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Scope and opportunities of agricultural diversification for increasing farmer's income in Bihar

A Roy, N Ahmad, T Kumari, KM Singh, DK Sinha and K Kumar

Abstract

Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. Bihar is blessed with natural resources, especially water and fertile soil which provide a diversified cropping system. The contribution of agriculture and allied sectors in State's Gross State Value Added (GSVA) is around 20%. Among the sub-sectors, the share of the crop cultivation in GSVA is 9.3% followed by livestock 6.6% in 2020-21. This paper has assessed the diversification scenario of agriculture and horticulture crops in Bihar. The study period was from 2000-01 to 2019-20 and it had divided into 2 periods: 2000-01 to 2009-10 and 2010-11 to 2019-20 to have an understanding of decadal performance. Simpson's Index of Diversification (SID) was used for the estimation of crop diversification in Bihar. On the basis of primary data and secondary data collected from various secondary sources, indicated that the horticulture sector is more diversified as compared to agriculture sector because, share of the rice and wheat to the total area of the agriculture sector estimated to be more than 70% which makes that the rice and wheat farming as a specialized one. The total area under crops during 2000-01 was 7701.09 thousand hectares and SID worked out to be 0.34. During 2019-20 the area under crops was 7296.81 thousand hectares and SID for the same period was estimated to be 0.33. It was clear from the analysis that no significant change has been observed in the diversification index between the two periods in spite of the substantial decrease in area. The highest SID was found during the year 2010-11 and the index value was 0.40. Among the horticultural crops, marginal and small farmers allocate the area in the range of 60-75% for the vegetable crops and 5-7% for fruit crops to the total area under horticulture crops. Through primary survey, the potential crops identified for diversification on the basis of increasing farmer's income were mango, guava, pineapple, litchi, banana, citrus, ginger, turmeric, brinjal, cabbage, cauliflower and capsicum. High value crops may be given priority in the diversification to reap the benefit of the emerging marketing scenario due to globalization and liberalization.

Keywords: Diversification, Simpson's index of diversification, high value crops and farmer's income

Introduction

Bihar is blessed with natural resources, especially water and fertile soil which provide a diversified cropping system. It shares its borders with Nepal in north, Jharkhand in south, West Bengal in east and Uttar Pradesh in west. Based on rainfall, soil, temperature and terrain this State is divided into three agro-climatic zones which are North-West alluvial plain, North-East alluvial plain and South Bihar alluvial plain. The Ganga river dissects the State into two parts i.e. Northern Bihar gets its water from the Himalayan river and it is prone to flood, Southern Bihar is prone to drought as it depends on central Indian rivers' for its water source. The Gangetic plains are rich in fertile alluvial soil, which is spread across three agro climatic zones.

The contribution of agriculture and allied sectors in State's Gross State Value Added (GSVA) is around 20%. Among the sub-sectors, the share of the crop cultivation in GSVA is 9.3% followed by livestock 6.6% during the year 2020-21. The crop sector contribute 48.7% in agricultural Gross State Domestic Product (GSDP) in 2020-21 which shows highest share among all sub-sectors. The livestock has contributed 34.7% in State Agricultural GSDP during 2020-21. In Bihar, more than 90% of farmers comes under small and marginal category. The State's population density is 1106 people per square kilometre as compared to only 382 at national level. It seems like State's agriculture is under significant population pressure.

Bihar's total geographical area is 9.4 million hectares. The forest area contributes 6.6% of total land area. The area under unculturable and barren land is 4.6%, culturable waste land is 0.5%, area under tree crops is 2.7%, and area under permanent pastures is 0.2%. The gross cropped area is 72.97 lakh hectares with net sown area of 50.77 lakh hectares in 2019-20 which reflect

a cropping intensity of 144%. Land is a fixed resource but population is increasing continuously which is causing pressure on per capita land availability for agricultural and non-agricultural purposes. The maximum net sown area is in Buxar district. The cropping intensity which is ratio of gross cropped area to net sown area is highest in Sheohar district (191). The Kaimur district contributes maximum area under forest cover (1.13 lakh hectares).

