monthly per capita consumption

Monthly per capita consumption (consumption expenditure) for food groups was estimated using the following formula:

$$MPC = \frac{\sum_{i=1}^n C_i}{\sum_{i=1}^n f_i}$$

Where,

MPC = monthly per capita consumption (Kg)/expenditure (Rs.)

C_i = monthly consumption (Kg)/expenditure (Rs.)

n = number of households

f_i = family size of i^{th} sample household

3.3.2.2 Share of food groups in total consumption expenditure

Share of food groups in total consumption expenditure was calculated using the formula:

$$W_g^t = \frac{MPC_{Eg}^t}{\sum_{g=1}^m MPC_{Eg}^t} \times 100$$

Where,

W_g^t = share of g^{th} food group in total food consumption expenditure in the t^{th} period

MPC_{Eg}^t = monthly per capita consumption expenditure of g^{th} food group in the t^{th} period

g = number of food groups in the food basket.

The monthly per capita consumption of food commodities in quantity was calculated by converting all the food commodities into one unit i.e., Kg (Srivastava et. al. 2013). The conversion rates of various units to kilograms used are as follows:

1 litre milk= 1.03 kg, 1 egg = 0.055 Kg, 1 lemon= 0.033 kg, 1 banana= 0.1 kg, 1 green coconut= 0.25 kg, 1 orange= 0.125 kg.

Income categorization

Income category wise food consumption pattern was examined by dividing the household into four expenditure classes based on the poverty line. The households were classified as, very poor with the consumption expenditure of less than 75 per cent of the poverty line, poor with consumption expenditure below the poverty line up to 75 per cent of the poverty line, middle class with consumption expenditure ranging between poverty line up to 150 per cent of the poverty line, while the rich with the consumption expenditure of more than 150 per cent of the poverty line (Radhakrishna & Ravi, 1990; Kumar et al., 2011; Srivastava et al., 2013)

Choice of monetary variable

Both income and expenditure present advantages and disadvantages when it comes to using them as monetary variables for measuring poverty. The annual income reflects a household's economic capacity, but it only provides a partial view. Also, income can vary a lot from one year to the next without there being changes to living conditions. On the other hand, the expenditure variable is more stable as households do not modify their spending habits when there are occasional decreases in income. As the expenditure depends more on the concept of permanent income than on actual income. Thus, poverty is very closely linked to permanent income therefore it would be a good variable to measure it.

3.3.2.3 Simpson index of dietary diversity

The Simpson Index of Dietary Diversity (SIDDD) was used to measure the diversity in food consumption of the households. The index was put forward by Edward Simpson in 1949 for the measurement of species diversity (Simpson, 1949). The index

was further modified by Orris C. Herfindahl in 1950 for use in economic studies. Several studies on dietary diversity were conducted by Katanoda et al. 2006, Thiele and Weiss 2003, Parappurathu et al. 2015, Joshi et al. 2016, Khed and Saravanakumar, 2019 using this formula. Thus, dietary diversity was computed as:

$$SID = 1 - \sum_{i=1}^n P_i^2$$

Where,

SID= Simpson Index of diversity

P_i = proportion of the i^{th} food item in total monthly consumption of food items by members of the household.

3.3.3 Factors affecting demand, estimation of elasticity of agricultural commodities

3.3.3.1 Quadratic Almost Ideal Demand System (QUAIDS)

The demand structure and consumer behaviour have a significant role to play in the formulation of a wide range of development policies relating to food and nutritional security, food subsidy, sectoral and macro policies analysis. The variation in demand structure is based on a matrix of price and income elasticity of demand for goods. The demand elasticities reveal the likely effect of the changes in the prices and income of the food commodities. The income elasticity tells the impact of the income change on consumption of commodities, while the own price and cross-price elasticities explain the shift in consumption due to changes in the price of commodities and other related commodities.

The demand elasticity of food commodities was estimated using cross-sectional data pertaining to the 68th round of consumption expenditure survey conducted by the National Sample Survey Organization (NSSO) during 2011-12. The complete demand system takes into account the mutual interdependence of several commodities in the budget decision of the consumer and forecasts the demand after considering urbanization and distribution of income. Further, the demand system assumes no price

differences within clusters and, unit variations across households in the same cluster are only because of quantity differentials and measurement errors.

The various models available for demand estimation are Linear Expenditure System (LES) by Richard Stone (1954), Rotterdam model of Theil (1976) and Barnett (1969), and Translog model of Christensen et al. (1975).

In 1980, Deaton and Muellbauer have proposed a model for demand estimation which has been named as Almost Ideal Demand System (AIDS). The AIDS model gives an arbitrary first-order approximation to the demand system. Further, it satisfies the axiom of choice exactly. It aggregates perfectly over consumers without invoking parallel linear Engel curves. It has a functional form that is consistent with household budget data, it is simple to estimate in linear form. It can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters.

Quadratic Almost Ideal Demand System QUAIDS model is an extended form of the AIDS model, in which the assumption of linearity is given away. This model is quadratic in per capita expenditure under the assumption that there is a non-linear relationship between income and expenditure. Kumar et al. (2005), Mittal (2006), Mittal (2010), Kumar et al. (2011) have used the QUAIDS model to estimate the demand system. The equation for estimation in this study is the model developed by Ray (1983) and Poi (2012), where QUAIDS equation becomes:

$$w_i = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln p_j + \beta_i \ln \left\{ \frac{x}{a(p)} \right\} + \frac{\lambda_i}{b(p)} \left[\ln \left\{ \frac{x}{a(p)} \right\} \right]^2 + \alpha_{ihsize} + \varepsilon_i$$

where:

$w_i = p_i q_i / m =$ expenditure share of food commodities

$p_i =$ price paid for good i ; $q_i =$ quantity of good i consumed; $m =$ total expenditure on all goods in the demand system

$\ln p_j =$ the aggregate price of the j^{th} food group

$x =$ household expenditure for food commodities

$\ln(a(p)) =$ price index

$b(p)$ = price aggregator

hsize= household size

Adding up condition requires that, homogeneity and Slutsky impose the requirements that

$$\sum_{i=1}^k \alpha_i = 1, \quad \sum_{i=1}^k \beta_i = 0, \quad \sum_{i=1}^k \gamma_{ij} = 0, \quad \sum_{i=1}^k \lambda_i = 0,$$

$$\text{Homogeneity: } \sum_{j=1}^k \gamma_{ij} = 0; \quad \text{Slutsky symmetry: } \gamma_{ij} = \gamma_{ji}$$

The quads command imposes these conditions automatically.

1. Income elasticity

$$\mu_i = 1 + \frac{1}{w_i} \left[\beta_i + \frac{2\lambda_i}{b(p)} \left\{ \ln \left(\frac{x}{a(p)} \right) \right\} \right]$$

2. Price elasticity (uncompensated)

$$\varepsilon_{ij}^{NC} = \frac{1}{w_i} [\gamma_{ij} - \mu_i (\alpha_j + \sum_{k=1}^n \lambda_{jk} \ln p_k) - \frac{\lambda_i \beta_i}{b(p)} \left\{ \ln \left(\frac{x}{b(p)} \right) \right\}^2] - \delta_{ij}$$

3. Compensated price elasticity

$$\varepsilon_{ij}^C = \varepsilon_{ij} + \mu_i w_j$$

Where,

μ_i = income elasticity

ε_{ij} = price elasticity

γ_{ij} = parameter of food prices

β_i, λ_i = linear and quadratic parameters of income

w_i = average share of food expenditure

δ_{ij} = the delta Kronecker is zero for own price ($i=j$) and worth for cross-price ($i \neq j$)

3.3.3.2 Projections for the demand for food

The demand for the food commodities will be projected for the year 2025 and 2030 using the following expression:

$$D_t = d_0 * N_t (1 + y * e)^t$$

Where,

D_t = household demand for commodities in the base year

d_0 = per capita demand of the commodities in the base year

y = growth in per capita income

e = expenditure elasticity of demand for the commodity

N_t = the projected population in year t .

The household food demand is primarily driven by growth in population, income, and change in income distribution (Kumar, 1997). The data on the population projection was collected from the Report of population Projection, Ministry of Health and Family Welfare, Government of India (2019).

3.3.4 Change in dietary intake of nutrients:

To estimate the nutritional intake data on the consumption pattern of the households is required. The intake of the calories, proteins, and fats was estimated for the 50th (1993-94), 61st (2004-05) and 68th (2011-12) rounds. Thus, the quantities of food recorded as consumed by the household were converted into equivalent amounts of calorie, protein, and fat on basis of the Nutritional Chart, which gives the energy, protein and fat content per unit of different foods in the Indian diet. The percentage share and tabular analysis was used to accomplish this objective.

3.3.4.1 Nutritional security status

Security Ratio was used to analyse the nutritional security status of the households, which was computer by ratio of the energy intake to Recommended Dietary

Allowance (RDA) for energy as recommended by ICMR, 2010. The categorization of the households into nutritionally secure status was done in the following manner:

1. If the ratio was greater than or equals to one, then the households were “nutritionally secure”
2. If the ratio was less than one, then the households were “nutritionally insecure”. These nutritionally insecure households were further grouped into three sub-categories as:
 - i. Mildly insecure: security ratio ranging from 0.80 to 0.99
 - ii. Moderately insecure: security ratio ranging from 0.50 to 0.70
 - iii. Severely insecure: security ratio less than 0.50.

The security ratio was calculated by Kiresur and Raghavendra, 2015; Nazni and Vimala, 2010; Khed and Saravanakumar, 2019.



DESCRIPTION OF THE STUDY AREA

Description of the study area provides a synthesised knowledge of the area thus helps to get better insight into the research problem and improve the concluding remarks of the results. This chapter provided the agro-economic information of the Himachal Pradesh such as general profile, geographical location, agroclimatic conditions, land utilization pattern and irrigation status which will enable to understand production and consumption pattern of the state. The chapter is divided into three parts:

- 4.1 Profile of Himachal Pradesh
- 4.2 Agroclimatic features and soils
- 4.3 Economic profile of Himachal Pradesh

4.1 Profile of Himachal Pradesh

Himachal Pradesh also known as Dev Bhoomi lies in the lap of the Himalayas. The state is an agrarian state, where more than 85 per cent of the population lives in rural area and depends on agriculture for income, employment and food security. After Independence, 30 erstwhile princely states of Punjab and Shimla hills were merged and Himachal Pradesh was formed on 15th April, 1948 as a Chief commissioner Province of Indian Union. Initially, there were four districts viz., Chamba, Mahasu, Mandi and Sirmaur. The state was made a full-fledged State on 25th January, 1971.

4.1.1 Geographical Location

Himachal Himalaya extends from the Shivalik hills in the south to the great Himalaya range, including a slice of Trans-Himalaya in the north between 30° 22' 40'' to 33° 12' 20'' North latitude and 75° 45' 55'' to 79° 04' 20'' East longitude. The state is wholly mountainous with altitude varying from 300 meters in plains of Kangra and Una to nearly 7,000 meters above mean sea level in central Himalayan range of Lahaul Spiti. The state covers total geographical area of 55,673 Sq. km, which is about 1.16 per cent of India's total area.



Fig 4.1: Location of Himachal Pradesh in India



Fig 4.2: Map of districts of Himachal Pradesh

4.1.2 Topography

According to the elevation and slope, the state has been grouped into four distinct topographical regions. These are:

4.1.2.1 Shiwalik Hills

4.1.2.2 Mountains- Lesser Himalaya, Greater Himalaya and Trans Himalaya

4.1.2.3 Valleys – Shiwalik dun valleys, Fluvial, and glacio-fluvial valleys

4.1.2.4 Mountain Passes.

4.1.2.1 Shiwalik Hills: The outermost ranges separating Himachal Himalaya from the Punjab plain. The altitude ranges from 600 to 1200 m AMSL. These are the youngest of the Himalayan ranges and are made up of tertiary sediments consisting of sand, clay and boulder conglomerates brought down by the rivers from the main Himalayan ranges situated further North.

4.1.2.2 Mountains: The mountains of Himachal Pradesh are classified into three categories:

- a. **Lesser Himalaya:** These are middle Himalaya located North of Shiwalik range. They are about 60-80 km wide and 1000-4000 m high and several peaks rise to nearly 5000 m and remain snow-covered almost throughout the year. Lesser Himalaya consists of a number of smaller ranges like Dhauladhar, Pir Panjal, Churdhar, and Shimla ranges but its not continuous range like Shiwalik hills.
- b. **Great Himalaya:** The inner Himalaya is the highest mountain range that runs along the northeastern border of Himachal Pradesh, through Lahaul, Spiti, and Kinnaur districts. Most prominent in eastern section of the state, particularly in the southern part of Spiti. For rivers like the Chandra, the Bhaga, the Baspa and the Spiti the source of water are the glaciers of these Himalayas.
- c. **Trans-Himalaya:** The cold arid region of Kinnaur, Lahaul and Spiti lies beyond the almost inaccessible snow-covered great covered Great Himalayan ranges. The average elevation of the Trans-Himalayan is over 3,000 m. The monsoon winds cannot reach this region; thus, it is cold and

arid region is cold and arid because the monsoon winds cannot reach here. Zaskar range separates Spiti and Kinnaur from Tibet and is the most prominent range of the Trans-Himalaya.

4.1.2.3 Valleys: The valleys of state are divided into following categories:

a. Shiwalik duns

b. Fluvial, glacio-fluvial valleys of outer, inner, and greater Himalayas:

The Kangra valley is the most prominent valley of outer Himalaya. It is located between the north of the Dhauladhar range and Shiwalik in the south.

4.1.2.4 Mountain Passes: Himachal Pradesh, is a hilly state and is bounded on many sides by high hills and there are several inhabited valleys enclose around by high mountains.

4.1.3 Administrative profile

The administrative information of the state is presented in Table 4.1.1. The state is divided into three divisions and 71 sub-divisions. Further the state is divided into 12 districts and has 169 tehsils in the state, 80 development blocks, 3226 panchayats. The has 206990 villages and 59 towns and cities.

Table 4.1.1 General information about Himachal Pradesh

Sr. No.	Description	Particulars
1.	Divisions	3
2.	Sub-divisions	71
3.	Districts	12
4.	Tehsils	106
5.	Sub-tehsils	63
6.	Development blocks	80
7.	Villages	20690
	Inhabited Villages	17882
	Un Inhabited Villages	2808
8.	Towns and cities	59
9.	Panchayats	3226
10.	Zila parishad	12
11.	Nagar Nigam	2
13.	No. of Parliament constituency	
	Lok Sabha	4
	Rajya Sabha	3
14.	No. of Assembly constituency	68

Source: Department of Economics and Statistics, GoHP, Shimla

4.1.4 Demographic profile

The details of the demographic profile are presented in table 4.1.2. The state has total geographical area of 55673 Sq. Km. Around 68.64 Lakhs is the total population of the state, of which, 34.82 Lakhs is male population and 33.82 Lakhs is female population. The rural population of the state is the 90 per cent of the total population and remaining 10 per cent resides in the urban areas. The growth in the population of the state is presented in the Fig 4.3.

Table 4.1.2 Demographic profile of Himachal Pradesh

Sr. No.	Description	Particulars
1.	Geographical area (Sq. Km.)	55673
2.	Population (Lakhs)	68.64
	Males (Lakhs)	34.82
	Females (Lakhs)	33.82
	Rural (Lakhs)	61.75
	Urban (Lakhs)	6.89
3.	Density (Per Sq. Km.)	123
4.	Sex ratio (females per 1000 males)	972
5.	Birth rate (per 1000)	22.1
6.	Death rate (per 1000)	7.2
7.	Literacy rate (%)	82.80
	Male (%)	89.53
	Female (%)	75.93

Source: Economic Survey 2019-20, GoHP, Shimla

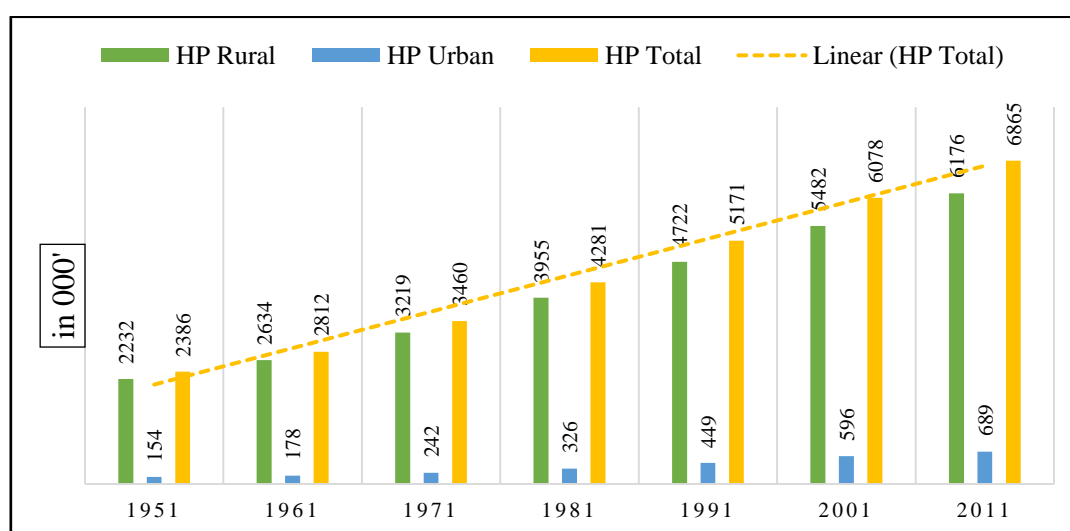


Fig 4.3: Rural and urban population of Himachal Pradesh

4.1.5 Land use pattern

The district wise geographical area in state is presented in Table 4.1.3 and district wise land use pattern is presented in Table 4.1.4. The state has the total geographical area of 55673 Sq. Kms. The district Lahaul & Spiti has the maximum geographical area of 13835 Sq. Km. followed by districts of Chamba (6528 Sq. Km) and Kinnaur (6401 Sq. Km.). The forest area of the state is 1125.37 thousand ha which is 24.58 per cent of the total reported area. The cultivable waste land is 121.71 thousand ha and current fallow land is 55.75 thousand ha. The area under non-agricultural uses is 352.41 thousand ha and maximum is in district of Kinnaur (121.86 thousand ha). The net sown area of the state was 547.56 thousand ha which is 11.96 per cent of the total cropped area. The net sown area is highest in Kangra district is 116.80 thousand ha followed by Mandi (90.80 thousand ha) and Shimla (70.52 thousand ha). The state has 411.67 thousand ha of area sown more than once, which is maximum in Kangra (123.12 thousand ha).

Table 4.1.3: District wise geographical area in Himachal Pradesh

Sr. No.	District	Area (Sq. Kms)
1.	Bilaspur	1167
2.	Chamba	6528
3.	Hamirpur	1118
4.	Kangra	5739
5.	Kinnaur	6401
6.	Kullu	5503
7.	Lahaul & Spiti	13835
8.	Mandi	3950
9.	Shimla	5131
10.	Sirmaur	2825
11.	Solan	1936
12.	Una	1540
13.	Himachal Pradesh	55673

Table 4.1.4: District wise land use pattern of Himachal Pradesh (2016-17)

(in 000' ha)

Districts	Total reported area	Area under forest	Area under non-agricultural uses	Barren & unculturable land	Permanent pasture & other grazing land	Land under misc. tree crops & groves not included in net area sown	Culturable waste land	Other Fallow lands	Current fallow land	Net area sown	Cropped area	Area sown more than once
Bilaspur	111.78	13.80	17.18	3.34	39.58	0.13	5.43	0.96	1.54	29.82	55.51	25.69
Chamba	692.42	272.01	13.65	4.85	350.88	0.13	6.63	0.63	1.78	41.86	69.78	27.91
Hamirpur	110.22	18.23	12.47	13.85	11.45	-	12.10	1.94	5.33	34.84	69.04	34.20
Kangra	577.68	231.52	75.08	19.76	84.37	7.47	27.19	1.38	14.11	116.80	239.92	123.12
Kinnaur	624.20	38.59	121.86	130.84	319.57	0.23	3.18	0.12	1.55	8.26	10.63	2.37
Kullu	65.48	1.63	7.12	2.73	7.08	3.63	2.21	0.45	4.16	36.47	55.55	19.07
L & S	911.20	137.38	16.86	541.31	211.44	0.11	0.57	0.01	0.13	3.40	4.24	0.84
Mandi	398.89	178.81	22.16	2.85	94.64	0.16	5.41	1.65	2.41	90.81	161.89	71.08
Shimla	525.33	150.35	18.72	12.15	235.76	7.64	10.74	7.16	12.29	70.52	86.88	16.36
Sirmaur	224.76	48.22	12.97	6.41	57.51	38.31	13.80	2.01	5.48	40.07	74.89	34.82
Solan	180.95	20.22	13.53	11.24	79.32	1.06	12.94	2.80	3.93	35.91	55.56	19.66
Una	154.85	14.63	20.81	29.67	16.36	7.72	21.53	2.25	3.07	38.81	75.35	36.54
HP	4577.74	1125.37	352.41	779.00	1507.97	66.60	121.71	21.37	55.75	547.56	959.22	411.67

4.2 Agroclimatic features

The great diversity in relief, elevation variation and geographical location of Himachal Pradesh has given the diverse climatic conditions to the state. The climate of the state is from hot and sub-humid tropical in the southern tracts. In northern and eastern mountain ranges it is cold, alpine and glacial. The state geographically located roughly within the 30° North latitude, which corresponds to the warm temperate zone of Mediterranean region, but the high Himalayan mountain ranges and the southwest monsoons play an important role in modifying the climate. The factors like altitude modify the climate into a mountainous type, while southwest monsoon winds make it more humid than the Mediterranean type of climate.

4.2.1 Agroclimatic zones

Agro-climatically the state is divided into four zones based on topography, rainfall and altitude

4.2.1.1 Shivalik Hill Zone (Sub Tropical Mountain and Low Hills): The climate is Sub Tropical, consists of foothills and valley area ranging from 240 meters to 1000 meters above mean sea level. The zone comprises of upland part of Chamba, Kangra, Hamirpur, Solan, Sirmour and Bilaspur. About 35 per cent of the geographical area and 33 per cent of the total cultivated area of the state comes under this zone. The major crops cultivated are wheat, maize, paddy, Gram, sugarcane, Mustard, Potato, vegetables, pulses and barley.

4.2.1.2 Mid Hill Zone (Sub Humid Mid Hills): The climate is mild temperature and extended upto 1001 meters to 1500 meters above mean sea level and comprising of parts of Chamba, Kangra, Mandi, Solan, Shimla and Sirmour. The zone occupies around 32 per cent and 53 per cent of the total geographical area and cultivated area of the state, respectively. The main crops grown in the zone are wheat, maize, barley, paddy, black gram, beans, etc. The climate of this zone is very suitable for cultivation of cash crops like off-season vegetables, ginger and production of quality seeds of temperate vegetables like cauliflower and root crops.

4.2.1.3 High Hill Zone (Wet Temperate High Hills): This zone has humid temperate climate and extends from 1501-2500 meters above mean sea level. The zone comprising of parts of Chamba, Kangra, Mandi, Sirmaur district and inner most of Shimla and Kullu districts. Out of the 35 per cent of geographical area covered by this zone 21 per cent is the cultivated land. Wheat, barley, lesser millets, buckwheat and amaranthus (pseudo-cereals), maize, and potato etc. are the major crops grown in this zone. The zone is suited for the production of quality seed potato and temperate vegetables.

4.2.1.4 Cold Dry Zone (Dry Temperate High Hills): This zone of the state lies about 2500 meters above mean sea level. It comprises of entire Lahaul Spiti and parts of Kinnaur, northern part of Kullu and Pangi Tehsil of Chamba district. The zone occupies 8 per cent geographical area and only 3 per cent area is cultivable. The zone suitable for cultivation of crops like wheat, barley, pseudo-cereals like buckwheat and amaranthus. It is ideally suited for the production of quality seed potato, temperate and European type of vegetables and their seeds, seed potato, and peas.

Table 4.2.1: Agroclimatic zones of Himachal Pradesh

Sr. No.	Agro-climatic zones	Areas	Altitude (m)	Rainfall (mm)
1.	Sub-mountain low hills sub-tropical (zone-I)	Una, Bilaspur and Hamirpur Districts and parts of Sirmaur, Kangra, solan and Chamba districts	Upto 650	1100
2.	Mid-hills sub-humid (zone-II)	Palampur and Kangra tehsil of district Kangra, Rampur tehsil of Shimla districts and parts of Mandi, Kangra and Sirmaur districts	651-1800	2200
3.	High hills sub temperate wet (Zone- III)	Shimla district (except Rampur tehsil) parts, of Kullu, solan, Chamba, Mandi, Kangra and Sirmaur Districts	1800-2200	1000
4.	High hills Temperate dry (Zone-VI)	Kinnaur, Lahaul & Spiti district and parts of Chamba districts	Above 2200	Snow fall

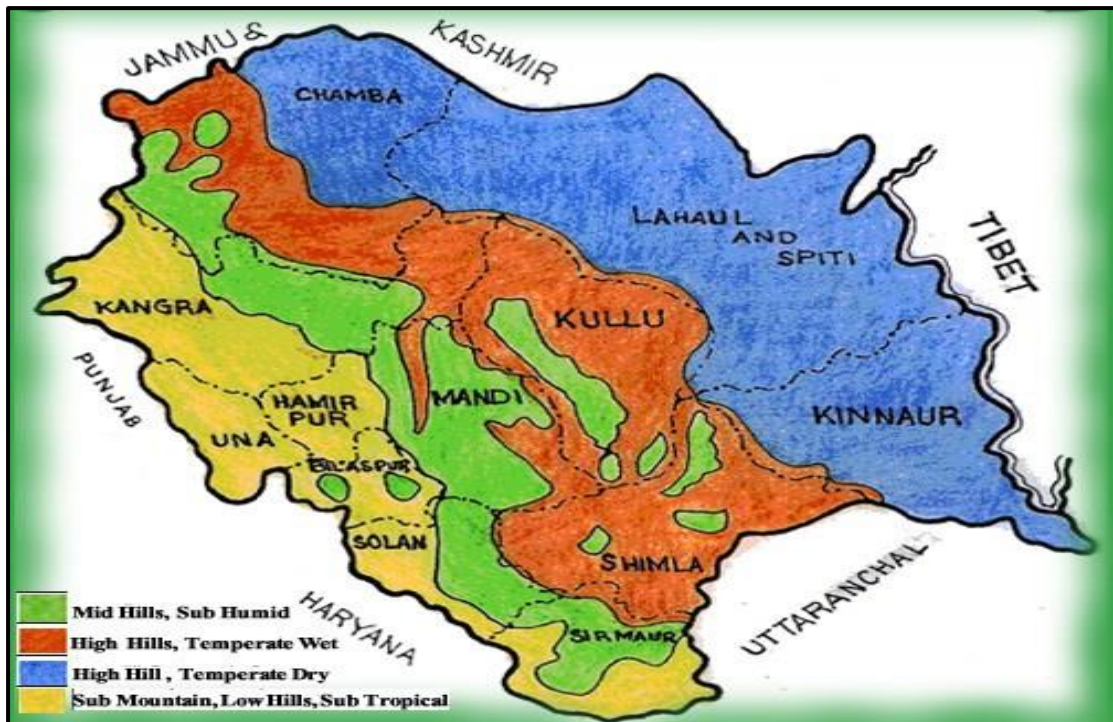


Fig 4.4: Map of Agro-climatic zones of Himachal Pradesh

4.2.2 Soils

The soils of the state are broadly divided into nine groups on the basis of their development and physio-chemical properties. These are:

- i. Alluvial soils
- ii. Brown hill soil
- iii. Brown earth
- iv. Brown forest soils
- v. Grey wooded or podzolic soils
- vi. Grey brown podzolic soils
- vii. Planosolic soils
- viii. Humus and iron podzols
- ix. Alpine humus mountain speletal soils.

The soils like brown, alluvial and grey brown podzolic are found in the districts of Mandi, Kangra, Bilaspur, Una, Solan, Hamirpur and Sirmaur. The grey wooded podzolic soils are found in Kullu and Shimla, while Kinnaur, Lahaul and Spiti and some parts of Chamba district have humus mountain speletal soils.

4.3 Economic Profile of Himachal Pradesh

Economy of the Himachal Pradesh vitally depends upon the agriculture and allied sectors. The growth rate of the state was 7.1 per cent during 2018-19 as against 6.8 per cent during previous year. Over the years the state GSDP has increased from Rs. 1.14 trillion to Rs. 1.65 trillion as presented in Fig 4.5. The per capita income at the current prices raised by 11 per cent as it increased to Rs. 1,83,108 in 2018-19 from Rs. 1,65,025 in 2017-18 and by 6.63 per cent during 2019-20 from previous year. (Fig 4.6)

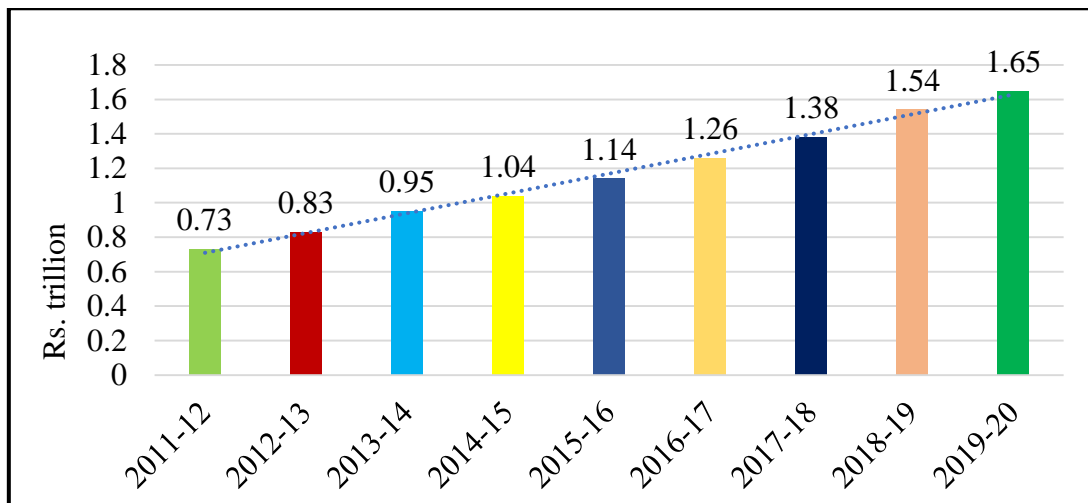


Fig 4.5: Gross state domestic product of Himachal Pradesh at current prices (Rs. Trillion)

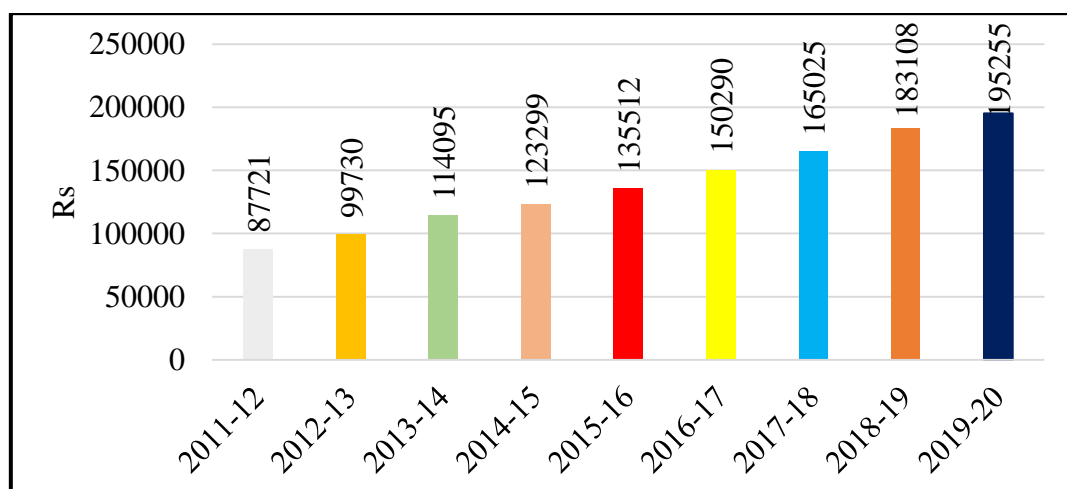


Fig 4.6: Per capita income of Himachal Pradesh at current prices

The economic growth in the state is governed by the agricultural activities but over the years economy has shifted from agricultural sector to industrial sector and service sector. The contribution of the agriculture sector in the total State Domestic Product declined from 57.9 percent in 1950-51 to 55.5 per cent in 1967-68, 26.5 per cent in 1990-91 and to 8.4 per cent in 2018-19 and the share of the industrial and services sectors increased with time. Fig 4.7 presented the decline in the contribution of the primary sector in GSVA from 17.16 per cent during 2011-12 to 13.22 per cent in 2019-20 whereas, the contribution of the tertiary sector has increased by from 39.06 per cent (2011-12) to 43.88 per cent (2019-20).

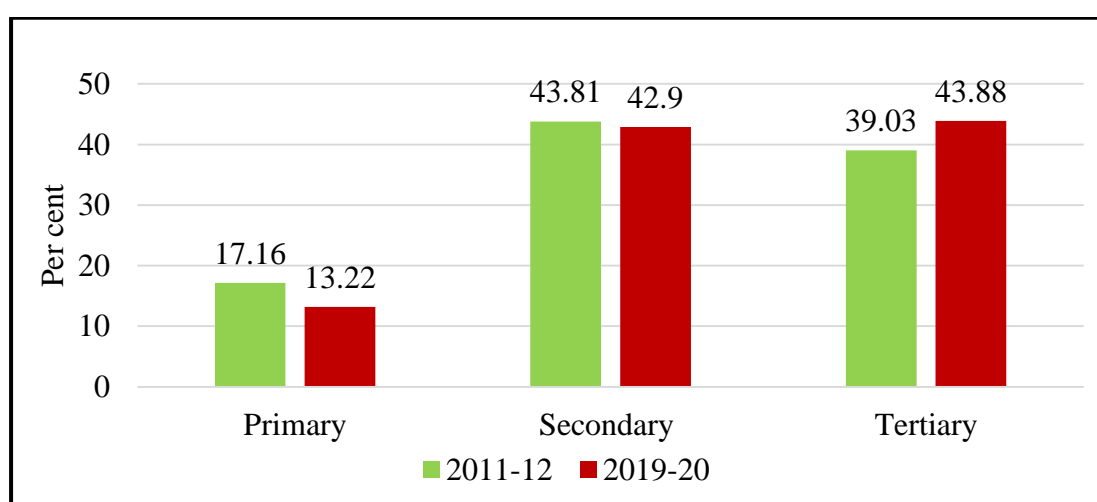


Fig 4.7: Sector wise distribution of Gross State Value Added (GSVA) in Himachal Pradesh

The annual growth rate of the different sectors at constant prices has shown a varying trend over the years as presented in Fig 4.8. The agriculture and allied sectors performed well from 2000-01 to 2005-06 and thereafter, the annual growth has declined and it declined maximum to -10.2 per cent during 2009-10, further for the recent years also it has been declining.

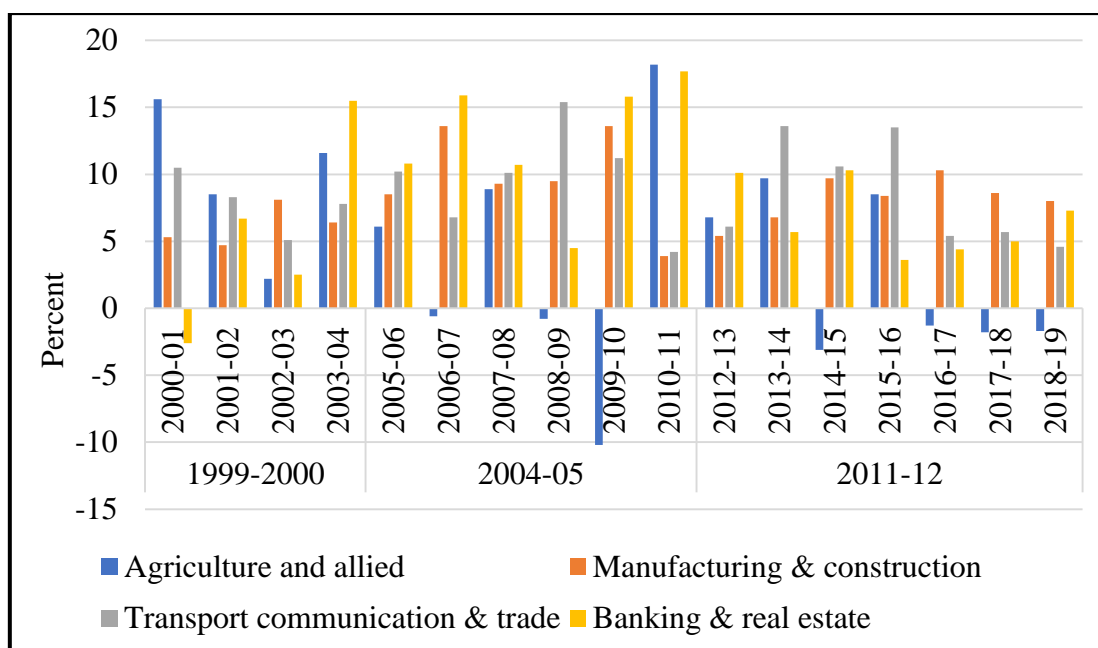


Fig 4.8: Annual growth rate of Gross State Domestic Product (GSDP) at constant prices (per cent)

4.4 Distribution of land holdings

The size of land holdings gives an over view about the status of agriculture sector. Table 4.3.1 presents the size and distribution of land holdings in Himachal Pradesh. The area of operational holdings in the state is 9.55 lakh hectares being operated by 9.61 lakh farmers. The average size holding according to 2010-11 agricultural census was about one hectare. The total number of holdings are 9.61 lakh out of which the holdings under marginal farmers is 6.70 lakh followed by small farmers, semi-medium farmers and medium farmers i.e., 1.75 lakh, 0.85 lakh, and 0.28 lakh, respectively. Whereas, the holdings under large farmers are 0.03 lakh. Hence, marginal and small farmers constitute about 88.54 per cent of land holdings. Further, Table 4.3.2 present the number and size of holdings in the different districts of the state. The number of land holdings were maximum in the Kangra district which is 24.55 per cent of the total land holdings in the state followed by the Mandi (16.06 %) and Shimla (11.45 %).

