THE EXTENT OF CROP DIVERSIFICATION IN BIHAR

MENKA SINGH,

Assistant Professor, Department of Economics,

Motilal Nehru College, University of Delhi

ABSTRACT

Crop diversification has been identified as one of the ways to improve farm income and develop rural economy. Bihar is one of the poorest states in India and is basically an agrarian economy. The papers tries to find the nature and extent of diversification of crop. During the period of study, there is very low diversification and food grain still occupies a major proportion of cultivable area. However, there is a slight increase in the area under sugarcane. We also see a trend of moving towards horticulture in the state.

INTRODUCTION

Agriculture is still the most important source of livelihood in India. The country has made considerable progress in the sector over the last 40 years. The green revolution of the 1960s created a sea change in the agricultural sector. The use of high yielding varieties of seeds, better irrigation facilities, and subsidized fertilizers increased the food production manifold, especially of wheat and rice. India is now self-sufficient in food grain production. It no longer needs to import food grains. The green revolution had increased the income of the farmers all across the country especially that in Punjab and Haryana. However, we are now in a situation where output of food grain has reached a plateau and there is a need to think of other avenues to increase the productivity as well as the farm income. Government policies should be re-defined. Up till now the MSP (Minimum Support Price) has made farmers to use their land mainly for rice and wheat cultivation. This has created its own set of problems in Punjab and Haryana. It has led to ground water depletion, and soil degradation and other environmental issues. Need of the hour is to encourage farmers to diversify from growing rice and wheat to other coarse grains and maize and other crops which will help in restoring the fertility of the soil back and requires less water.

Globalization and liberalization has opened the India agriculture to new challenges. In the globalized world, the farmers have to compete with foreign produce as well as with reduced government support and at the same time provide food security to its rising population. India has a lot to achieve in farming sector. A majority of farmers still depends on rainfall, which is highly unpredictable. They are not able to compete with better and high yield quality produce of the advanced nations due to which the farmers are not able to take advantages of the opportunities created by liberalization. The economic reforms were expected to improve the terms of trade in favour of agriculture and promote its growth. But a study by Bhalla and G Singh, shows that there has been a deceleration in crop yields as well as totalagricultural output in most states during the post reform period (1990-93 to 2003-06).A more serious matter is that agricultural workers constitutes 58% of the total work forces and deceleration in agriculture means their productivity and

income levels will fall, putting them under lot of distress. There is therefore, a desperate need to improve the productivity of the sector as well as find new avenues to increase the income of the farmers. Growth in the agriculture sector can be achieved through increase in area under cultivation and increase in production. But since expansion of area under cultivation is limited as demand for land for non-agricultural purposes increases with economic progress and urbanization. Therefore, the focus should be more in raising productivity. Improvement in productivity can be achieved through high yielding varieties of seeds, better irrigation facilities, modernization of farms and reducing cost by minimizing losses due to post harvest loss, better marketing facilities, cropping intensity, also through diversificationtowards high valued crops.

Diversification towards more high valued crops will help in facing the emerging challenges of the agricultural sector. It will help in increasing farm income, provide employment and thereby remove rural poverty (Pingali and Rosegrant, 2012). New varieties of crops/cash crops will help farmers to produce for the international market and thereby improve their well-being. Diversification will also mitigate risk as the prices of all crops in the market will not fall at the same time and save the farmers from uncertainties.

LITERATURE REVIEW

Most of the Southeast Asian countries are diversifying their agriculture in favour of high valued crops of fruits, vegetables, fishery, livestock etc. due to food security issues. But the sub-continent still giving emphasis on food grain production even though they have achieved self-sufficiency in the production of rice and wheat. However a "Silent Revolution is already taking place in production of high valued crops" (Joshi et al (2004) .Key determinant of such high valued crops is market and roads. Such crops are demand driven. With the increase in purchasing power of majority of population and improved living standards, the demand for high valued nutritional and quality food crop such as dairy, sugar, oilseeds, fruits and vegetables etc., increases. This calls for greater crop diversification. Some of the high value food commodities are perishable, and require to be consumed immediately. Transportation to markets and storage or processing into less perishable forms becomeimperative. India lacks miserably in it. Markets for high value commodities are mainly in urban and semi-urban areas, and transport facilities are inadequate especially for small producers in remote rural areas. "Lack of access to markets, transport facilities and post-harvest infrastructure inflate the transaction costs of marketing, discouraging producers to diversify towards high value agriculture".'(Bidyut Kumar Ghosh, 2011). Access to market is, therefore, one of the most important determinates of crop diversification. Chand (1995) identified access to motor able road, market and irrigation facilities as determinants of diversification to high paying crops like off-season vegetables. Verma (2005) identified the technological changes especially in irrigation, increase in use of inputs and institutional arrangements as forces behind diversification. Relative prices of Agricultural commodities also play an important role in changing the cropping pattern (Narain, 1965, Nayyar and Sen, 1994, Vyas, 1996). Farmers producecrops which are remunerative and improves their income. However, this has worked against crop diversification in states of Punjab and Haryana where the land is put to wheat rice rotational cultivation, mainly due to high assured MSP for their production. There is very less crop diversification in the region which has serious repercussion like, soil degradation, ecological problems, over use of natural resources like ground water depletion and income risk. It is seen that less diversity has increased output variability in the