With this background, a study has been conducted to see the diversification pattern in Bihar with the following objectives:

1. To explore and assess the emerging patterns of agricultural diversification in the State
2. To explore the possibility that how small holders can harness the opportunities through high value agriculture in the State

Data and Methodology

The study was primarily based on secondary data collected from various sources of publication from State Government, National Horticultural Board (NHB) and DAC, Government of India. To provide the comparisons in various agricultural indicators, secondary data on area of different crops and economic, social and climatic variables were collected. To supplement the secondary data, primary data were also collected from different parts of Bihar. Tabular analysis was used to examine the agricultural performance and cropping category. Simpson's Index of Diversification (SID) was used for the estimation of diversification among the different districts as per the following formula;

- 1) Simpson's Index of Diversification, $SID = 1 -$

$$\sum_{i=1}^n (A_i/GCA)^2$$

Where,

A_i = Area under i^{th} crop

GCA = Gross cropped area

Crops included in estimation of SID are cereals, pulses, oilseeds, sugarcane, potato and others. Simpson' index of diversification varies from 0 (perfect specialization) to 1 (perfect diversification).

Result and Discussion

The favourable agro-climatic conditions and rich biodiversity have made a diversified cropping pattern in Bihar. The main agricultural crops (rice, wheat, maize, sugarcane and oilseeds) are grown in all the three agricultural seasons which are kharif, rabi and zaid. Cereal crops accounted for more than 85% of total cropped area, where as pulses accounts for 6.6% and sugarcane 3.3%. Food grains which includes cereals and pulses accounts for about 95% of the gross cropped area in Bihar in 2020-21. The question lies between food security and diversification since the farmers meet their cash demand by growing vegetable and horticultural crops. There was a need to examine separately the diversification pattern being observed in horticultural sector. In addition to this the Government of India had launch the horticulture mission program during 2001-02 to increase the productivity and income of the farmers. Keeping all the factors together the diversification pattern in horticultural crops in Bihar has worked out and result was presented in the Table 1.

Table 1: Diversification of agricultural crops in Bihar from 2000-01 to 2019-20

| Year | Cereals | Pulses | Food-grains | Sugar | Spices & Condiments | Fruits | Vegetables | SID |
|-----------|---------|--------|-------------|--------|---------------------|--------|------------|-------|
| 2000-2001 | 6224.00 | 616.61 | 6840.61 | 93.53 | 13.46 | 116.49 | 280.61 | 0.338 |
| 2001-02 | 6244.00 | 694.00 | 6938.00 | 113.44 | 10.97 | 272.30 | 298.78 | 0.38 |
| 2002-03 | 6372.00 | 697.00 | 7069.00 | 107.27 | 11.18 | 116.71 | 315.03 | 0.35 |
| 2003-04 | 6317.00 | 681.00 | 6998.00 | 103.60 | 10.94 | 91.84 | 305.92 | 0.35 |
| 2004-05 | 5879.00 | 649.00 | 6528.00 | 104.48 | 11.14 | 108.42 | 304.94 | 0.36 |
| 2005-06 | 5996.00 | 593.00 | 6589.00 | 101.25 | 12.71 | 276.44 | 314.55 | 0.37 |
| 2006-07 | 6224.00 | 610.00 | 6834.00 | 117.49 | 11.99 | 279.41 | 315.03 | 0.37 |
| 2007-08 | 6310.00 | 611.00 | 6921.00 | 107.04 | 11.30 | 286.24 | 304.24 | 0.36 |
| 2008-09 | 6255.00 | 575.00 | 6830.00 | 110.78 | 9.93 | 291.50 | 317.12 | 0.36 |
| 2009-10 | 5910.00 | 552.00 | 6462.00 | 72.92 | 9.17 | 293.58 | 333.46 | 0.37 |
| 2010-11 | 5633.00 | 538.00 | 6171.00 | 250.67 | 9.63 | 296.42 | 260.90 | 0.40 |
| 2011-12 | 6175.50 | 524.00 | 6699.50 | 218.29 | 8.73 | 299.24 | 344.51 | 0.39 |
| 2012-13 | 6227.70 | 515.77 | 6743.47 | 250.34 | 10.27 | 301.50 | 350.99 | 0.38 |
| 2013-14 | 6055.84 | 499.95 | 6555.78 | 258.07 | 10.06 | 302.07 | 369.00 | 0.39 |
| 2014-15 | 6151.42 | 494.16 | 6645.58 | 254.34 | 9.65 | 304.00 | 363.67 | 0.38 |
| 2015-16 | 6073.07 | 498.30 | 6571.37 | 244.02 | 8.90 | 101.18 | 360.36 | 0.35 |
| 2016-17 | 6191.54 | 493.14 | 6684.68 | 239.57 | 9.95 | 92.75 | 349.49 | 0.34 |
| 2017-18 | 6110.47 | 476.01 | 6586.47 | 233.77 | 8.32 | 84.06 | 357.95 | 0.33 |
| 2018-19 | 6016.14 | 479.37 | 6495.52 | 225.57 | 10.07 | 80.59 | 357.95 | 0.33 |
| 2019-20 | 5936.75 | 457.40 | 6394.15 | 223.89 | 9.37 | 81.07 | 362.50 | 0.33 |