Table 4.3.1: Size and distribution of operational holdings in Himachal Pradesh

Sr. No.	Distribution	In Lakh	1990-91	2010-11	% change in 2010-11 over 1990-91	Avg. size of holding (ha)
1.	Marginal (< 1 ha)	Number	5.32(63.79)	6.7(69.78)	25.99	0.41
		Area	2.15(28.63)	2.73(28.63)	27.27	
2.	Small (1 - 2 ha)	Number	1.66(19.9)	1.75(18.17)	4.92	1.39
		Area	2.35(23.27)	2.44(25.55)	3.74	
3.	Semi-Medium (2 - 4 ha)	Number	0.94(11.27)	0.85(8.84)	-9.63	2.72
		Area	2.58(25.54)	2.31(24.14)	-10.54	
4.	Medium (4 - 10 ha)	Number	0.36(4.32)	0.28(2.87)	-22.91	5.61
		Area	2.05(20.3)	1.57(16.39)	-23.75	
5.	Large (>10 ha)	Number	0.06(0.72)	0.03(0.34)	-40.78	17.00
		Area	0.97(9.6)	0.51(5.29)	-47.97	
6.	Total All Sizes	Number	8.34	9.61	15.23	1.00
		Area	10.1	9.55	-5.46	

Table 4.3.2: District wise number and area of operational holdings (2010-11)

Sr. No.	District	Number	Area (000'Ha)
1.	Bilaspur	57422 (5.98)	50.66 (5.31)
2.	Chamba	70630 (7.35)	54.91 (5.75)
3.	Hamirpur	76140 (7.92)	73.50 (7.70)
4.	Kangra	235904 (24.55)	201.86 (21.14)
5.	Kinnaur	10757 (1.12)	14.23 (1.49)
6.	Kullu	74444 (7.75)	41.64 (4.36)
7.	Lahaul & Spiti	4274 (0.44)	6.74 (0.71)
8.	Mandi	154302 (16.06)	127.05 (13.31)
9.	Shimla	110005 (11.45)	117.94 (12.35)
10.	Sirmaur	50721 (5.28)	99.22 (10.39)
11.	Solan	53456 (5.56)	86.62 (9.07)
12.	Una	62710 (6.53)	80.29 (8.41)
13.	Himachal Pradesh	960765 (100.00)	954.65 (100.00)

4.4 Irrigation status

The irrigation facilities area provided to the farmers of the state from the different sources such as canals, tank, tube well, other wells, and other sources including Kuhl etc. Kuhls are the traditional irrigation system in the state in which the surface channels diverts water from the natural flowing streams. About 2.76 per cent of the irrigation in the state is carried out by canals, 16.44 per cent by tube well, 3.10 per cent by other wells and around 78 per cent of the irrigation in the state is done by the other sources.

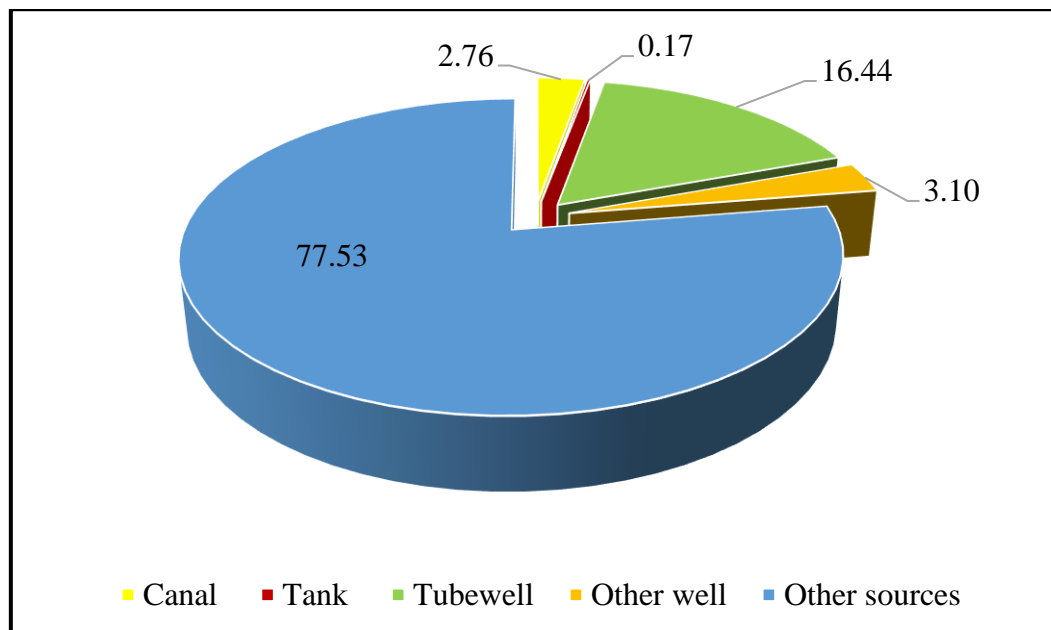


Fig 4.9: Source-wise irrigated area in Himachal Pradesh

Table 4.3.3 presents the district wise net irrigated and gross irrigated area in the state. The net irrigated area in the state was 96197 ha during 1991-92 which increased by 2 per cent during 2016-17 to 114381 ha. the gross irrigated area in the state has increased by 20 per cent over the years in the state. The maximum areas under irrigation in state was increased una district i.e., 17 per cent net irrigated and 196 per cent gross irrigated areas followed by Bilaspur district.

Table 4.3.3: District wise change in net irrigated and gross irrigated area in Himachal Pradesh**(000' ha)**

Sr. No.	Districts	Net irrigated area			Gross irrigated area		
		1991-92	2016-17	% change	1991-92	2016-17	% change
1.	Bilaspur	2.89	6.82	13.62	5.68	7.38	29.8
2.	Chamba	5.25	3.55	-3.24	6.33	6.74	6.45
3.	Hamirpur	1.77	1.73	-0.18	3.22	3.61	12.17
4.	Kangra	31.91	35.69	1.18	62.85	71.80	14.24
5.	Kinnaur	4.19	5.47	3.07	5.05	6.35	25.68
6.	Kullu	2.25	2.68	1.90	2.73	3.04	11.22
7.	Lahaul & Spiti	3.15	3.40	0.80	3.23	3.17	-1.78
8.	Mandi	10.79	12.69	1.76	25.67	25.36	-1.18
9.	Shimla	4.48	2.56	-4.30	7.33	3.39	-53.78
10.	Sirmaur	14.38	14.81	0.30	25.97	27.48	5.82
11.	Solan	9.55	9.67	0.13	15.86	23.85	50.4
12.	Una	5.60	15.31	17.33	8.47	25.10	196.3
13.	Himachal Pradesh	96.20	114.38	1.89	172.40	207.27	20.23

Concluding remarks

This chapter presented the complete picture of the Himachal Pradesh state. Over view oof the state including geographical features, number of districts, administrative divisions, blocks and villages, total population including rural and urban population was presented. The land utilization pattern of the state revealed the forest area, net sown areas and total cropped areas of the state. The detail description of the agroclimatic zones has been presented in this chapter. The economic profile of the state was also presented in this chapter which revealed the shifting trend of the state from the primary sectors towards secondary and tertiary sectors. The irrigation status also showed that the irrigated area in the state has increased over the years.

Further, it can be concluded from this chapter that the economy of the state is predominantly agrarian and 80 per cent of the population is rural and most of the farmers are marginal and small.



RESULTS AND DISCUSSION

This chapter is devoted to the presentation of the results and discussion of the empirical findings of the study according to the objectives stated in chapter I followed by the economic interpretation. Both descriptive statistics and production function approach were used as analytical tools in this study. The whole chapter has been broadly divided into the five sections as follows:

5.1 Production pattern of agricultural commodities

In this section, an attempt has been made to show the shift in the production pattern of the agricultural commodities over the years and across the districts in the state from traditional cereals production towards high-value commodities production. The variation in the land use pattern, changes in the cropping pattern and cropping intensity have been discussed in this chapter. The trends in area, production and productivity of the major agricultural commodities along with their growth rates were studied in this chapter. This section has been presented under the following headings:

5.1.1 District wise net cropped and gross cropped area in Himachal Pradesh

5.1.2 District wise cropping pattern in Himachal Pradesh

5.1.3 District wise cropping intensity in Himachal Pradesh

5.1.4 Spatial and temporal changes in area, production and productivity of agricultural commodities

5.1.5 Compound annual growth rate and coefficient of variation of area, production and productivity of agricultural commodities

5.1.6 Diversification of agricultural commodities

5.2 Changes in consumption pattern of agricultural commodities

In this section, the transformation in the consumption pattern of the households across the income-groups and sectors has been studied. The change in the monthly consumption expenditure in terms of value and quantity of households has been discussed over the years. This section has been presented under the following heads:

5.2.1 Consumption expenditure in Himachal Pradesh

5.2.2 Households budget allocation in Himachal Pradesh

5.2.3 Share of food commodities in food expenditure in Himachal Pradesh

5.2.4 Monthly per capita consumption of food commodities in Himachal Pradesh

5.2.5 Dietary diversity index in Himachal Pradesh

5.3 Factors affecting demand for agricultural commodities and demand projections for agricultural commodities

In this section, the various factors which affect the demand of food commodities along with income elasticity, compensated and uncompensated price elasticities have been analysed. The future demand for food commodities was projected. This section has been presented under the following headings:

5.3.1 Factors affecting demand of agricultural commodities in Himachal Pradesh

5.3.2 Income elasticities of agricultural commodities in Himachal Pradesh

5.3.3 Price elasticities of agricultural commodities in Himachal Pradesh

5.3.4 Demand projections for agricultural commodities in Himachal Pradesh

5.4 Change in nutrient intake in Himachal Pradesh

In this section, the change in the nutrient intake has been discussed. The increase or decrease in the intake of nutrients from various food groups and their sources have been analysed. This section has been presented under the following headings:

5.4.1 Income group and sector wise per capita nutrient intake in Himachal Pradesh

5.4.2 Income group and sector wise change in per capita nutrients intake in Himachal Pradesh

5.4.3 Income group and sector wise change in nutrient intake from different food groups in Himachal Pradesh

5.4.4 Dietary sources of calorie, protein and fats in Himachal Pradesh

5.4.5 Nutritional security status in Himachal Pradesh

5.1 Production pattern of agricultural commodities

5.1.1 District wise net cropped and gross cropped area in Himachal Pradesh

The net sown area of Himachal Pradesh was distributed unequally among the different districts of the state. Table 5.1.1 presents the net sown area, gross cropped area and net irrigated areas of districts of Himachal Pradesh for the period TE 1991-92 and TE 2016-17. Around 11.96 per cent of total culturable land was the net sown in the state and around 20 per cent of net sown area has irrigation facilities. The net sown and gross cropped area in Himachal Pradesh declined over the years by around four per cent and two per cent respectively. Kangra district accounted for the maximum net sown area (120.17 thousand ha) and gross cropped area (214.14 thousand ha) in the state followed by Mandi district during TE 1991-92. However, over the years the net sown area in Kangra declined to 116.80 thousand ha. A maximum decline of around 13.13 per cent in the net sown area was found in the district of Una i.e., from 44.67 thousand ha to 38.81 thousand ha followed by Solan, Shimla and Sirmour. The gross cropped area has shown a mixed trend as it increased in some districts and declined in others. Irrigation

is the most important factor for the enhancement of crop production and contributed in the development of the state as the net irrigated area in the state increased from 96.20 thousand ha to 114.38 thousand ha. In Lahaul Spiti, 100 per cent of the net sown area was under irrigation. The share of the net irrigated area in the net sown area has increased during the study period showing the improved irrigation facilities in almost all the districts of the state.

5.1.2 District wise cropping pattern in Himachal Pradesh

The cropping pattern shows the extent of area under each crop out of the total cropped area at a particular point of time. Table 5.1.2 shows the district-wise cropping pattern in Himachal Pradesh. Among cereals wheat occupies the maximum area in the state followed by maize. The area under rice, wheat and maize has declined steadily over the period. The area under rice has declined from 8.75 per cent during TE 1991-92 to 8.16 per cent in TE 2016-17 in the state further it declined in almost all the districts of the state, but increased marginally in Chamba by 3 per cent from 4.62 per cent to 4.77 per cent and Kangra from 17.29 per cent to 17.91 per cent and prominently in Sirmour i.e., from 6.28 per cent to 9.84 per cent. The share of wheat in total cropped areas has declined from 39.48 per cent to 37.37 per cent, maximum decline was observed in district of Kinnaur (8.38 % to 1.44 %) and Lahaul & Spiti (8.02% to 1.56%). The area under wheat has increased by a small proportion in Bilaspur, Chamba, Kangra, Mandi, Solan and Una.

Maize is the next important cereal in the state after wheat which occupied around 30 per cent of the total cropped areas during TE 2016-17 (Thakur et al. 2014). The share of area under maize increased in Bilaspur and Hamirpur over the years. These districts contributed around 99 per cent of their area under cereals and Chamba, Kangra, Mandi, Solan and Una around 85-90 per cent. The share of the area of total cereals declined from 84.64 per cent to 78.32 per cent in the state (Sharma, 2011). Pulses were among other foodgrains which has witnessed a decline in the share of the area from 4.18 per cent to 2.80 per cent over the period.

Table 5.1.1: District wise net sown and gross cropped area in Himachal Pradesh**(000' ha)**

Districts	TE 1991-92				TE 2016-17			
	Net sown area	Gross Cropped area	Net Irrigated area	% share of net irrigated area in net sown area	Net sown area	Gross Cropped area	Net irrigated area	% share of net irrigated area in net sown area
Bilaspur	31.78 (5.58)	59.96 (6.13)	2.89 (3.00)	9.09	29.82 (4.45)	55.51 (5.79)	6.82 (5.97)	22.89
Chamba	41.71 (7.32)	64.66 (6.61)	5.25 (5.45)	12.58	41.86 (7.65)	69.78 (7.27)	3.55 (3.10)	8.47
Hamirpur	38.61 (6.78)	75.57 (7.72)	1.77 (1.84)	4.57	34.84 (6.36)	69.04 (7.20)	1.73 (1.52)	4.98
Kangra	120.17 (21.09)	214.14 (21.89)	31.98 (33.17)	26.55	116.80 (21.33)	239.92 (25.01)	35.69 (31.20)	30.55
Kinnaur	7.48 (1.31)	8.93 (0.91)	4.19 (4.35)	56.00	8.26 (1.51)	10.63 (1.11)	5.47 (4.79)	66.30
Kullu	36.61 (6.43)	60.45 (6.18)	2.25 (2.34)	6.15	36.47 (6.66)	55.55 (5.79)	2.68 (2.34)	7.35
Lahaul & Spiti	3.15 (0.55)	3.31 (0.34)	3.15 (3.27)	100.00	3.40 (0.62)	4.24 (0.44)	3.40 (2.97)	100.00
Mandi	85.20 (14.95)	165.34 (16.90)	10.79 (11.22)	12.67	90.86 (16.58)	161.89 (16.88)	12.69 (11.10)	13.98
Shimla	76.24 (13.38)	109.12 (11.15)	4.48 (4.66)	5.88	70.52 (12.88)	86.88 (9.06)	2.56 (2.24)	3.63
Sirmaur	43.25 (7.59)	78.61 (8.03)	14.38 (14.95)	33.24	40.07 (7.32)	74.89 (7.81)	14.81 (12.95)	36.97
Solan	40.91 (7.18)	68.32 (6.98)	9.55 (9.93)	23.35	35.91 (6.56)	55.56 (5.79)	9.67 (8.46)	26.94
Una	44.67 (7.84)	70.00 (7.15)	5.60 (5.82)	12.54	38.81 (7.09)	75.35 (7.86)	15.31 (13.38)	39.44
HP	569.78 (100.00)	978.38 (100.00)	96.20 (100.00)	16.88	547.56 (100.00)	959.22 (100.00)	114.38 (100.00)	20.89

Source: Directorate of Land records, Shimla

Note: Figures in parentheses is the per cent to the total net sown and gross cropped area in Himachal Pradesh

Table 5.1.2: Temporal changes in cropping pattern in districts of Himachal Pradesh

Crops	TE	(Per cent)												
		Bilaspur	Chamba	Hamirpur	Kangra	Kinnaur	Kullu	L&S	Mandi	Shimla	Sirmaur	Solan	Una	HP
Rice	1991-92	4.82	4.62	4.53	17.29	0.24	4.00	0.00	13.71	3.48	6.28	5.77	2.14	8.75
	2016-17	2.31	4.77	2.37	17.91	0.06	1.17	0.00	11.03	0.72	9.84	6.95	2.12	8.16
Wheat	1991-92	44.38	30.03	47.28	42.15	8.38	34.68	8.02	41.16	27.40	37.72	35.40	43.58	39.48
	2016-17	45.38	33.16	46.63	45.57	1.44	21.33	1.56	41.60	9.22	33.53	41.71	46.94	37.37
Maize	1991-92	43.58	43.26	45.54	26.52	5.30	28.66	1.01	29.94	19.69	32.95	37.78	42.39	32.25
	2016-17	50.54	38.75	49.54	23.86	0.58	25.45	0.33	29.65	7.90	24.10	35.49	40.92	29.82
Barley	1991-92	0.77	6.19	0.25	1.52	17.76	5.80	23.35	2.66	5.11	3.67	2.85	0.08	2.93
	2016-17	0.42	6.78	0.12	1.08	6.45	3.87	10.15	2.19	2.99	3.06	2.87	0.00	2.22
Total Cereals	1991-92	93.56	87.12	97.62	87.56	64.76	77.33	35.38	89.62	64.57	82.03	81.81	88.19	84.64
	2016-17	98.65	85.11	98.66	88.65	23.58	52.49	12.70	85.15	22.96	71.04	87.12	89.98	78.32
Pulses	1991-92	2.71	5.52	1.46	2.72	10.67	6.18	27.16	2.79	6.47	5.75	7.21	2.97	4.18
	2016-17	0.11	4.96	0.01	1.15	8.42	6.93	20.80	5.20	3.06	1.98	3.19	0.19	2.80
Total Foodgrains	1991-92	96.27	92.64	99.07	90.28	75.43	83.51	62.55	92.41	71.04	87.78	89.02	91.16	88.82
	2016-17	98.76	90.07	98.66	89.80	32.00	59.43	33.51	90.35	26.01	73.02	90.30	90.18	81.12
Vegetables	1991-92	0.78	1.11	0.21	0.95	4.13	3.36	32.17	2.60	9.48	2.84	3.61	1.03	2.75
	2016-17	0.44	2.88	0.37	1.54	9.39	7.48	58.80	4.05	10.58	11.34	4.27	2.85	4.53
Fruits	1991-92	0.63	2.13	0.03	1.60	19.66	11.45	0.43	3.35	18.44	1.99	1.06	0.32	4.30
	2016-17	0.29	5.85	0.13	3.29	57.88	30.00	5.69	4.22	62.45	2.21	0.43	0.61	10.52
Oilseeds	1991-92	1.64	3.96	0.32	4.56	0.33	1.16	0.29	0.58	0.66	1.63	3.07	3.42	2.22
	2016-17	0.17	0.83	0.14	2.13	0.00	0.73	0.38	0.42	0.33	1.92	1.32	2.20	1.13
Spices	1991-92	0.25	0.16	0.04	0.04	0.17	0.28	0.00	0.15	0.34	2.01	0.36	0.07	0.31
	2016-17	0.34	0.27	0.14	0.06	0.54	2.31	0.00	0.34	0.58	7.24	2.86	0.08	1.08
Others	1991-92	0.43	0.00	0.32	2.59	0.28	0.24	4.56	1.14	0.05	3.75	2.88	4.01	0.62
	2016-17	0.00	0.10	0.55	3.18	0.19	0.04	1.63	0.62	0.04	4.27	0.81	4.08	1.61

Source: Directorate of Land Records, Shimla

Note: L&S- Lahaul & Spiti

With the diversification of agriculture towards high-value crops, a shift was witnessed in the cereal and pulse-based cropping pattern. As the area under the fruits and vegetables has increased over the period by varying degree from 4.30 per cent to 10.52 per cent and 2.75 per cent to 4.53 per cent, respectively from TE 1991-92 to TE 2016-17. The area under oilseeds in the state has also fallen from 2.22 per cent to 1.13 per cent. While for other crops the area increased from around 0.62 per cent to 1.61 per cent from TE 1991-92 to TE 2016-17. The state-level averages in context of Himachal Pradesh did not show much extent of diversification, as there was a marked variation in the climatic conditions among districts.

The districts of Kinnaur and Lahaul & Spiti and major portion of Shimla, Kullu, Chamba and some parts of Sirmaur, Solan and Mandi comes under temperate climatic conditions and hence have huge potential to grow temperate fruits and vegetables including off-season vegetables. A significant increase in the area under fruits and vegetables in the districts of Kinnaur, Kullu, Lahaul & Spiti, Mandi and Shimla were observed during past few decades, while other districts has witnessed a mild increase in the share of area under these crops.

5.1.3 District wise cropping intensity in Himachal Pradesh

The cropping intensity in the state has shown a constant trend over the years from TE 1991-92 to TE 2016-17 (Table 5.1.3). Among districts a mild increase was observed in the cropping intensity of Chamba, Hamirpur, Kangra, Kinnaur, Lahaul & Spiti, Solan and Una. However, districts of Bilaspur, Kullu, Mandi, Shimla and Sirmaur showed a decline in the cropping intensity over two and half decades. In Una, the cropping intensity has surged from 157 per cent to 194 per cent. The cropping intensity was found greater in low-lying areas of Hamirpur (199 %), Una (194 %), Bilaspur (178 %), Kangra (186 %) during TE 2016-17 as compared to higher altitude areas because low-lying areas were subject to more intensive tillage cultivation. Thus, the cropping intensity in tribal districts of the state namely Lahaul & Spiti (112 %) and Kinnaur (129 %) was low as these regions are the single cropped zones, and were not viable for multiple cropping due to mountainous and snowbound areas. High cropping intensity indicates progressive farming and very good crop rotation in the state. Further, the high cropping intensity reduces the risk of seasonality and leads to higher production of crops.

Table 5.1.3: District wise cropping intensity in Himachal Pradesh

(Per cent)

District	TE 1991-92	TE 2001-02	TE 2011-12	TE 2016-17	% Change
Bilaspur	189	191	193	178	-5.82
Chamba	155	153	162	170	9.68
Hamirpur	196	195	192	199	1.53
Kangra	178	187	186	186	4.49
Kinnaur	119	176	122	129	8.40
Kullu	165	168	153	148	-10.30
L & S	105	103	104	112	6.67
Mandi	194	184	179	176	-9.28
Shimla	143	137	130	124	-13.29
Sirmaur	182	185	186	180	-1.10
Solan	167	164	167	168	0.60
Una	157	173	194	194	23.57
H P	172	173	172	171	-0.58

5.1.4 Spatial and temporal changes in the area, production and productivity of agricultural commodities

5.1.4.1 Spatial and temporal changes in the area, production and productivity of rice

Cereals play a major role in providing food security in the state. Rice, wheat and maize are among the major cereals consumed by the population of Himachal Pradesh. Rice is the major staple food followed by wheat which meets the energy/ food requirements of the population of the state. The spatial and temporal changes in area, production and productivity of rice were presented in Table 5.1.4. Rice is an important Kharif cereal crop of the state next to maize and occupied around 72.01 thousand ha area with the production of 115.52 thousand tonnes during TE 2019-20 (Fig 5.1). Kangra was the largest producer of rice (51.62 thousand tonnes) and occupied around 47 per cent of the total area. The crop was grown under varied agro-climatic conditions ranging from foot-hills (350m) to high hills (2200m). It was grown in all districts except Lahaul & Spiti where the entire area was irrigated but short growing season restricted its cultivation. The table further revealed that the area under rice has declined by around 16 per cent from 85.60 thousand ha to 72.01 thousand ha in Himachal Pradesh and this

decline occurred because the farmers has shifted towards the cultivation of other crops like fruits, which required less water comparatively (Thakur et al. 2014). The productivity of the rice has increased from 1.19 MT/ha in TE 1991-92 to 1.60 MT/ha in TE 2019-20.

Table 5.1.4: District wise area, production and productivity of rice (1991-92 to 2019-20)

District	Area (000' Ha)		Production (000'MT)		Productivity (MT/Ha)	
	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20
Bilaspur	2.89	1.43	3.29	2.94	1.15	2.05
Chamba	2.99	2.80	3.58	3.66	1.20	1.30
Hamirpur	3.43	1.84	3.78	2.77	1.11	1.50
Kangra	37.02	33.84	39.07	51.62	1.06	1.53
Kinnaur	21.67	0.01	0.03	0.02	1.18	1.57
Kullu	2.42	1.31	3.36	1.72	1.38	1.32
L & S	-	-	-	-	-	-
Mandi	22.67	18.20	22.43	30.90	0.99	1.70
Shimla	3.79	0.89	3.74	0.84	1.00	0.95
Sirmaur	4.94	6.11	8.09	7.28	1.64	1.19
Solan	3.94	3.93	5.11	9.88	1.28	2.52
Una	1.50	1.67	2.20	3.90	1.46	2.34
HP	85.60	72.01	101.35	115.52	1.19	1.60

Source: Directorate of Land Records, Shimla

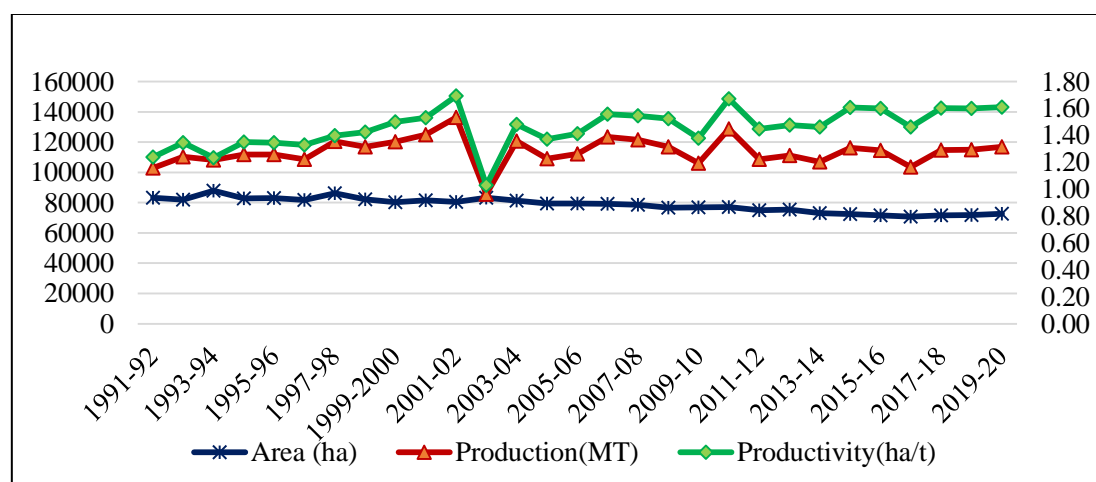


Fig 5.1: Trends in area, production and productivity of rice in Himachal Pradesh

5.1.4.2 Spatial and temporal changes in the area, production and productivity of wheat

Wheat is the principal cereal crop and grown in all the districts of the state but negligible in Lahaul & Spiti (0.08 thousand ha) and Kinnaur (0.18 thousand ha). Table 5.1.5 and Fig 5.2 showed that the area under wheat has declined over the years from 376.27 thousand ha (TE 1991-92) to 326.93 thousand tonnes (TE 2019-20). But the production of the crop has grown from 579.62 thousand tonnes to 595.97 thousand tonnes in the last 30 years. The area under wheat has declined in all the districts except Solan as increased from 24.18 thousand ha to 27.87 thousand ha. Kangra was the leading wheat-growing district and accounted for 26 per cent of the total wheat area in the state followed by Mandi (117.98 thousand tonnes). A significant decline of around 70 per cent in the area under wheat was observed in the district of Lahaul & Spiti from 0.27 thousand ha to 0.08 thousand ha and this decline attributed to the rising popularity of potato and pea in the district. The decline in the area under wheat in Shimla attributed to reason of increased cultivation of fruits and vegetables. The productivity of the wheat increased from 1.54 MT/ha to 1.82 MT/ ha over last 30 years in Himachal Pradesh.

Table 5.1.5: District wise area, production and productivity of wheat (1991-92 to 2019-20)

District	Area (000' Ha)		Production (000'MT)		Productivity (MT/Ha)	
	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20
Bilaspur	26.61	23.80	42.75	41.74	1.61	1.75
Chamba	19.42	18.32	26.77	45.05	1.38	2.46
Hamirpur	35.72	30.47	48.69	43.20	1.36	1.42
Kangra	90.26	85.39	152.25	190.66	1.69	2.23
Kinnaur	0.75	0.18	0.80	0.18	1.07	1.02
Kullu	20.96	16.33	42.27	25.99	2.03	1.59
L & S	0.27	0.08	0.41	0.11	1.55	1.42
Mandi	68.06	59.37	92.45	117.98	1.36	1.99
Shimla	29.90	9.79	44.93	18.85	1.50	1.91
Sirmaur	29.65	26.49	47.84	35.15	1.62	1.33
Solan	24.18	27.87	37.84	37.40	1.56	1.34
Una	30.50	28.83	42.62	39.66	1.39	1.38
HP	376.27	326.93	579.62	595.97	1.54	1.82

Source: Directorate of Land Records, Shimla

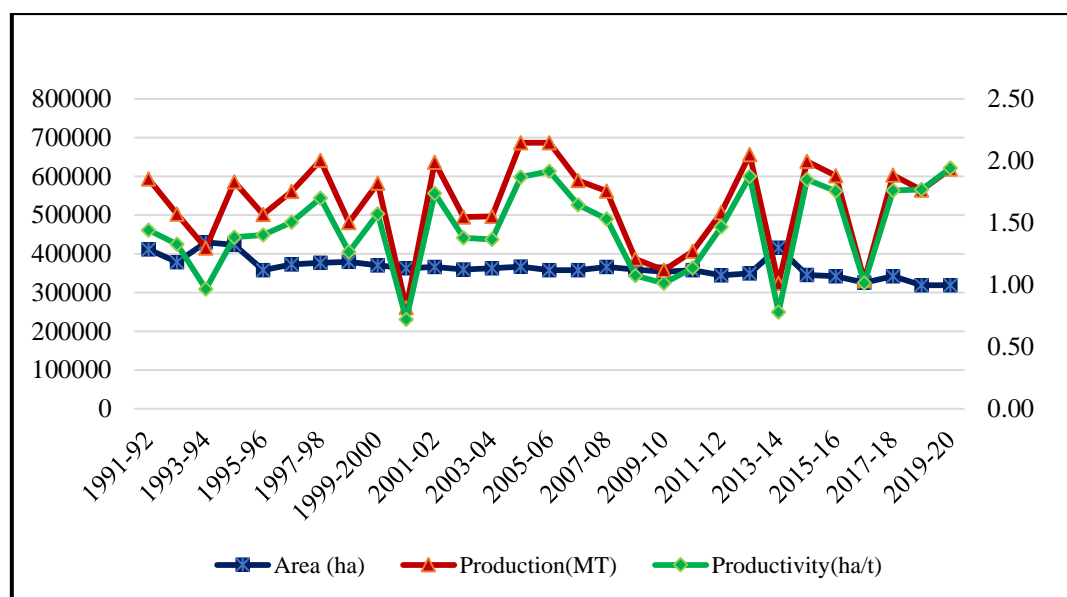


Fig 5.2: Trends in area, production and productivity of wheat in Himachal Pradesh

Table 5.1.6: District wise area, production and productivity of maize (1991-92 to 2019-20)

District	Area (000' Ha)		Production (000' MT)		Productivity (MT/Ha)	
	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20
Bilaspur	26.13	24.54	44.29	57.57	1.70	2.35
Chamba	27.97	26.72	69.52	79.57	2.49	2.98
Hamirpur	34.41	31.92	68.35	84.55	2.00	2.65
Kangra	56.80	56.50	94.22	128.57	1.66	2.28
Kinnaur	0.47	0.12	0.96	0.36	2.03	2.80
Kullu	17.32	15.74	36.06	48.75	2.09	3.12
L & S	0.03	0.02	0.07	0.06	2.02	2.75
Mandi	49.50	49.03	105.75	90.67	2.14	1.81
Shimla	21.49	9.19	47.14	25.98	2.19	2.81
Sirmaur	25.90	19.51	67.86	59.47	2.62	3.04
Solan	25.81	20.96	53.70	63.99	2.07	3.05
Una	29.67	30.77	49.88	87.55	1.68	2.85
HP	315.52	285.01	637.79	727.09	2.02	2.55

Source: Directorate of Land Records, Shimla

5.1.4.3 Spatial and temporal changes in the area, production and productivity of maize

Maize is one among the major Kharif crops in Himachal Pradesh and occupied eighth place among all maize-producing states. Table 5.1.6 and Fig 5.3 shows that the total production of maize grown by 14 per cent from 637.79 thousand tonnes (TE 1991-92) to 727.09 thousand tonnes (TE 2019-20) despite the decline in area under the crop by around 9.67 per cent from 315.52 thousand ha to 285.01 thousand ha the productivity has increased from 2.02 MT /ha to 2.55 MT/ha by around 26.24 per cent over the years in the state. The production of maize was increased in the state due to the cultivation of the high-yielding varieties of the crop. Maize was cultivated in all the districts of the state but negligible in Kinnaur and Lahaul & Spiti. Further, Kangra district accounted for the largest area and maximum production of the crop, followed by the Mandi while productivity was highest in Solan (3.05 MT/ha).

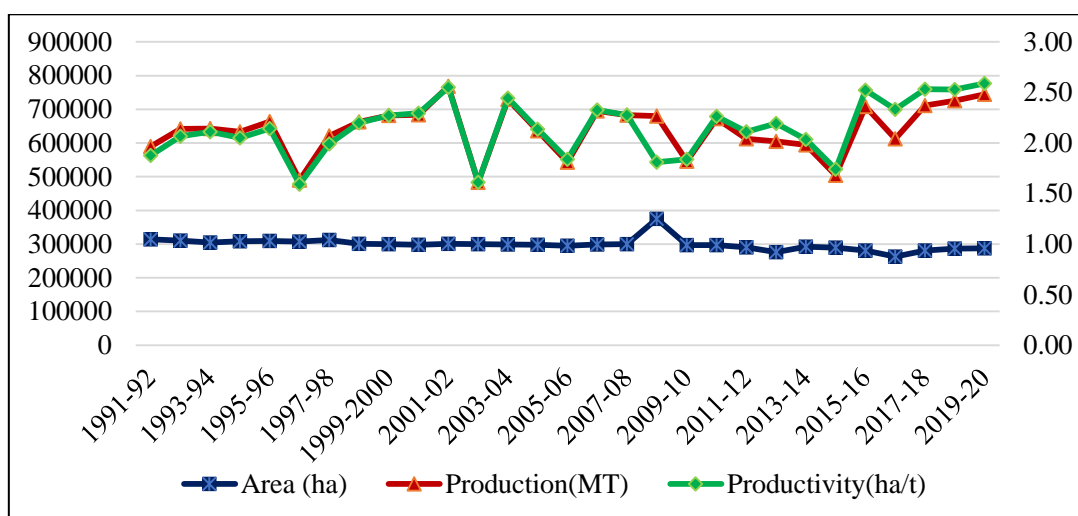


Fig 5.3: Trends in area, production and productivity of maize in Himachal Pradesh

5.1.4.4 Spatial and temporal changes in the area, production and productivity of total cereals

The area under total cereals in the state was maximum in Kangra followed by Mandi. Over the three decades, the area under cereals has remained highest in these districts (Table 5.1.7 and Fig 5.4). Shimla experienced the maximum decline in the area

under cereals from 70.46 thousand ha to 24.75 thousand ha followed by Kinnaur and Lahaul & Spiti. The production of cereals increased over the years from 1263.88 thousand tonnes to 1456.40 thousand tonnes in the states. Kangra was the largest producer of cereals in the state with the production of 372.40 thousand tonnes from an area of 178.27 thousand ha. The productivity of the cereals in the state has increased from 1.53 t/ha to 2.05 t/ha. The decline in the cultivation of cereals in Shimla district was attributed to relatively more allocation of the area towards the cultivation of the apple which was one of the principal fruit crops grown in the district

Table 5.1.7: District wise area, production and productivity of cereals (1991-92 to 2019-20)

District	Area (000' Ha)		Production (000'MT)		Productivity (MT/Ha)	
	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20
Bilaspur	56.10	49.92	90.95	102.34	1.62	2.05
Chamba	56.33	53.25	105.52	131.67	1.87	2.48
Hamirpur	73.76	64.32	121.09	130.58	1.64	2.03
Kangra	187.49	178.27	296.69	372.40	1.58	2.09
Kinnaur	5.79	2.42	5.14	1.87	0.89	0.75
Kullu	46.74	35.79	88.46	77.97	1.90	2.16
L & S	1.17	0.65	1.52	.52	1.30	0.92
Mandi	148.17	130.77	228.81	242.84	1.54	1.85
Shimla	70.46	24.75	110.41	49.64	1.57	1.97
Sirmaur	64.48	54.73	127.99	103.54	1.99	1.89
Solan	55.89	54.39	98.85	112.12	1.76	2.06
Una	61.72	61.28	94.78	131.11	1.53	2.14
HP	828.11	710.54	1263.88	1456.40	1.53	2.05

Source: Directorate of Land Records, Shimla

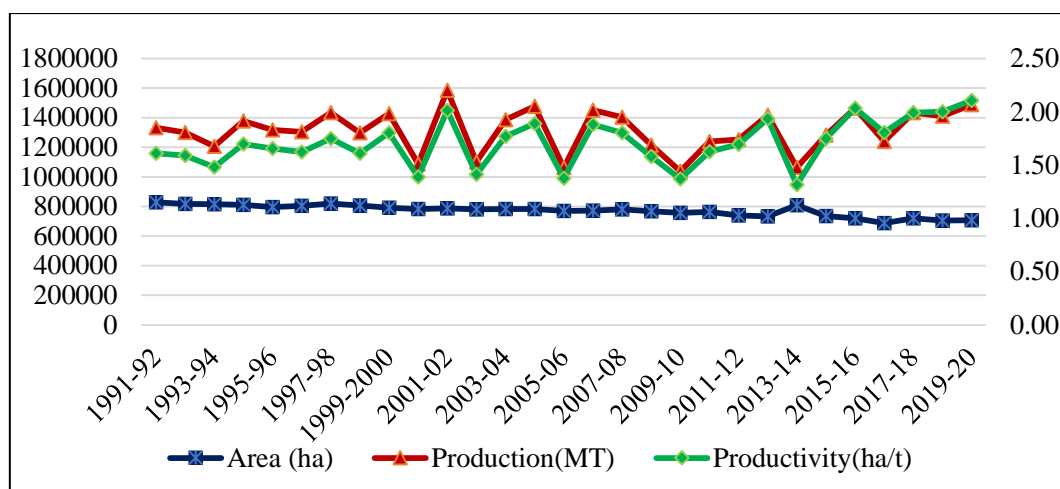


Fig 5.4: Trends in area, production and productivity of cereals in Himachal Pradesh

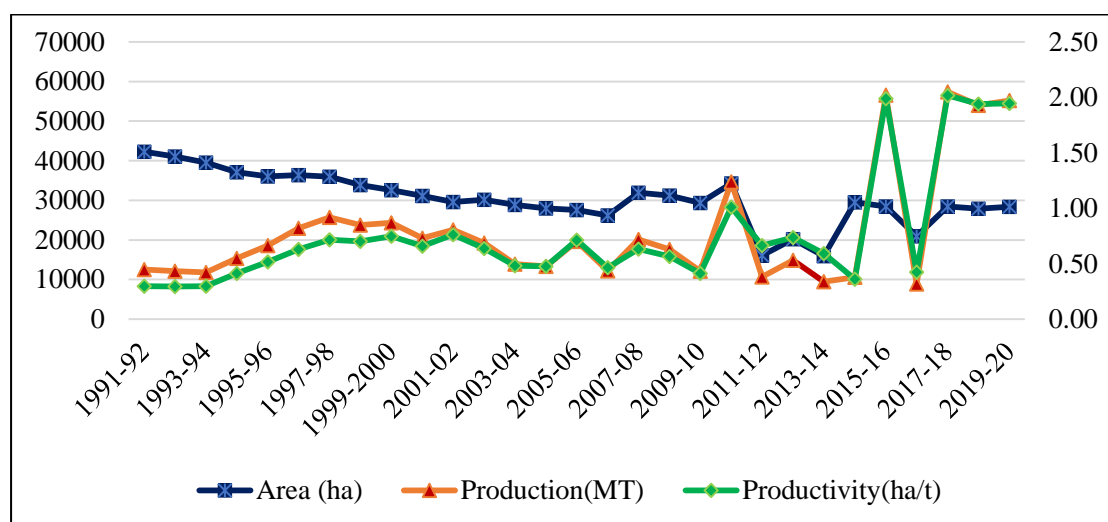
5.1.4.5 Spatial and temporal changes in the area, production and productivity of pulses

Pulses are among major food grains constituting important foodstuff for mountainous people. The major pulses grown in the state are gram, black gram, horse gram, green gram. Table 5.1.8 and Fig 5.5 shows that the area under pulses decreased from 40.91 thousand ha in TE 1991-92 to 28.23 thousand ha in TE 2019-20 with a decline of around 36 per cent over the years. A proportionate decrease in the cultivation of pulses was observed during TE 1991-92 to TE 2019-20 in almost all the districts. Kangra accounted for the maximum area under pulses but over the past three decades it has declined by 28 per cent from 5.83 thousand ha to 4.15 thousand ha and the maximum decline of 97 per cent in the area was observed in Hamirpur i.e., from 1.10 thousand ha to 0.03 thousand ha. The production of the pulses was highest in Mandi district followed by Shimla, Sirmaur and Chamba. Over the past 3 decades, the production of the pulses in Himachal Pradesh has increased by many folds i.e., 55.53 thousand tonnes (TE 2019-20) from 13.03 thousand ha (TE 1991-92). The increase in production of pulses was maximum in Chamba followed by Kullu, Shimla and Sirmaur. Thus, the productivity has increased to 1.97 MT/ha (TE 2019-20) from 0.29 MT/ha (TE 1991-92). The increase in the production of the pulses in the state was due to the cultivation of the high yielding varieties in the state and the decline in the pulse cultivation was due to the less output per unit area and varying climatic conditions.

Table 5.1.8: District wise area, production and productivity of pulses (1991-92 to 2019-20)

District	Area (000' Ha)		Production (000'MT)		Productivity (MT/Ha)	
	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20	TE 1991-92	TE 2019-20
Bilaspur	1.62	0.15	0.73	0.13	0.47	0.89
Chamba	3.57	3.95	0.86	8.58	0.24	2.17
Hamirpur	1.10	0.03	0.26	0.02	0.25	0.66
Kangra	5.83	4.15	1.80	7.74	0.31	1.87
Kinnaur	0.95	0.37	0.26	0.76	0.27	2.07
Kullu	3.74	3.41	0.86	7.55	0.23	2.21
L & S	0.90	0.38	0.95	0.88	1.07	2.29
Mandi	4.61	4.51	1.77	9.44	0.38	2.09
Shimla	7.06	5.00	1.35	9.33	0.19	1.86
Sirmaur	4.52	4.36	1.60	9.01	0.35	2.06
Solan	4.93	1.76	0.95	1.96	0.20	1.11
Una	2.08	0.16	0.66	0.13	0.32	0.80
HP	40.91	28.23	12.03	55.53	0.29	1.97

Source: Directorate of Land Records, Shimla

**Fig 5.5: Trends in area, production and productivity of pulses in Himachal Pradesh**

5.1.4.6 Spatial and temporal changes in the area, production and productivity of fruits

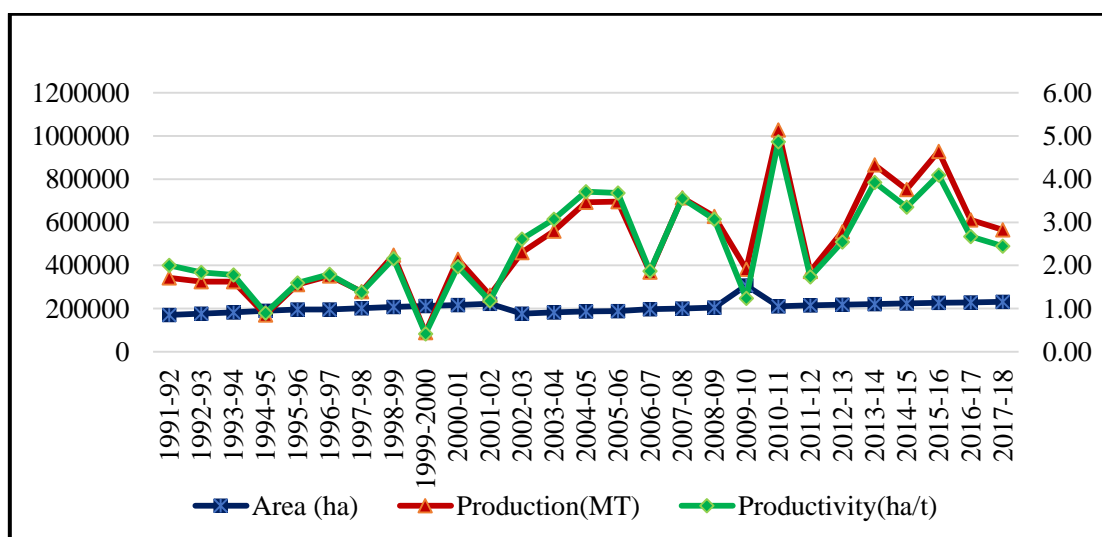
Horticulture of Himachal Pradesh is the priority of the nation. About 40 per cent of the agricultural GDP was contributed by horticulture alone in the state. The richness of agroclimatic conditions, topography and altitudinal differences along with fertile, and well-drained soils promote the cultivation of temperate and subtropical fruits in Himachal Pradesh. The trend in the area, production and productivity of fruits is given in Table 5.1.9 and Fig 5.6. The area under fruits, which was 163.52 thousand ha during TE 1991-92 with a total production of 396.20 thousand tonnes has increased to 228.95 thousand ha and 702 thousand tonnes, respectively in TE 2017-18. Shimla district led in terms of area, production and productivity of apples in Himachal Pradesh. Further, the total area under fruits was maximum in Shimla i.e., 47.19 thousand ha followed by Kangra (40.20 thousand ha), Mandi (37.07 thousand ha) and Kullu (30.33 thousand ha) during TE 2017-18.

The area under the fruit crops increased in almost all the districts from TE 1991-92 to TE 2017-18 while the maximum increase of 774 per cent was seen in the district of Lahaul & Spiti from 0.20 thousand ha to 1.76 thousand ha followed by Kinnaur from 5.76 thousand ha to 12.97 thousand ha. The increase in area under fruit crops in these districts was mainly because these were the tribal regions situated at very high altitudes on high mountains with a cold and dry temperate climate which was suitable for the cultivation of temperate fruits and also horticultural development programmes took place in these regions. Further, the cultivation of the sea buckthorn in Lahaul & Spiti was picking up pace in the district. Due to better market networks, price incentives and favourable climatic conditions, the area under fruits has increased in the state (Singh et. al., 2006).

Table 5.1.9: District wise area, production and productivity of fruits (1991-92 to 2017-18)

District	Area (000' Ha)		Production (000'MT)		Productivity (MT/Ha)	
	TE 1991-92	TE 2017-18	TE 1991-92	TE 2017-18	TE 1991-92	TE 2017-18
Bilaspur	6.56	7.98	1.09	3.45	0.17	0.43
Chamba	8.52	16.97	4.60	21.88	0.54	1.29
Hamirpur	4.39	7.55	1.07	3.45	0.25	0.46
Kangra	34.68	40.20	14.66	44.82	0.43	1.12
Kinnaur	5.76	12.97	13.00	63.14	2.25	4.87
Kullu	19.78	30.33	97.20	127.83	4.94	4.23
L & S	0.20	1.76	0.05	0.33	0.28	0.19
Mandi	24.85	37.07	16.46	50.72	0.67	1.37
Shimla	30.59	47.19	234.76	339.56	7.67	7.20
Sirmaur	13.26	14.88	5.56	20.10	0.38	0.43
Solan	10.92	6.15	4.57	8.78	0.42	1.43
Una	4.00	5.92	3.18	17.93	0.80	3.02
H P	163.52	228.95	396.20	702.00	2.44	3.07

Source: Directorate of Land Records, Shimla

**Fig 5.6: Trends in area, production and productivity of fruits in Himachal Pradesh**

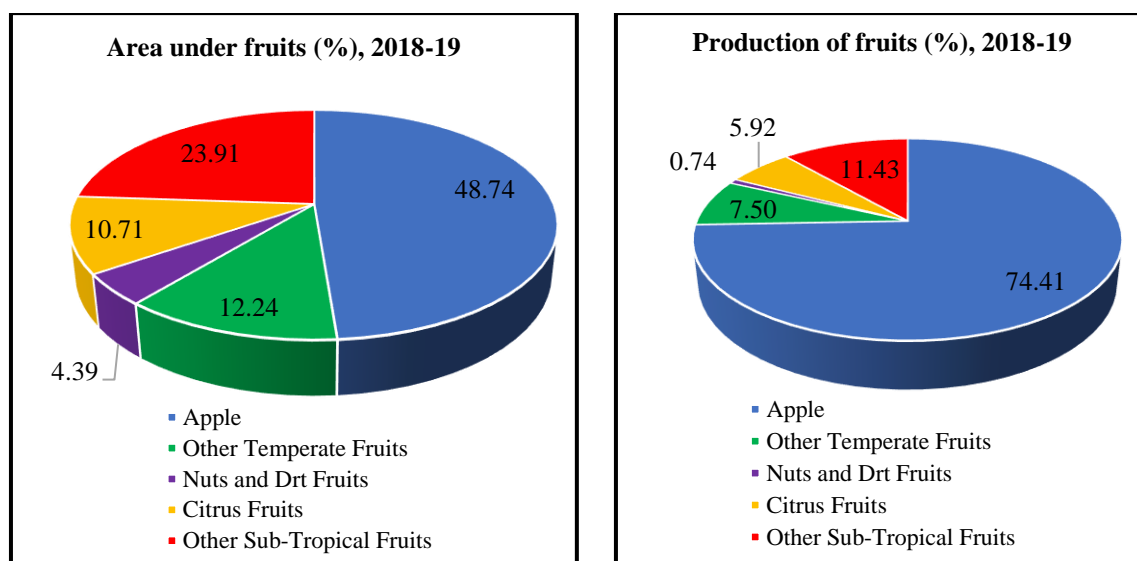


Fig 5.7: Share of different fruits in area and production in Himachal Pradesh (2018-19)

The productivity of fruits was grown to 3.07 MT/ha in TE 2017-18 from 2.44 MT/ha in TE 1991-92. The productivity of fruits in Shimla was 7.20 MT/ha (TE 2017-18) which was more than the state average. Fig 5.7 shows the share of the different fruits in area and production which depicted that around 49 per cent of the area under fruits was occupied by apple alone which accounted for 74 per cent of the total production of the fruits in the state. The fruits like other temperate fruits, nuts and dry fruits, citrus fruits and other sub-tropical fruits account for around 12.24, 4.39, 10.71 and 23.91 per cent of total areas under fruits.

5.1.4.7 Spatial and temporal changes in the area, production and productivity of vegetables

Vegetable cultivation has led the state towards diversification over the last few decades. The cultivation of the off-season vegetables helped the producers in the improvement of the quality of life in rural areas. Table 5.1.10 and Fig 5.8 shows that the total area under vegetables in the state was 32.05 thousand ha which increased to 82.41 thousand ha from TE 2001-02 to TE 2019-20. The vegetables grown in Himachal Pradesh includes peas, brinjal, cauliflower, cabbage, mushroom, capsicum, tomato and onion. Like fruits, Shimla leads in the area under vegetables and the production was maximum in Solan followed by Shimla. The area under vegetable cultivation has increased maximum in districts of Hamirpur from 0.89 thousand ha to 3.88 thousand

ha by 336 percent followed by Kinnaur. The production of vegetables increased by 370 per cent in Mandi from 49.24 thousand tonnes to 231.40 thousand tonnes followed by Hamirpur, Kangra and Chamba. Kangra, Kullu, Mandi, Shimla, Sirmaur and Solan were the major vegetable growing districts of the state. The production of vegetables was maximum in Solan as the farmers of the state mostly grow cash crops like tomato, capsicum, pea, cauliflower, ginger and French bean etc. The productivity of vegetables in the state has increased from 17.97 MT/ha (TE 2001-02) to 21.55 MT/ha (TE 2019-20).

Table 5.1.10: District wise area, production and productivity of vegetables (2001-02 to 2019-20)

Districts	Area (000' Ha)		Production (000'MT)		Productivity (MT/Ha)	
	TE 2001-02	TE 2019-20	TE 2001-02	TE 2019-20	TE 2001-02	TE 2019-20
Bilaspur	1.63	3.31	28.01	90.09	17.15	27.24
Chamba	1.32	3.42	18.93	69.31	14.38	20.25
Hamirpur	0.89	3.88	13.82	73.83	15.53	18.99
Kangra	2.65	8.68	43.35	174.45	16.36	20.16
Kinnaur	0.95	3.74	11.67	47.16	12.23	12.60
Kullu	3.01	7.33	59.42	158.99	19.74	21.73
L & S	1.77	4.68	18.83	63.54	10.65	13.57
Mandi	3.33	11.15	49.24	231.40	14.80	20.75
Shimla	5.95	12.91	98.46	242.55	16.55	18.79
Sirmaur	4.15	10.73	84.78	231.67	20.42	21.65
Solan	5.41	10.20	131.35	351.77	24.29	34.50
Una	0.99	2.38	17.94	41.77	18.13	17.40
HP	32.05	82.41	575.81	1776.12	17.97	21.55

Source: Directorate of Horticulture, Shimla

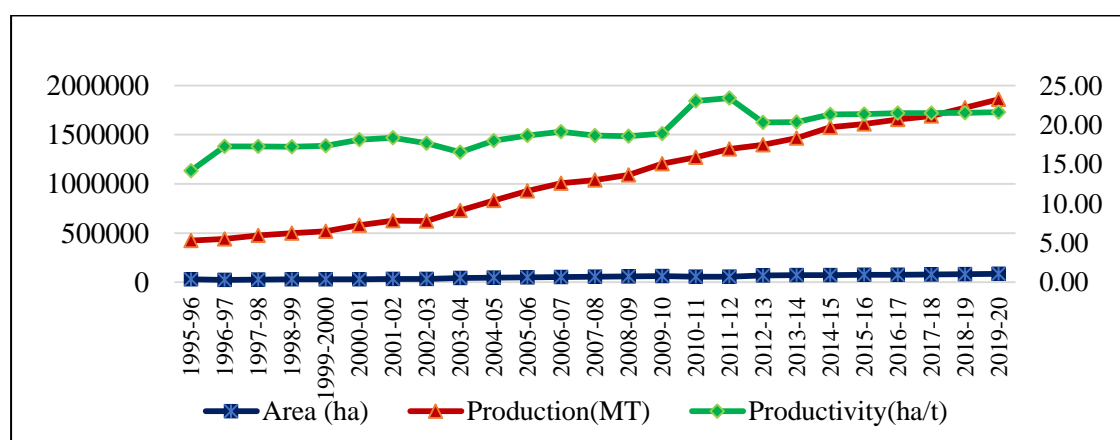


Fig 5.8: Trends in area, production and productivity of vegetables in Himachal Pradesh

5.1.5 Compound annual growth rate and coefficient of variation of area, production and productivity of agricultural commodities

5.1.5.1 Compound annual growth rate and coefficient of variation of area, production and productivity of rice

The compound annual growth rate of the area, production and yield of rice is presented in Table 5.1.11 and revealed a significant downfall in the growth rate of area (0.66 %) during TE 1991-92 to TE 2019-20, whereas the growth rate of production has shown a non-significant rise of 0.07 per cent and productivity grew significantly at rate of 0.73 per cent per annum over three decades. The annual growth rate of the area under rice was negative and significant in almost all the districts and maximum decline found in Shimla (5.51 %), followed by Kinnaur (3.73 %). The declining growth of the area revealed that farmers in the state started raising crops requiring less water and labour compared to rice. The trend in the annual growth of production of rice was negative in half of the districts, Shimla witnessed the maximum fall in the growth rate of the production followed by Kullu (2.42 %). The growth rate of the production was positive but non-significant in districts of Bilaspur (0.54 %), Kangra (0.32 %), Sirmaur (0.08 %), Mandi (0.01 %) and significantly positive for Solan (2.65 %). Further, the fluctuation in the area under rice in the state was 5.89 per cent and it was maximum in the district of Shimla with the coefficient of variation of 45.68 per cent.

Table 5.1.11: District wise CAGR and CV of rice (1991-92 to 2019-20)

District	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-2.49*	28.91	0.54	25.62	3.10*	30.95
Chamba	-0.76***	25.68	-1.06**	26.77	-0.30	16.22
Hamirpur	-2.27*	25.84	-1.64*	19.42	0.65	15.45
Kangra	-0.34*	4.34	0.32	9.76	0.67*	10.35
Kinnaur	-3.73*	36.52	-2.98*	30.74	0.78*	11.34
Kullu	-1.96*	20.10	-2.42*	29.68	-0.48	14.40
L& S	-	-	-	-	-	-
Mandi	-0.65*	5.86	0.01	12.23	0.66**	14.41
Shimla	-5.51*	45.68	-6.46*	57.40	-1.01*	17.04
Sirmaur	0.51*	7.28	0.08	31.87	-0.43	29.42
Solan	0.19	14.96	2.65*	26.74	2.46*	21.68
Una	-0.98**	24.77	-0.08	27.25	0.91*	13.08
HP	-0.66*	5.89	0.07	8.05	0.73*	9.84

Note: * denotes significant at 1 per cent, ** denotes Significant at 5 per cent
CAGR- Compound annual growth rate, CV- Coefficient of variation

5.1.5.2 Compound annual growth rate and coefficient of variation of area, production and productivity of wheat

The CAGR of area, production and productivity of wheat was given in Table 5.1.12. The table revealed that the growth rate of the area has declined significantly in almost all the districts and the state as a whole. The decline in the annual growth rate of the area was 0.64 per cent in Himachal Pradesh. Lahaul & Spiti, Kinnaur and Shimla showed the maximum decline in the growth rate of area under wheat. The production of wheat registered an annual decline of 0.08 per cent per annum. The growth rate of production of wheat was negative in almost all the districts of the state. The decrease in the annual growth rate of production was highest in Kinnaur (6.12 %) followed by Lahaul-Spiti (5.95 %) and Shimla (3.13 %). The growth rate of productivity was found positive with an increase of 0.56 per cent per annum. The fluctuations in the area, production and productivity of the wheat were 7.40 per cent, 21.59 per cent and 22.99 per cent, respectively. Among districts, the maximum fluctuation in area and production was found in district of Lahaul & Spiti i.e., 58.33 per cent and 65.19 per cent, respectively. The fluctuation in area was more in districts of Kinnaur (46.86 %), Lahaul & Spiti (58.33 %) and Shimla (42.61%) as these districts are shifting away from the cultivation of wheat.

Table 5.1.12: District wise CAGR and CV of wheat (1991-92 to 2019-20)
(Per cent)

District	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-0.52*	5.46	-0.39	39.16	0.13	37.64
Chamba	0.00	8.09	1.61**	33.76	1.61**	33.26
Hamirpur	-0.54*	4.94	-1.04	34.62	-0.50	32.41
Kangra	-0.06	7.21	1.04	25.34	1.10	25.83
Kinnaur	-5.26*	46.86	-6.12*	49.76	-0.91***	23.03
Kullu	-0.45	19.18	-1.57*	25.28	-1.12**	21.18
L & S	-5.83*	58.33	-5.95*	65.19	-0.13	22.65
Mandi	-1.13*	20.03	-0.44	27.22	0.70	29.22
Shimla	-4.49*	42.61	-3.13*	43.22	1.42**	26.93
Sirmaur	-0.41**	9.44	-0.60	27.42	-0.19	30.42
Solan	0.58**	12.76	1.04	29.51	0.45	32.43
Una	-0.75**	18.05	-0.74	27.47	0.00	29.72
HP	-0.64*	7.40	-0.08	21.59	0.56	22.99

Note: * denotes significant at 1 per cent, ** denotes Significant at 5 per cent
CAGR- Compound annual growth rate, CV- Coefficient of variation

5.1.5.3 Compound annual growth rate and coefficient of variation of area, production and productivity of maize

The compound annual growth of the area, production and productivity of maize is given in Table 5.1.13 which reveals a declining trend in the growth rate of area in the state by 0.36 per cent. The area under maize has declined in most of the districts with the varying growth rate. Over the years the maximum decline in the area was found in district Kinnaur (4.96 %) and the growth rate of the area was positive but non-significant in the district Chamba, Kangra and Una. The state registered a positive but insignificant growth rate in production of maize by 0.22 per cent over the years and it was positive in all the districts except for Kinnaur, Lahaul & Spiti, Mandi, Shimla and Sirmaur. The growth rate of the productivity of maize increased significantly by 0.58 per cent per annum in the state and it was increasing at different rates in the districts of Bilaspur, Chamba, Hamirpur, Kangra, Kullu, Solan and Una and declined in other districts.

Table 5.1.13: District wise CAGR and CV of maize (1991-92 to 2019-20)

(Per cent)

District	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-0.31*	5.54	0.95**	19.91	1.27*	20.52
Chamba	0.10	6.24	0.34	19.07	0.24	19.45
Hamirpur	-0.26*	4.40	1.10*	18.74	1.37*	19.25
Kangra	0.02	18.20	0.88**	15.63	0.86***	18.55
Kinnaur	-4.96*	41.62	-4.10*	37.87	0.91***	19.68
Kullu	-0.48**	9.75	1.52**	23.76	2.00*	27.07
L & S	-2.56*	48.79	-1.96**	42.57	0.62	19.32
Mandi	-0.10	2.97	-5.52*	53.95	-5.42*	53.98
Shimla	-3.14*	28.35	-2.24*	25.83	0.92**	19.45
Sirmaur	-1.14*	10.94	-0.47	13.69	0.69**	14.43
Solan	-0.76*	7.68	0.35	21.34	1.11***	24.45
Una	0.24	7.07	2.63*	40.49	2.38*	43.21
HP	-0.36*	6.12	0.22	11.47	0.58***	12.86

Note: * denotes significant at 1 per cent, ** denotes Significant at 5 per cent
CAGR- Compound annual growth rate, CV- Coefficient of variation

The growth rate of productivity of maize was positive for almost all the districts except for Mandi which was declining with the rate of 5.42 per cent per annum. The growth rate of production of maize was positive and significant in most of the districts and negative for districts of Kinnaur (4.10 %), Lahaul & Spiti (1.96 %), Mandi (5.52 %) and Shimla (2.24 %). The instability in the area was more in Lahaul & Spiti (48.79 %) followed by Kinnaur (41.62 %) whereas, the production of maize was more fluctuated in Mandi followed by Lahaul & Spiti.

5.1.5.4 Compound annual growth rate and coefficient of variation of area, production and productivity of total cereals

The annual growth in area (Table 5.1.14) under total cereals in the state has recorded a mild decrement (0.53 %), the growth in the output of the cereals showed a mild increase of 0.06 per cent per annum from TE 1991-92 to TE 2019-20. Shimla (3.94 %) and Kinnaur (3.82%) registered a maximum decline in the growth rate of the area further, these districts have the least area under cereals cultivation in the state. Kangra, Mandi, Hamirpur and Una has the largest share of area under cereals which registered a mild decline in the annual growth rate of the area. Among districts, the maximum decline in the annual growth rate of the production of cereals was observed in Lahaul & Spiti (7.51 %) and Kinnaur (4.60 %). The growth in the productivity of the cereals was significantly positive in all the districts except in Mandi.

Table 5.1.14: District wise CAGR and CV of cereals (1991-92 to 2019-20)

(Per cent)

District	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-0.52*	5.38	0.30	20.82	0.82***	20.88
Chamba	-0.06	4.77	0.59	19.15	0.65	19.96
Hamirpur	-0.48*	4.45	0.14	17.98	0.62	18.30
Kangra	-0.13	4.16	0.82**	15.59	0.95**	17.78
Kinnaur	-3.82*	33.28	-4.60*	37.19	-0.81	27.35
Kullu	-0.68*	11.33	-0.20	17.31	0.49	16.85
L & S	-2.95*	27.67	-7.51*	121.98	-4.71*	95.58
Mandi	-0.47*	4.26	-2.09*	27.55	-1.63**	26.24
Shimla	-3.94*	34.53	-2.90*	30.05	1.08*	16.38
Sirmaur	-0.71*	7.56	-0.54***	13.31	0.17	13.14
Solan	-0.05	5.76	0.80**	17.34	0.85**	17.99
Una	-0.06	4.76	0.58	17.28	0.64	17.47
HP	-0.53*	4.93	0.06	10.83	0.59**	12.66

Note: * denotes significant at 1 per cent, ** denotes Significant at 5 per cent
CAGR- Compound annual growth rate, CV- Coefficient of variation

Over the years the cereals have shown a mild fluctuation of 4.93 per cent, 10.83 per cent and 12.66 per cent in the area, production and productivity respectively. The maximum fluctuation in the area under cereals was in Shimla (34.53 %) followed by Kinnaur (33.28 %). The fluctuation in the production of cereals was maximum in Lahaul & Spiti with coefficient of variation of 121.98 per cent followed by Kinnaur (37.19 %).

5.1.5.5 Compound annual growth rate and coefficient of variation of area, production and productivity of pulses

The compound annual growth rate of the area, production and productivity of pulses is presented in Table 5.1.15. The growth in the area under pulses in the state has shown a decrease of 1.89 % per annum. While the production and productivity has registered a rise of 2.07 % per annum and 4.04 % per annum, respectively. The rise in growth of production of pulses was due to the introduction of high yielding varieties (HYV). The highest decline in the growth rate of area and production of pulses was in Hamirpur i.e., 13.74 per cent and 13.76 per cent per annum.

Table 5.1.15: District wise CAGR and CV of pulses (1991-92 to 2019-20)

District	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-8.97*	115.63	-6.79*	78.09	2.40**	42.23
Chamba	-0.10	13.38	5.73*	119.00	5.83*	105.61
Hamirpur	-13.74*	124.87	-13.76*	132.82	-0.01	35.70
Kangra	-1.52*	19.75	2.76	82.39	4.35*	79.26
Kinnaur	-8.77*	57.90	-5.55**	66.80	3.53**	61.00
Kullu	-1.38**	24.10	4.51	116.34	5.97*	104.67
L & S	-6.46***	74.78	0.00	115.18	0.00	81.91
Mandi	-0.43	32.39	4.36*	80.44	4.82*	68.31
Shimla	-1.55*	22.68	5.12*	87.16	6.78*	89.02
Sirmaur	-1.07**	19.30	4.02*	81.82	5.14*	72.59
Solan	-4.57*	40.06	-3.03**	47.21	1.62	52.60
Una	-8.86*	70.83	-6.36*	60.98	2.74*	32.58
HP	-1.89*	21.04	2.07***	64.72	4.04*	66.97

Note: * denotes significant at 1 per cent, ** denotes Significant at 5 per cent
CAGR- Compound annual growth rate, CV- Coefficient of variation

The annual growth rate in the area under pulses was significantly negative in all the districts and the growth rate of the production was declining in Bilaspur, Hamirpur, Kinnaur, Solan and Una districts i.e., 6.79 per cent, 13.76 per cent, 5.55 per cent and 3.03 per cent, respectively. The fluctuation in the area of pulses was 70.83 per cent in the state and maximum in Bilaspur and Hamirpur district. The fluctuation in the production of pulses was more in Hamirpur (132.82 %) followed by Chamba (119 %), Kullu (116.34 %) and Lahaul & Spiti (115.18 %).

5.1.5.6 Compound annual growth rate and coefficient of variation of area, production and productivity of food grains

Table 5.1.16 presents the annual growth rate of the area, production and productivity of the food grains in the state. The growth rate of area for food grains declined by around 0.57 per cent per annum over the years. The production of food grains has registered a mild increase with the growth rate of 0.12 per cent per annum. The yield on the other hand has shown a significant positive growth rate of 0.69 per cent per annum. Kinnaur (3.94 %), Shimla (3.77 %) and Lahaul & Spiti (3.41%) has shown the highest decline in the annual growth rate of area under food grains.

Table 5.1.16: District wise CAGR and CV of foodgrains (1991-92 to 2019-20)
(Per cent)

District	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-0.48*	5.28	0.28	20.74	0.76	21.23
Chamba	-0.02	4.47	0.73	19.94	0.75	19.77
Hamirpur	-0.43*	4.77	0.13	17.97	0.56	18.11
Kangra	-0.15***	3.96	0.85**	15.96	1.00*	18.01
Kinnaur	-3.94*	32.59	-4.08*	37.33	-0.15	22.92
Kullu	-0.83*	11.99	-0.01	16.85	0.82**	21.28
L & S	-3.41*	43.65	-6.55*	102.91	-3.25**	75.59
Mandi	-0.43*	4.30	-1.98*	27.22	-1.56**	26.24
Shimla	-3.77*	33.00	-2.45*	27.72	1.37*	23.94
Sirmaur	-0.75*	7.75	-0.36	15.72	0.40	16.49
Solan	-0.34**	6.48	0.76***	17.29	1.11*	19.81
Una	-0.09	4.72	0.96*	14.84	1.04*	16.00
HP	-0.57*	5.11	0.12	11.17	0.69**	13.15

Note: * denotes significant at 1 per cent, ** denotes Significant at 5 per cent

CAGR- Compound annual growth rate, CV- Coefficient of variation

The productivity of food grains has shown negative growth in Kinnaur (0.15 %) and Lahaul & Spiti (3.25 %). The fluctuation in the area, production and productivity were less for the food grains in the state. Among districts the instability in area under food grains was witnessed more in Lahaul & Spiti (43.65 %) followed by Shimla (33 %) and Kinnaur (32.59%).

5.1.5.7 Compound annual growth rate and coefficient of variation of area, production and productivity of fruits

The growth in the area, production and productivity of fruits is presented in Table 5.1.17. The growth in the area of total fruits has recorded an increment of 0.93 per cent per annum and the production and productivity has increased annually with the significant growth rate of 4.49 per cent and 3.35 per cent per annum, respectively. The growth rate of area under fruits declined in Bilaspur (0.003 % pa), Kangra (0.05 % pa), Shimla (4.30 % pa), and Solan (3.37 % pa), whereas, the production has increased significantly in all the districts. There was a constant growth in the production of fruits in all the districts. The growth rate of the production of fruits was maximum in Hamirpur (9.90 %) followed by Sirmaur (8.04 %).

Table 5.1.17: District wise CAGR and CV of fruits (1991-92 to 2017-18)

(Per cent)

Districts	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-0.003	11.37	7.97*	68.02	7.97*	68.31
Chamba	2.13*	22.94	6.47*	73.19	4.25*	64.33
Hamirpur	1.55*	16.00	9.90*	66.18	8.22*	64.99
Kangra	-0.05	7.19	6.70*	56.55	6.76*	60.40
Kinnaur	3.54*	33.04	6.41*	48.45	2.77*	29.55
Kullu	1.69*	21.71	3.38**	49.96	1.66	48.02
L & S	8.72*	64.50	7.21*	67.17	-1.39	57.72
Mandi	1.37*	14.01	5.71*	59.41	4.27*	53.88
Shimla	-4.30*	35.96	4.15*	49.86	8.82*	89.25
Sirmaur	5.63*	62.01	8.04*	58.75	2.28	70.53
Solan	-3.37*	33.24	7.19*	54.14	10.92*	69.20
Una	0.90*	8.81	7.69*	64.62	6.72*	57.72
H P	0.93*	12.62	4.49*	45.53	3.53*	44.02

Note: * denotes significant at 1 per cent, ** denotes Significant at 5 per cent

CAGR- Compound annual growth rate, CV- Coefficient of variation

The productivity of the fruits grew at varying rates in different districts of the state and it was positive and significant in all the districts except Lahaul and Spiti (-1.39 %). The state witnessed the fluctuation in the area, production and productivity of the fruits by 12.62 per cent, 45.53 per cent and 44.02 per cent respectively over the year. The instability in the area under fruits was found maximum in Lahaul & Spiti (64.50 %) followed by Sirmaur (62.01 %)

5.1.5.8 Compound annual growth rate and coefficient of variation of area, production and productivity of vegetables

There was a constant positive and significant growth in the area and production of vegetables in Himachal Pradesh and in almost all the districts of the state is given in Table 5.1.18. The shift of the state agriculture from traditional subsistence farming towards high value agricultural commodities due to factors like increase in demand for vegetables, better prices for the off-season produce and improvement in income levels with improved varieties and production technology and suitable agro-climatic conditions for the production of vegetables might have encouraged farmers to increase the area under vegetables (Sharma, 2011).

Table 5.1.18: District wise CAGR and CV of vegetables (1991-92 to 2019-20)
(Per cent)

District	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	4.04*	26.92	6.81*	42.51	2.67*	17.55
Chamba	5.97*	37.17	7.84*	49.63	1.76*	17.05
Hamirpur	9.61*	55.12	9.28*	129.39	-0.30	144.17
Kangra	6.75*	39.46	8.25*	48.12	1.40*	11.79
Kinnaur	8.60*	45.75	9.14*	53.51	0.49	11.91
Kullu	4.96**	86.32	5.82*	41.76	0.82	23.09
L & S	6.03*	35.74	7.05*	45.36	0.97*	11.42
Mandi	7.22*	43.76	9.32*	56.34	1.96*	15.27
Shimla	4.91*	31.82	5.68*	37.73	0.73*	7.00
Sirmaur	5.01*	34.43	5.84*	41.34	0.78*	8.33
Solan	3.92*	26.25	6.44*	43.23	2.43*	17.62
Una	4.47*	32.42	4.25*	30.01	-0.21	4.58
HP	5.51*	34.67	6.82*	43.66	1.24*	10.00

Note: * denotes significant at 1 per cent, ** denotes Significant at 5 per cent

CAGR- Compound annual growth rate, CV- Coefficient of variation

The growth rate of area under vegetables has recorded an annual increment of 5.51 per cent per annum and the production has increased significantly with a growth rate of 6.82 per cent for the state and it was positively significant for all the districts. The productivity of the vegetables increased significantly with rate of 1.24 per cent per annum over the years. The annual growth rate in the area of the vegetables was maximum in Hamirpur (9.61 %) and Kinnaur (8.60 %). The annual growth in the production of vegetables was found highest in Mandi (9.32 %) followed by Hamirpur (9.28 %) and Kinnaur (9.14 %).

5.1.6 Diversification of agricultural commodities

To see the extent of diversification in the state the Simpson Index of Diversification was used. Table 5.1.19 shows that in the state crop diversification has taken place and the value of the index has increased over the period from 0.727 during TE 1991-92 to 0.740 during TE 2001-02 which further increased to 0.757 during TE 2017-18 (Singh 2006, Krishan 2014, Birthal et. al. 2014). Thus, in the state as a whole, diversification has taken place, but at the district level, a mixed result was observed for the crop diversification. During TE 1991-92 except Bilaspur, Hamirpur and Una. All other districts have high diversification index ranging from 0.704 to 0.835. Districts like Chamba, Kullu and Sirmour were moving towards diversification during TE 2017-18. While, Bilaspur, Hamirpur, Kangra, Solan, and Una has shown a decline in the diversification index over the three decades. During the 1990s Lahaul & Spiti moved towards diversification, and the diversification index declined during 2001-02 and 2011-12 and further during TE 2017-18 it increased to 0.709. Kinnaur and Lahaul & Spiti which were tribal districts shifted towards fruits and vegetable production from foodgrains which led to specialization as visible from the cropping pattern also and a decline was witnessed in the diversification index from 0.820 to 0.663 for Kinnaur and 0.835 to 0.709 for Lahaul & Spiti. Shimla also witnessed a decline in the diversification index over the three decades from 0.835 to 0.606.

Table 5.1.19: District wise changing levels of crop diversification indices (Simpson) in Himachal Pradesh: 1991-92 to 2017-18

Districts	TE 1991-92	TE 2001-02	TE 2011-12	TE 2017-18
Bilaspur	0.599	0.567	0.558	0.538
Chamba	0.713	0.722	0.726	0.729
Hamirpur	0.564	0.544	0.534	0.532
Kangra	0.707	0.697	0.689	0.690
Kinnaur	0.820	0.842	0.755	0.663
Kullu	0.775	0.787	0.790	0.826
L & S	0.751	0.685	0.665	0.709
Mandi	0.711	0.718	0.712	0.717
Shimla	0.835	0.840	0.733	0.606
Sirmaur	0.725	0.756	0.773	0.790
Solan	0.704	0.697	0.679	0.686
Una	0.600	0.616	0.579	0.579
HP	0.727	0.740	0.736	0.757

5.2 Changes in consumption pattern of agricultural commodities

The consumption pattern of the food commodities in Himachal Pradesh across income groups and the rural and urban sectors are presented in this section. Various factors affect the consumption pattern of the households. Income is one of the factors which affects most the consumption of food and non-food commodities the most. The income of the households varied across the rural and urban sectors based upon their occupations and employment opportunities. In this study monthly per capita expenditure was taken as a proxy to examine the income of households.

5.2.1 Consumption expenditure in Himachal Pradesh

To analyse the consumption expenditure pattern across income groups and rural and urban sectors the households were divided into the four income categories viz. very poor, poor, middle and rich households. The analysis of the consumption pattern of the food products showed that monthly per capita expenditure and food expenditure varied among the sectors and income groups. The monthly per capita consumption expenditure of urban and rural households was Rs. 3134.90 and Rs. 1858.52, respectively in absolute terms during 2011-12 (Table 5.2.1). Thus, urban households monthly

expenditure was 68.68 per cent more than rural households and expenditure on food of urban households was 44.36 per cent more than rural areas. The food expenditure was inversely related to the income of the households. The very poor urban households spent 53.93 per cent of income on food as compared to the rich urban household who spent only 35.43 per cent of their income on the food commodities. Whereas, the very poor rural households spent 62.56 per cent of their income on food commodities compared to the rich rural households who spent 37.58 per cent (Hasan 2012). This inverse relationship between income and food budget confirms Engel's law which stated that with the increase in income the expenditure on food decreased. (Srivastava et al. 2013). This trend was found both in rural and urban sectors of the state (2011-12). Further, the expenditure on the food commodities was relatively higher in rural areas than urban areas. The rural households spent around 42.27 per cent on total food commodities and urban households spent around 36.18 per cent of monthly per capita consumption expenditure (MPCE). In Himachal Pradesh, the monthly consumption expenditure on the food commodities was 41.23 per cent of the total monthly consumption expenditure.