The study period was from 2000-01 to 2019-20 and it had divided into 2 periods: 2000-01 to 2009-10 and 2010-11 to 2019-20 to have an understanding of decadal performance. Simpson's Index of Diversification (SID) was used for the estimation of crop diversification in Bihar. On the basis of primary data and secondary data collected from various secondary sources, indicated that the horticulture sector is more diversified as compared to agriculture sector because, share of the rice and wheat to the total area of the agriculture sector estimated to be more than 70% which makes that the

rice and wheat farming as a specialized one. The total area under crops during 2000-01 was 7701.09 thousand hectares and SID worked out to be 0.34. During 2019-20 the area under crops was 7296.81 thousand hectares and SID for the same period was estimated to be 0.33. It was clear from the analysis that no significant change has been observed in the diversification index between the two periods in spite of the substantial decrease in area. The highest SID was found during the year 2010-11 and the index value was 0.40.

Table 2: Area under Non-Food crops in Bihar (Year-wise)

| Year | Oilseeds | Total fibre | Total Drugs, Narcotics and Plantation Crops | Total Non Food Crop |
|---------|----------|-------------|---|---------------------|
| 2000-01 | 154.00 | 169.92 | 15.61 | 356.40 |
| 2001-02 | 139.00 | 160.60 | 16.01 | 355.10 |
| 2002-03 | 137.00 | 178.42 | 15.20 | 353.48 |
| 2003-04 | 141.00 | 178.31 | 14.58 | 362.12 |
| 2004-05 | 137.00 | 161.04 | 17.76 | 339.09 |
| 2005-06 | 138.00 | 148.89 | 16.17 | 324.41 |
| 2006-07 | 142.00 | 153.92 | 15.30 | 334.13 |
| 2007-08 | 142.00 | 157.92 | 15.00 | 339.88 |
| 2008-09 | 130.00 | 141.28 | 9.97 | 313.02 |
| 2009-10 | 135.00 | 145.68 | 9.07 | 329.89 |
| 2010-11 | 130.00 | 153.07 | 9.43 | 327.86 |
| 2011-12 | 133.40 | 151.54 | 10.42 | 364.35 |
| 2012-13 | 133.37 | 142.26 | 11.00 | 324.85 |
| 2013-14 | 130.18 | 123.05 | 12.69 | 302.79 |
| 2014-15 | 116.03 | 114.51 | 10.65 | 282.88 |
| 2015-16 | 119.45 | 111.90 | 9.14 | 283.27 |
| 2016-17 | 115.93 | 109.08 | 10.14 | 267.07 |
| 2017-18 | 106.41 | 105.63 | 10.93 | 263.07 |
| 2018-19 | 105.04 | 86.74 | 10.84 | 236.69 |
| 2019-20 | 115.88 | 63.76 | 10.27 | 225.84 |

Source: Directorate of Economics and Statistics, GoB

During the year 2000-01, the highest area under non-food crops was under fibre crops followed by oilseeds but recent trend is reverse. During the year 2019-20, it was observed that highest area was under oilseeds followed fibre crops. But it is a matter of concern because both the area of oilseeds and fibre crops is declining day by day.