Table 5.2.1: Income group and sector wise household expenditure of agricultural commodities in Himachal Pradesh (2011-12)

(Rupees)

Income Group	MPCE			Food Expenditure			RUD (%)	
	Rural	Urban	HP	Rural	Urban	HP	MPCE	Food Expenditure
Very Poor	632.82	710.06	639.97	395.92 (62.56)	383.15 (53.96)	394.74 (61.68)	12.21	-3.22
Poor	810.77	921.35	814.15	478.15 (58.98)	513.00 (55.68)	479.22 (58.86)	13.64	7.29
Middle	1142.43	1220.71	1145.41	631.15 (55.25)	582.20 (47.69)	629.29 (54.94)	6.85	-7.76
Rich	2542.16	3501.87	2694.07	955.25 (37.58)	1240.55 (35.43)	1000.41 (37.13)	37.75	29.87
All	1858.52	3134.90	1996.67	785.60 (42.27)	1134.11 (36.18)	823.32 (41.23)	68.68	44.36

Note: RUD= Rural-urban difference $\{(Urban-rural)/rural*100\}$

Figures in parentheses is the per cent of food expenditure to MPCE

5.2.2 Households budget allocation in Himachal Pradesh

Table 5.2.2 represents the allocation of the monthly consumption expenditure towards expenditure on food commodities. The share of food in the total monthly expenditure of a household in Himachal Pradesh has declined over the years. The share of the food has declined from 59.70 per cent in 1987-88 to 57.13 per cent in 1993-94 to 48.66 per cent in 2004-05 and further to 41.23 per cent in 2011-12. Across income groups with the increment in income, the expenditure share on food reduced (Engel's law). The very poor households spent around two-third of their total income on food which has declined over the years and the rich households spent less than 50 per cent which declined to 37 per cent during 2011-12. Thus, the monthly consumption expenditure of very poor households in Himachal Pradesh declined from 69.24 per cent in 1987-88 to 61.68 per cent in 2011-12. Whereas, for poor households, fell from 65.49 per cent to 58.86 per cent over the years. The middle-income households spent around 54.94 per cent of income on food in 2011-12 which was 60.27 per cent during 1987-88 and rich household expenditure on food declined to 37.13 per cent during 2011-12 which was 47.78 per cent in 1987-88 (Mittal, 2006). Over the years the maximum decline in food expenditure was found for rich households.

Table 5.2.2: Household budget allocation on food across different expenditure classes and years

(per cent)

Income group	1987-88	1993-94	2004-05	2011-12	% change
Very Poor	69.24	71.11	65.04	61.68	-10.92
Poor	65.49	70.22	64.25	58.86	-10.12
Middle	60.27	68.20	61.99	54.94	-8.84
Rich	47.75	49.22	44.74	37.13	-22.24
All	59.70	57.13	48.66	41.23	-30.94

5.2.3 Share of food commodities in food expenditure in Himachal Pradesh

With the development of the economy, rise in the per capita income, urbanization and variety in food commodities, the variation exists in the consumption pattern of households across the expenditure classes. The household's income is the major factor that influences the consumption behaviour of households. With the rise in income the household expenditure on food not only increased but the food basket also

diversified. Hence, the consumption pattern of the poor households varied from the rich households. Table 5.2.3 shows mixed trends of the share of the food groups in the total food expenditure. The income group-wise and sector-wise consumption pattern of households revealed that very poor rural households spent 29.99 per cent of food budget on cereals and 9.85 per cent on pulses and poor rural households spent 28.29 per cent and 8.36 per cent on cereals and pulses, respectively. Therefore, low-income rural households spent around 40 per cent of their food expenditure on food grains which further declined to about 25 per cent for rich rural households.

In rural areas, the expenditure on milk and milk products increased from 17.94 per cent to 31.42 percent of food expenditure from very poor to rich income households. Similarly, for non-vegetarian food (egg, fish, meat) it raised from 0.13 per cent to 4.75 per cent, for vegetables from 6.50 per cent to 7.61 per cent and similarly for fruits it increased from very poor to rich income households. This confirmed the shift in the consumption pattern from food grains (cereal-pulses) to high-value commodities with increase in the income of households. This shift in the expenditure share from essential food like cereal, pulses, edible oils towards high-value commodities i.e., milk and milk products, egg, fish, meat, vegetables, fruits with an increase in the income confirms Bennett's law of consumption which states that the consumption shifts towards more expensive diet as income of households rises (Srivastava et al. 2013). The very poor urban households spent around 47 per cent of their income on food grains i.e., 34.98 per cent on cereals and 11.64 per cent on pulses. The expenditure on food grains declined to around 25 per cent of food expenditure i.e., 17.50 per cent and 7.28 per cent on cereals and pulses, respectively for rich urban households. The share of expenditure on the livestock products (milk, egg, fish, meat, etc.) was higher in the rural areas i.e., 29.41 per cent (MMP) and 4.48 per cent (EFM) compared to the urban areas of Himachal Pradesh as more than two-thirds of the population of the state resides in the rural areas and the availability of the livestock products is more in the rural areas. (Sharma et al. 2006). Also, the shift in the dietary intake of food commodities away from foodgrains towards more expensive HVCs like milk, non-vegetarian products was consistent related to economic growth of the state (Meenakshi, 1996).

Table 5.2.3: Income group and sector-wise share of food commodities in food expenditure in Himachal Pradesh (2011-12)

(per cent)

Income Group	Cereal	Pulses	MMP	Edible oils	EFM	Vegetables	Fruits
Rural							
Very Poor	29.99	9.85	17.94	7.53	0.13	6.50	0.68
Poor	28.29	8.36	20.43	7.52	2.64	7.23	2.02
Middle	22.07	7.98	27.12	6.69	4.47	7.62	2.81
Rich	17.75	7.32	31.42	5.64	4.75	7.61	4.58
All	19.72	7.59	29.41	6.06	4.48	7.57	3.91
Urban							
Very Poor	34.98	11.64	14.13	7.92	2.93	9.70	1.34
Poor	22.95	9.97	24.07	7.11	2.05	10.10	2.89
Middle	21.75	8.57	29.18	6.74	1.98	9.22	3.15
Rich	17.05	7.14	26.92	5.21	3.88	8.67	6.55
All	17.50	7.28	26.91	5.33	3.75	8.72	6.29
HP							
Very Poor	30.44	10.01	17.60	7.57	0.38	6.79	0.74
Poor	28.11	8.41	20.55	7.50	2.62	7.32	2.05
Middle	22.06	8.00	27.19	6.69	4.38	7.67	2.82
Rich	17.61	7.28	30.54	5.55	4.58	7.82	4.96
All	19.39	7.54	29.04	5.95	4.37	7.75	4.26

5.2.3.1 Change in the share of food commodities in food expenditure in Himachal Pradesh

Fig 5.9 depicts the change in the share of food commodities in the consumption pattern in Himachal Pradesh for different NSSO rounds and between rural and urban sectors. Although cereals continued to be the most important part of food basket but a perceptible decline in the proportion of its expenditure was witnessed in the past few decades, the decline was more in the rural areas compared to the urban areas i.e., from 33.54 per cent to 19.72 per cent in 1987-88 to 2011-12 in rural areas and 22.10 per cent to 17.50 per cent in urban areas during same period. Further, the share of expenditure on pulses showed mixed trend in both sectors which first increased in the rural area from 7.66 per cent in 1987-88 to 8.38 per cent in 1993-94 and further declined to 7.59 per cent in 2011-12 and urban area also it increased from 6.51 per cent (1987-88) to 6.68 per cent in 1993-94 and declined during 2004-05 (6.46 %) and further increased in 2011-12.

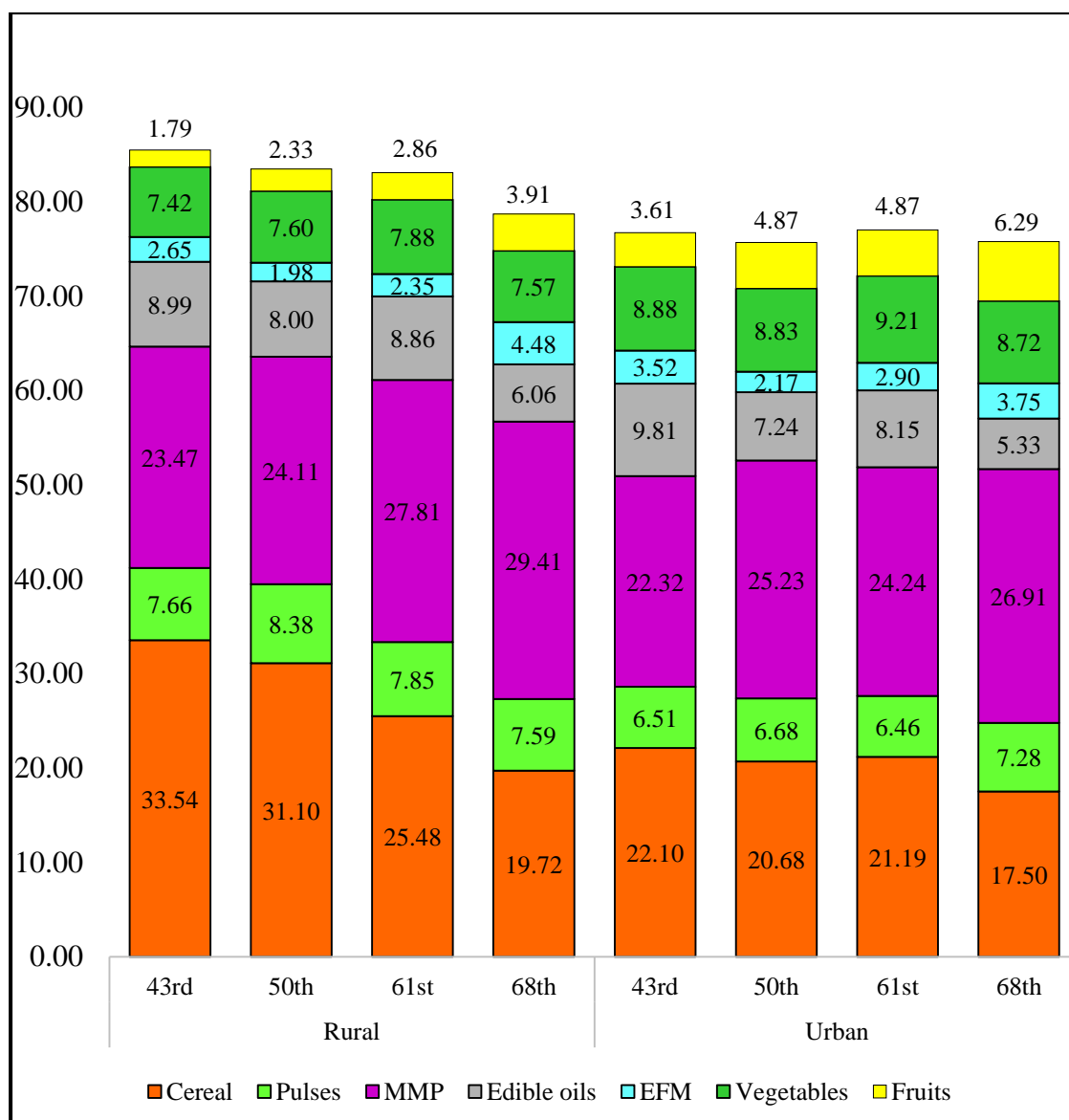


Fig 5.9: Change in share of food expenditure on different food commodities in Himachal Pradesh

The composition of food basket has changed as the share of food grains declined and that of milk and milk products, egg, fish, meat, vegetables and fruits has increased (Arun et al., 2017). The increase in the share of expenditure on milk and milk products in total food expenditure was more in the rural area (23.47% to 29.41 %) and comparatively lesser in urban areas (22.32 % to 26.91 %). In percentage term, only a marginal increase was observed in vegetables from 43rd to 61st round in both rural and urban sectors which declined by a small percentage during 68th round. But the share of fruits in total food expenditure increased many folds. These products (HVC) provide

nutritional security as they are rich in protein, vitamins, minerals and other required micronutrients. Although the share of expenditure on cereals has declined despite their importance remaining the same in the food basket.

5.2.4 Monthly per capita consumption of food commodities in Himachal Pradesh

Table 5.2.4 presents the monthly per capita consumption of food commodities across income groups and sector-wise in Himachal Pradesh in 68th round (2011-12). In rural areas, the consumption of almost all the commodities increased from lower-income households to higher-income households. The per capita consumption of rice was 4.18 Kg and 4.26 Kg for very poor and poor households, which increased to 4.53 Kg for rich households. Similar pattern was followed in the consumption of wheat and total cereals and pulses. But the per capita consumption of High-value commodities (HVC) viz. milk and milk products, egg, fish and meat, vegetables and fruits showed a different trend across the income groups as percentage increase in the consumption was high for rich households as compared to the low-income households.

Table 5.2.4: Income group and sector-wise monthly per capita consumption of food commodities in Himachal Pradesh (2011-12)

Income group	(Kg/capita/month)								
	Rice	Wheat	Cereals	Pulses	MMP	Edible oils	EFM	Vegetables	Fruits
Rural									
Very Poor	4.18	5.72	10.55	0.91	3.54	0.50	0.01	1.90	0.05
Poor	4.26	6.17	11.41	0.96	5.02	0.57	0.08	2.51	0.23
Middle	4.49	6.42	11.67	1.12	8.13	0.64	0.17	3.07	0.41
Rich	4.53	6.95	12.42	1.46	12.17	0.80	0.28	4.34	0.83
All	4.48	6.66	12.02	1.28	9.88	0.72	0.22	3.67	0.61
Urban									
Very Poor	3.45	5.31	8.80	0.88	2.22	0.42	0.07	2.47	0.20
Poor	3.86	6.06	10.35	1.17	5.13	0.60	0.10	3.52	0.37
Middle	3.21	5.19	8.54	1.00	5.73	0.57	0.06	3.21	0.44
Rich	4.34	6.41	11.28	1.64	10.22	0.87	0.35	5.52	1.34
All	4.19	6.25	10.91	1.54	9.45	0.82	0.31	5.17	1.19
HP									
Very Poor	4.12	5.68	10.38	0.91	3.42	0.49	0.01	1.96	0.07
Poor	4.25	6.17	11.38	0.96	5.02	0.57	0.08	2.54	0.24
Middle	4.44	6.37	11.55	1.12	8.04	0.64	0.17	3.08	0.41
Rich	4.50	6.86	12.24	1.49	11.86	0.81	0.29	4.52	0.91
All	4.45	6.62	11.91	1.31	9.83	0.73	0.23	3.83	0.67

The increase in monthly per capita consumption from very poor to rich households was 3.54 kg to 12.17 kg for milk and milk products, 0.01 Kg to 0.22 Kg for the egg, fish and meat, 1.90 Kg to 4.34 Kg for vegetables and 0.05 kg to 0.83 kg for fruits. The monthly per capita consumption of cereals in urban areas increased with the rise in income but comparatively less than rural sector. As presented in the table, the monthly per capita consumption of cereals was 10.55 kg for very poor rural households which was 8.80 kg for very poor urban households and it increased to 12.42 kg for rich rural households and 11.28 kg for rich urban households revealing that the consumption of cereals was more for the rural households compared to urban households. The high-value commodities like milk and milk product were consumed more in rural areas than urban areas. Whereas, the consumption of the egg, fish, meat, vegetables and fruits was more in urban areas. The intake of these HVCs increased with the rise in the income of the households of both sectors of the state.

5.2.4.1 Change in monthly per capita consumption of food commodities in Himachal Pradesh

Table 5.2.5 shows the change in the consumption pattern of households in the rural and urban sectors of Himachal Pradesh over the years. The table revealed that during 1987-88 to 2011-12, there has been an increase in the monthly per capita consumption of rice from 4.07 kg to 4.48 kg in rural Himachal and 4.15 kg to 4.19 kg in urban areas. Also, the per capita consumption of rice was found more in urban areas as compared to rural areas from 1987-88 to 2004-05 and during 2011-12 it was more in the urban area i.e., 4.48 kg in comparison to 4.19 kg in the rural area. The consumption of the wheat has declined over the years in the state in both the sectors as the wheat intake was 7.10 Kg per capita per month (pcpm) in 1987-88 in rural sector which declined to 6.66 Kg pcpm in 2011-12, likewise in the urban sector it declined from 7.57 Kg pcpm to 6.25 Kg pcpm during the same period.

In case of cereals, a persistent decline in consumption was observed in both sectors and the decline in the consumption of cereals was more in rural areas (-24.12 %) compared to the urban households (11 %). The per capita per month consumption of pulses also showed the mixed trends as the monthly per capita consumption of the

pulses first declined from 1.39 kg (1987-88) to 1.17 Kg (1993-94) and later increased to 1.20 Kg (2004-05) to 1.28 Kg (2011-12) in rural areas of the state. Similar trends were observed in the urban sector as the consumption declined from 1.60 Kg (1987-88) to 1.34 Kg (2004-05) but increased to 1.54 Kg (2011-12) but was not more than 1987-88 consumption rate.

Table 5.2.5: Sector-wise change in monthly per capita consumption of food commodities in Himachal Pradesh (1987-88 to 2011-12)

(Kg/capita/month)

Food Items	1987-88	1993-94	2004-05	2011-12
Rural				
Rice	4.07	3.64	4.09	4.48
Wheat	7.10	6.27	6.09	6.66
Cereal	15.84	13.37	12.06	12.02
Pulses	1.39	1.17	1.20	1.28
MMP	7.59	7.80	9.06	9.88
Edible oils	0.47	0.45	0.60	0.72
EFM	0.14	0.11	0.11	0.22
Vegetables	3.55	3.57	3.77	3.67
Fruits	0.50	0.50	0.66	0.61
Urban				
Rice	4.15	3.77	4.12	4.19
Wheat	7.57	6.85	6.43	6.25
Cereal	12.31	11.01	10.84	10.91
Pulses	1.60	1.34	1.34	1.54
MMP	8.51	9.41	8.65	9.45
Edible oils	0.66	0.60	0.78	0.82
EFM	0.30	0.19	0.22	0.31
Vegetables	5.33	5.21	5.44	5.17
Fruits	1.13	1.24	1.11	1.19

The per capita intake of pulses was more in urban households compared to rural households. However, the decline in the consumption of the foodgrains was more in the rural Himachal Pradesh compared to the urban due to the improvement of the rural infrastructure which made other food commodities available to the rural households. The consumption of the milk and its products was increased considerably from 7.59 Kg per capita per month (pcpm) to 9.88 Kg pcpm from 1987-88 to 2011-12 in the rural area and from 8.51 Kg pcpm to 9.45 Kg pcpm in the urban area of the state. The increase in the consumption of these products was more in the rural areas (30%) compared to

the urban area (11 %) due to the availability of the milch animals in the rural sector. Similarly, the monthly per capita consumption of non-vegetarian products (egg, fish, meat), fruits and vegetables increased from year 1987-88 to 2011-12 in the rural sector of the state. In urban areas, a mild increase in the consumption of non-vegetarian products and fruits was observed in the state, whereas, for vegetables, it declined from 5.33 kg to 5.17 kg.

Likewise, the consumption of edible oils increased from 0.47 Kg pcpm to 0.72 Kg pcpm in the rural area and from 0.66 Kg pcpm to 0.82 Kg pcpm in the urban area during the study period. The consumption of non-vegetarian food (egg, fish, meat) has shown a decline in the per capita consumption from 0.14 Kg in 1987-88 to 0.11 Kg during 1993-94 and 2004-05 and further increased significantly to 0.22 Kg during 2011-12 in rural Himachal Pradesh. While the consumption of EFM in the urban area increased marginally by around 2 per cent over the years. The per capita consumption of the vegetables was more in the urban areas over the years compared to the rural areas, but a significant increase in the consumption was seen only in the rural areas i.e., from 3.55 Kg to 3.67 Kg from 1987-88 to 2011-12 and declined by 3 per cent in the urban areas. Fruits consumption was also high in the urban areas as compared to the rural and also the consumption increased considerably from 0.50 Kg pcpm in 1987-88 to 0.66 Kg in 2004-05 and declined to 0.61 Kg pcpm in 2011-12 in rural areas whereas in urban areas it increased by 6 per cent from 1.13 Kg pcpm to 1.19 Kg pcpm in 1987-88 to 2011-12.

The reduced consumption of food grains and increased consumption of agricultural commodities has changed the consumption pattern both in rural and urban areas because of the rising incomes of households and increased preferences towards more nutritious foods. Also, over the years the per capita consumption of cereals was more in the rural Himachal than in the urbans except for pulses, edible oils, milk and products, EFM, vegetables and fruits. This difference in the consumption pattern of food commodities in rural and urban areas can be explained by the income and price effect. The more consumption of cereal and less consumption of other food items in rural areas was due to lower food prices in these areas and the improvement of the

public distribution system in the state. Hence, urban diets were relatively more diverse than rural diets due to higher income levels (Chopra 2015).

The trends in the per capita consumption of food commodities over more than two decades were presented in Table 5.2.6. The change in the per capita consumption of rice was 9.27 per cent from 1987-88 to 2011-12 and the rice consumption grew at the rate of 0.37 per cent. Across the income groups, the consumption of rice increased from 2.08 kg to 4.12 kg for very poor households and from 4.50 kg to 4.68 kg for rich households (Fig 5.10) The intake of wheat in the state has declined by around 7 per cent for over two decades. Fig 5.11 revealed that the per capita monthly intake of wheat has increased for the very poor and poor household from 4.81 kg to 5.68 kg and 5.32 Kg to 6.17 Kg respectively, however, for the middle and rich-income households it declined from 6.79 kg to 6.37 kg and 8.05 kg to 6.86 kg during 1987-88 to 2011-12.

Table 5.2.6: Monthly per capita consumption of food commodities in different NSSO rounds in Himachal Pradesh (1987-88 to 2011-12)

Food Items	(Kg/capita/month)					
	43 rd	50 th	61 st	68 th	Change (%)	Growth (%)
Rice	4.07	3.65	4.09	4.45	9.27	0.37
Wheat	7.13	6.32	6.12	6.62	-7.21	-0.31
Cereal	15.61	13.17	11.94	11.91	-23.71	-1.12
Pulses	1.40	1.18	1.21	1.31	-6.40	-0.28
MMP	7.65	7.94	9.02	9.83	28.57	1.05
Edible oils	0.48	0.47	0.62	0.73	51.48	1.75
EFM	0.15	0.11	0.12	0.23	49.24	1.68
Vegetables	3.67	3.71	3.92	3.83	4.55	0.19
Fruits	0.54	0.56	0.70	0.67	23.26	0.88

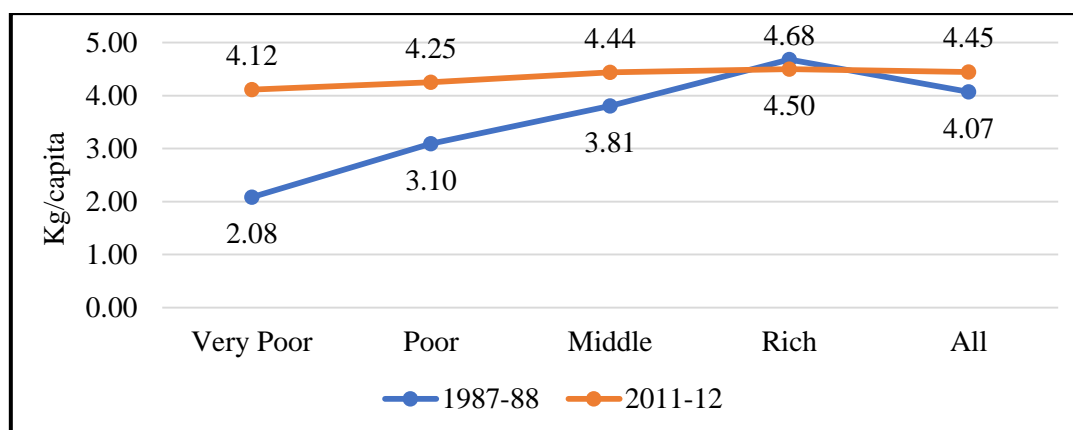


Fig 5.10: Monthly per capita consumption across years and expenditure classes for rice

The per capita monthly consumption of the cereals has fallen from 15.61 kg in 1987-88 to 11.91 Kg in 2011-12 showing a fall of 24 per cent in consumption with the decline in growth at the rate of 1.12 per cent (Fig 5.12). The per capita consumption of cereals declined since the 1970s (Rao, 2000). The reduction in the relative quantity of cereal consumption might be because of the change in the taste and preference of households from food to non-food items and within food groups from cereals to non-cereal food items and from coarse cereals to fine cereals (Radhakrishna and Murthy, 1999, Radhakrishna 2005). Across the income groups a constant decline was observed in the consumption of the cereals for households i.e., 11.09 Kg to 10.38 Kg (very poor), 13.44 Kg to 11.38 Kg (poor), 14.99 Kg to 11.55 Kg (middle) and 17.00 Kg to 12.24 Kg (rich) as presented in Fig 5.12.

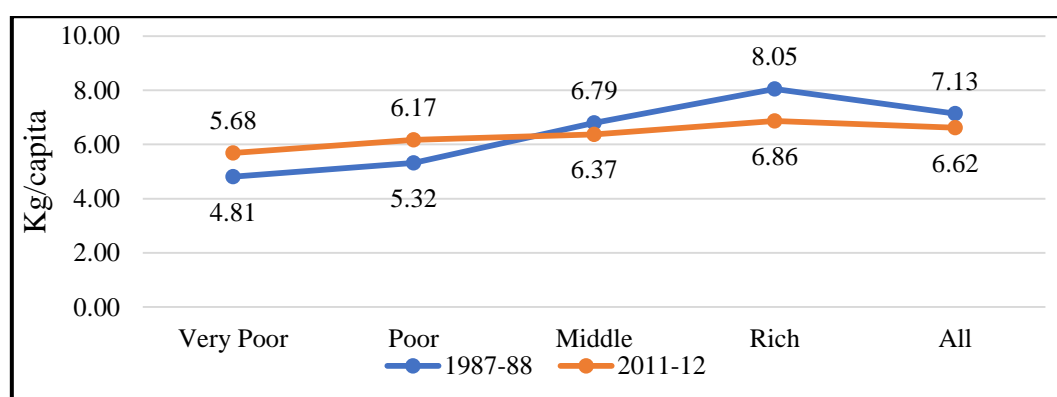


Fig 5.11: Monthly per capita consumption across years and expenditure classes for wheat

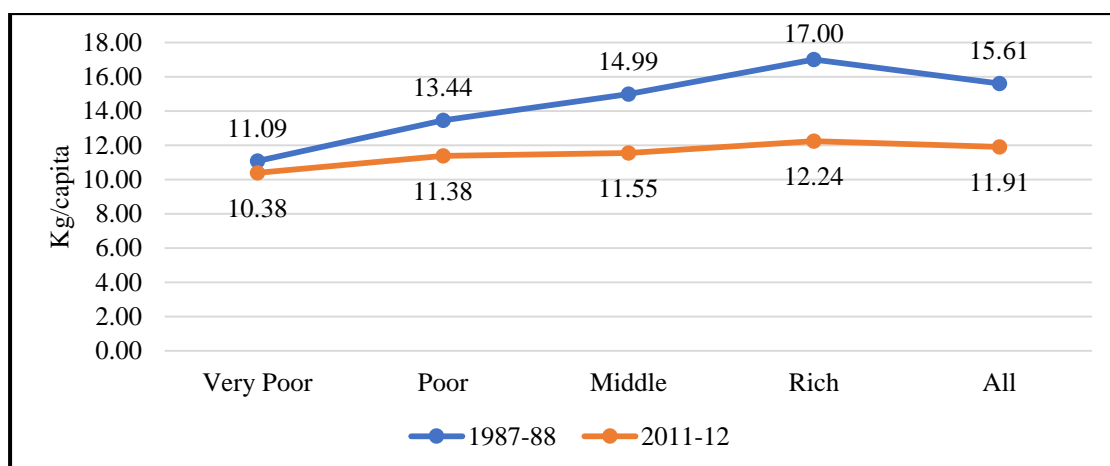


Fig 5.12: Monthly per Capita consumption across years and expenditure classes for cereals

The intake of the pulses has declined marginally for the poor, middle and rich households from 1987-88 to 2011-12, except for very poor households which showed a mild increment in the monthly per capita consumption of pulses from 0.68 Kg to 0.91 Kg (Fig 5.13). The monthly consumption of the milk and milk products increased many folds over two and half decades in Himachal Pradesh from 7.65 Kg (1987-88) to 9.83 Kg (2011-12) with a growth rate of 1.05 per cent. Fig 5.14 showed that consumption of the milk increased from 2.56 Kg pcpm to 3.42 Kg pcpm for very poor households which further increased from 3.78 Kg pcpm to 5.02 Kg pcpm for poor households, 5.86 Kg pcpm to 8.04 Kg pcpm for middle-income households and 10.46 Kg pcpm to 11.86 Kg pcpm for rich income households.

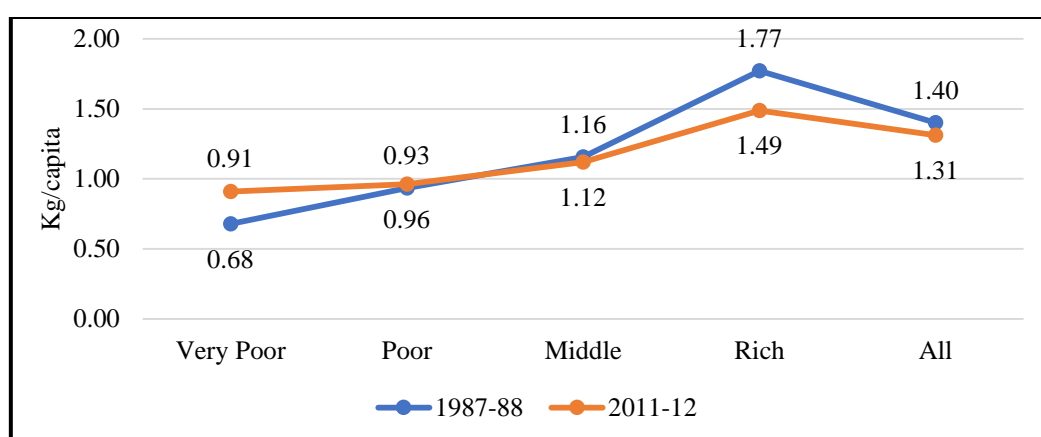


Fig 5.13: Monthly per capita consumption across years and expenditure classes for pulses

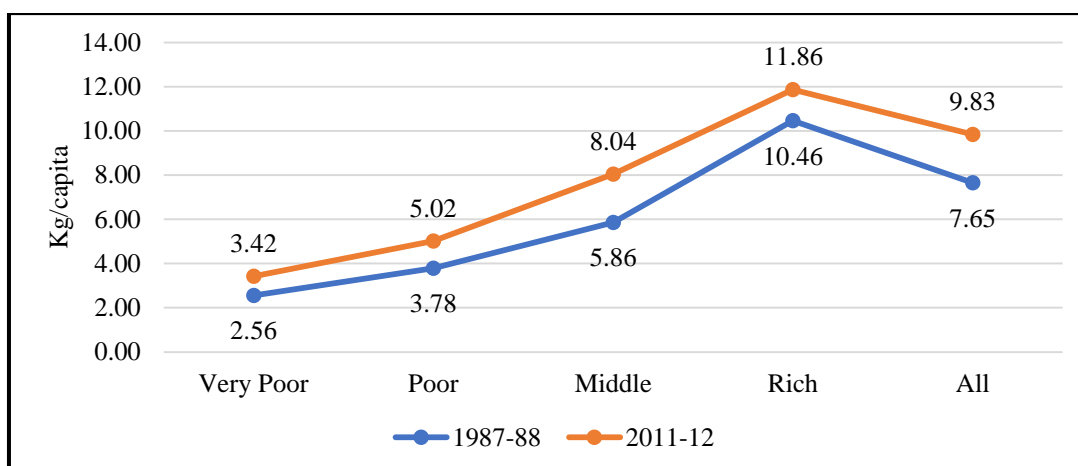


Fig 5.14: Monthly per capita consumption across years and expenditure classes for milk and milk products

The monthly consumption of edible oils has shown a rise from 1987-88 to 2011-12 across all the income groups (Fig 5.15). The non-vegetarian products in Himachal Pradesh have shown the maximum increase of around 49 per cent among all food commodities for the past two and half decade as the consumption has increased from 0.15 Kg pcpm to 0.23 Kg pcpm. For the very poor households the consumption has remained almost same over the period i.e., 0.01 Kg pcpm however, for the poor, middle and rich-income households it inclined from 0.04 Kg pcpm to 0.08 Kg pcpm, 0.10 Kg pcpm to 0.17 Kg pcpm and 0.23 Kg pcpm to 0.29 Kg pcpm, respectively (Fig 5.16).

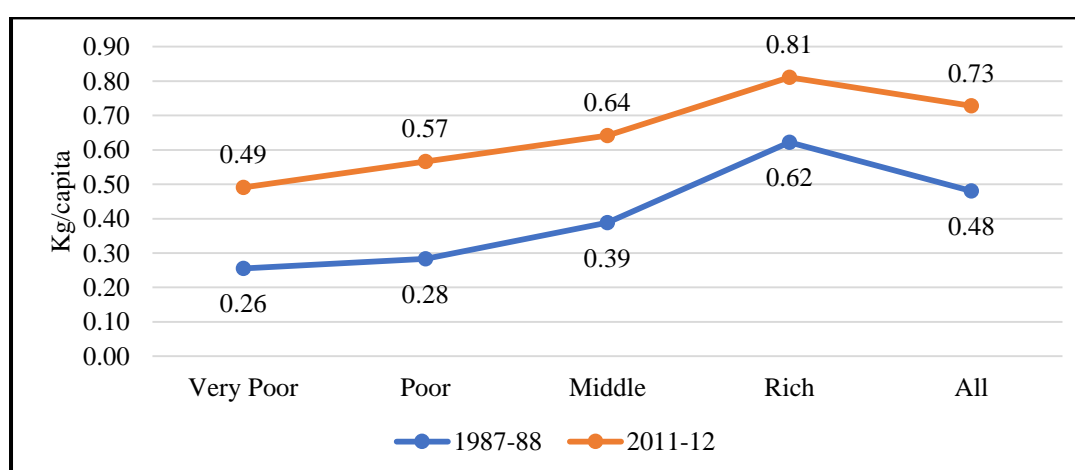


Fig 5.15: Monthly per capita consumption across years and expenditure classes for edible oils

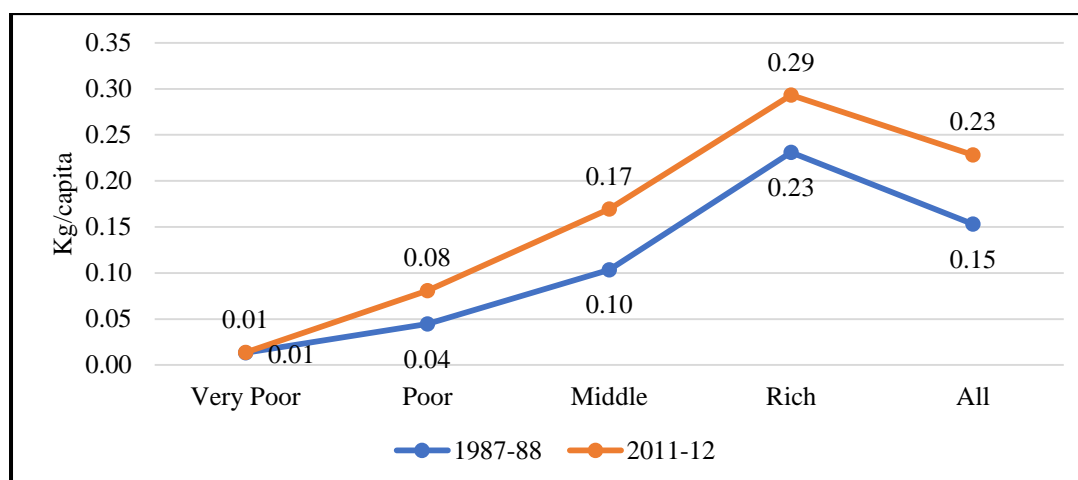


Fig 5.16: Monthly per capita consumption across years and expenditure classes for egg, fish, meat

For vegetables, a mixed trend was observed in the state for monthly per capita consumption as the consumption was 3.67 Kg pcpm during 1987-88 which raised marginally to 3.71 Kg pcpm in 1993-94 and finally to 3.92 Kg pcpm in 2004-05 and thereafter it declined to 3.83 Kg pcpm during 2011-12, but over the past two and half decades, it increased by around 5 per cent. Fig 5.17 showed that the consumption of the vegetables across the income groups was not constant as the per capita consumption of vegetables for very poor households increased from 1.85 kg to 1.96 Kg and likewise for poor and middle-income households it increased over the years but the rich income household's monthly consumption has declined from 4.74 Kg pcpm to 4.52 Kg pcpm.

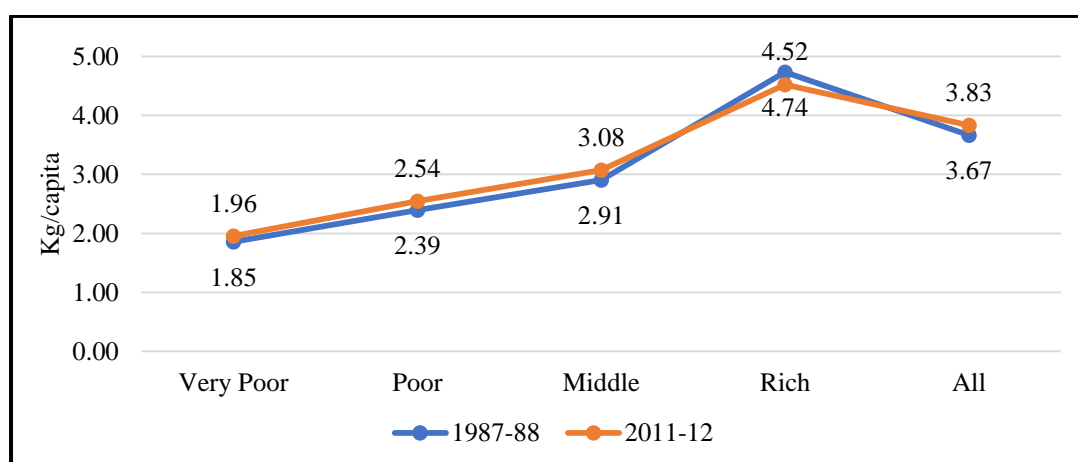


Fig 5.17: Monthly per capita consumption across years and expenditure classes for vegetables

The per capita consumption of the fruits has increased by 23 per cent at growth rate of 0.88 per cent from 0.54 Kg to 0.67 Kg from 1987-88 to 2011-12. Across the income groups, the intake of the fruits remained more or less the same during the study period except for the rich income households which increased from 0.76 Kg pcpm to 0.91 Kg pcpm (Fig 5.18). Thus, as the income goes up, the food basket becomes more diversified and there exists variations in the consumption pattern across income categories. The per capita consumption of all food groups increased with growth in income of households (Chopra 2015).