Table 3: Land utilization pattern in Bihar during 2019-20

| Sl. No. | Land use | Area in '000 hectares |
|---------|------------------------------|-----------------------|
| 1 | Geographical area | 9359.57 |
| 2 | Area under Forest | 621.64 |
| 3 | Barren and Unculturable land | 431.72 |
| 4 | Culturable waste | 43.84 |
| 5 | Permanent pastures | 14.98 |
| 6 | Land under Tree Crops | 249.69 |
| 7 | Fallow land | 1186.46 |
| 8 | Total Unculturable Land | 4282.44 |
| 9 | Net Sown Area | 5077.13 |
| 10 | Gross Sown Area | 7296.81 |
| 11 | Cropping Intensity (%) | 144.00 |

Source: Directorate of Economics and Statistics, GoB

The total food grain production was 17.95 lakh tonnes in 2020-21. Production of cereals was 17.57 lakh tonnes and productivity was 2961 kg per hectare in 2020-21. Increase in production was noticed in rice and maize. This production growth in rice and maize was due to increasing productivity. The productivity of rice and maize were 2447 kg per hectare and 5229 kg per hectare respectively in 2020-21. The major pulses grown in Bihar is moong, urad and ghagra. The overall productivity of kharif pulses was 896 kg per hectare in 2020-21. Bihar's agriculture is heavily depending on rainfall and delay in monsoon gives negative impact on crop yield.

Rice is staple food crop of Bihar. It is cultivated in kharif season. The leading district in terms of production of rice is Rohtas (9.5 lakh tonnes) but productivity of rice is maximum in West Champaran (4620 kg per hectare). The leading district in wheat productivity was Begusarai (3641 kg per hectare) in 2020-21 and its production was maximum in Rohtas district (6.88 lakh tonnes). The productivity of summer or rabi maize is high in Bihar. The production of

maize is highest in Katihar (6.86 lakh tonnes) and its productivity is highest recorded in Araria (9419 kg per hectare). The role of maintaining soil fertility and nutritional content of pulses made it one of the most important crop of Bihar. Patna was the top contributor in terms of production of pulses with its share of 0.60 lakh tonnes in 2020-21 and Jehanabad recorded highest productivity with 1452 kg per hectare.

Bihar's agriculture is enhanced with horticulture sector which includes fruits, vegetable and flower cultivation. The state government is encouraging farmers for cultivation of horticulture products. The total fruit production of Bihar was 50.02 lakh tonnes grown in area of 3.74 lakh hectares in 2020-21. In 2020-21 the production of major fruits was banana (19.80 lakh tonnes), mango (15.50 lakh tonnes), guava (4.34 lakh tonnes), litchi (3.08 lakh tonnes), pineapple (1.14 lakh tonnes), papaya (0.95 lakh tonnes), watermelon (0.49 lakh tonnes), muskmelon (0.22 lakh tonnes) and gooseberry (0.16 lakh tonnes). Nalanda district contributes maximum production of guava with 1.71 lakh tonnes in 2020-21. Muzaffarpur, Darbhanga and East Champaran together contribute approx 25% of total mango production in Bihar. Muzaffarpur was the leading producer of litchi with 1.48 lakh tonnes, produced 48% of total litchi production in 2020-21. To meet the demand for good quality fruits in local, national and international markets, there is a need to produce high quality fruit with low cost of production.

Table 4: Area and Production of major Fruits in Bihar in 2020-21

| Name of Fruit crop | Area (in '000 hectares) | Production (in '000 tonnes) |
|--------------------|-------------------------|-----------------------------|
| Mango | 160.24 | 1549.97 |
| Guava | 29.80 | 434.41 |
| Litchi | 36.67 | 308.06 |
| Banana | 42.96 | 1979.59 |
| Papaya | 3.21 | 95.02 |

During the year 2020-21, among the fruit crops highest area was occupied by mango followed by banana and litchi but in terms of production banana occupies the first position followed by mango and guava. In some pockets pineapple is

grown as a commercial crop. Gangetic alluvial soil is ideal for cultivation of vegetables. The major vegetables cultivated in the State are, tomato, potato, onion, brinjal, cabbage cauliflower. The total area under vegetable cultivation was 9.15 lakh hectare in 2020-21. Total vegetable production was 179.05 lakh tonnes in which tomato contributed to 11.62 lakh tonnes, potato contributed 91.26 lakh tonnes, onion 13.28 lakh tonnes, brinjal 12.04 lakh tonnes and cauliflower contributed 10.31 lakh tonnes.

Samastipur, Nalanda and Patna are the leading districts in production of potato. They together accounts 28.9% (26.33 lakh tonnes). The leading districts in production of onion are Nalanda (2.45 lakh tonnes), West Champaran (0.7 lakh tonnes) and Patna (0.8 lakh tonnes). For cauliflower cultivation major districts are Vaishali (0.95 lakh tonnes), Katihar (0.67 lakh tonnes) and Nalanda (0.64 lakh tonnes) in 2020-21.

Table 5: Area and Production of Vegetables in Bihar during 2020-21

| Name of Vegetables | Area (000 hectares) | Production (000 tonnes) |
|--------------------|---------------------|-------------------------|
| Potato | 330.79 | 9125.84 |
| Onion | 58.34 | 1328.30 |
| Tomato | 62.70 | 1161.79 |
| Cauliflower | 68.73 | 1031.47 |
| Cabbage | 41.41 | 721.92 |
| Brinjal | 57.86 | 1203.77 |

Commercial production of flowers like rose, marigold jasmine has benefited the farmers. Total production of flowers was 11.14 thousand tonnes which was cultivated in 1.21 thousand hectares during 2020-21.

Economics of the potential crops identified for diversification in Bihar.

In order to find out the economic feasibility of crops the primary data was collected from two districts of Bihar i.e. Muzaffarpur and Samastipur and pooled analysis was done. 80 farmers were contacted to collect primary data. The result is presented in the Table 6. On the basis of the primary data

collected from the farmers the following crops have been identified as potential crops on the basis of that profitability, extent of marketable surplus, marketing facility, external seasonal demand and quality parameter of the products. Mango, guava, litchi, banana, pineapple, tomato, capsicum, cauliflower, cabbage, brinjal, ginger and turmeric were identified as potential crops since this diversification in the large scale there is a need for strengthening for both backward and forward linkages to meet the challenges arising due to the liberalization of the economy. Further detail study has to be undertaken in marketing aspects.

Table 6: Economics of various crops cultivated in farmer's field in Bihar

| Crops | Yield in range (Qt/ha) | Cost (Rs/ha) | Gross income (Rs/ha) | Selling Price (Rs/Qt) |
|-------------|------------------------|---------------|----------------------|-----------------------|
| Paddy | 40-45 | 50000-60000 | 60000-68000 | 1500 |
| Maize | 70-90 | 70000-90000 | 126000-162000 | 1800 |
| Cabbage | 200-225 | 76000-95000 | 180000-200000 | 900-1000 |
| Cauliflower | 180-200 | 80000-100000 | 200000-250000 | 1000-1200 |
| Tomato | 150-180 | 75000-95000 | 150000-180000 | 1000-1100 |
| Potato | 160-200 | 60000-75000 | 128000-160000 | 800-900 |
| Guava | 80-100 | 35000-40000 | 70000-80000 | 1800-2000 |
| Pineapple | 150-200 | 130000-150000 | 200000-250000 | 1500-2000 |
| Litchi | 70-80 | 40000-50000 | 80000-100000 | 8000-10000 |
| Ginger | 180-200 | 75000-95000 | 200000-225000 | 2750-3350 |
| Turmeric | 220-240 | 75000-95000 | 150000-200000 | 1350-1600 |
| Capsicum | 110-125 | 95000-115000 | 200000-225000 | 1800-2000 |
| Chilli | 90-100 | 60000-80000 | 120000-140000 | 1650-2000 |
| Brinjal | 190-200 | 60000-70000 | 120000-140000 | 1050-1200 |

Source: Authors compilation, 2020-21

Paddy: It was observed that paddy is major crops grown in Lowland. The yield was observed to be range from 40 to 45 quintals/ha. The range of Gross income for paddy cultivation under different system was observed to be ranged between Rs 60000 to 68000. If we see the range of input-output ratio lowland paddy gives higher output which range from 1.09 to 1.47.

Maize: The maize is the second most important cereal crops of Bihar. Its yield ranges from 70 to 90 quintals/ha and cost of cultivation ranges from Rs 70000 to 90000 per ha which gives in return gross income of range between Rs 126000 to 162000 per ha. Its input-output ratio was observed to be range from 2.57 to 2.73. The selling price of maize in Bihar was ranges

from Rs. 1700 to 1800 per quintal.

Cabbage: Cabbage is one of the major vegetable which is grown in almost whole part of Bihar. The cost of cultivation was observed to be Rs 76000-95000 per hectare while in return it yield 200-225 quintals/ha and provide gross income between Rs. 200000 to Rs. 250000 per ha. The selling price in market was found to be Rs. 8 to 10 per Kg.