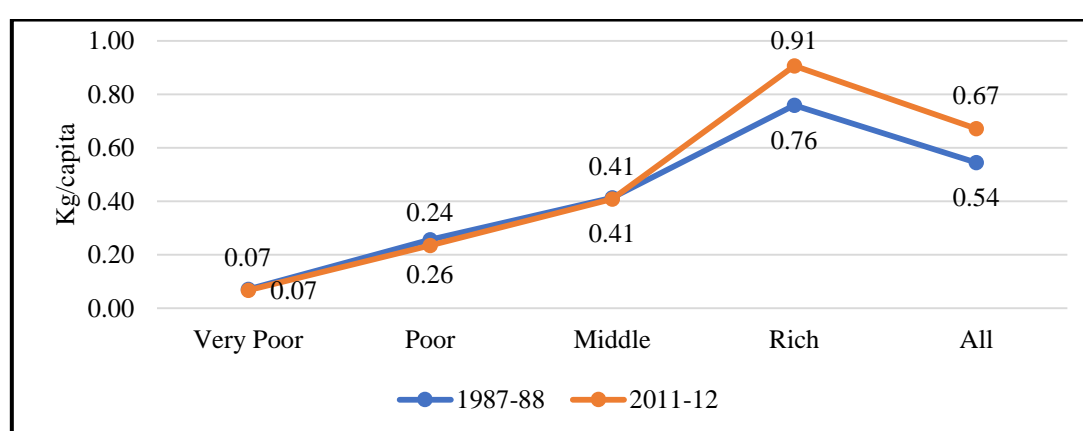


Fig 5.18: Monthly per capita consumption across years and expenditure classed for fruits

5.2.5 Dietary diversity index in Himachal Pradesh

The discussion in the previous tables revealed that the food preferences of the households have diversified over time in the favour of fruits, vegetables and livestock products from the traditional food grains.

Table 5.2.7 presents the dietary diversity across income groups and for rural and urban sectors during the 68th round i.e., 2011-12. The dietary diversity was calculated for the food commodities viz., cereals, pulses, milk and milk products (MMP), edible oils, egg, fish, meat (EFM), vegetables, fruits and spices. The beverages and processed foods were not included in the calculation due to non-availability of data on quantities (in kilograms) of these products. The dietary diversity index was significantly higher with Simpson Index of Diversification (SID) score of 0.843 for very poor urban households compared to the very poor rural households with SID Score of 0.817.

Whereas, the diversity in intake of food is marginally higher for poor urban households (0.857) compared to the poor rural households (0.850). Similarly, the dietary diversity index for the middle and rich urban households was 0.846 and 0.815 respectively, which was higher than the rural middle and rich households. Thus, the dietary diversity was significantly more for all income categories of the urban households compared to the rural households. This could be due to the high-income earning sources and more employment opportunities in the urban areas than the rural areas.

Table 5.2.7: Income group and sector-wise dietary diversity index in Himachal Pradesh (2011-12)

Income group	Rural	Urban	HP
Very Poor	0.817	0.843	0.819
Poor	0.850	0.857	0.850
Middle	0.831	0.846	0.832
Rich	0.814	0.815	0.814
All	0.822	0.818	0.821

Table 5.2.8 presents the diversity estimates for the years 1987-88, 1993-94, 2004-05 and 2011-12 in terms of per cent and growth rate. Over the years the level of dietary diversity varied, as the SID estimates for the year 2011-12 were higher than 1987-88 estimates for all income groups. The dietary diversity for very poor people increased by 16 per cent followed by poor households i.e., 12 per cent and middle-income households by 9 per cent and rich households by 3 per cent. This increased dietary diversity was due to changing lifestyle of households, availability of the new food items in food basket, health consciousness, changes induced with urbanization, etc. (Joshi et al. 2016). The higher increase in the dietary diversity for the lower-income people over the years revealed the availability of diversified food baskets to them compared to earlier times. The diversification in the food basket due to urbanization would provide food security and improve the quality of life by adding to the nutritional status and welfare of the population (Kumar 1997).

Table 5.2.8: Income group-wise change in dietary diversity index in Himachal Pradesh, (1987-88 to 2011-12)

Income Group	1987-88	1993-94	2004-05	2011-12	Change (%)	Growth (%)
Very Poor	0.706	0.717	0.777	0.819	16.00	0.62
Poor	0.758	0.776	0.805	0.850	12.14	0.47
Middle	0.765	0.792	0.805	0.832	8.76	0.35
Rich	0.790	0.775	0.798	0.814	3.04	0.12
All	0.777	0.777	0.800	0.821	5.66	0.23

5.3 Factors affecting demand for agricultural commodities and demand projections for agricultural commodities

There are several studies conducted by economists over the year which revealed that the consumption pattern of food commodities has shifted gradually from cereals and pulses towards high-value commodities. Along with this a wide inter-regional and inter-temporal difference has been observed in the consumption pattern (Srivastava, 1991, Paroda and Kumar, 1999, Radhakrishna, 2005). However, several factors affect the consumption pattern of the households. The increased urbanization and growth in income reduced the per capita demand for cereals and on the other hand demand for non-cereal food items increased. Further, the mechanization of agriculture and infrastructure improvement also reduces the energy requirement and thus less requirement for the demand for cereals (Rao 2000). Kumar and Mathur (1996) argued that the demand for food influenced not only by the rise or fall in income, but also by the variation in the urban and rural lifestyles, change in the occupations and advances in the marketing system of the economy. Some of these factors which affect the demand for food commodities are income, prices of own and related commodities and demographic variable like age, family size, etc. In this section, the factors affecting the demand for food commodities were studied. The households were divided into non-vegetarian (consumes egg, fish and meat) and vegetarian groups in the rural and urban sectors.

5.3.1 Factors affecting demand for agricultural commodities in Himachal Pradesh

5.3.1.1 Sector wise factors affecting demand for agricultural commodities of the non-vegetarian households in Himachal Pradesh

The estimated results of the Quadratic Almost Ideal Demand System (QUAIDS) for non-vegetarian and vegetarian rural and urban households were presented in Table 5.3.1 and Table 5.3.2. For the non-vegetarian households, the commodities included were cereals, pulses, milk and milk products, salt & sugar, edible oil, egg, fish, meat, vegetables, fruits, spices and for the vegetarian households other than the egg, fish, meat all other items were included. It was evident from Table 5.3.1 that almost all the parameters were significantly different from zero, except in few isolated cases. The alpha coefficient (intercepts) was statistically significant and positive for all commodities except for cereals and pulses for the rural non-vegetarian households. It also showed the negative but non-significant effect for the egg, fish and meat. The effect of the own-price variable on each group of food commodities was negative and significant for the food group's expenditure share. Thus, with a one per cent increase in the prices of the food commodities, the expenditure share declined by 0.553 % for milk and milk products, 0.386 % for cereals and 0.167 % for pulses and minimum for the spices by 0.006 % for the rural non-vegetarian households. For urban households, the one per cent increase in the prices led to the decline in the expenditure share by 0.427 per cent for milk and milk products, followed by cereals (0.266 %) and pulses (0.094 %) which is comparatively lesser than the rural households. Hence, the increase or decrease in the prices of the food commodities in the state affected milk and milk products, cereals, pulses more in rural and urban areas.

Table 5.3.1: Factors affecting demand for food commodities of rural and urban (non-vegetarian) households in Himachal Pradesh

Parameters	Rural								
	Cereals	Pulses	MMP	Sugar	Edible Oil	EFM	Vegetables	Fruits	Spices
Constant	-0.322*	-0.347*	1.200*	0.046***	-0.062	-0.039	0.231*	0.201*	0.092**
Cereals price	-0.386*	-0.063*	0.404*	-0.014**	-0.032*	0.013	0.035***	0.046*	-0.003
Pulses price	-0.063*	-0.167*	0.147*	0.009*	0.034*	-0.001	0.019**	0.016**	0.006
MMP price	0.404*	0.147*	-0.553*	0.026*	0.065*	0.001	-0.024	-0.065*	-0.001
Sugar price	-0.014**	0.009*	0.026*	-0.048*	0.004**	0.005**	0.009*	0.005*	0.003**
Edible Oil price	-0.032*	0.034*	0.065*	0.004**	-0.094*	0.009***	0.000	0.008**	0.005**
EFM price	0.013	-0.001	0.001	0.005**	0.009***	-0.053*	0.009*	0.015*	0.002
Vegetables price	0.035***	0.019**	-0.024	0.009*	0.000	0.009*	-0.052*	-0.025	-0.005
Fruits price	0.046*	0.016**	-0.065*	0.005*	0.008**	0.015*	0.005	-0.025*	-0.005*
Spices price	-0.003	0.006	-0.001	0.003**	0.005**	0.002	-0.001	-0.005*	-0.006*
Income	0.208*	0.083*	-0.316*	0.015*	0.037*	0.009	-0.007	-0.031**	0.002
Quadratic Income	-0.014*	-0.004*	0.022*	-0.001*	-0.003*	0.000	0.000	0.002**	-0.001***
hh_size	0.0011*	-0.0002*	0.0001	0.0001*	-0.0002*	-0.0005*	-0.0002*	-0.0001	-0.0001*
Urban									
Constant	-0.036	0.126	1.281*	0.054	-0.157***	-0.361**	0.009	-0.051	0.136**
Cereals price	-0.266*	0.021	0.235**	0.014	-0.023	-0.023	0.032	-0.011	0.021
Pulses price	0.021	-0.094*	-0.001	0.017*	0.021**	0.023**	0.008	0.005	0.000
MMP price	0.235**	-0.001	-0.427*	0.015	0.088*	0.102***	0.007	0.019	-0.037***
Sugar price	0.014	0.017*	0.015	-0.057*	0.003	0.004	0.005	0.005	-0.006***
Edible Oil price	-0.023	0.021**	0.088*	0.003	-0.094*	-0.006	-0.008	0.000	0.021*
EFM price	-0.023	0.023**	0.102***	0.004	-0.006	-0.114*	0.002	0.000	0.012***
Vegetables price	0.032	0.008	0.007	0.005	-0.008	0.002	-0.062*	0.005	0.011
Fruits price	-0.011	0.005	0.019	0.005	0.000	0.000	0.005	-0.028*	0.004
Spices price	0.021	0.000	-0.037***	-0.006***	0.021*	0.012***	0.011***	0.004	-0.025*
Income	0.172*	0.001	-0.329*	0.006	0.063*	0.067	0.023	0.019	-0.021
Quadratic Income	-0.016*	-0.001	0.025*	-0.001	-0.005*	-0.003	-0.001	-0.001	0.001
hh_size	-0.0001	-0.0008*	0.0023**	0.0000	-0.0005*	-0.0006	-0.0001	0.0001	-0.0003*

Note: * denotes significant at 1%, ** denotes significant at 5% and *** denotes significant at 10%, hh_size- household size

For linear and quadratic income, all food groups depicted statistically significant coefficients except for egg, fish, meat and vegetables. For rural households, the linear income variables demonstrated a positive relation with expenditure share of commodities like cereals, pulses, salt & sugar, edible oils but it declined for the food groups like milk and milk products, vegetable and fruits, which signified that with an increase in income the consumption of essential food commodities increased initially as the consumption expenditure share of these commodities increased due to shifting from poor quality towards good quality food.

Further, with quadratic income the consumption expenditure share shifted towards the high-value commodities like milk and milk products, egg, fish, meat, vegetables, and fruits. Similarly, the urban non-vegetarian households also depicted the same behaviour that with an initial increase in income the requirement for essential food commodities like cereals, edible oil, etc. was met. The quadratic income values are smaller in magnitude than the linear income estimates, as would be expected. The statistical significance of both the linear and quadratic income indicated that the total food budget was an important determinant for the expenditure shares of most of the food groups and that apart from the egg, fish meat and vegetables for non-vegetarian rural households and pulses, egg, fish meat, vegetables and fruits for non-vegetarian urban households the consumption of all other food groups were sensitive to food expenditure.

For demographic variables, household size (number of family members) was less strong operationally and was quite close to zero. The study indicated a negative effect between households' size and share of food expenditure. As the expenditure share of the food commodities like pulses, egg, fish, meat and vegetables, fruits declined significantly with the increase in the household size for rural non-vegetarian households. The expenditure share of food groups declined in the urban sector but it was significantly negative only for pulses and edible oils. The negative effect indicated that the expenditure share was less as the family size increased (Mittal 2010, Kharisma et al. 2020). Thus, the phenomenon of decline in the food expenditure pattern with increased family size is called the Deaton-Paxon paradox proposed by Deaton and Paxson (1998).

5.3.1.2 Sector wise factors affecting demand for agricultural commodities of the vegetarian households in Himachal Pradesh

The factors affecting demand for the food commodities of the vegetarian rural and urban households were presented in Table 5.3.2. For the vegetarian households in Himachal Pradesh the intercept was statistically significant and positive for cereals (0.785 %), pulses (0.510 %) and spices (0.263%) in rural areas and pulses (0.514 %), edible oil (0.330 %) and spices (0.657) in urban areas. The own-price effect of the food groups revealed a significantly negative relationship with the expenditure shares i.e., one per cent increase in prices of cereals resulted in 0.136 per cent and 0.145 per cent decline in the expenditure share of cereals and pulses by 0.122 per cent and 0.111 per cent in rural and urban areas, respectively. Further, the decline in the food expenditure share was more in the urban areas compared to the rural areas of the state. Also, with the increase in own prices of food commodities the decline in the expenditure share of cereals would be more in urban areas than in rural areas whereas for milk and milk products it would be more in urban areas than rural areas.

For vegetarian rural households, the linear income variables demonstrated a positively significant relation with expenditure share for food commodities like vegetable and fruit but with an increase in income the expenditure share on pulses, edible oils and spices decreased, which signified that with an increase in income the consumption of normal food commodities declined. Further, with a quadratic increase in income, the consumption of cereals declined significantly while vegetables and fruits increased significantly, which revealed that with the growth in income the consumption of high-value commodities would be higher compared to the normal food commodities.

For the rural households, the family size played a significant role in the expenditure share of the food commodities like cereals, edible oils, vegetables fruits and spices. With an increase in the family size, the expenditure share has decreased significantly for the commodities like edible oils (0.0002 %), vegetables (0.0004 %), fruits (0.0003 %) and spices (0.0002 %), confirming the Deaton-Paxon paradox. Likewise, for the urban vegetarian households, the expenditure share was significant for cereals, salt, sugar and fruits. In urban households with an increase in the family member by one number the expenditure share of fruits decreased significantly by - 0.0004 per cent and for cereals, it significantly increased by 0.0010 per cent.

Table 5.3.2: Factors affecting demand for food commodities of rural and urban (vegetarian) households in Himachal Pradesh

Parameters	Rural							
	Cereals	Pulses	MMP	Sugar	Edible Oil	Vegetables	Fruits	Spices
Constant	0.785*	0.510*	-0.343	-0.016	0.099	-0.050	-0.247**	0.263*
Cereals price	-0.136*	0.026***	0.025**	0.015*	0.023*	0.033*	0.006	0.007
Pulses price	0.026***	-0.122	-0.008*	0.026**	0.024**	0.033**	0.038**	-0.016***
MMP price	0.025**	-0.008*	-0.022	0.004	0.000	0.001	0.007	-0.007
Sugar price	0.015*	0.026**	0.004	-0.059*	0.013*	0.002	-0.008	0.008**
Edible Oil price	0.023*	0.024**	0.000	0.013	-0.080*	0.012***	0.012	-0.004
Vegetables price	0.033*	0.033**	0.001	0.002	0.012***	-0.073*	-0.019	0.011
Fruits price	0.006	0.038**	0.007	-0.008	0.012	-0.019	-0.045**	0.009
Spices price	0.007	-0.016***	-0.007	0.008**	-0.004	0.011	0.009	-0.008
Income	-0.006	-0.084*	-0.031	0.029**	-0.010**	0.063**	0.075*	-0.036**
Quadratic Income	-0.005**	0.004**	0.011*	-0.002*	0.000	0.005*	0.005*	0.001
hh_size	0.0011*	-0.0001	0.0000	0.0000	-0.0002*	-0.0004*	-0.0003*	-0.0002*
Urban								
Constant	0.156	0.514*	-0.630*	0.023	0.330**	0.234	-0.284**	0.657***
Cereals price	-0.145*	0.051	-0.022	0.009	0.053***	0.019	-0.033	0.068
Pulses price	0.051	-0.111*	0.041	0.023**	-0.010	0.017	0.037	-0.048
MMP price	-0.022	0.041	-0.091***	-0.009	0.045***	0.009	-0.040***	0.068**
Sugar price	0.009	0.023**	-0.009	-0.062*	0.023**	0.008	-0.004	0.012
Edible Oil price	0.053***	-0.010	0.045***	0.023**	-0.099*	0.005	0.036***	-0.053**
Vegetables price	0.019	0.017	0.009	0.008	0.005	-0.078*	0.005	0.016
Fruits price	-0.033	0.037	-0.040***	-0.004	0.036***	0.005	-0.061**	0.060**
Spices price	0.068	-0.048	0.068**	0.012	-0.053**	0.016	0.060**	-0.124*
Income	0.076	-0.069***	0.096*	0.015	-0.066**	0.003	0.072**	-0.127*
Quadratic Income	-0.006**	0.002	-0.001	-0.001	0.003**	0.001	0.003**	0.006*
hh_size	0.0010*	-0.0001	-0.0003	0.0002*	-0.0001	-0.0002	-0.0004*	0.0000

Note: * significant at 1%, ** significant at 5% and *** significant at 10%

hh_size- household size

5.3.2 Income elasticities of agricultural commodities in Himachal Pradesh

The demand elasticities are major parameters in the projection of food demand. The expenditure elasticity is the responsiveness of expenditure on consumption of food commodities with change in Income. The income elasticities of the food commodities of non-vegetarian and vegetarian households for the rural and urban sectors were presented in Table 5.3.3 and Table 5.3.4. The elasticities were calculated for the food groups cereals, pulses, milk and milk products, salt & sugar, edible oils, egg, fish, meat, vegetables, fruits and spices. Table 5.3.3 depicted that the income elasticities of food commodities were positive for both sectors indicating that these commodities were necessary. For the rural non-vegetarian households, the income elasticity of the demand was highest for milk and milk products (1.37) followed by the fruits (1.00), egg fish meat (0.99), pulses (0.91) and vegetables (0.82) and least for the cereals (0.64). Thus, with an increase in income, the demand for food commodities other than cereals would increase much faster (Kumar et al. 2011).

The income elasticities of food commodities were lower in the rural areas compared to the urban areas except for the pulses, milk and milk products. For urban households, the income elasticity was sensitive for milk and milk products (1.22) followed by egg, fish, meat (1.20), fruits (1.17), vegetables (1.09), pulses (0.87) and comparatively least for the cereals. Thus, milk and milk products were luxury food items for rural non-vegetarian households and milk and milk products, egg, fish meat, vegetables and fruits were luxury items for urban non-vegetarian households. Compared to other food commodities the cereals consumption was little affected by the income changes and the food commodities with expenditure elasticities of more than one, implied that as the expenditure share on the food increases the proportion of expenditure on these food groups would be higher than other food groups. The income elasticity for pulses, milk and milk products was higher in the rural sector compared to urban sectors. The income elasticity for cereals, eggs, fish, meat, vegetables and fruits was higher in the urban areas. Thus, with the increase in the income the consumption of non-vegetarian products (egg, fish, meat) would be higher in urban areas.

Table 5.3.3: Sector-wise income elasticity of demand for food commodities for non-vegetarian households in Himachal Pradesh

Food group	Rural	Urban
Cereal	0.64	0.67
Pulses	0.91	0.87
MMP	1.37	1.22
Sugar	0.72	0.83
Edible Oil	0.70	0.86
EFM	0.99	1.20
Vegetables	0.82	1.09
Fruits	1.00	1.17
Spices	0.71	0.83

Table 5.3.4: Sector-wise income elasticity of demand for food commodities for vegetarian households in Himachal Pradesh

Food group	Rural	Urban
Cereal	0.61	0.84
Pulses	0.74	0.76
MMP	1.39	1.22
Sugar	0.75	0.90
Edible Oil	0.77	0.92
Vegetables	0.76	0.91
Fruits	0.79	1.08
Spices	0.67	0.74

For the vegetarian households of the state, the income elasticities varied from the non-vegetarian households in both sectors (Table 5.3.4). The income elasticity was maximum for the milk and milk products (1.39) for rural households followed by fruits (0.79), edible oils (0.77), vegetables (0.76) and comparatively less for the cereals (0.61). For the urban households the income elasticities comparatively more than the rural households for cereals, pulses, salt & sugar, edible oil vegetables fruits and spices. The Income elasticity for milk and milk products was more in the rural households of the state indicating that with a one per cent increase in the income of the households the demand for the milk would increase but it would be more in the rural areas compared to the urban areas. The high-value commodities were more income elastic compared to the cereals. Therefore, for rural vegetarian households milk and milk products was luxury items, however for urban households luxury food was fruits along with milk and milk products.

5.3.3 Price elasticities of agricultural commodities in Himachal Pradesh

The household's response to the price was summarized in form of own-price and cross-price elasticity. Both uncompensated and compensated own-price and cross-price elasticity of demand derived for different food commodities for the non-vegetarian and vegetarian rural and urban households of the state is presented in Table 5.3.5, Table 5.3.6, Table 5.3.7 and Table 5.3.8.

5.3.3.1 Sector wise uncompensated own-price and cross-price elasticities of agricultural commodities (non-vegetarian households) in Himachal Pradesh

The uncompensated price elasticity denoted the change in the quantity demanded due to the changes in the prices, including both price effect and income effect. The compensated elasticity represents the portion of the change in quantity demand captures only the price effect. Table 5.3.5 presents the uncompensated and compensated own-price and cross-price elasticity of demand for the rural non-vegetarian households.

Table 5.3.5: Uncompensated and compensated own and cross-price elasticities of food commodities for non-vegetarian rural households in Himachal Pradesh

Uncompensated elasticity									
Food group	Cereal	Pulses	MMP	Sugar	Edible Oil	EFM	Vegetables	Fruits	Spices
Cereals	-1.45	0.19	0.07	0.05	0.09	0.13	0.18	0.06	0.03
Pulses	0.43	-2.60	0.07	0.21	0.63	0.02	0.21	0.03	0.09
MMP	-0.12	-0.02	-0.91	-0.03	-0.05	-0.06	-0.09	-0.05	-0.05
Sugar	0.29	0.49	-0.12	-2.29	0.25	0.18	0.27	0.08	0.11
Edible Oil	0.34	0.89	-0.05	0.15	-2.44	0.20	0.03	0.05	0.12
EFM	0.23	0.02	-0.12	0.06	0.12	-1.60	0.10	0.16	0.02
Vegetables	0.43	0.21	-0.21	0.12	0.01	0.13	-1.60	0.08	0.01
Fruits	0.29	0.07	-0.34	0.07	0.06	0.40	0.17	-1.56	-0.15
Spices	0.16	0.21	-0.21	0.10	0.18	0.08	0.03	-0.13	-1.13
Compensated elasticity									
Cereals	-1.31	0.24	0.30	0.07	0.14	0.18	0.24	0.09	0.06
Pulses	0.62	-2.53	0.41	0.24	0.68	0.11	0.28	0.07	0.13
MMP	0.17	0.09	-0.40	0.02	0.03	0.06	0.02	0.01	0.01
Sugar	0.44	0.55	0.16	-2.27	0.29	0.24	0.33	0.11	0.14
Edible Oil	0.49	0.95	0.21	0.18	-2.40	0.27	0.08	0.07	0.15
EFM	0.44	0.10	0.25	0.10	0.18	-1.51	0.19	0.20	0.06
Vegetables	0.61	0.28	0.09	0.14	0.06	0.20	-1.53	0.11	0.04
Fruits	0.50	0.15	0.03	0.11	0.12	0.49	0.25	-1.53	-0.12
Spices	0.31	0.26	0.05	0.13	0.22	0.14	0.09	-0.11	-1.10

Note: Diagonal elements represents own-price elasticities

Elements above and below diagonal represents cross- price elasticities

The uncompensated own-price elasticity (Marshallian elasticity) of demand for all food commodities has expected negative signs which means the price of the commodity and demand for that commodity were inversely related. The uncompensated own-price elasticity of all the food commodities was higher than unity except for milk and milk products. The elasticity was highest for the pulses (-2.60), edible oil (-2.44) and sugar (-2.29) and least for the milk and milk products (-0.91). While the own-price elasticity for the high-value commodities like egg, fish, meat (EFM), vegetables and fruits were -1.60, -1.60, -1.56, respectively implying that with the marginal increase in the prices of these food commodities, a substantial decline in its consumption would occur. Further, the uncompensated own-price elasticity of most of the food commodities was more than income elasticity, implying that the responsiveness of demand to the own-price changes of these food groups was higher than the responsiveness of the demand to the change in the income of the households (Felix and Kumar, 2020).

Table 5.3.6: Uncompensated and compensated own and cross-price elasticities of food commodities for non-vegetarian urban households in Himachal Pradesh

Uncompensated elasticity									
Food group	Cereals	Pulses	MMP	Sugar	Edible Oil	EFM	Vegetables	Fruits	Spices
Cereals	-1.55	0.14	0.12	0.11	0.12	0.10	0.24	0.01	0.051
Pulses	0.28	-2.04	0.03	0.21	0.24	0.26	0.10	0.06	0.009
MMP	-0.03	-0.02	-1.11	0.01	0.02	0.07	-0.08	-0.02	-0.048
Sugar	0.54	0.47	0.20	-2.43	0.13	0.14	0.15	0.13	-0.157
Edible Oil	0.34	0.33	0.19	0.07	-2.21	0.15	-0.03	0.06	0.244
EFM	0.10	0.19	0.20	0.04	0.07	-1.95	0.06	0.05	0.048
Vegetables	0.42	0.07	-0.21	0.05	-0.04	0.07	-1.61	0.07	0.085
Fruits	-0.05	0.08	-0.10	0.11	0.08	0.12	0.15	-1.61	0.050
Spices	0.23	0.02	-0.23	-0.15	0.38	0.16	0.23	0.07	-1.535
Compensated elasticity									
Cereals	-1.41	0.19	0.32	0.13	0.16	0.17	0.31	0.04	0.08
Pulses	0.47	-1.97	0.29	0.24	0.30	0.35	0.19	0.09	0.05
MMP	0.23	0.09	-0.74	0.06	0.10	0.19	0.04	0.04	0.01
Sugar	0.72	0.54	0.45	-2.39	0.18	0.22	0.24	0.17	-0.12
Edible Oil	0.52	0.40	0.45	0.11	-2.15	0.24	0.05	0.10	0.28
EFM	0.35	0.29	0.57	0.08	0.15	-1.83	0.18	0.10	0.10
Vegetables	0.65	0.17	0.12	0.09	0.03	0.19	-1.50	0.12	0.13
Fruits	0.20	0.19	0.26	0.15	0.15	0.24	0.27	-1.56	0.10
Spices	0.40	0.10	0.03	-0.11	0.43	0.24	0.31	0.10	-1.50

Note: Diagonal elements represents own-price elasticities

Elements above and below diagonal represents cross- price elasticities

The table further depicts that the uncompensated cross-price elasticity for most of the food commodities was very small. The positive sign of the cross-price elasticity indicates a substitution relationship among the food groups and the negative sign depicts the complementary relationship. The increase in the price of egg, fish, meat by one per cent declined the demand for milk and milk products by 0.12 per cent thus exhibits complementary relation and increased the demand for cereal (0.25 %), pulses (0.02%), vegetables (0.02%) and fruit (0.16 %) which are substitute goods. With the rise in the prices of vegetables, the demand for milk declined while for egg, fish, meat, and fruits increased. Likewise, an increase in the price of fruits by one per cent led to the decline in the demand for milk and milk products by 1.56 per cent, spices by 0.15 per cent and increased for the other food groups for the rural non-vegetarian households.

For the non-vegetarian rural households, the compensated price elasticity (Hicksian elasticity) was smaller than the uncompensated price elasticity in absolute terms. But for the milk and milk products, the compensated own-price elasticity was much lower than the uncompensated price elasticity, which revealed that the rise or fall in price of the respective commodities would have a considerable real income effect. Also, the compensated own price elasticity for all the food commodities was more than unity except for milk and milk products. The cross-price elasticity was almost positive for all the food commodities.

The uncompensated and compensated own-price elasticity of demand for the urban non-vegetarian households was maximum for sugar (-2.43) followed by edible oils (-2.21) which means with an increase in prices of these commodities a significant decline in demand of these commodities would occur (Table 5.3.6). The uncompensated own-price elasticity was more than one for all the food groups. The cross-price elasticity showed that with a one per cent increase in prices of cereals, consumption of other commodities would increase by varying proportions. However, with a one per cent increase in the prices of milk and milk products the consumption expenditure share of cereals declined by 0.03 per cent, pulses by 0.02 per cent, vegetables by 0.08 per cent, fruits by 0.02 per cent and that of egg, fish and meat increased by 0.07 per cent. The compensated own-price elasticity was lesser than the uncompensated own-price elasticity. The cross-price elasticities were smaller in

absolute terms. In urban areas, with the increase in the price of the one food group the demand for other commodities more or less increased which was not the case for the rural households. The price elasticities of demand were more in the urban areas compared to the rural areas except for the pulses and edible oils. The decline in the demand for milk and milk products with an increase in its prices was more in the urban areas compared to the rural areas as the availability of milk was more in rural areas and likewise for cereals, salt and sugar, egg, fish, meat, vegetables and fruits.

5.3.3.2 Sector wise uncompensated own-price and cross-price elasticities of agricultural commodities (vegetarian households) in Himachal Pradesh

The uncompensated and compensated own-price and cross-price elasticities for the vegetarian rural and urban households were presented in Table 5.3.7 and Table 5.3.8. The uncompensated own-price elasticity was negative and more than unity for all the commodities except milk and milk products (-0.86) which depicted that one per cent increase in the price of milk the consumption of milk declined by -0.86 per cent compared to other commodities and the largest decline was in sugar and edible oils. The cross-price elasticity for the vegetarian rural households was positive for all the commodities except for milk and milk products.

Table 5.3.7: Uncompensated and compensated own and cross-price elasticities of food commodities for vegetarian rural households in Himachal Pradesh

Uncompensated elasticity								
Food group	Cereals	Pulses	MMP	Sugar	Edible Oil	Vegetables	Fruits	Spices
Cereals	-1.39	0.20	-0.06	0.11	0.16	0.23	0.06	0.08
Pulses	0.51	-2.04	-0.06	0.20	0.39	0.13	0.10	0.03
MMP	-0.19	-0.06	-0.86	-0.04	-0.05	-0.11	-0.04	-0.05
Sugar	0.52	0.38	-0.13	-2.33	0.31	0.32	0.09	0.09
Edible Oil	0.53	0.51	-0.07	0.21	-2.29	0.19	0.16	-0.01
Vegetables	0.52	0.11	-0.21	0.14	0.13	-1.54	0.06	0.03
Fruits	0.29	0.20	-0.22	0.09	0.24	0.14	-1.43	-0.10
Spices	0.39	0.06	-0.18	0.09	-0.01	0.06	-0.09	-1.00
Compensated elasticity								
Cereals	-1.27	0.25	0.20	0.13	0.20	0.29	0.09	0.11
Pulses	0.67	-1.98	0.26	0.23	0.44	0.20	0.13	0.06
MMP	0.10	0.05	-0.25	0.02	0.04	0.03	0.01	0.01
Sugar	0.68	0.44	0.20	-2.29	0.36	0.39	0.12	0.12
Edible Oil	0.70	0.57	0.27	0.24	-2.25	0.26	0.19	0.02
Vegetables	0.68	0.17	0.13	0.17	0.17	-1.47	0.09	0.06
Fruits	0.46	0.26	0.12	0.12	0.29	0.22	-1.40	-0.06
Spices	0.53	0.11	0.11	0.12	0.03	0.13	-0.06	-0.97

Note: Diagonal elements represents own-price elasticities

Elements above and below diagonal represents cross- price elasticities

The compensated own-price elasticities were smaller in magnitude compared to the uncompensated own-price elasticity and least for milk and milk products. Further, the substitution effect was observed in almost all food commodities. Similarly, in urban areas, the uncompensated own-price elasticity was negative for all the food commodities.

For the urban vegetarian households, the uncompensated and compensated price elasticity was presented in Table 5.3.8. The uncompensated price elasticity was more than the compensated price elasticity. The own-price- elasticities were negative and more than unity for all the commodities. The uncompensated cross-price elasticity was positive for most of the commodities depicting that these commodities were complementary products. However, with the one per cent increase in the prices of milk the consumption of cereals, pulses, sugar, edible oils, vegetables, spices declined by -0.02, -0.06, -0.02, -0.01, -0.01 and -0.06 per cent, respectively. The compensated cross-price elasticity was positive for all the food commodities

Table 5.3.8: Uncompensated and compensated own and cross-price elasticities of food commodities for vegetarian urban households in Himachal Pradesh

Uncompensated elasticity								
Food group	Cereals	Pulses	MMP	Sugar	Edible Oil	Vegetables	Fruits	Spices
Cereals	-1.42	0.11	0.11	0.09	0.10	0.12	0.02	0.02
Pulses	0.25	-1.79	-0.06	0.19	0.23	0.22	0.06	0.14
MMP	-0.02	-0.06	-1.05	-0.02	-0.01	-0.01	0.01	-0.06
Sugar	0.44	0.40	-0.02	-2.37	0.38	0.20	0.08	-0.01
Edible Oil	0.35	0.33	0.05	0.26	-2.10	0.08	0.10	0.05
Vegetables	0.22	0.17	0.07	0.08	0.05	-1.70	0.05	0.14
Fruits	0.04	0.08	0.07	0.05	0.11	0.09	-1.56	0.02
Spices	0.13	0.28	-0.28	-0.01	0.08	0.35	0.04	-1.35
Compensated elasticity								
Cereals	-1.24	0.18	0.43	0.13	0.16	0.22	0.07	0.06
Pulses	0.41	-1.72	0.23	0.23	0.28	0.30	0.10	0.17
MMP	0.23	0.06	-0.58	0.04	0.07	0.12	0.07	0.00
Sugar	0.63	0.48	0.33	-2.33	0.44	0.30	0.12	0.03
Edible Oil	0.51	0.41	0.40	0.30	-2.04	0.18	0.15	0.09
Vegetables	0.41	0.26	0.42	0.12	0.11	-1.60	0.10	0.18
Fruits	0.27	0.18	0.49	0.10	0.18	0.21	-1.49	0.07
Spices	0.29	0.35	0.01	0.03	0.13	0.43	0.08	-1.31

Note: Diagonal elements represents own-price elasticities

Elements above and below diagonal represents cross- price elasticities

5.3.4 Demand projections for agricultural commodities in Himachal Pradesh

Food security is a primary concern of any developing country as adequate nourishment in form of quantity and quality is necessary for a healthy life. Hence, the availability and accessibility of food are important from a food security and nutrition point of view. According to an estimate, the share of calorie supply of food grains, non-grain crops and animal products would change from 63 per cent, 85 per cent, 29 per cent and 8 per cent in 2000 to 48 per cent, 36 per cent and 16 per cent in 2050, respectively in India (Amarasinghe et. al., 2007). To estimate the demand projection for agricultural commodities some assumptions were made regarding the population growth and income growth. In this section, the demand projections were made for the years 2025, 2030 and 2035.

5.3.4.1 Population growth scenario for demand projections of agricultural commodities

The projections and growth rate of the population are presented in Table 5.3.9. According to the Report of Population Projection, MoHFW, Government of India (2019), the total population of the state was likely to increase from 6865 thousand in 2011 to 7542 thousand in 2025 to 7685 thousand in 2030 and further to 7770 thousand in 2035. The growth rate of population was estimated for the periods 2011-2025, 2011-2030 and 2011-2035.

Table 5.3.9: Base and projected population of Himachal Pradesh

(in Lakh)

Year	Rural	Urban	Total
2011	61.76	6.89	68.65
2025	67.61	7.81	75.42
2030	68.80	8.05	76.85
2035	69.46	8.24	77.70
Annual growth rates			
2011-25	0.65	0.9	0.67
2011-30	0.57	0.82	0.59
2011-35	0.49	0.75	0.52

5.3.4.2 Income growth scenario for demand projections of agricultural commodities

Along with the population projection, the income growth is another major factor that influences the demand projections. The population projections are more reliable owing to more persistent demographic dynamics, income growths are uncertain (Cirera and Masset, 2010). The alternate two scenarios of the income growth rate were used given in Table 5.3.10.

The Business as Usual (BAU) was constructed by estimating the growth rate in GDP at constant prices, from the year 2011-12 to 2019-20. In the Second scenario, the growth rate of 8 per cent per annum was used. The growth rate in per capita income was obtained by netting out the population growth rate from the GDP (Kumar et al., 2009; Hasan, 2012; Srivastava et al., 2013). These values along with the expenditure (income) elasticities were used to project demand for agricultural commodities

Table 5.3.10: Projected income growth rates of Himachal Pradesh

(Per cent)

	GDP (BAU)	GDP (High)	Income per capita (BAU)			Income per capita (high)		
			2011-25	2011-30	2011-35	2011-25	2011-35	2011-35
Rural	7.11	8.00	6.46	6.54	6.62	7.35	7.43	7.51
Urban	7.11	8.00	6.21	6.29	6.36	7.10	7.18	7.25
Total	7.11	8.00	6.44	6.52	6.59	7.33	7.41	7.48

Note: BAU- Business as Usual

5.3.4.3 Demand projections for agricultural commodities

The demand projections were made for the cereals, pulses, milk products, edible oils, vegetables, egg, fish, meat and fruits for the years 2025, 2030 and 2035 in Table 5.3.11. The cereals exhibited inelastic demand; however, various studies have confirmed that its total demand in the future would be higher due to increasing population and rising indirect demand (seed, animal feed, industrial use and waste, etc.). Many studies have confirmed that the requirement of cereals will be adequate from the food security point of view. A study conducted by Kumar (1998) using the Food characteristic Demand System projected that the future demand in India for total cereals and food grains was 265.7 mt and 296.6 mt, respectively in 2020, further another study

by Bhalla (2001) calculated the demand for cereals to be 274 mt by 2020. Mittal (2006) computed the demand for the total cereals and food grains to be 215.7 mt and 242.9 mt in 2020. Hasan (2012) computed the demand for cereals in Uttar Pradesh to be 39 mt in 2020 and 45 mt in 2025. Srivastava et al. (2013) projected the food demand for cereal to be 226 mt for 2020 whereas, Chopra (2015) projected the demand for total cereals to be 235 mt by 2020 and 248 mt by 2026.

The previous studies have revealed the declining per capita consumption of the cereals over the years in the country and the decline in the consumption of the cereal in Himachal Pradesh occurred from 15.61 kg pcpm in 1987-88 to 13.17 Kg pcpm in 1993-94 further to 11.94 Kg pcpm in 2004-05 and 11.91 Kg pcpm in 2011-12. Whereas, in rural areas it declined from 15.84 Kg pcpm to 12.02 Kg pcpm from 1987-88 to 2011-12 and in urban areas, it decreased from 12.31 Kg pcpm to 10.91 Kg pcpm during the same period (Table 4.2.5). However, the literature confirmed that the decline in consumption continued from the early 1970s.

Table 5.3.11: Projected demand for food commodities in Himachal Pradesh

(million tonnes)

Food groups	2025	2030	2035
BAU Scenario			
Cereals	16.28	18.74	26.26
Pulses	2.12	2.53	3.88
MMP	21.34	27.25	48.72
Edible oil	1.17	1.39	2.12
EFM	0.49	0.63	1.11
Vegetables	7.49	9.34	15.80
Fruits	1.40	1.77	3.10
High-income growth scenario			
Cereal	20.72	24.83	32.64
Pulses	2.87	3.62	5.12
Milk	32.27	44.20	71.14
Oil	1.58	1.98	2.79
EFM	0.74	1.01	1.62
Vegetables	10.89	14.47	22.25
Fruits	2.08	2.82	4.46

Note: BAU- Business as usual

The demand projection for the food commodities in Himachal Pradesh was computed under the BAU scenario and high-income growth rate scenario. Under the BAU scenario, among all the food commodities the projected demand for the years 2025, 2030 and 2035 were higher for milk and milk products i.e., 21.34 mt, 27.25 mt and 48.72 mt respectively. The demand for cereals was second highest after the milk and milk products i.e., 16.28 mt, 18.74 mt and 26.26 mt for the years 2025, 2030 and 2035 respectively. The projected household demand for vegetables was 7.49 mt (2025), 9.34 mt (2030) and 15.80 mt (2035). The demand for other food commodities like pulses, edible oils, egg, fish, meat and fruits increased slightly over the years from 2025 to 2035. The projected demand for non-vegetarian products (egg, fish and meat) was 0.49 mt in 2025, which will rise to 0.63 mt in 2030 and further to 1.11 mt in 2035.

The demand projection under the high-income scenario (economy grows at 8 per cent) followed the same pattern as the BAU scenario, here the demand for milk and milk products will be highest in the state i.e., 32.27 mt in 2025, 44.20 mt in 2030 and 71.14 mt in 2035. The demand for cereals under the high-income growth scenario was comparatively higher than the demand for the under BAU scenario. The projected demand for the cereals is 20.72 mt, 24.83 mt, 32.64 mt during 2025, 2030, and 2035, respectively and for vegetables, it is 10.89 mt, 14.47 mt and 22.25 mt during the same period. The future demand for egg, fish and meat will be 0.74 mt in 2025, 1.01 mt in 2030 and 1.62 mt in 2035 and projected demand for fruits is 2.08 mt, 2.82 mt and 4.46 mt in 2025, 2030 and 2035, respectively.

5.4 Change in nutrient intake in Himachal Pradesh

The change in intake of nutrients (calorie, proteins and fats) by both rural and urban households of the state and across the income groups viz, very poor, poor, middle and rich-income households were discussed in this section. Since various institutions have come up with recommended dietary allowances (RDA). The recommended calorie intake level for different Indian households is set by the National Institute of Nutrition (NIN), ICMR, based on age, sex, body mass and nature of work. The planning commission of India uses energy norms 2400 Kcal per person per day for the rural sector and 2100 Kcal per person per day for the urban sector. The ICMR-NIN norm suggested a per capita per day intake of 2226 Kcal for rural people and 2022 Kcal for

urban people. The per consumer per day recommended intake of the calorie was 2737 Kcal and 2488 Kcal for rural and urban people respectively. The recommended dietary allowances were presented in Table 5.4.1. The recommended energy intake for moderately active person in India is 2730 Kcal/day, 60g/day protein and 30 g/day fat.

Table 5.4.1: Recommended dietary allowances (RDA) for a moderately active person

Energy/Nutrient	Unit	Value
Calorie	Kcal/day	2730
Protein	g/day	60
Fat (Inclusive of invisible fats)	g/day	30

Source: Revised RDA for Indians, ICMR, 2010

5.4.1 Income group and sector-wise nutrient intake in Himachal Pradesh

The nutrient intake of the households, estimated in terms of calories, proteins and fats per capita per day across income groups and sectors wise for Himachal Pradesh are presented in Table 5.4.2. The per capita per day calorie intake in Himachal Pradesh has increased from 2333 kcal (1993-94) to 2503 kcal (2011-12). In rural areas, a significant increase was observed in the calorie intake from 2325 Kcal to 2502 Kcal during 1993-94 to 2011-12, whereas in the urban areas the intake of calories increased from 2416 kcal to 2512 kcal. The results indicated that across income groups the calorie intake was increased with the increase in the income from low income towards higher-income households. The calorie intake during 2011-12 was increased from 1910 Kcal for very poor rural households to 2703 Kcal for rich rural households during 2011-12 and from 1523 Kcal to 2640 Kcal for the very poor to rich urban households showing a robust positive relationship between per capita income and calorie intake. The intake of the calorie was more in rural areas compared to the urban areas because a major portion of the calorie intake comes from the cereals and the consumption of the cereals was more in the rural Himachal Pradesh (Joshi et al., 2016). The decline in calorie intake in the state might be due to decline in calorie requirement (Rao, 2000; Deaton and Drèze, 2009; Eli & Li, 2013), change in the price of food (Patnaik, 2010), diversification of diet (Rao, 2000; Landy, 2009) or a reduction in the households' share on food expenditure (Mehta and Venkatraman, 2000; Sen, 2005).

Table 5.4.2: Income group and sector-wise intake of nutrients in Himachal Pradesh**(per capita per day)**

Income group	50 th			61 st			68 th		
	Rural	Urban	HP	Rural	Urban	HP	Rural	Urban	HP
Calorie (Kcal)									
Very Poor	1637	1786	1638	1537	1390	1525	1910	1523	1874
Poor	1919	1924	1919	1735	1572	1732	2116	2007	2113
Middle	2265	2110	2256	2067	2085	2069	2335	1803	2315
Rich	2814	2603	2783	2586	2517	2578	2703	2640	2693
All	2325	2416	2333	2327	2390	2333	2502	2512	2503
Protein (g)									
Very Poor	50	57	50	45	38	45	52	44	52
Poor	58	59	58	50	45	50	59	57	59
Middle	69	63	68	60	60	60	66	50	65
Rich	85	74	84	76	70	75	78	74	77
All	71	70	71	68	67	68	71	71	71
Fat (g)									
Very Poor	23	21	23	26	19	25	34	25	33
Poor	29	26	29	29	31	29	41	42	41
Middle	41	42	41	41	41	41	51	42	51
Rich	63	66	63	63	67	64	69	71	69
All	45	56	46	53	60	53	59	66	60

The per capita per day intake of proteins in the state remained almost constant over the years. The per capita per day intake of protein was 71 g for rural households and 70 g for urban households during 1993-94 which declined to 68 g and 67 g for rural and urban households, respectively during 2004-05 and further increased to 71 g each for the rural and urban sector during 2011-12. Across the income groups, the intake of nutrients increased with the increase in income of the households as evident from Table 5.3.2, thus showing the positive relationship of income with protein intake in the state.

Fats intake in the state increased from 46 g per capita per day in 1993-94 to 53 g pcpd in 2004-05 and further to 60 g pcpd in 2011-12. In rural sectors of the state, the intake of fats was lesser in proportion compared to the urban households. It also varied across income groups, as the intake of the fats by low-income households was less compared to the rich households in both the sectors.

5.4.2 Income and sector wise change in per capita nutrients intake in Himachal Pradesh

Table 5.4.3 presents the change in the intake of the nutrient (Calorie, proteins and fats) over the years from 1993-94 to 2011-12. The intake of the calories increased by 17 per cent and 10 per cent during same period for the very poor and poor rural households. However, it declined by around 4 per cent for the rich households. but the inverse trend was observed in the urban areas, as the intake of calories declined by around -15 per cent each for very poor households and middle-income households.

Further, looking into the change in the intake of the proteins it was revealed that protein intake increased by four per cent and one per cent for very poor and poor rural households however it declined for the middle income (- 4 %) and rich-income rural households (- 9 %). In urban areas, the protein intake has declined maximum for the very poor households (- 23 %), followed by middle-income households (-21 %) and poor households (-4%). Thus, the low-income households of rural areas showed increase in the intake of protein whereas for rich income households it declined significantly.

The change in the intake of the fats increased by around 46 per cent for the very poor households, followed by poor (38.39 %), middle-income households (24.15 %) and 9.68 per cent for rich income households for rural households from 1993-94 to 2011-12. However, the intake of fats increased by 63 per cent for poor urban households, followed by very poor households (18.58 %) and 7.96 per cent for the rich household in the urban areas during the same period. The increase in the intake of fats in the state was due to the change in the dietary pattern of households. The increase in the intake of fats was more for the rural households (32.95 %) as compared to the urban households (17.93 %).

Table 5.4.3: Income group and sector-wise changes in per capita per day intake of nutrients in Himachal Pradesh (1993-94 to 2011-12)

(per cent)

Income group	Calorie			Protein			Fats		
	Rural	Urban	HP	Rural	Urban	HP	Rural	Urban	HP
Very Poor	16.69	-14.73	14.38	3.76	-23.18	2.07	46.05	18.58	42.75
Poor	10.26	4.29	10.07	0.91	-3.83	0.76	38.39	63.09	39.11
Middle	3.07	-14.55	2.61	-3.93	-21.38	-4.37	24.15	0.08	23.14
Rich	-3.94	1.40	-3.22	-8.59	0.00	-7.49	9.68	7.96	9.44
All	7.60	3.98	7.29	1.14	0.68	1.08	32.95	17.93	31.75

The marked increase in the consumption of fats over the years was due to the increase in the intake of fat-rich food i.e., edible oils, livestock products including milk and its products and non-vegetarian food. Contrary, to calorie and protein intake, fat consumption in the state increased significantly. In general, the per capita per day fat intake was higher for rural households concerning the urban households and so for poor and rich households. This could be due to the changing lifestyle of the urban households and consciousness towards the healthy diet.

5.4.3 Income group and sector wise change in nutrient intake from different food groups in Himachal Pradesh

After examining the overall nutrient (calorie, proteins and fats) intake from total food, the study further examined the pattern of nutrient intake for different food groups. Table 5.4.4 presents the change in the intake of nutrients from different food groups in Himachal Pradesh. The pattern of calorie intake from cereals declined by 10.08 per cent in rural areas and three per cent in urban areas and revealed that calorie intake has declined more in rural areas than urban over the years. Similarly, protein and fat intake has declined by 12.32 per cent and 32.34 per cent over the years in the state. The protein intake in the rural areas from cereals has declined for all income households. Similarly, it declined by varying per cent for urban households except for rich income households.

The calorie intake from the roots and tuber crops has increased by 3.02 per cent and 4.97 per cent for rural and urban households, respectively. The calorie intake has

increased for the lower-income households but decreased for middle (11.87 %) and rich-income households (5.06 %) in rural sectors. Likewise, protein intake from roots and tuber crops increased by varying per cent for the lower-income rural households but it declined for the middle (12.74 %) and rich (3.50 %) rural households. However, the intake of fats increased by around 5.50 per cent and 3.01 per cent in the rural and urban sectors and total by 6 per cent in Himachal Pradesh

From the pulses and oilseeds, the calorie intake in the rural areas increase for all income groups except for rich households (-2 %). The overall intake of calories in the state increased by 14 per cent from 1993-94 to 2011-12. The increase in the intake was more for the very poor urban households as the availability of the pulses for the low-income household increased over time due to the distribution of the pulses through the fair price shops in the rural areas of the state. The overall intake of protein in the state has increased by 11.68 per cent from 1993-94 to 2011-12 in Himachal Pradesh. Like calorie, the increased intake of proteins was found maximum in the very poor households (54.58 %) in rural areas. The changes in the fat intake were more in the rural (55.05 %) than urban households (34.92 %) and more in poor compared to rich households in Himachal Pradesh.

The calorie intake from the vegetables and fruits has declined for all the income groups of rural households and over time the change was highest for poor households (-49.96 %). An increase in the intake of the calorie was observed for the urban households of the state for low-income households and it declined for the high-income households. The protein intake has declined across the income groups for rural households and the state as a whole. While for the urban households an increase of 11 per cent in protein intake from vegetables and fruits was witnessed.

The overall nutrient consumption from the non -vegetarian food in Himachal Pradesh increased over the past two decades. The intake of calories has increased by around 87 per cent, proteins by 88 per cent and fats 89 per cent. The change in the intake of calories, proteins and fats was positive for poor, middle and rich households in rural and urban areas, and declined only for the very poor households. This shift in the consumption pattern of the nutrient in the state is because of the changes in the dietary pattern of food, health status, increased income of the households of Himachal Pradesh.

Table 5.4.4: Income group and sector-wise change in nutrient intake from different food groups in Himachal Pradesh (1993-94 to 2011-12)

Income group	Calorie			Proteins			Fat		
	Rural	Urban	HP	Rural	Urban	HP	Rural	Urban	HP
Cereals & cereal substitutes									
Very Poor	-7.01	-25.92	-8.46	-12.26	-30.42	-13.60	-45.59	-34.96	-46.52
Poor	-7.58	-18.27	-7.92	-10.51	-20.14	-10.81	-30.58	-30.96	-30.55
Middle	-12.92	-26.06	-13.06	-15.44	-27.81	-15.56	-33.88	-34.68	-33.41
Rich	-14.34	3.88	-12.38	-16.22	2.32	-14.26	-34.92	2.22	-32.08
All	-10.08	-3.10	-9.85	-12.59	-5.19	-12.34	-33.18	-9.91	-32.34
Roots and tubers									
Very Poor	6.56	1.67	7.75	7.04	1.15	7.90	9.69	-3.50	10.28
Poor	1.79	5.50	1.88	2.73	8.71	2.89	8.30	-15.68	6.94
Middle	-11.87	-26.21	-12.74	-12.74	-26.41	-13.56	-9.16	-30.55	-10.75
Rich	-5.06	4.42	-3.50	-4.88	3.53	-3.44	-7.65	3.90	-5.66
All	3.02	4.97	3.76	3.35	4.93	4.11	5.50	3.01	6.00
Pulses, nuts and oilseeds									
Very Poor	58.51	-7.49	57.04	54.58	-6.11	53.64	95.71	43.92	92.82
Poor	12.14	28.21	12.63	8.81	25.94	9.34	50.73	27.96	49.71
Middle	1.74	-15.60	0.85	-0.45	-14.92	-1.19	34.26	-14.49	31.09
Rich	-2.03	11.04	-0.04	-3.65	10.49	-1.52	31.25	29.81	31.13
All	13.46	14.23	14.04	10.96	13.37	11.68	55.05	34.92	53.54
Vegetables and fruits									
Very Poor	-49.96	46.26	-43.35	-58.96	17.44	-52.45	-51.59	-36.47	-51.12
Poor	-9.98	21.27	-8.92	-26.02	-12.38	-25.55	-24.83	1.37	-23.92
Middle	-10.51	-19.13	-11.58	-26.19	-21.06	-26.12	-26.76	-27.45	-27.03
Rich	-14.68	-8.64	-13.05	-16.46	4.07	-12.59	-25.82	-12.00	-23.10
All	2.38	3.12	4.39	-10.21	10.68	-6.38	-16.26	-4.90	-13.70
Egg, fish & meat									
Very Poor	-77.25	-39.14	-64.95	-89.57	-35.50	-77.39	-45.91	-44.12	-33.58
Poor	34.96	531.02	39.78	30.29	363.44	33.79	46.76	975.48	54.51
Middle	108.75	0.02	106.34	115.32	-0.71	112.95	100.52	13.11	98.70
Rich	49.74	6.61	39.76	48.97	7.72	39.80	52.39	5.03	40.40
All	96.52	30.99	87.48	96.18	31.91	87.57	99.54	30.61	89.34
Milk and milk products									
Very Poor	62.28	-20.60	56.34	63.75	-18.46	57.90	61.31	-22.11	55.30
Poor	27.20	50.23	27.87	27.64	49.22	28.27	26.81	50.99	27.50
Middle	16.38	-21.92	14.81	16.55	-23.23	14.85	16.24	-21.07	14.75
Rich	-1.74	-8.23	-2.77	-1.62	-6.74	-2.45	-1.82	-9.11	-2.96
All	26.86	-0.16	24.01	27.04	1.04	24.32	26.74	-0.86	23.81

Over time, across income groups and the rural-urban sector, the intake of calories from milk and milk product increased maximum for rural very poor households (62 %) followed by rural poor (27%) and middle households (16%). However, it declined for the rich rural households (-1.74 %). The change in calorie consumption was positive and high for the urban poor (50 %) and declined for the other three income groups by varying rates. Likewise, the protein intake has increased for all the households of rural areas except for rich households which decreased marginally by -2 per cent. The protein consumption increased by 50 per cent for poor urban households. The fat consumption has increased by 26 % for rural households due to the more consumption and availability of milk and milk products in the rural areas compared to urban areas where it declined (-1 %).

5.4.4 Dietary sources of calorie, protein and fats in Himachal Pradesh

To study the changing pattern of the nutrient intake further, the compositional changes of food items towards the supply of nutrients were analysed over the years. The share of major food items in the supply of energy, proteins and fat are presented in Table 5.4.5, Table 5.4.6 and Table 5.4.7 for years 1993-94 and 2011-12.

5.4.4.1 Income group and sector wise dietary sources of the calories for households in Himachal Pradesh

Table 5.4.5 reveals that cereals constitute the main source of calorie intake for rural and urban households of the state during 1993 and 2011. The share of the cereals in calorie contribution was more for the low-income households than high-income households in both sectors. But over the years there was a decline in the calorie contribution of cereals from 66.67 per cent to 55.72 per cent in rural areas and 53.60 per cent to 49.70 per cent in urban areas during the study period. However, the share of the pulses as a calorie source increased marginally from 5.99 per cent to 6.32 per cent in rural areas and 7.01 per cent to 7.48 per cent in urban areas. Except, cereals the contribution of all other food items in the calorie supply has increased over the year. The notable changes have been observed in the food items like egg, fish, meat, milk and milk products and oils & fats.

Table 5.4.5: Income group and sector-wise dietary sources of calories in Himachal Pradesh (2011-12)

(% share of total intake)

Food group	Income group	Rural		Urban		HP	
		1993-94	2011-12	1993-94	2011-12	1993-94	2011-12
Cereals and cereal substitutes	Very Poor	77.98	62.46	75.87	66.22	77.96	62.81
	Poor	72.90	61.60	74.22	58.65	72.94	61.51
	Middle	67.02	57.33	61.46	53.82	66.68	57.20
	Rich	59.53	53.28	47.71	48.50	57.76	52.52
	All	66.67	55.72	53.60	49.70	65.56	55.07
Pulses, nuts & oilseeds	Very Poor	4.44	5.80	6.70	7.22	4.46	5.93
	Poor	5.52	5.52	5.83	7.19	5.53	5.57
	Middle	6.05	5.98	7.00	6.86	6.11	6.01
	Rich	6.63	6.71	7.16	7.58	6.71	6.85
	All	5.99	6.32	7.01	7.48	6.08	6.45
Egg, fish & meat	Very Poor	0.12	0.02	0.28	0.20	0.13	0.04
	Poor	0.14	0.17	0.05	0.22	0.14	0.17
	Middle	0.16	0.32	0.14	0.15	0.16	0.31
	Rich	0.27	0.46	0.55	0.58	0.31	0.48
	All	0.19	0.37	0.40	0.52	0.21	0.39
Milk & milk products	Very Poor	0.12	6.40	0.28	4.95	0.13	6.26
	Poor	0.14	7.89	0.05	8.44	0.14	7.90
	Middle	0.16	11.05	0.14	10.25	0.16	11.02
	Rich	0.27	14.06	0.55	12.56	0.31	13.82
	All	0.19	12.23	0.40	12.04	0.21	12.21
Vegetables & fruits	Very Poor	1.15	0.48	0.85	1.47	1.15	0.57
	Poor	1.05	0.85	1.24	1.40	1.06	0.87
	Middle	1.29	1.13	1.82	1.67	1.32	1.15
	Rich	1.88	1.67	2.99	2.63	2.04	1.82
	All	1.43	1.38	2.53	2.47	1.52	1.50
Roots & tubers	Very Poor	1.58	1.40	1.68	2.06	1.58	1.46
	Poor	1.66	1.52	1.84	1.85	1.66	1.53
	Middle	1.88	1.61	2.32	1.96	1.91	1.62
	Rich	1.87	1.82	2.10	2.10	1.90	1.86
	All	1.80	1.71	2.13	2.08	1.83	1.75
Oils & fats	Very Poor	4.74	7.81	3.86	8.15	4.73	7.84
	Poor	5.25	8.14	4.75	9.65	5.23	8.18
	Middle	6.12	8.60	7.73	10.91	6.22	8.68
	Rich	6.85	9.38	9.80	11.59	7.29	9.73
	All	6.06	8.96	8.81	11.39	6.29	9.22
Others	Very Poor	5.38	15.62	5.32	9.73	5.38	15.08
	Poor	6.54	14.31	6.20	12.61	6.53	14.26
	Middle	7.30	13.99	8.20	14.42	7.35	14.00
	Rich	9.42	12.62	16.14	14.45	10.42	12.91
	All	7.70	13.31	13.24	14.30	8.17	13.42

5.4.4.2 Income group and sector-wise dietary sources of protein for households in Himachal Pradesh

Further, cereals contribution was highest among other food commodities in the share of protein for both rural and urban households. The share of proteins from cereals was more for rural households compared to the urban households of the state as shown in Table 5.4.6 but over the years the share of proteins from cereals has declined from 68 per cent to 58.88 per cent for rural households and from 55.40 per cent to 52.37 per cent for urban households. After cereals, milk and its products and pulses contribute maximum proteins to the households. The share of pulses, egg, fish, meat, milk and its products, root & tuber crops in protein contribution has increased marginally over the years. There was a substantial growth in the protein contribution from the other food commodities in both sectors.

5.4.4.3 Income group and sector wise dietary sources of fats for households in Himachal Pradesh

The intake of the fats in the Indian diets are met from the oils and fats, in Himachal Pradesh also the share of the fats coming from oils and fats has increased considerably in rural and urban sectors, comparatively more in the rural household (Table 5.4.7). Interestingly, the contribution of the oils and fats in fat intake increased with rise in income of the households during 1993-94, but over the years the trend has changed and the share of these commodities in fat contribution has shown a declining trend with the rise in the income of the households. This was due to the changing lifestyle and awareness of respective households towards healthy diet plans. Contrary to the oils and fats the contribution of the cereals in the share of fats has declined drastically from 21.84 per cent (1993-94) to 10.39 per cent (2011-12) for rural households and from 10.61 per cent to 7.39 per cent for urban households. The share of fats from pulses, egg, fish, meat, and other food products has increased in the state and commodities like vegetables, fruits, roots and tubers has declined. For milk and milk products the share of the fats has increased marginally from 34.17 per cent to 34.76 per cent for rural households but declined significantly for the urban households (35.72 % to 30.96 %).

Table 5.4.6: Income group and sector-wise dietary sources of protein in Himachal Pradesh (2011-12)

(% share of total intake)

Food group	Income group	Rural		Urban		HP	
		1993-94	2011-12	1993-94	2011-12	1993-94	2011-12
Cereals & cereal substitutes	Very Poor	79.98	67.90	75.45	68.52	79.93	67.96
	Poor	74.31	66.39	74.90	62.60	74.33	66.27
	Middle	68.17	60.79	63.12	58.30	67.86	60.69
	Rich	60.84	55.84	49.74	50.91	59.18	55.06
	All	68.00	58.88	55.40	52.37	66.94	58.18
Pulses, nuts & oilseeds	Very Poor	9.21	13.18	13.16	16.07	9.26	13.44
	Poor	11.69	12.33	12.26	15.93	11.71	12.44
	Middle	12.75	13.20	14.84	15.82	12.88	13.30
	Rich	13.87	14.41	15.37	16.51	14.09	14.74
	All	12.59	13.77	14.96	16.41	12.79	14.05
Egg, fish & meat	Very Poor	0.69	0.07	1.33	1.05	0.69	0.16
	Poor	0.79	0.96	0.34	0.99	0.77	0.96
	Middle	0.87	1.91	0.75	0.85	0.86	1.87
	Rich	1.41	2.58	2.62	3.11	1.59	2.66
	All	1.02	2.12	1.95	2.77	1.10	2.19
Milk & products	Very Poor	6.05	9.34	6.73	6.99	6.05	9.12
	Poor	9.17	11.25	7.72	11.86	9.12	11.27
	Middle	13.32	15.45	15.31	14.99	13.44	15.43
	Rich	17.62	19.27	18.99	17.72	17.82	19.02
	All	13.27	16.92	17.02	17.05	13.59	16.93
Vegetables & fruits	Very Poor	2.25	0.90	1.87	2.90	2.24	1.09
	Poor	1.83	1.33	2.40	2.18	1.85	1.36
	Middle	2.15	1.66	2.50	2.44	2.17	1.69
	Rich	2.53	2.29	3.42	3.44	2.66	2.47
	All	2.22	1.95	3.09	3.29	2.29	2.10
Roots & tubers	Very Poor	1.01	0.99	0.99	1.34	1.01	1.03
	Poor	1.07	1.08	1.17	1.30	1.08	1.08
	Middle	1.26	1.13	1.54	1.41	1.27	1.14
	Rich	1.25	1.28	1.51	1.52	1.29	1.32
	All	1.19	1.20	1.48	1.49	1.22	1.23
Others	Very Poor	0.86	7.87	0.46	3.13	0.85	7.43
	Poor	1.14	6.92	1.21	5.73	1.14	6.88
	Middle	1.51	8.41	1.95	10.79	1.54	8.50
	Rich	2.49	8.93	8.38	19.32	3.37	10.58
	All	1.71	8.51	6.11	17.72	2.08	9.51

Table 5.4.7: Income group and sector-wise dietary sources of fats in Himachal Pradesh (2011-12)

(% share of total intake)

Food group	Income group	Rural		Urban		HP	
		1993-94	2011-12	1993-94	2011-12	1993-94	2011-12
Cereals & cereal substitutes	Very Poor	36.61	13.99	26.26	14.67	36.49	14.05
	Poor	27.07	13.71	26.08	11.48	27.04	13.64
	Middle	20.33	10.82	13.08	8.81	19.89	10.74
	Rich	16.33	9.29	7.50	6.90	15.01	8.92
	All	21.84	10.39	10.61	7.39	20.90	10.06
Pulses, nuts & oilseeds	Very Poor	3.22	4.00	4.21	4.26	3.23	4.03
	Poor	3.02	3.13	4.24	3.30	3.06	3.13
	Middle	3.13	3.23	3.45	3.35	3.15	3.23
	Rich	3.21	3.59	3.34	3.63	3.23	3.60
	All	3.14	3.43	3.45	3.61	3.17	3.45
Egg fish & meat	Very Poor	0.31	0.10	0.98	0.55	0.31	0.14
	Poor	0.32	0.34	0.11	0.69	0.31	0.35
	Middle	0.34	0.55	0.31	0.29	0.34	0.54
	Rich	0.51	0.74	0.90	0.94	0.57	0.77
	All	0.39	0.62	0.69	0.85	0.42	0.65
Milk & products	Very Poor	20.73	21.56	31.42	20.38	20.85	21.45
	Poor	29.07	27.31	28.16	27.39	29.04	27.31
	Middle	35.34	33.55	36.51	29.77	35.41	33.41
	Rich	39.62	37.57	36.43	31.48	39.14	36.60
	All	34.17	34.76	35.72	30.96	34.30	34.35
Vegetables & fruits	Very Poor	0.98	0.33	0.89	0.48	0.97	0.34
	Poor	0.72	0.38	0.99	0.61	0.72	0.39
	Middle	0.73	0.42	0.78	0.55	0.74	0.43
	Rich	0.78	0.49	0.83	0.65	0.79	0.52
	All	0.77	0.45	0.83	0.64	0.77	0.47
Roots & Tubers	Very Poor	0.14	0.10	0.18	0.15	0.14	0.11
	Poor	0.14	0.11	0.24	0.13	0.15	0.11
	Middle	0.14	0.11	0.17	0.13	0.15	0.11
	Rich	0.14	0.11	0.13	0.12	0.14	0.11
	All	0.14	0.11	0.15	0.12	0.14	0.11
Oils & fats	Very Poor	36.50	50.16	35.18	55.32	36.48	50.64
	Poor	37.72	46.91	38.45	50.23	37.75	47.01
	Middle	37.56	44.48	43.05	50.91	37.90	44.72
	Rich	36.07	42.53	43.39	48.10	37.16	43.41
	All	36.98	43.82	42.82	48.60	37.48	44.34
Others	Very Poor	1.52	10.11	0.89	4.20	1.51	9.56
	Poor	1.94	8.21	1.73	6.16	1.93	8.15
	Middle	2.41	7.08	2.64	6.29	2.43	7.05
	Rich	3.35	5.91	7.47	8.24	3.97	6.28
	All	2.56	6.64	5.73	7.90	2.83	6.78

5.4.5. Nutritional security status in Himachal Pradesh

The nutritional security status of the households was calculated with the help of the ratio of actual intake and Recommended Dietary Allowance (RDA) for energy as recommended by Indian council of Medical Research (ICMR). The households were categorised into the four nutritional status viz., secure (> 1), mildly insecure (0.80-0.99), moderately insecure (0.50 and 0.79) and severely insecure (<0.50). The description of the households under various groups of nutritional security status is given in Table 5.4.8. In the rural sector around 33.41 per cent of the households were nutritionally secure and around 21.8 per cent and 0.25 per cent households were moderate and severely insecure. Whereas, the per cent of the nutritionally secure households was more in the urban areas i.e., 45.83 per cent compare to the rural households and the nutritionally insecure households were also more (0.94 %) than the rural households. Major proportion of the rural households falls in the mildly insecure category (44.54 %) of the nutritional status and urban households were nutritionally secured (45.83 %). However, across the income groups, the very poor rural and urban households fall in the moderately insecure category (91.50 % and 80.64 %, respectively) and no low-income households were nutritionally secured in both the sector of the state.

Table 5.4.8: Income group and sector-wise nutritional security status of households in Himachal Pradesh (2011-12)

Nutritional Security status	Very poor	Poor	Middle	Rich	All
Rural					
Secure (> 1)	0.00	0.66	11.88	48.34	33.41
Mildly insecure (0.80-0.99)	4.50	36.17	59.58	39.77	44.54
Moderately insecure (0.50-0.79)	91.50	61.00	28.12	11.78	21.8
Severely insecure (<0.50)	4.00	2.17	0.42	0.11	0.25
Urban					
Secure (>1)	0.00	0.00	1.42	50.81	45.83
Mildly insecure (0.80-0.99)	0.00	40.41	16.00	29.76	28.91
Moderately insecure (0.50-0.79)	80.64	53.44	73.28	19.43	24.32
Severely insecure (<0.50)	19.36	6.14	9.29	0.00	0.94
HP					
Secure (>1)	0.00	0.63	11.42	48.83	35.23
Mildly insecure (0.80-0.99)	4.1	38.27	57.95	37.78	42.25
Moderately insecure (0.50-0.79)	90.54	60.82	29.86	13.3	22.17
Severely insecure (<0.50)	5.35	0.28	0.77	0.08	0.35

Most of middle-income rural households fall in the mildly insecure category and the middle-income urban households in the moderately insecure category of nutrition status. But the high-income households were mostly nutritionally secure with 48.34 per cent households in rural areas and 50.81 per cent households in urban areas, only 0.11 per cent households in the rural areas were severely insecure and none was nutritionally insecure in urban areas. Thus, the low-income households were major victims of the nutritional insecurity in the state due to the non-availability of nutritious food and low purchasing power capacity (Kiresur and Raghavendra, 2015; Khed and Saravanakumar, 2019)

Policy options

On the basis of the study, the policy options for ensuring food and nutritional security in the state were suggested. A significant transformation was observed in the cropping pattern of the state, but foodgrains still dominate the economy. However, the decreasing areas under the foodgrains is of greater concern, as these crops are the pillars of the food security. Therefore, sincere effective and continuous efforts are needed to increase the area under cultivation as well as yield of these crops by bringing fallow land under cultivation. The cropping pattern suitable for the local agro-climatic conditions should be practiced and the irrigation facilities need to be strengthened to accelerate the process of crop diversification in the state. Declining importance of coarse cereals overtime should not be neglected. Their production needs to be promoted in location specific and in a regional development framework for sustaining livelihood of producers and food security of poor consumers. The pulses have shown high instability and fluctuation in the area and production in the state, since the state has potential to grow these crops therefore, state agriculture department should promote the cultivation of pulses through introduction of development programmes in the state. The declining per capita cereal and pulses consumption needs due consideration of the people from the food and nutritional security point of view. Cereals inhibit inelastic demand and its per capita demand has fallen in the past few decades, but the demand of cereals will increase in the future on account of population growth, also these crops are the cheapest source of calories and protein compared to other foods and thus vital for food and nutrition security of the low-income class. Thus, there is a need to improve

the productivity, control prices, develop marketing strategies and further strengthen the public distribution system to fulfil the future demand. The lower income households of the state were moderately nutrition insecure, hence the nutrient rich food should be made available to them at subsidized rates to enhance nutrient status of such households for improving their health



SUMMARY AND CONCLUSIONS

A summary of the present study along with important policy implications emerged out of the results of the study is presented in this chapter. It was tried that the policy implications suggested would help planners and policymakers to take appropriate policy measures to invest in agricultural research and development programmes.

Structural transformation is defined as the reallocation of economic activity across broad sectors like agriculture, manufacturing, and services. The economic transformation of a developing nation like India vitally depends upon the performance of its agricultural and the allied sectors. Since this sector plays a significant role in rural livelihood, employment and national food security. Following major economic reforms initiated by the government in the early 1990s and social reforms, India has achieved an improved standard of living accompanied by rapid economic growth, increased agricultural production, improvement of private enterprises and the service sector. One of the most significant trends accompanying this growth is dietary transition resulting in changes in food demand, food supply and composition and thus, the economy has shifted its consumption towards high-value crops. Despite the rapid fall of the agriculture sector in the share of GDP, it enjoys a significant part in the Indian economy because of its strategic importance in food and nutritional security, employment generation (direct and indirect) and poverty reduction. According to Census 2011 GOI, around 31 per cent of India's population lives in the urban area and it has increased by 83 per cent over 60 years since 1951 and it will increase to approximately 40 per cent by 2030. Thus, the demand for various HVC is expected to double over the current levels. Achieving food security and improvement of nutrition - the second sustainable Development Goal by 2030 of the United Nations is the most pressing development challenge in the world. The production of the food is the basis for food security. Hence, the growth of the agricultural sector is a must for the overall economic growth of the nation.

Himachal Pradesh is observed to be the most progressive state over the years among all the hill states, which has made remarkable achievement in the socio-economic development of its people and has created a new concept in the development of hill economy through transformation brought about in agriculture, horticulture and animal husbandry. Due to peculiar topography and climatic conditions the state has different cropping pattern from other states of India. Earlier food grains dominated the cropping pattern in Himachal Pradesh. But over time, the state has realized the importance of commercial crops including off-season vegetables, potatoes and ginger.

The structural composition of the state economy witnessed significant transformation during the decade. The economy has shifted from the agriculture sector to the industrial and service sector as the contribution of agriculture and allied sector in a total domestic product has declined over the years. With the cultivation of high-value crops in some of the niches of the state, there has been an increase in income in the rural sector in the specific areas. Thus, an increase in population, per capita income, etc. over the years put continuous pressure on food. As the share of agriculture in GDP continues to fall, the level of food consumption is expected to continue to rise with the shift towards high-value agricultural commodities (HVACs). This led to a change in consumption patterns and nutrient intake of households in the state. Further, the consumption pattern of households also differs from region to region and among different income categories.

The present study was undertaken with the following specific objectives;

1. To examine the structural changes in production pattern of agricultural commodities.
2. To analyse change in consumption pattern.
3. To identify the factors affecting demand, to estimate demand elasticity of agricultural commodities and forecast their demand.
4. To examine the change in dietary intake of nutrients for rural and urban households.
5. To draw policy implications based on the study.

The proposed study was conducted in Himachal Pradesh. There are 12 districts in the state. The state is selected purposively as it exhibits a wide variation in agro-climatic conditions, resource endowment, and diverse consumption pattern of agricultural commodities due to regional disparities. The production pattern was studied for all the 12 districts of the state and the consumption pattern of agricultural commodities was studied for the rural and urban areas. To study the production pattern of the state the major agricultural commodities like rice, wheat, maize, total cereals, pulses, total food grains, fruits and vegetables were selected. The major food commodities like cereals, pulses, milk and milk products, edible oils, non-vegetarian products (egg, fish, meat), vegetables, fruits, and other foods were selected to study consumption pattern. The district-wise time series data on area, production, and yield of crops for the period 1991-92 to 2019-20 were collected from the various published and unpublished sources, Annual Season Crop Report, Directorate of Land Records, Department of Agriculture and Directorate of Horticulture, Shimla, Himachal Pradesh. The consumption pattern of agricultural commodities and nutrient intake was analysed using household-level consumption data from the consumption expenditure survey conducted by the National Sample Survey Organization (NSSO) from rounds 43rd, 50th, 61th and 68th.

For the first objective i.e., to examine the structural changes in production pattern of agricultural commodities compound annual growth rate, Simpson Index of Diversification and coefficient of variation was used. For the second objective i.e., to analyse change in consumption pattern monthly per capita consumption and budget shares of food groups were analysed using tabular analysis and Simpson Index of Dietary Diversity. The third objective was calculated using Quadratic Almost Ideal Demand System to estimate the income and price elasticity of demand and further projection of the future demand for food commodities. For the fourth objective i.e., to examine the change in dietary intake of nutrients for rural and urban households' tabular analysis were used. Finally, policies were suggested based on the results.

6.1 Findings of the Study

1. About 11.96 per cent of the total culturable land was net sown area and 20 per cent of the net sown area has irrigation facilities in the state. Kangra district accounted for the maximum net sown and gross cropped area in the state followed by Mandi district.
2. The net sown area and gross cropped area of the state has declined by around four and two per cent, respectively from TE 1991-92 to TE 2016-17. Una district has experienced maximum decline of around -13 per cent in the net sown area during the same period. However, the share of net irrigated area in the net sown area increased in the state over the years, depicting improved irrigation facilities in the state.
3. The cropping pattern of the state has experienced a decline in the share of area under cereals from 85 per cent to 78 per cent from TE 1991-92 to TE 2016-17. The districts of Kinnaur, Lahaul & Spiti and Shimla has experienced a decline in the share of the area of more than 60 per cent. This is because Lahaul & Spiti has shifted towards the cultivation of pea and potato and Shimla towards the apple cultivation.
4. Pulses are major food crops for the hilly area population, the share of the area in cropping pattern had declined by around 33 per cent from TE 1991-92 to TE 2016-17. The share of area under total food grains had declined from 89 per cent to 81 per cent in the state.
5. Fruits and vegetables area share in cropping pattern increased by around 145 per cent and 65 per cent, respectively in Himachal Pradesh. A major shift in the area under vegetables was found in districts of Kinnaur, Kullu and Sirmaur and for fruits the shift was observed in Kinnaur, Kullu, Lahaul & Spiti and Shimla.
6. The area under rice declined from 85.60 thousand ha to 72.01 thousand ha from TE 1991-92 to TE 2019-20, whereas, the production and productivity increased from 101.35 thousand tonnes to 115.52 thousand tonnes and 1.19 t/ha to 1.60 t/ha respectively. Kangra contributed the maximum area under rice in the state followed by Mandi.