Cauliflower: As a major vegetable, cauliflower is grown in all parts of the State. The yield ranges from 180-200 q/ha. The cost of cultivation was worked out to be between Rs 80000-100000 per ha which returned gross amount range from Rs 200000-250000 per ha. The retail price for cauliflower in

Bihar ranges from Rs 10 to Rs.12 per kg.

Tomato: The tomato is one of the most important vegetable crops of Bihar. Its yield ranges from 150-180 quintals/ha and cost of cultivation ranges from Rs 75000 to 95000 per hectare which gives in return gross income of range between Rs 150000-180000 per hectare with net income range from Rs 75000-85000 per ha. The average selling price ranges from Rs 10 to 12 per kg.

Potato: Potato is most important vegetable and major tuber crops grown in Bihar. It is grown in almost all the part of State and gives yield between 160-200 quintals/ha. Amount of Rs. 60000-75000 per hectare is required to cultivate the potato and in return it gives gross income of Rs 128000-160000 per ha. It is highly profitable crop with net income range between Rs 68000-85000 per hectare.

Guava: It is one of the most important fruit crops grown in Bihar and its yield ranges from 80-100 quintals per hectare. Its cost of cultivation varies from Rs 35000-40000 per hectare. Gross income of Rs 70000-80000 per hectare was recorded from guava cultivation. Guava cultivation is very profitable in Bihar.

Pineapple: Earlier pineapple was grown abundantly in Northeast India, Kerala, Karnataka and West Bengal but due to good market price and available production technologies, pineapple is now grown abundantly in Bihar also. The yield ranges from 150 to 200 quintals/ha which cost Rs 130000 to 150000 per hectare. The gross income for the crop was worked out to be Rs 200000 to 250000 per hectare with net income of Rs 70000 to 100000 per ha.

Litchi: Bihar produces almost 40 percent of all litchis grown in the country. The yield ranges from 50 to 60 quintals/ha which accounts cost Rs 40000 to 50000 per hectare. The gross income for the crop was worked out to be Rs 80000 to 100000 per hectare with net income of Rs 40000 to 50000 per hectare.

Ginger: Ginger is one of the important spice crop grown in Bihar as a major source of family income for farmers and grown in all parts of the State. The yield of ginger ranges from 180 to 200 quintals per hectare. The cost of cultivation was worked out to be between Rs 75000 to 95000 per hectare which returned amount range from Rs 200000 to 225000 per ha. Ginger is highly profitable crops which give net income from Rs 125000 to 130000 per hectares. The retail price for ginger in Bihar ranges from Rs. 2750 to Rs. 3350 per quintal.

Turmeric: Bihar has never been known for turmeric cultivation but during last one decade or so farmers in Bihar are cultivating turmeric. The cost of cultivation was observed to be Rs 75000 to 95000 per ha while in return its yield ranges from 220 to 240 quintals per hectare ha and provide gross income between Rs 150000 to 200000 per ha. The selling price in market was found to be Rs 1350 to 1600 per quintal.

Chilli: It was observed chilli yield range from 90-100 q/ha. Its cost of cultivation was worked out to be between Rs 60000-80000/ha. The range of Gross income for chilli cultivation was observed to be range between Rs 150000-200000 per ha, while the range of net income in Rs/ha was

worked out to be Rs 90000-120000 per ha.

Brinjal: The brinjal is one of the most important vegetable crops of Bihar. Its yield ranges from 190-200 quintals per hectare and cost of cultivation ranges from Rs 60000 to 80000 per ha which gives in return gross income of range between Rs 120000-150000 per ha with net income range from Rs 60000-70000 per ha.

Capsicum: capsicum is another important spice crops grown in Bihar. The yield ranges from 110-125 q/ha which cost Rs 95000-115000 per ha. The gross income for the crop was worked out to be Rs 200000-250000 per ha with net income of Rs 105000-135000 per ha. Its average selling price varies from Rs. 18 to Rs. 20 per Kg.