7. Wheat is the major cereal crop of the state has witnessed a decline in the area from 376.27 thousand ha to 326.93 thousand ha over past 30 years. Kangra and Mandi district together accounted for about 44 per cent area and 52 per cent production of wheat in the state.
8. The area under the cereals in the state during TE 2019-20 was 710.54 thousand ha which declined by 14 per cent over three decades. The area and production of the total cereals were maximum in Kangra and Mandi because these are low-lying regions and suitable for the cultivation of these crops.
9. Pulse cultivation in the state was declined from 40.91 thousand ha (TE 1991-92) to 28.23 thousand ha (TE 2019-20) however the cultivation increased significantly from 12.03 thousand tonnes to 55.53 thousand tonnes due to the cultivation of high yielding varieties. Chamba, Kangra, Kullu, Mandi, Shimla, Sirmaur were the few prominent pulses growing districts of the state.
10. Apple accounted for around 49 per cent of the total fruit area and 74 per cent of the total fruit production in the state. Shimla accounted for the maximum area and production of fruits in the state and districts Kangra, Kullu, Mandi and Shimla together contributed around 68 per cent of the area under fruits in the state.
11. Vegetable cultivation picked up the pace in the state and the area under wheat cultivation increased from 32.05 thousand ha to 82.41 thousand ha over past three decades. The production had increased by around 208 per cent. Kangra, Kullu, Mandi, Shimla, Sirmaur and Solan were the major vegetable growing districts of the state.
12. The area under the cereals decreased with the growth rate of -0.53 per cent per annum from TE 1991-92 to TE 2019-20 and the production and productivity increased with the growth rate of 0.06 per cent and 0.59 per cent, respectively. Likewise, the area under pulses and total foodgrains in the state declined with the compound annual growth rate of 1.89 per cent and 0.57 per cent over three decades. The maximum decline in the annual growth rate of area under foodgrains was found in districts of Kinnaur, Lahaul & Spiti and Shimla.

13. The area and production of the fruits increased significantly over three decades with a growth rate of 0.93 per cent per and 4.49 per cent per annum. The area under vegetables with a growth rate of 5.51 per cent per annum.
14. The degree of diversification varied across the districts of the state. The districts of Chamba, Kullu, Mandi, Shimla and Sirmaur were comparatively more diversified than other districts.
15. The monthly per capita consumption expenditure showed greater variability across income groups and sectors. The urban households have high MPCE than the rural households. The food expenditure of urban households was comparatively greater than the rural households.
16. The share of the food expenditure in total expenditure declined from 60 per cent in 1987-88 to 57 per cent in 1993-94 to 49 per cent in 2004-05 and further to 41 per cent in 2011-12.
17. The expenditure on the food commodities was inversely related to the income of the households as the very poor households spent around two- third of their income on food which declined by certain per cent from 43rd to 68th round and rich households spend less than 50 per cent of income on food which further decline to 37 per cent of their income in 2011-12 and this confirms Engel's law.
18. With rise in income of households the expenditure share on cereals and pulses has declined. However, the share has increased for high value commodities like livestock products (milk and milk products, egg, fish and meat), vegetables and fruits with the increase in the income. The decline in expenditure share of cereals was more in rural than urban areas due to the improved infrastructure facilities rural areas, enhanced public distribution system and diversification of the food basket.
19. The long -term trend in the consumption pattern of the households revealed the decline in per capita direct consumption of foodgrains and the intake of milk and milk products, non-vegetarian products (egg, fish and meat), fruits and vegetables increased in both the sectors of the state.
20. The monthly per capita consumption of cereals was more in rural areas compared to the urban areas. The consumption of milk and milk products was also higher in rural sector due to the availability of these products with rural

households. The intake of high value commodities like egg, fish, meat and fruits was higher in urban areas due to improved per capita income.

21. The per capita per day consumption of rice has increased in the state. However, the consumption of wheat, total cereals and pulses has declined over the years. The consumption of milk and milk products, edible oils, egg, fish and meat, vegetable and fruits increased significantly, providing the proof of shift in the consumption pattern of the households over the years.
22. The dietary diversity index revealed the increased diversification in the food baskets of the households as index increased from 0.777 in 1987-88 to 0.821 in 2011-12.
23. The factors affecting the demand of HVACs were determined using Quadratic almost ideal demand system for the vegetarian and non-vegetarian households in both the sectors. The consumption of the food items was found to be influenced by both the economic and demographic factors like income of households, food prices, family size, etc.
24. The income variable demonstrated a positive relationship with the expenditure share of cereal and pulses and further with quadratic increase in income the expenditure share on milk and milk products and fruits increased for the non-vegetarian households which confirms the Bennet's law in Himachal Pradesh. However, for the vegetarian households the increase in the income increased the expenditure share on pulses, milk and milk products, vegetables, and fruits.
25. The expenditure elasticity of the food commodities was higher in urban areas compared to the rural areas except for milk and milk products. Cereals exhibit inelastic demand among all food groups, and the responsiveness of food commodities like milk, egg, fish, meat, vegetables and fruits was higher with the improved income of households for respective non-vegetarian and vegetarian households.
26. Due to the rise in the population of the state the demand of households for cereals will increase by 16.28 million tonnes, 18.74 million tonnes and 26.26 million tonnes during 2025, 2030 and 2035, respectively under the BAU scenario and from 20.72 million tonnes to 24.83 million tonnes and further to

- 32.64 million tonnes under high income growth scenario. The demand for the milk and milk products in the state will be more in the near future.
27. The per capita per day intake of calories in state increased from 2333 Kcal in 1993-94 to 2503 Kcal in 2011-12. The calorie intake was more in the rural areas compared to the urban households in the state. The protein intake was remained more or less similar in the state through the study period and the fat intake has increased significantly.
 28. The very poor urban households had experienced a prominent decline of calories and proteins in the state.
 29. The intake of the calorie, proteins and fats in the state were higher than national average. Also, the intake of fats was higher in rural areas compared to the urban areas of the state as urban households were more conscious about health and their diet.
 30. Food grains are the major and cheapest source of the energy and protein in the state. But over the years the contribution of food grains in the energy and protein has declined and intake from the milk and milk products increased which signifies the shift in consumption pattern towards the high value commodities
 31. The low-income households of the state were nutritionally insecure in both sectors of the state.

6.2 Conclusion

The state cropping pattern of the state was shifted from the traditional cereals-based cultivation towards the high-value agricultural commodities (HVAC) due to the varied agroclimatic conditions of the state and changing consumption pattern. The irrigation system in the state was improved. The cultivation of the fruits and vegetables (especially off-season vegetables) had picked up pace in districts Kinnaur, Kullu, Sirmaur, Lahaul and Spiti, and Shimla. The wide variation in the consumption pattern of the rural and urban households and across income group was observed. The monthly per capita consumption expenditure of urban households was comparatively high than rural households because of the better income and employment opportunities in the urban sector of the state. However, the share of the expenditure of urban households on food commodities was less compared to the rural households. The very poor households

devote a major portion of their income towards the food expenditure as compared to the middle income and rich income households. Over the years, the consumption of the food grains was declined in both the rural and urban sectors of the state and the intake of milk and milk products, non-vegetarian products, fruits and vegetables increased due to the improved incomes of households, improved standard of living, diversification of the food basket and the availability of the variety of food in the market. The food expenditure of the urban households on the High- value food commodities was more in the urban sector than the rural sector of the households. The non-vegetarian and vegetarian households showed different consumption behaviours in the rural and urban sectors. For non-vegetarian households, the increase in income increased the expenditure share for milk and milk products and fruits. However, for vegetarian households the increase in income increased the expenditure share for milk and milk products and pulses. The intake of the calorie, proteins and fats was increased over the years for both rural and urban households. The food grains were the major source of calories and proteins for all income categories and both the sectors.

6.3 Policy implications

On the basis of the study, the policy options for ensuring food and nutritional security in the state were suggested. A significant transformation was observed in the cropping patter of the state, but food grains still dominate the economy. However, the decreasing areas under the food grains is of greater concern, as these crops are the pillars of the food security. Therefore, sincere effective and continuous efforts are needed to increase the area under cultivation as well as yield of these crops by bringing fallow land under cultivation. The cropping pattern suitable for the local agro-climatic conditions should be practiced and the irrigation facilities need to be strengthened to accelerate the process of crop diversification in the state. Declining importance of coarse cereals overtime should not be neglected. Their production needs to be promoted in location specific and in a regional development framework for sustaining livelihood of producers and food security of poor consumers. The pulses had shown high instability and fluctuation in the area and production in the state, since the state has potential to grow these crops therefore, state agriculture department should promote the cultivation of pulses through introduction of development programmes in the state. The

declining per capita cereal and pulses consumption needs due consideration of the people from the food and nutritional security point of view. Cereals inhibit inelastic demand and its per capita demand had fallen in the past few decades, but the demand of cereals will increase in the future on account of population growth, also these crops are the cheapest source of energy and protein compared to other foods and thus vital for food and nutrition security of the low-income class. Thus, there is need to improve the productivity, control prices, develop marketing strategies and further strengthen the public distribution system to fulfil the future demand. The lower income households of the state were moderately nutrition insecure, hence the nutrient rich food should be made available to them at subsidized rates to enhance nutrient status of such households for improving their health.



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APPENDICES

Appendix 1. Income group-wise categorisation of households

Categories	Income group	1987-88 (43rd round)		1993-94 (50th round)		2004-05 (61st round)		2011-12 (68th round)	
		Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
<75% of PL	Very poor	<92.18	<108.08	<175.34	<190.21	<295.71	<378.68	<684.75	<798.00
75% of PL- PL	Poor	92.18-122.9	108.08-144.10	175.34-233.79	190.21-253.61	295.71-394.28	378.68-504.9	684.75-913.0	798.00-1064
PL-150 % of PL	Middle	123.0-184.35	144.11-216.15	233.80-350.69	253.62-380.42	394.29-591.42	504.91-757.35	913.1-1369.50	1064.1-1596.00
>150% of PL	Rich	>184.35	>216.15	>350.69	>380.42	>591.42	>757.35	>1369.5	>1596.0

Note: PL= Poverty line

Appendix 2: Income group and sector wise share of food commodities in food expenditure in Himachal Pradesh in 1987-88

(per cent)

Income Group	Cereal	Pulses	MMP	Edible oils	EFM	Vegetables	Fruits
Rural							
V. Poor	47.69	8.22	15.04	8.88	0.57	7.29	0.32
Poor	43.63	8.27	17.55	8.36	1.15	7.35	1.09
Middle	38.05	7.69	21.08	8.77	2.28	7.11	1.41
Rich	29.41	7.54	25.75	9.20	3.11	7.60	2.12
All	33.54	7.66	23.47	8.99	2.65	7.42	1.79
Urban							
V. Poor	49.32	6.74	9.03	7.06	0.00	7.95	1.69
Poor	37.23	7.77	17.49	10.38	3.65	7.61	0.91
Middle	24.40	5.71	13.87	7.49	2.02	6.23	2.97
Rich	20.78	6.66	24.75	10.39	3.91	9.61	3.89
All	22.10	6.51	22.32	9.81	3.52	8.88	3.61
Combine							
V. Poor	47.71	8.20	5.76	8.85	0.56	7.30	0.34
Poor	43.38	8.25	9.28	8.44	1.25	7.36	1.08
Middle	37.21	7.57	14.92	8.69	2.26	7.06	1.51
Rich	28.39	7.44	29.38	9.34	3.20	7.84	2.33
All	32.46	7.55	20.70	9.07	2.73	7.56	1.96

Appendix 3: Income group wise and sector wise monthly per capita consumption of food commodities in Himachal Pradesh 1987-88

(Kg/capita/month)

Income Group	Rice	Wheat	Cereal	Pulses	MMP	Edible oils	EFM	Vegetables	Fruits
Rural									
Very Poor	2.10	4.82	11.03	0.68	2.56	0.26	0.01	1.86	0.07
Poor	3.10	5.23	13.52	0.94	3.79	0.28	0.04	2.40	0.25
Middle	3.83	6.77	15.19	1.16	5.91	0.39	0.10	2.90	0.40
Rich	4.69	8.09	17.43	1.76	10.45	0.61	0.21	4.55	0.70
All	4.07	7.10	15.84	1.39	7.59	0.47	0.14	3.55	0.50
Urban									
Very Poor	0.83	4.33	15.17	0.58	2.58	0.25	0.00	1.83	0.20
Poor	3.02	7.84	11.28	0.93	3.51	0.35	0.13	2.35	0.31
Middle	3.38	7.21	11.03	1.09	4.77	0.42	0.12	3.09	0.76
Rich	4.59	7.72	12.88	1.87	10.50	0.78	0.39	6.53	1.36
All	4.15	7.57	12.31	1.60	8.51	0.66	0.30	5.33	1.13
Combine									
Very Poor	2.08	4.81	11.09	0.68	2.56	0.26	0.01	1.85	0.07
Poor	3.10	5.32	13.44	0.93	3.78	0.28	0.04	2.39	0.26
Middle	3.81	6.79	14.99	1.16	5.86	0.39	0.10	2.91	0.41
Rich	4.68	8.05	17.00	1.77	10.46	0.62	0.23	4.74	0.76
All	4.07	7.13	15.61	1.40	7.65	0.48	0.15	3.67	0.54

Appendix 4: Dietary diversity index across income classes in Himachal Pradesh (43 round)

Income group	Rural	Urban	HP
Very Poor	0.705	0.735	0.706
Poor	0.759	0.753	0.758
Middle	0.776	0.646	0.765
Rich	0.789	0.800	0.790
All	0.780	0.752	0.777

**Appendix 5: Dietary diversity index across income classes in Himachal Pradesh
(50 round)**

Income group	Rural	Urban	HP
Very Poor	0.717	0.770	0.717
Poor	0.775	0.788	0.776
Middle	0.790	0.811	0.792
Rich	0.784	0.740	0.775
All	0.780	0.755	0.777

**Appendix 6: Dietary diversity index across income classes in Himachal Pradesh
(61 round)**

Income group	Rural	Urban	HP
Very Poor	0.771	0.872	0.777
Poor	0.805	0.808	0.805
Middle	0.803	0.833	0.805
Rich	0.793	0.824	0.798
All	0.796	0.825	0.800



LIST OF PUBLICATIONS

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Original Research Article

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Diversification of Agricultural Crops in Himachal Pradesh: A Shift towards High-Value Crops

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ABSTRACT

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During the last few decades, the agricultural diversification in Himachal Pradesh towards high-value crops i.e. fruits and vegetables including off-season vegetables have increased at a fast rate. The process of diversification has started in the late sixties and picked up pace in the eighties after that the state has made reasonable progress. This paper has studied the growth in the area, production, and productivity of all foodgrains and non-foodgrains for over three decades. The analysis brings out a shift in the cropping pattern of agricultural commodities as the area under foodgrains declined and increased in the area under high-value commodities in the state. The districts with the favourable agroclimatic conditions shifted from cereal-based cropping patterns towards temperate fruits and vegetable (temperate) production at the commercial level.

Introduction

Diversification is an essential component of the structural transformation of an economy. India is an agrarian economy so as the state Himachal Pradesh and shares about 1.7 per cent area in the total geographical area of the country. The state is in the northern part of India, situated in the western Himalayas. It is a small mountainous state with a total geographical area of 55,673 sq. Km and the altitude range from 350 m to 6975 m above mean sea level which is one among the reasons for diverse agroclimatic conditions in

the state. Agriculture is the main source of income and about 12.73 per cent of total GSDP comes from agriculture and allied sectors. More than 85 per cent of the population depends upon agriculture for their livelihood, and about 87 per cent being marginal and small farmers owning average landholdings of 1.8 hectares accounts for about 54 per cent area and only 0.34 per cent by large farmers. Thus, the agriculture in mountainous region is circumscribed by specificities like, marginality, inaccessibility, niche and human adaptation mechanism prevail due to vertical dimension that

distinguishes them from plains and another ecosystem. The agriculture in hilly areas was always featured as cereal-based and characterized by low and stagnant productivity. But with the introduction of the high-value cash crops and high yielding varieties in the production system, the production pattern has shifted from traditional subsistence-oriented, cereal-based agriculture to high-value cash crops based commercial agriculture.

Over the decades the contribution of the agriculture and allied sectors in gross state domestic product has declined from 57.9 per cent in 1950-51 to 55.5 per cent in 1967-68, 26.5 per cent 1990-91 and to 8.4 per cent in 2018-19 as it shifted to industrial and services (Economic Survey of HP, 2019-20). Despite declining share, the importance of the agriculture sector does not affect, as its major contributor in total domestic product and also its contribution to other sectors via input linkages, employment, trade, and transportation. Since the early 1970s, this sector has made considerable progress, as is evident from an increase in foodgrain production from 9.45 lakh tonnes in 1972-73 to lakh tonnes in 15.81 lakh metric tonnes 2017-18 and 16.92 lakh metric tonnes in 2018-19 (Sharma and Chauhan, 2013). The productivity of different crops has also increased but the important transformation has been the diversification of agriculture towards high-value cash crops, including fruits and vegetables (off-season) which was the main policy thrust in Himachal Pradesh since it attained the statehood in 1971. The process of diversification towards fruits and vegetables started in the late fifties and sixties in the districts of Shimla, Kullu, Solan, and Lahaul & Spiti which extended in late seventies and eighties to other parts and gained momentum in the nineties when the process spread even to low and mid-hill districts (Sharma, 2011). The crop

diversification towards high-value cash crop-based commercial agriculture promotes the productive use of abundant small and marginal lands (54 %) in these regions. It also helps in maintaining and improving the ecology and environment by promoting soil conservation and improving soil fertility (Kumari, 20007). Further, the diversification of agriculture with high-value off-season vegetable crops has made a noticeable impact on the standard of living and quality of life of rural people (Sharma and Chauhan, 2008). Thus, keeping this in view the present study has been conducted to study the growth in the area production and productivity of various agricultural commodities and the extent of diversification in agriculture over the years.

Materials and Methods

For this study, the time series data regarding the area, production, and productivity of various agricultural commodities have been collected. The data germane to the study was collected from the various publications of the state government and records from different departments like Department of Agriculture, Directorate of Horticulture and the Directorates of Land Records for all the 12 districts of the state namely Bilaspur, Chamba, Hamirpur, Kangra, Kinnaur, Kullu, Lahaul & Spiti, Mandi, Shimla, Sirmour, Solan and Una. The data is collected for the year 1991-92 to 2017-18. The data were analysed using appropriate tools like tabular analysis, using average and percentages. The extent of crop diversification has been studied by analysing temporal changes in the cropping pattern, the area under fruit and vegetable crops. The Simpson Index of Diversification used to compute crop diversity in the districts and state as a whole. A zero (0) value of SID indicates specialization and its value approaches one (1) with an increase in the extent of diversification.

$$SID = 1 - \sum_{i=1}^n \left(\frac{A_i}{GCA}\right)^2$$

Where, A_i = Area under i^{th} crop,
GCA = Gross cropped area

Compound growth rates (CAGR) of area, production, and yield of crops were estimated as:

$$Y_t = AB^t$$

Where, Y_t = area/ production/ yield of major crops in t^{th} period
 t = time variable (1,2,3....., n),
 A = constant,
 B = regression coefficient of Y on time t

After log transformation and estimation of the above function as $\ln Y_t = \ln A + t \ln B$, compound growth rate will be estimated as:

$$r = (\text{antilog } B - 1) \times 100$$

Instability was estimated using the Coefficient of variation as follows:

$$CV = \frac{\sigma_x}{\bar{X}} \times 100$$

Where, σ_x = standard deviation of X
 \bar{X} = mean of X
 X = area/ production/ yield

Results and Discussion

The cropping pattern in Himachal Pradesh is examined for all the districts looking at the share of individual crop area in the gross cropped area (GCA). It also indicates the extent of the intensification of agriculture. Table 1 shows that the two crops namely wheat and maize occupied around 67.19 per cent of GCA during TE 2016-17 which was 71.73 per cent during 1991-92. Wheat is the major staple crop of Himachal Pradesh and

maize is second in place after wheat. But over the years the share of area under rice, wheat, and maize has declined steadily. The area share of area under pulses has also declined drastically from 4.18 per cent (1991-92) to 2.80 per cent (2016-17). Hence the share of area under total foodgrains has declined from 88.82 % to 81.71 % during the study period. This decline in area under foodgrains might be happened due to a shift in production pattern from traditional cereals-based cropping pattern towards high-value crops and off-season vegetables. The share of area under foodgrains has fallen in almost all the districts except few and the maximum decline in the area is in Kinnaur, Kullu, Lahaul and Spiti, Shimla and Sirmaur. The share of vegetables has increased from 2.75 per cent to 4.53 per cent and for fruits from 4.30 per cent to 10.52 per cent during the study period. the maximum increase in the share of area under vegetables is in Lahaul and Spiti (58.80 % during 2016-17) followed by Sirmaur, Kinnaur and Kullu over the years the area under spices has increased in Sirmaur where the crops like ginger cultivation have taken place in recent years. Therefore, the decrease in the area under rice, wheat, maize, barley and other cereals, pulses and increase in the area under vegetable and fruit crops shown the process of diversification (Sharma, 2011).

Crop diversification in the state

To see the extent of diversification in the state the Simpson Index of Diversification has used. Table 2 shows that in the state crop diversification has taken place and the value of the index has increased all over the period from 0.727 during 1991-92 to 0.740 during 2001-02 which further increased to 0.757 during 2017-18 (Singh, 2006; Krishan, 2014). Thus, in the state as a whole, the diversification has taken place, but at the district level, the mixed result has been found in the diversification. During 1991-92 except

Bilaspur, Hamirpur, Una all other districts have high diversification index ranging from 0.704 to 0.835. Districts like Chamba, Kullu, Sirmaur are moving towards diversification during 2017-18. While, Bilaspur, Hamirpur, Kangra, Solan, and Una has shown a decline in the diversification index over the three decades. During the 1990s Lahaul Spiti moved towards diversification similarly and started moving towards specialization during 2001-02 and 2011-12 and further during 2017-18 showed a shift towards diversification. The District Kinnaur and Lahaul and Spiti which are tribal districts shifted towards fruits and vegetable production from foodgrains which led to specialization as shown by cropping pattern also and a decline is seen in diversification index from 0.820 to 0.663 for Kinnaur and 0.835 to 0.606 for Lahaul and Spiti.

Temporal changes in area, production and productivity of cereals

Cereals play a major role in providing food security. Rice, wheat, and maize are the major cereals consumed by the population in Himachal Pradesh. The temporal changes in the area production and productivity of cereals presented in Table 3. The area under cereals is maximum in Kangra which is the largest district area-wise, followed by Mandi districts during 1991-92 and 2017-18. Over the years the area under cereals has shown a mild decline. The maximum decline in area under cereals was in Shimla (58 %) followed by Lahaul & Spiti (56%) and Kinnaur (56 %). The production of cereals has increased over the years from 1263.88 thousand tonnes to 1366.95 thousand tonnes in the states, Kangra being the largest producer of the cereals in the state. Over three decades the production of cereals has increased by 28 % in the Chamba and decreased drastically in the Lahaul-Spiti (84%), Kinnaur (57%), Shimla (50%), Mandi (38 %), Sirmaur (21%) and Hamirpur (16 %).

The productivity of the cereals in the state has increased from 1.53 t/ha to 1.94 t/ha.

Temporal changes in area, production and productivity of pulses

Pulses are among major foodgrains that constitute important foodstuff for hilly people. The major pulses grown in the state are gram, black gram, horse gram, green gram. Table 4 tells the changing levels of the area, production, and productivity of pulses in different districts of the state. The area under pulses has nosedived from 40.91 thousand hectares during TE 1991-92 to 25.95 thousand hectares during TE 2017-18 with a decline of around 36 per cent.

A proportionate decrease in the cultivation of pulses has been seen during 1991-92 to 2017-18 in almost all the districts. Kangra accounts for the maximum area under pulses but over the years it has declined by 37 per cent and the maximum decline in the area has been occurred in the district Hamirpur (97 %), followed by Bilaspur (89%) and Kinnaur (51 %). The production of the pulses is highest in Mandi district followed by Shimla, Sirmaur, and Chamba. Over three decades, the production of the pulses in Himachal Pradesh has increased by about 240 %. The maximum increase in production was observed in Chamba (654 %) followed by Kullu (483%), Shimla (405 %) and Sirmaur (326 %). The increase in production may be due to the introduction of high yielding varieties. Further, the increase in production led to the rise in the yield of the pulses from 0.29 t/ha to 1.48 t/ha over the years.

Temporal changes in area, production and productivity of fruits

Over the past few decades, the state has made significant progress in the development of horticulture as shifted the cultivation pattern

from cereal-based farming towards high-value commodities due to topographical variations and altitudinal differences along with fertile and well-drained soils suitable for the cultivation of temperate to sub-tropical fruits.

The total area under fruits is 228.95 thousand hectares during TE 2017-18 which has shown a proportionate increase of about 40 % over the period (Table 5). The area under fruits during 2017-18 is maximum in Shimla (47.19 '000 ha) followed by Kangra, Mandi and Kullu. The area under the fruit crops has increased in almost all the districts between 1991-92 to 2017-18 and the maximum increase was in district Lahaul-Spiti (774 %) followed by Kinnaur (125 %).

The production of fruits has increased by 77 % over 27 years. Shimla is the largest producer of the fruits (2017-18) as half of the fruit production in the state comes from this district followed by Kullu (8%), Kinnaur (9 %) and Mandi (7%). These four districts have a maximum contribution to apple production. The productivity of fruits is increased to 3.07 t/ha during 2017-18 from 2.44 t/ha. the productivity of fruits is maximum in Shimla (22.89 t/ha). Since the tribal districts Lahaul and Spiti and Kinnaur, most of the areas of Shimla, Kullu and Chamba and some areas of Sirmaur, Solan and Mandi that falls under the temperate region and thus have potential to grow temperate fruits.

Temporal changes in area, production and productivity of vegetables

Vegetable cultivation has led the state towards the diversification over the last few decades. The cultivation of the off-season vegetables helped the producers in the improvement of the quality of life in rural areas. Table 6 showed the area under vegetables has increased from 32.05 thousand ha to 76.95 thousand ha from TE 2001-02 to

TE 2017-18. Like fruits, Shimla has the largest area under vegetables. But over the two decades, the area has increased maximum in Hamirpur followed by Kinnaur. The production of vegetables was highest in Solan, followed by Shimla. The maximum increase in the production of the vegetables is in Mandi (351.71 %) followed by Hamirpur (332.97 %), Kangra (312.03 %) and Chamba (243.54 %). The productivity of vegetables in the state has increased from 17.97 t/ha (TE 2001-02) to 21.46 t/ha (TE 2017-18).

Growth in the area, Production and Productivity of cereals

The growth in the area under the cereals (Table 7) in the state has recorded a mild annual significant decrease of 0.51%, among districts, it has shown significantly declined maximum in the Kinnaur (-4.00 %), followed by the Shimla and Lahaul & Spiti with a decline of -3.86 % and -3.53% respectively. The fluctuation in the area under cereals in the state is low (4.49 %) and in Shimla, Kinnaur and Lahaul & Spiti the fluctuation is found high i.e. 32.02 %, 31.90 % and 28.35 %, respectively due to varying climatic conditions.

Similarly, the growth rate of production in the state is negative and non-significant (-0.12 %). The growth rate of production in districts is positive and non-significant in half of the districts and negative in other i.e. Hamirpur, Kinnaur, Lahaul and Spiti Mandi, Shimla and Sirmaur.

The state has registered an annual increment of 0.39 % in the productivity of the cereals with fluctuation of 11.97 %. The growth in the productivity of cereals in almost all the districts was positive but non-significant except in Lahaul & Spiti (-3.76%) and Mandi (-2.55%).

Table.1 District wise cropping pattern of Himachal Pradesh (1991-92 to 2016-17)

Crop	Year	Bilaspur	Chamba	Hamirpur	Kangra	Kinnaur	Kullu	Lahaul & Spiti	Mandi	Shimla	Sirmaur	Solan	Una	HP
Rice	1991-92	4.82	4.62	4.53	17.29	0.24	4.00	0.00	13.71	3.48	6.28	5.77	2.14	8.75
	2016-17	2.31	4.77	2.37	17.91	0.06	1.17	0.00	11.03	0.72	9.84	6.95	2.12	8.16
Wheat	1991-92	44.38	30.03	47.28	42.15	8.38	34.68	8.02	41.16	27.40	37.72	35.40	43.58	39.48
	2016-17	45.38	33.16	46.63	45.57	1.44	21.33	1.56	41.60	9.22	33.53	41.71	46.94	37.37
Maize	1991-92	43.58	43.26	45.54	26.52	5.30	28.66	1.01	29.94	19.69	32.95	37.78	42.39	32.25
	2016-17	50.54	38.75	49.54	23.86	0.58	25.45	0.33	29.65	7.90	24.10	35.49	40.92	29.82
Barley	1991-92	0.77	6.19	0.25	1.52	17.76	5.80	23.35	2.66	5.11	3.67	2.85	0.08	2.93
	2016-17	0.42	6.78	0.12	1.08	6.45	3.87	10.15	2.19	2.99	3.06	2.87	0.00	2.22
Pulses	1991-92	2.71	5.52	1.46	2.72	10.67	6.18	27.16	2.79	6.47	5.75	7.21	2.97	4.18
	2016-17	0.11	4.96	0.01	1.15	8.42	6.93	20.80	5.20	3.06	1.98	3.19	0.19	2.80
Total foodgrains	1991-92	96.27	92.64	99.07	90.28	75.43	83.51	62.55	92.41	71.04	87.78	89.02	91.16	88.82
	2016-17	98.76	90.07	98.66	89.80	32.00	59.43	33.51	90.35	26.01	73.02	90.30	90.18	81.12
Vegetables	1991-92	0.78	1.11	0.21	0.95	4.13	3.36	32.17	2.60	9.48	2.84	3.61	1.03	2.75
	2016-17	0.44	2.88	0.37	1.54	9.39	7.48	58.80	4.05	10.58	11.34	4.27	2.85	4.53
Fruits	1991-92	0.63	2.13	0.03	1.60	19.66	11.45	0.43	3.35	18.44	1.99	1.06	0.32	4.30
	2016-17	0.29	5.85	0.13	3.29	57.88	30.00	5.69	4.22	62.45	2.21	0.43	0.61	10.52
Oilseeds	1991-92	1.64	3.96	0.32	4.56	0.33	1.16	0.29	0.58	0.66	1.63	3.07	3.42	2.22
	2016-17	0.17	0.83	0.14	2.13	0.00	0.73	0.38	0.42	0.33	1.92	1.32	2.20	1.13
Spice	1991-92	0.25	0.16	0.04	0.04	0.17	0.28	0.00	0.15	0.34	2.01	0.36	0.07	0.31
	2016-17	0.34	0.27	0.14	0.06	0.54	2.31	0.00	0.34	0.58	7.24	2.86	0.08	1.08
Others	1991-92	0.43	0.00	0.32	2.59	0.28	0.24	4.56	1.14	0.05	3.75	2.88	4.01	0.62
	2016-17	0.00	0.10	0.55	3.18	0.19	0.04	1.63	0.62	0.04	4.27	0.81	4.08	1.61

Source: Directorate of Land Records, Shimla

Table.2 Changing levels of crop diversification Indices (Simpson) across districts in Himachal Pradesh: 1991-92 to 2017-18

Districts	1991-92	2001-02	2011-12	2017-18
Bilaspur	0.599	0.567	0.558	0.538
Chamba	0.713	0.722	0.726	0.729
Hamirpur	0.564	0.544	0.534	0.532
Kangra	0.707	0.697	0.689	0.690
Kinnaur	0.820	0.842	0.755	0.663
Kullu	0.775	0.787	0.790	0.826
Lahaul & Spiti	0.751	0.685	0.665	0.709
Mandi	0.711	0.718	0.712	0.717
Shimla	0.835	0.840	0.733	0.606
Sirmaur	0.725	0.756	0.773	0.790
Solan	0.704	0.697	0.679	0.686
Una	0.600	0.616	0.579	0.579
Hp	0.727	0.740	0.736	0.757

Source: Directorate of Land Records, Shimla

Table.3 Area, production and productivity of cereals (1991-92 to 2017-18)

	Area ('000 ha)		Production ('000 Metric tonnes)		Productivity (t/ha)	
	TE 1991-92	TE 2017-18	TE 1991-92	TE 2017-18	TE 1991-92	TE 2017-18
Bilaspur	56.10	49.31	90.95	93.68	1.62	1.89
Chamba	56.33	51.90	105.52	135.77	1.87	2.61
Hamirpur	73.76	61.69	121.09	101.41	1.64	1.64
Kangra	187.49	178.17	296.69	323.56	1.58	1.81
Kinnaur	5.79	2.55	5.14	2.22	0.89	0.86
Kullu	46.74	40.71	88.46	88.71	1.90	2.18
Lahaul & Spiti	1.17	0.51	1.52	.25	1.30	0.48
Mandi	148.17	128.72	228.81	141.42	1.54	1.10
Shimla	70.46	29.51	110.41	55.51	1.57	1.85
Sirmaur	64.48	53.73	127.99	101.34	1.99	1.88
Solan	55.89	52.07	98.85	107.56	1.76	2.06
Una	61.72	60.11	94.78	108.92	1.53	1.80
HP	828.11	708.96	1263.88	1366.95	1.53	1.94

Source: Directorate of Land Records, Shimla

Table.4 Area, production and productivity of pulses (1991-92 to 2017-18)

	Area ('000 ha)		Production ('000 Metric tonnes)		Productivity (t/ha)	
	TE 1991-92	TE 2017-18	TE 1991-92	TE 2017-18	TE 1991-92	TE 2017-18
Bilaspur	1.62	0.17	0.73	0.11	0.47	0.65
Chamba	3.57	3.44	0.86	6.51	0.24	1.64
Hamirpur	1.10	0.02	0.26	0.01	0.25	0.31
Kangra	5.83	3.64	1.80	5.66	0.31	1.41
Kinnaur	0.95	0.47	0.26	0.69	0.27	1.65
Kullu	3.74	2.68	0.86	5.00	0.23	1.56
Lahaul & Spiti	0.90	0.69	0.95	0.82	1.07	1.69
Mandi	4.61	4.42	1.77	6.93	0.38	1.55
Shimla	7.06	4.58	1.35	6.84	0.19	1.36
Sirmaur	4.52	3.93	1.60	6.81	0.35	1.61
Solan	4.93	1.73	0.95	1.45	0.20	0.83
Una	2.08	0.17	0.66	0.12	0.32	0.74
HP	40.91	25.95	12.03	40.94	0.29	1.48

Source: Directorate of Land Records, Shimla

Table.5 Area, production and productivity of fruits (1991-92 to 2017-18)

	Area ('000 ha)		Production ('000 Metric tonnes)		Productivity (t/ha)	
	TE 1991-92	TE 2017-18	TE 1991-92	TE 2017-18	TE 1991-92	TE 2017-18
Bilaspur	6.56	7.98	1.09	3.45	0.17	0.43
Chamba	8.52	16.97	4.60	21.88	0.54	1.29
Hamirpur	4.39	7.55	1.07	3.45	0.25	0.46
Kangra	34.68	40.20	14.66	44.82	0.43	1.12
Kinnaur	5.76	12.97	13.00	63.14	2.25	4.87
Kullu	19.78	30.33	97.20	127.83	4.94	4.23
Lahaul & Spiti	0.20	1.76	0.05	0.33	0.28	0.19
Mandi	24.85	37.07	16.46	50.72	0.67	1.37
Shimla	30.59	47.19	234.76	339.56	10.63	22.89
Sirmaur	13.26	14.88	5.56	20.10	0.38	0.43
Solan	10.92	6.15	4.57	8.78	0.42	1.43
Una	4.00	5.92	3.18	17.93	0.80	3.02
H P	163.52	228.95	396.20	702.00	2.44	3.07

Source: Directorate of Land Records, Shimla

Table.6 Area, production and productivity of vegetables (2001-02to 2017-18)

	Area ('000 ha)		Production ('000 Metric tonnes)		Productivity (t/ha)	
	TE 2001-02	TE 2017-18	TE 2001-02	TE 2017-18	TE 2001-02	TE 2017-18
Bilaspur	1.63	3.12	28.01	85.15	17.15	27.26
Chamba	1.317	3.31	18.93	65.03	14.38	19.61
Hamirpur	0.89	3.83	13.82	59.86	15.53	15.64
Kangra	2.65	8.20	43.35	178.63	16.36	21.78
Kinnaur	0.95	3.66	11.67	45.63	12.23	12.45
Kullu	3.01	6.19	59.42	133.94	19.74	21.65
Lahaul & Spiti	1.77	4.36	18.83	57.31	10.65	13.14
Mandi	3.33	11.01	49.24	222.44	14.80	20.21
Shimla	5.95	12.67	98.46	231.57	16.55	18.27
Sirmaur	4.15	8.86	84.78	201.31	20.42	22.73
Solan	5.41	9.64	131.35	333.91	24.29	34.63
Una	0.99	2.09	17.94	36.43	18.13	17.45
HP	32.05	76.95	575.81	1651.21	17.97	21.46

Source: Directorate of Horticulture, Shimla

Table.7 District wise CAGR and CV of cereals (1991-92 to 2017-18) (Per cent)

Districts	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-0.50*	5.12	0.17	21.44	0.68	21.15
Chamba	-0.03	4.87	0.62	19.87	0.64	20.68
Hamirpur	-0.54*	4.50	-0.34	16.48	0.20	16.17
Kangra	-0.05	3.96	0.57	14.50	0.62	16.03
Kinnaur	-4.00*	31.90	-3.75*	31.34	0.26	23.13
Kullu	-0.32	8.87	0.16	16.57	0.48	17.46
Lahaul & Spiti	-3.53*	28.35	-7.16*	117.39	-3.76*	91.51
Mandi	-0.49*	4.17	-3.03*	28.28	-2.55*	26.40
Shimla	-3.86*	32.02	-2.88*	28.62	1.02*	16.39
Sirmaur	-0.74*	7.47	-0.47	13.25	0.27	13.47
Solan	-0.09	5.96	0.77	17.79	0.86	18.55
Una	0.001	4.77	0.45	17.62	0.45	17.51
HP	-0.51*	4.49	-0.12	10.90	0.39	11.97

Note = * 1 % level of significance, ** 5 % level of significance

Table.8 District wise CAGR and CV of pulses (1991-92 to 2017-18) (Per cent)

Districts	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-9.39*	111.55	-7.61*	76.66	1.96	42.40
Chamba	-0.36	13.49	3.97**	122.07	4.35*	103.78
Hamirpur	-15.25*	119.77	-16.40*	129.67	-1.36**	24.89
Kangra	-1.95*	20.49	1.07	76.32	3.08*	72.69
Kinnaur	-9.98*	54.58	-7.61	68.74	2.63	59.58
Kullu	-2.00**	24.92	2.34	111.88	3.00**	99.30
Lahaul & Spiti	-7.91**	73.24	-	111.88	-	84.07
Mandi	-0.77	33.69	3.12**	77.08	3.92*	62.59
Shimla	-1.80*	23.22	3.91*	84.81	5.82*	84.27
Sirmaur	-1.53*	19.95	2.63	77.91	4.23*	67.95
Solan	-4.97*	38.99	-4.55*	49.17	0.44	49.11
Una	-8.98*	66.35	-6.60*	58.25	2.61*	32.15
HP	-2.25*	21.59	0.68	59.85	3.00*	60.92

Note = * 1 % level of significance, ** 5 % level of significance

Table.9 District wise CAGR and CV of fruits (1991-92 to 2017-18) (Per cent)

Districts	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	-0.003	11.37	7.97*	68.02	7.97*	68.31
Chamba	2.13*	22.94	6.47*	73.19	4.25*	64.33
Hamirpur	1.55*	16.00	9.90*	66.18	8.22*	64.99
Kangra	-0.05	7.19	6.70*	56.55	6.76*	60.40
Kinnaur	3.54*	33.04	6.41*	48.45	2.77*	29.55
Kullu	1.69*	21.71	3.38**	49.96	1.66	48.02
LahaulSpiti	8.72*	64.50	7.21*	67.17	-1.39	57.72
Mandi	1.37*	14.01	5.71*	59.41	4.27*	53.88
Shimla	-4.30*	35.96	4.15*	49.86	8.82*	89.25
Sirmaur	5.63*	62.01	8.04*	58.75	2.28	70.53
Solan	-3.37*	33.24	7.19*	54.14	10.92*	69.20
Una	0.90*	8.81	7.69*	64.62	6.72*	57.72
HP	0.93*	12.62	4.49*	45.53	3.53*	44.02

Note = * 1 % level of significance, ** 5 % level of significance

Table.10 District wise CAGR and CV of vegetables (1995-96 to 2017-18) (Per cent)

Districts	Area		Production		Productivity	
	CAGR	CV	CAGR	CV	CAGR	CV
Bilaspur	5.18*	30.12	7.06*	41.84	1.79**	27.87
Chamba	6.46*	39.19	7.66*	49.16	1.13	18.05
Hamirpur	11.68*	60.82	9.52*	140.93	-1.94	150.37
Kangra	7.49*	42.48	9.08*	49.91	1.48*	12.25
Kinnaur	9.64*	50.04	10.55*	56.11	0.83**	13.28
Kullu	5.46**	197.96	5.70*	37.17	0.22	24.08
Lahaul & Spiti	7.28*	40.25	8.43*	45.48	1.07*	12.31
Mandi	6.96*	44.08	9.44*	56.94	2.32*	17.10
Shimla	4.29*	31.46	6.41*	37.58	2.03**	16.60
Sirmaur	5.12*	31.47	5.96*	38.00	0.80*	8.68
Solan	4.77*	29.04	6.75*	42.08	1.89*	18.64
Una	4.43*	30.33	3.73*	26.28	-0.67	13.05
HP	5.59*	34.59	7.16*	42.65	1.49*	11.39

Note = * 1 % level of significance, ** 5 % level of significance

The detail of the annual growth in area, production and productivity of pulses is presented in Table 8. The area under pulses in the state has shown a significant decrease (-2.25%). Among districts, the growth rate is decreasing and significant Hamirpur (15.25%) followed by Kinnaur (-9.98%), Bilaspur (-9.39%) and Una (-8.98%) during the study period. There is a mild fluctuation in the area of the pulses in the state (21.59 %). The growth in pulses production in the state positive but non-significant was 0.68 % with fluctuation of 59.85 %. The growth rate of productivity of the pulses was positive and significant (3.00%). This growth may be due to the increase in the research work of the state and the introduction of the high yielding varieties. Shimla has shown a maximum annual significant increase in the productivity of the pulses i.e. 5.82 % followed by Chamba (4.35 %) and Sirmaur (4.23 %).

Table 9 represents the growth trend in the area, production, and productivity of the total fruits. The area and production of the fruits have shown a positive and significant growth rate of 0.93 % and 4.49 % respectively. This increment in the area of the fruits again symbolises the shift in the production pattern towards the high-

value commodities. The annual growth rate of the production of fruits is positive and significant for all the districts ranging from 3.38 % to 9.90%, maximum being in Hamirpur. The productivity of the fruits has shown positive significant growth rate for almost all the districts except for Lahaul & Spiti (-1.39 %). Table 10 presents the significant and positive growth in the area and production of vegetables in the state and all the districts. The area under the vegetables in the state has registered a positive and significant annual growth rate of 5.59 % during the study period. The increment was highest for the district Hamirpur (11.68 %), Kinnaur (9.64 %) and Lahaul & Spiti (7.28 %). The variation in the area of the vegetables for the state is 34.59 %.The annual growth in the production of the vegetables was 10.55 % in Kinnaur, followed by Hamirpur (9.52 %), Mandi (9.44 %) and Kangra (9.08 %), whereas in the state it has shown a growth rate of 7.16 % per annum. The productivity of the vegetables has also registered a positive growth rate in almost all the districts except for Hamirpur (-1.94 %) and Una (-.067 %) where it declined.

In conclusion the agricultural in Himachal Pradesh has transformed from foodgrains

towards non-foodgrains production as a shift can be seen in the change in cropping pattern over three decades. The analysis showed that this sector has made reasonably good growth over the years as can be witnessed from the increase in cereals production from 12.64 lakh tonnes to 13.67 tonnes from 1991-92 to 2017-18 and pulses production from 0.12 lakh tonnes to 0.41 Lakh tonnes despite the decline in the area under these crops. The yield of all the crops increased in all the districts at varying degrees. Agriculture has diversified from the cereal crops towards high-value commodities; thus, the horticulture sector also registered a significant increase in terms of vegetables including off-season crops (pea, cauliflower, cabbage, etc) and fruits production. Considerably better performance of the agriculture sector in the state became possible because of the flourishing horticultural sector. The crop diversification was most prominent in the districts which have favourable agroclimatic conditions for the cultivation of these crops as the shift can be seen in the gross cropped area under high-value commodities in these districts. Since high-value crops generate better returns and land productivity also increases with the increased diversification, thus this would help to boost the economy of the state.

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Structural shift in the consumption pattern of agricultural commodities in Himachal Pradesh

Jyoti Chaudhary and HP Singh

Abstract

The present study analysed the change in the consumption pattern of agricultural commodities in Himachal Pradesh using the consumption expenditure survey of the National Sample Survey Organization (NSSO) for 43rd, 50th, 61st, and 68th rounds across income groups and for rural and urban sectors. The results showed that the marked difference in the food expenditure pattern of rural and urban households, as they spend around 42 per cent and 36 per cent of their income on food respectively during 2011-12. The share of the foodgrains in total food expenditure has declined from 41% to 27% in rural areas and 29% to 25% in the urban areas during 43rd to 68th round. The cereals dominated the food expenditure followed by milk and milk products. The structural shift in the consumption pattern from the foodgrains to high-value commodities (HVC) like milk and milk products, fruits, vegetables, and non-vegetarian food (egg, fish, meat), etc. across income groups and in rural and urban sectors has been observed. Further, the increased in the diversification index of dietary intake from 0.777 (43rd) to 0.821 (68th) revealed the shift in dietary diversity in the state in both sectors. The boom in the consumption pattern in rural and urban Himachal Pradesh towards HVC was due to increased per capita income, agricultural diversification, urbanization, change in taste and preferences, economic growth, etc. The shift in consumption pattern towards the HVC led to the decline in the consumption of the foodgrains which is a concern for the food security of the state.

Keywords: Structural shift, high-value commodities, diversification, food expenditure

Introduction

Over the past few decades, the Indian economy has made impressive progress. With the growth in the economy, rapid urbanization, rising per capita income, changing lifestyles, availability of variety in the food basket, and change in taste and preferences have shifted the consumption of the food commodities from traditional food towards the high-value commodities like milk, milk products, fruits, vegetables and non-vegetarian food (egg, fish, meat). Several studies revealed the increased diversification and changing consumption pattern towards high-value commodities across India (Kumar and Mathur, 1996; Mittal, 2006; Srivastava *et al.*, 2013; Arun *et al.* 2017) ^[10, 11, 12, 18, 2]. The change in the dietary pattern is mainly due to the shift from traditional cereal based consumption towards high-value crops. This shift has been made both in demand and supply of these commodities.

The share of the agricultural and allied sector has gradually declined from 51.81 percent (1950-51) to 16.5 percent (2019-20) reflecting the development process and structural shift in the economy (Economic Survey, 2019-20). Despite the sluggish growth of the agricultural sectors, its importance in the Indian economy remains important however, it has created a disparity in the income distribution which led to the variations in the consumption pattern of rural and urban households in the country as well as the states.

Among all the hill states and regions of India, Himachal Pradesh is observed to be the most progressive state over the years which has made remarkable achievements in the socio-economic development of its households and transformation of hill economy through the development of agriculture, horticulture including animal husbandry. The net per capita income of the state was is Rs. 1,83,108 during 2018-19, percent higher than the Indian average. Two-third of the population in the state depends mainly on agriculture for their livelihood and employ 62 percent population indicating a massive dependence on this sector. The structural composition of the state economy witnesses significant transformation over the decade. The economy has shifted from agriculture to the industrial and service sector. The change in the cropping pattern of the agricultural commodities from cereal-based subsistence farming to high-value crops (Thakur *et al.*, 2014) ^[19] has resulted in the shift of the consumption pattern of the households of the state. The cultivation of the high-value crops in some of the niches of the state led to an increase in the income of the rural sector in the specific areas which led to the improved standard of living of the people.

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Also, the urban population of the state has increased by 347 percent from 1951 to 2011 which is one of the factors considered for the shift in the dietary pattern of the population in Himachal Pradesh. With this background, the present study is conducted to study the shift in the consumption pattern of this hilly state and disparity among rural and urban sectors and across the different income groups.

Data and Methodology

In this study, the changes in the food consumption were analyzed using secondary data on monthly per capita consumption (MPCE) of different food commodity collected from the consumer expenditure survey reports of the National Sample Survey Organisation (NSSO) relating to 43rd, 50th, 61th and 68th round for Himachal Pradesh. This state is purposively selected to study the changing consumption pattern of the households due to the diversification of agriculture towards high-value crops. The data pertain to the mean per-capita consumption of all food commodities in the sample household. The quantity consumed and expenditure on individual commodities were aggregated into food groups (cereals, pulses, edible oils, milk and milk products (MMP), egg, fish, meat (EFM), vegetables, fruits) and consumption pattern in terms of per capita consumption and budget share were analyzed. The study was carried out for households belonging to the different income groups and rural and urban sectors. The per-capita expenditure (MPCE) was used as the proxy for per-capita income, as the data on the per capita income is rarely available. For the analysis the four income groups were formed for both rural and urban households based on the poverty line adopted by the Planning Commission, Government of India (Kumar, 1998; Kumar *et al.*, 2009; Mittal, 2010) [8, 9, 13]. The households were categorized into the four income groups, very poor with the consumption expenditure of less than 75 percent of the poverty line, poor with consumption expenditure below poverty line up to 75 percent of the poverty line, middle class with consumption expenditure ranging between poverty line up to 150 percent of the poverty line, while the rich with the consumption expenditure of more than 150 percent of the poverty line

Measure of Dietary diversity

The Simpson Index of Diversity (SID) was used to measure the diversity in food consumption of the households. The index took into consideration all food commodities except beverages and processed food. The index was put forward by Edward Simpson in 1949 [17] for the measurement of species diversity (Simpson, 1949) [17]. Further, for use in economic studies, it was modified by Orris C. Herfindahl in 1950 [5]. The studies on dietary diversity were conducted by Katanoda *et al.* 2006; Thiele and Weiss, 2003; Shinoj *et al.* 2015; Joshi *et al.* 2016 [7, 6]. Thus, dietary diversity is computed as:

$$SID = 1 - \sum_{i=1}^n P_i^2$$

Where, SID= Simpson Index of diversity, P_i = proportion of the i^{th} food item in total monthly consumption food items by members of the household.

Results and Discussion

Income group-wise consumption expenditure in Himachal Pradesh

The analysis of the consumption pattern of the food products across income levels in rural and urban sectors in Himachal Pradesh showed that monthly per capita expenditure and food expenditure varied between sectors and across income groups as depicted in Table 1. The average monthly per capita total expenditure (income) was Rs. 1858 for the rural households and Rs. 3135 for urban households. The food expenditure was found inversely related to the income of the households. The very poor spend nearly 62 percent of their income on food as compared to the rich household who spends only 41 percent of their income on food commodities. This trend was prevalent both in rural and urban sectors of Himachal Pradesh during 2011-12. As the rural poor spent 63 percent of their income on food and the urban poor spent 54 percent, and food expenditure declined to 38 percent for rural rich and 35 percent for urban rich households. In food expenditure with improvement in Income, a decline is expected and it is consistent with Engle's Law. Further, the share of food expenditure in rural Himachal Pradesh was comparatively higher which signifies the poverty in the region compared to the urban households.

Table 1: Income group-wise household expenditure in Himachal Pradesh during 2011-12

Income group	MPCE			Food Expenditure			RUD (%)	
	Rural	Urban	HP	Rural	Urban	HP	MPCE	Food Expenditure
V. Poor	632.82	710.06	639.97	395.92 (62.56)	383.15 (53.96)	394.74 (61.68)	12.21	-3.22
Poor	810.77	921.35	814.15	478.15 (58.98)	513.00 (55.68)	479.22 (58.86)	13.64	7.29
Middle	1142.43	1220.71	1145.41	631.15 (55.25)	582.20 (47.69)	629.29 (54.94)	6.85	-7.76
Rich	2542.16	3501.87	2694.07	955.25 (37.58)	1240.55 (35.43)	1000.41 (37.13)	37.75	29.87
All	1858.52	3134.90	1996.67	785.60 (42.27)	1134.11 (36.18)	823.32 (41.23)	68.68	44.36

Note: RUD (%): Rural-urban difference) (Urban-Rural)/Rural*100)

The Figures in parenthesis are the share of food expenditure in total consumption expenditure

Source: Author's calculation from 68th round of NSSO

Table 2: Household Budget *al.* location to food across different expenditure classes and Years (per cent)

Income group	1987-88	1993-94	2004-05	2011-12	% change (1987-88 to 2011-12)
V. Poor	69.24	71.11	65.04	61.68	-10.92
Poor	65.49	70.22	64.25	58.86	-10.12
Middle	60.27	68.20	61.99	54.94	-8.84
Rich	47.75	49.22	44.74	37.13	-22.24
All	59.70	57.13	48.66	41.23	-30.94

Source: Author's calculation from various rounds of NSSO

The share of food in the total monthly expenditure of a household in Himachal Pradesh has declined over the years as presented in Table 2. The share of the food has declined from 60 percent during 1987-88 to 41 percent during 2011-12. Across the income groups with increased income, the expenditure share on food was reduced (Engel's law). During 1987-88 very poor households spent 69 percent of their income and rich household spends only 48 percent of income on food, which declined to 62 percent for very poor and 37 percent for rich households (2011-12). The major decline in

the food expenditure among expenditure groups has been observed for the rich households since improved income had shifted the expenditure pattern from food to non-food commodities. During 1987-88 to 2011-12, the food budget had marked decline by more than 31 percent, points to the increase in the income of the households.

Table 3: Income group and sector-wise share of food commodities in the consumption pattern of Himachal Pradesh in 2011-12 (share in percent)

Income Group	Cereals	Pulses	MMP	Edible oils	EFM	Vegetables	Fruits
Rural							
V. Poor	29.99	9.85	17.94	7.53	0.13	6.50	0.68
Poor	28.29	8.36	20.43	7.52	2.64	7.23	2.02
Middle	22.07	7.98	27.12	6.69	4.47	7.62	2.81
Rich	17.75	7.32	31.42	5.64	4.75	7.61	4.58
Total	19.72	7.59	29.41	6.06	4.48	7.57	3.91
Urban							
V. Poor	34.98	11.64	14.13	7.92	2.93	9.70	1.34
Poor	22.95	9.97	24.07	7.11	2.05	10.10	2.89
Middle	21.75	8.57	29.18	6.74	1.98	9.22	3.15
Rich	17.05	7.14	26.92	5.21	3.88	8.67	6.55
Total	17.50	7.28	26.91	5.33	3.75	8.72	6.29
HP							
V. Poor	30.44	10.01	17.60	7.57	0.38	6.79	0.74
Poor	28.11	8.41	20.55	7.50	2.62	7.32	2.05
Middle	22.06	8.00	27.19	6.69	4.38	7.67	2.82
Rich	17.61	7.28	30.54	5.55	4.58	7.82	4.96
Total	19.39	7.54	29.04	5.95	4.37	7.75	4.26

Source: Author's calculation from 68th round of NSSO

Note: MMP- Milk and milk products, EFM- Egg, Fish, Meat Income is a vital factor that influences the consumption behaviour of households. With the improved income, the household expenditure on food commodities has decreased but it has diversified the food basket and this led to variation in the food basket of the low income and high-income households. Table 3 revealed lower-income rural households

spend around 40 percent on foodgrains and rich rural households only about 25 percent. The expenditure on milk, milk products, edible oils, non-vegetarian food (egg, fish, meat), vegetables, and fruits was increased across the income groups, which shows the shift in the consumption pattern from foodgrains to high-value commodities across the income groups. In urban sectors, the very poor households spent 47 percent on foodgrains and rich households comparatively less i.e., around 25 percent on foodgrains. The share of expenditure on the livestock products (milk, egg, fish, meat, etc.) was higher in the rural areas compared to the urban areas of the state as more than two-thirds of the population of the state resides in the rural areas and the availability of the livestock products is more in the rural areas. With the growth in the state economy, improved per capita income, urbanization, and variety in food commodities the variation exists in the consumption pattern of households across the expenditure classes. Table 3 further showed mixed trends of the share of the food groups in the total food commodities. The expenditure share on cereals and pulses was declined with the rise in income for both the rural and urban sectors. The high-value commodities like MMP, EFM, vegetables, and fruits the expenditure shares had increased with the increase in income. This shift in the expenditure share from essential food like cereal, pulses, edible oils towards HVC with an increased income validated Bennett's law of consumption (the consumption switches towards a more expensive diet with a rise in income) (Srivastava *et al.* 2013) [18]. Further in Himachal Pradesh, the food expenditure share on MMP was higher for high-income households in urban areas, and for EFM, vegetables, and fruits it was higher for the rural households. This is because state agriculture has diversified towards high-value commodities and the major portion of the state population resides in rural areas and had access to these food commodities easily.

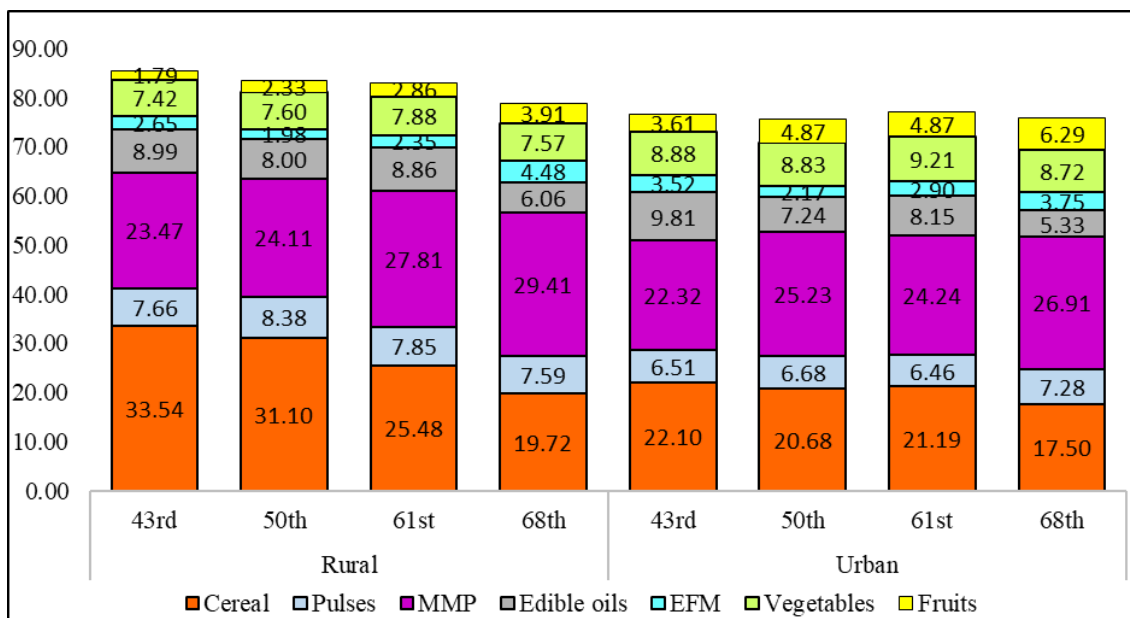


Fig 1: Share of food expenditure on different food commodities in Himachal Pradesh.

Fig 1 in the state although the cereals continue to constitute the major part of households' food basket a notable decline in the proportion of its expenditure was witnessed in the past few decades, the decline was more in the rural areas compared to the urban areas i.e., from 33.54 percent to 19.72 percent from 1987-88 to 2011-12 in rural areas and 22.10 percent to 17.50 percent in urban areas. This might be due to

the availability of cereals at lower prices through PDS. Further, the share of expenditure on pulses showed a mixed trend in both sectors, i.e., declined in the rural sector (7.66% to 7.59%) and increased in the urban sector (6.51% to 7.28%). The composition of food basket has changed as the share of food grains declined and that of MMP, EFM, vegetables, and fruits have increased (Arun *et al.*, 2017) [2]. The increase in the

share of expenditure on MMP in total food expenditure is more in the rural area (23.47% to 29.41%) and comparatively lesser in urban areas (22.32% to 26.91%). In percent composition, only a marginal increase was found in vegetables from 43rd to 61st round in both rural and urban sectors which decline by a small percent during the 68th round. But the share of fruits in total food expenditure was increased by many folds. These products (HVC) provide nutritional security as they are rich in protein, vitamins, minerals, and other required micronutrients. Although the share of expenditure on cereals has declined their importance has been the same in the food remain basket the same. Trends in the quantity of food commodities consumption Table 4 and Fig 2 to Fig 10 presents the trends in the per capita consumption of food commodities and revealed that over more than two decades, there was a marginal increase in the monthly per capita consumption of rice from 4.07 kg to 4.48 kg for rural households and from 4.15 kg to 4.19 kg in urban households. Fig 2 depicts the increase in per capita rice consumption across income groups. The per capita consumption of wheat in rural areas has declined from 7.10 kg to 6.66 kg and 7.57

kg to 6.25 kg in urban areas. The per capita consumption of wheat was increased with an increase in income from low to high income during the study period (Fig 3). There has been a significant decline in per capita consumption of cereals, i.e., 15.54 kg in 1987-88 to 12.02 kg in 2011-12 in rural areas and 12.31 kg to 10.91 kg in urban areas (Fig 4). The reduction in the relative quantity of cereal consumption might be because of the change in the taste and preference of households from food to non-food items (Radhakrishna and Murthy, 1999, Radhakrishna 2005) [15]. The monthly per capita consumption of the pulses declined from 1.39 kg (1987-88) to 1.17 Kg (1993-94) and later increased to 1.20 Kg (2004-05) to 1.28 Kg (2011-12) in rural areas of the state. Similar trends were observed in the urban sector as the consumption declined from 1.60 Kg (1987-88) to 1.34 Kg (2004-05) but increased to 1.54 Kg (2011-12) but not more than 1987-88. Thus, the decline in the consumption of the foodgrains was more in the rural Himachal Pradesh compared to the urban due to the improvement of the rural infrastructure which made other food commodities available to the rural households.

Table 4: Over the year's changes in the consumption of food commodities (kg/capita/month)

Year	Rural								
	Rice	Wheat	Cereal	Pulses	MMP	Edible oils	EFM	Vegetables	Fruits
1987-88	4.07	7.1	15.84	1.39	7.59	0.47	0.14	3.55	0.5
1993-94	3.64	6.27	13.37	1.17	7.8	0.45	0.11	3.57	0.5
2004-05	4.09	6.09	12.06	1.2	9.06	0.6	0.11	3.77	0.66
2011-12	4.48	6.66	12.02	1.28	9.88	0.72	0.22	3.67	0.61
%Change	10.07	-6.20	-24.12	-7.91	30.17	53.19	57.14	3.38	22.00
Urban									
1987-88	4.15	7.57	12.31	1.6	8.51	0.66	0.3	5.33	1.13
1993-94	3.77	6.85	11.01	1.34	9.41	0.6	0.19	5.21	1.24
2004-05	4.12	6.43	10.84	1.34	8.65	0.78	0.22	5.44	1.11
2011-12	4.19	6.25	10.91	1.54	9.45	0.82	0.31	5.17	1.19
%Change	0.96	-17.44	-11.37	-3.75	11.05	24.24	3.33	-3.00	5.31
Combine									
1987-88	4.07	7.13	15.61	1.4	7.65	0.48	0.15	3.67	0.54
1993-94	3.65	6.32	13.17	1.18	7.94	0.47	0.11	3.71	0.56
2004-05	4.09	6.12	11.94	1.21	9.02	0.62	0.12	3.92	0.7
2011-12	4.45	6.62	11.91	1.31	9.83	0.73	0.23	3.83	0.67
%Change	9.34	-7.15	-23.70	-6.43	28.50	52.08	53.33	4.36	24.07

Source: Author's calculation from various rounds of NSSO

The consumption of the milk and its products was increased considerably from 7.59 Kg per capita per month (pcpm) to 9.88 Kg pcpm from 1987-88 to 2011-12 in the rural area and from 8.51 Kg pcpm to 9.45 Kg pcpm in the urban area of the state. The increase in the consumption of these products was more in rural areas compared to the urban, because in rural areas of Himachal Pradesh almost every household possess cow/buffalo thus milk supply is sufficient. The consumption of non-vegetarian food (egg, fish, meat) has shown a rise in the per capita consumption from 0.14 Kg to 0.22 Kg during the study period in rural Himachal Pradesh. While the consumption of EFM in the urban area increased marginally by around 2 percent over the years. The per capita consumption of vegetables was more in the urban areas over the years compared to the rural areas, but a significant increase in the consumption was seen only in the rural areas i.e., from 3.55 Kg to 3.67 Kg. Fruits consumption was also high in the urban areas compared to the rural and the consumption has increased considerably from 0.50 Kg pcpm in 1987-88 to 0.61 Kg pcpm in 2011-12 in rural areas and it increased 6 percent by from 1.13 Kg pcpm to 1.19 Kg pcpm in 1987-88 to 2011-12 in urban areas. The decreased consumption of foodgrains and increased consumption of agricultural commodities was changing consumption pattern

both in rural and urban areas because of the rising incomes of households and increased preferences towards more nutritious foods. The difference in the consumption pattern of food commodities in rural and urban areas can be explained by the income and price effect. The more consumption of the cereal and less consumption of other food in rural areas was due to lower food prices in these areas. Hence, urban diets were relatively more diverse than rural due to higher non-farm incomes (Chopra 2015) [3].

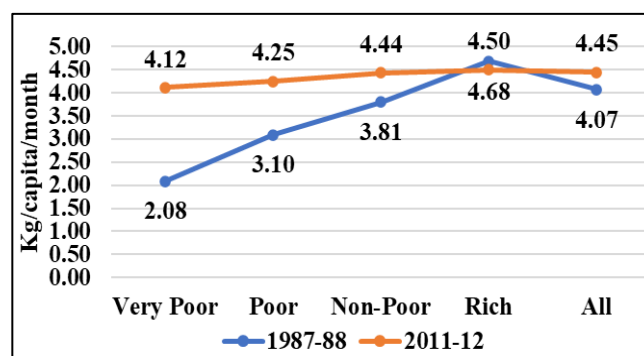


Fig 2: Income group-wise monthly per capita consumption of rice (1987-88 to 2011-12)

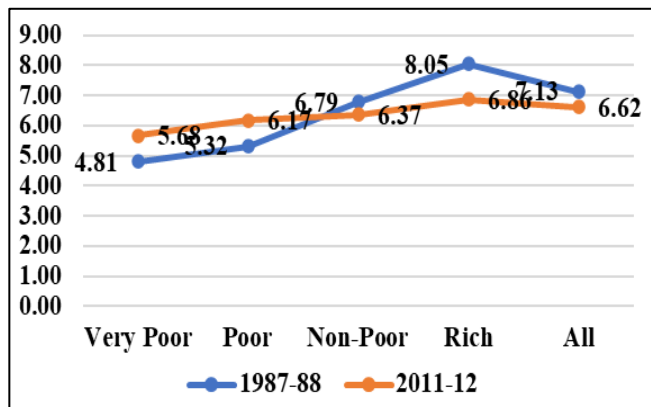


Fig 3: Income group-wise monthly per capita consumption of wheat (1987-88 to 2011-12)

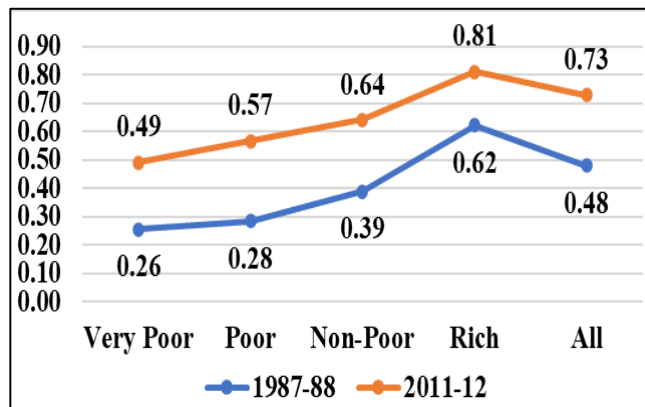


Fig 7: Income group-wise monthly per capita consumption of edible oils (1987-88 to 2011-12)

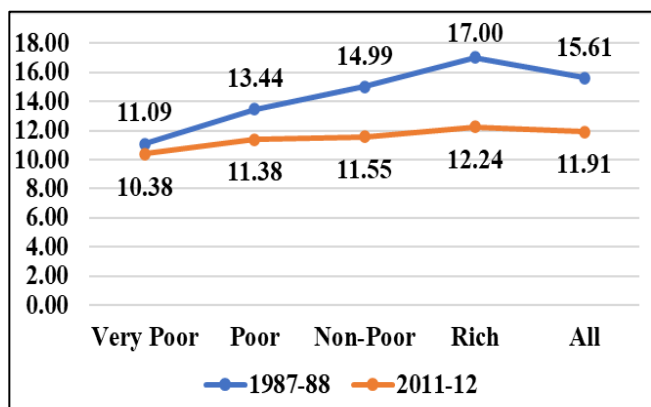


Fig 4: Income group-wise monthly per capita consumption of cereals (1987-88 to 2011-12)

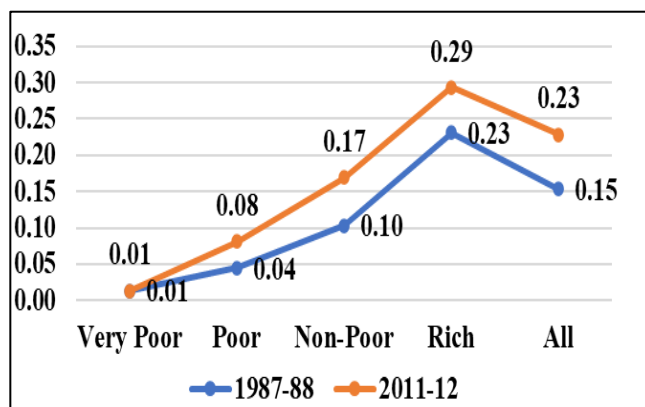


Fig 8: Income group-wise monthly per capita consumption of egg, fish & meat (1987-88 to 2011-12)

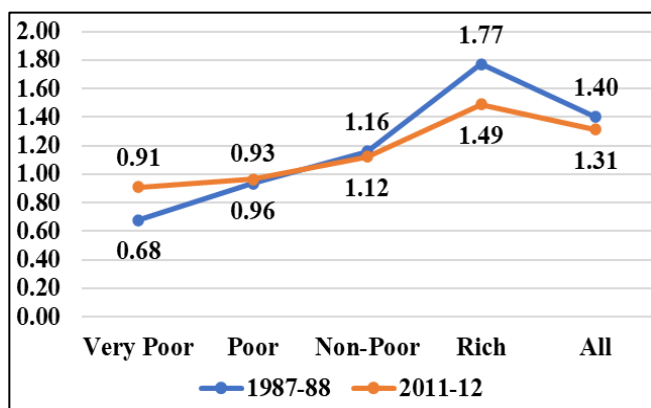


Fig 5: Income group-wise monthly per capita consumption of pulses (1987-88 to 2011-12)

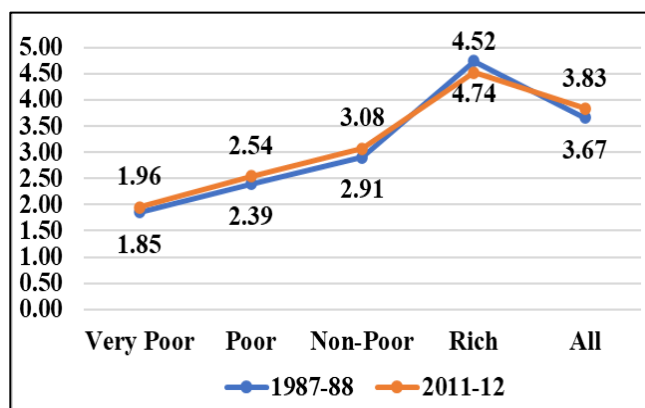


Fig 9: Income group-wise monthly per capita consumption of vegetables (1987-88 to 2011-12)

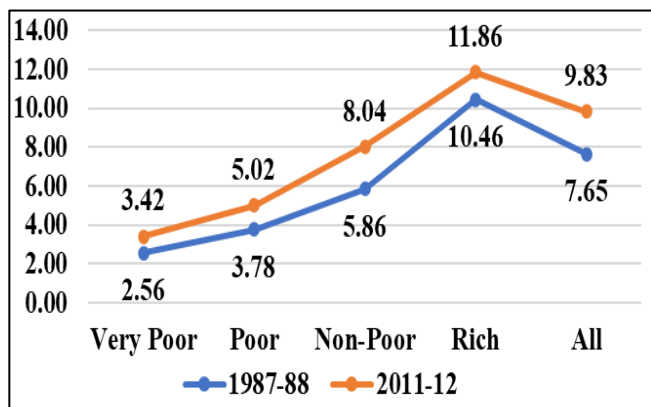


Fig 6: Income group-wise monthly per capita consumption of milk and milk products (1987-88 to 2011-12)

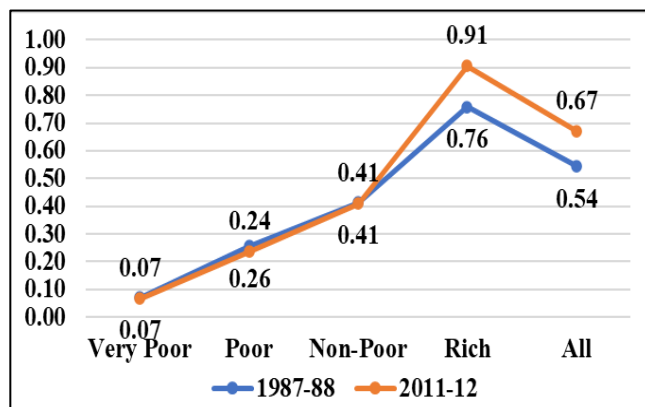


Fig 10: Income group-wise monthly per capita consumption of fruits (1987-88 to 2011-12)

Measure of Dietary Diversity

The food preferences of the households have diversified over time towards high-value commodities like fruits, vegetables, non-vegetarian food (egg, fish, meat), etc. Table 5 shows the diversity estimates (SID) for the years 1987-88, 1993-94, 2004-05, and 2011-12 along with the percent change during the period. The food diversity index of consumption has increased from 0.780 to 0.822 for the rural sector from 1987-88 to 2011-12 and similar was observed for the urban sector as the index has shown an increase of 9.33 percent from 1987-88 to 2011-12 from SID 0.752 to 0.818. Across the income

groups, the diversity in food consumption increased with the rise in the income of households except for 2011-12, where SID for very poor households was slightly higher than rich households. The level of diversity varied with time, as the SID estimates for 2011-12 was higher than 1987-88 for all the income groups. This shows that the basket of food commodities has widened with time due to changing consumption habits, availability of new food commodities, urbanization, diversification of the agriculture, increased non-farm income, etc in the state.

Table 5: Dietary diversity index across income classes and sector in Himachal Pradesh, 1987-2011

Income group	Rural				
	1987-88	1993-94	2004-05	2011-12	% change from 1987-88 & 2011-12
V. Poor	0.705	0.717	0.771	0.817	15.5
Poor	0.759	0.775	0.805	0.850	11.8
Middle	0.776	0.790	0.803	0.831	6.41
Rich	0.789	0.784	0.793	0.814	2.53
All	0.780	0.780	0.796	0.822	5.13
Urban					
V. Poor	0.735	0.770	0.872	0.843	13.5
Poor	0.753	0.788	0.808	0.857	14.67
Middle	0.646	0.811	0.833	0.846	30.77
Rich	0.800	0.740	0.824	0.815	1.25
All	0.752	0.755	0.825	0.818	9.33
HP					
V. Poor	0.706	0.717	0.777	0.819	15.49
Poor	0.758	0.776	0.805	0.850	11.84
Middle	0.765	0.792	0.805	0.832	7.79
Rich	0.790	0.775	0.798	0.814	2.53
All	0.777	0.777	0.800	0.821	5.13

Source: Author's calculation from various rounds of NSSO

Conclusion

The paper has examined the trends and pattern of food consumption in rural and urban Himachal Pradesh across different income groups using NSSO data. The analysis showed that the monthly per capita expenditure (income) of the urban households was higher than the rural households. Over the years the expenditure on food commodities has declined both in rural and urban households, which confirms the Engel's law. The rural households spent more of their income in the food commodities compared to the urban households. Further, a shift has been observed in the budget share of household income over the years from food to non-food commodities. Within the food basket, the share of expenditure has reduced for foodgrains and shifted towards the high-value commodities viz, milk, milk products, egg, fish, meat, vegetables, and fruits. The cereals dominated the expenditure share on food commodities followed by milk and milk products during 43rd, 50th and 61st round and reverse was observed during 68th round. Also, the per capita consumption of foodgrains has declined over the years and across income groups revealing less consumption of foodgrains by the poor households compared to high-income households. This reduction in the consumption of the foodgrains needs due consideration by the policymakers from the food and nutritional security point of view.

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Conferences Participated	8

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DECLARATION

I hereby declare that the above mentioned information is correct up to my knowledge and I bear the responsibility for the correctness of the above-mentioned particulars.

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