On the basis of Primary data and secondary data collected from various State indicated that the horticulture sector is more diversified to compare agriculture sector because, share of the rice and wheat to the total area of the agriculture sector estimated to be more than 80% which makes that the rice and wheat farming as a specialized one. Among the horticultural crops marginal and small farmers allocate the area in the range of 60-75% for the vegetable crops and 5-7% for fruit crops to the total area under horticulture crops. In Bihar, per capita consumption of cereals is higher than all-India average and therefore there is a need to increase the consumption of fruit and vegetables to make balanced diet for food consumption. Small and marginal farmers grow vegetables as cash crops to meet their day to day demand for the food and other obligations resulting the magnitude of the diversification is very high in small and marginal farmers but the total value of the crops are very low. Marketable surplus in pineapple was to be in range of 60-72%, banana 63-75%, litchi 70-75%, mango 75-80%, jack fruit 85-92%, guava 60-70%. Among the spice crops marketing surplus for ginger was estimate to be in range 67-72%, turmeric 73-80% and chillies 53-70%. In vegetables crops surplus for tomato was estimated to be in range of 93.8 to 97.5%, capsicum 96.47 to 98.17%, potato 55-65%, cauliflower and cabbage was estimated in range of 86.7% to 92.5% and bean in range of 83.7 to 90% and radish from 75 to 96.75%. The bulk of marketable surplus comes from (75-80%) from marginal and small farmers, with small surplus ranges from kilogram to quintals. The potential crops identified, as per the cost of production was litchi, banana, pineapple, guava, ginger, turmeric, tomato, potato, capsicum, brinjal and chillies. More than four channels are engaged in disposal of marketing of produce. The selection of the channel is depending upon the nature of crop, internal and external demand, transportation and marketing cost.

Conclusion

In Bihar, agricultural infrastructure and agricultural performance vary across the State. The internal and external demands are key deterrents of the selection of the crop as well as area high value crops. Improved technology for the production and processing is essential to enhance the farmer's income as well as reduced the post harvest loses (15-25%) in the State. High value crops may be given priority while making policy for this State to reap the benefit of the emerging marketing scenario due to globalization and liberalization. Crop diversification was found to be a coping mechanism by the farmers of Bihar. Agricultural diversification in Bihar is slowly picking up momentum in

favour of high-value crops primarily to augment income rather than the traditional concept of risk management. The nature of diversification differs across the State due to existence of wide heterogeneity in agro-climatic and socio-economic environments. There is a need to convergence the programmes of different line departments and accordingly the govt. agencies may redefine the role in agriculture development to make the State food secure as well as nutritionally secure.

References

1. Birthal PS, Joshi PK, Devesh Roy. Diversification in Indian Agriculture towards High-Value Crops: The Role of Smallholders. IFPRI Discussion Paper 00727, International Food Policy Research Institute, Washington, D.C, U.S.A; c2007.
2. Birthal PS, Roy D, Negi DS. Assessing the impact of crop diversification on farm poverty in India. *World Development*. 2015;72:70-92.
3. Birthal PS, Joshi PK, Gulati A. Vertical coordination in high-value food commodities: Implications for smallholders. In *Agricultural Diversification and Smallholders in South Asia*, Eds: P.K. Joshi, Ashok Gulati and Ralph Cummings (Jr). Academic Foundation, New Delhi; c2007.
4. Bradshaw B, Dolan H, Smit B. Farm-level adaptation to climatic variability and change: Crop diversification in the Canadian prairies. *Climatic Change*. 2004;67(1):119-141.
5. Bravo Ureta BE, Solis D, Cocchi H, Quiroga RE. The impact of soil conservation and output diversification on farm income in Central American hill side farming. *Agricultural Economics*. 2006;35(3):267-276.
6. Brown RL. The robustness of 2SLS estimation of a non-normally distributed confirmatory factor analysis model. *Multivariate Behavioral Research*. 1990;25(4):455-466.
7. Cochrane N, Schmitz A, Bojnec S. Agriculture: diversification and productivity: In: *Privatization of Agriculture in New Market Economies: Lessons from Bulgaria*. Springer, Netherlands; c1994. p. 23-53.
8. Deshpande RS, Pradeep Mehta, Khalil Shah. Crop Diversification and Agricultural Labour in India, *Indian Journal of Labour Economics*, October- December, 2007, 50(4).
9. Government of India. (Various years). *Farm Harvest Prices of Principal Crops in India*. Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi
10. Government of India. (Various years). *Statistical Abstract India*. Central Statistical Organisation, Ministry of Statistics & Programme Implementation, New Delhi www.mospi.gov.in