state (Joginder Singh, and R. S. Sidhu, 2004).Thus farm diversity reduces fluctuations and uncertaintyof farm income(Bhalla and Singh, 1997). Agricultural diversification helps in providing food security and improve human nutrition. It also helps in restoring soil fertility and reduces pest incidence.Several studies found that the level of diversification is inversely related to the size of the farm at a micro level (Singh et al.1985; Gupta and Tiwari, 1985).However Chand (1995) found the role of farm size on the level of diversification to be very weak. According to him, vegetable cultivation is highly labour intensive and is beneficial for marginal and small farmers as they can use their large size of family labour for cultivation. 'Indian agriculture is predominantly a small peasant based economy with approximately 80% of the operational holdings being below two hectares, and 34% of the agricultural land are cultivated by them' (GOI, 1997). Because of small operational holdings, it is very difficult for small farmers to improve their earnings simply by raising the yields of the existing crops. Attention on high value crops with available modern farm inputs may provide a stable economic base of the poor peasants (De and Chattopadhyay, 2010) According to FAO, small farmers use less synthetic fertilizers and chemical pesticides and preserve the biodiversity as they use more sustainable techniques and is good for high value nutritional crops.

OBJECTIVE AND METHODLOGY

In this paper we examine the cropping pattern of Bihar over the period of 2001-02 to 2010-11. Cropping pattern will show the proportion of area under different crops at a point of time. A change in cropping pattern thus implies a change in the proportion of area under different crops. This will help in accessing the nature and trend of agricultural diversification in Bihar from 2001-02 to 2010-11 and find emerging crops in the state.

There are lot of studies done to measure the extent of crop diversification in India both at the state levels as well as district and farm levels. To measure the extent of crop diversification in agriculture different diversification indices are used by authors. Some most commonly used are Herfindhale Index, Entropy Index, Composite Entropy Index, Simpson Diversity Index, Bhatia's index. Bhatia, (1965) in his "Patterns of Crop Concentration and Diversification in India" used a new technique for measuring crop diversification in India where he has taken the sum of the total area of all crops which have 10 per cent or more than 10 per cent of the cropped area and divided it by the number of crops. According to his method, higher the index, lower is the magnitude of crop diversification and vice-versa. Acharya, et.al. (2011) analyzed the economics of crop diversification in Karnataka on the bases of secondary data for a period of 26 years from 1982-83 to 2007-08. The nature and extent of crop diversification in the state of Karnataka has been analyzed by them using Composite Entropy Index (CEI) and Multiple Linear Regression Model. The results emphasized that the creation of basic facilities of infra-structure such as proper roads, transportation, market, fertilizer availability and sustained supply of irrigation water to affect the nature and extent of crop diversification. Dimensions and determinants of diversification on Kangra farms studied by Mahajan (2003) revealed that large farms had more diversified cropping structure than small farms of both irrigated as well as un-irrigated areas. In the overall farms situation, un-irrigated farms were found to be more diversified in terms of number of crops. Jha et.al (2009) regressed alternate measures of diversification on several possible factors such as income, road density, institutional credit, urbanization, market penetration, irrigation intensity.

In this paper, we will use Simpson's Index (SI) of diversification is used

$$SI = 1 - \sum \left(\frac{p_i}{\sum p_i}\right)^2$$

Where p_i is the area proportion of the *i*th crop in the total cropped area and $i = 1,2,3, \ldots\ldots, n$ number of crops?Lower value implies low level of diversification and high value, higher diversification.

The study is based on the secondary data taken from different sources like Statistical Abstracts of Bihar, Economic Survey of Bihar and various issues of Agricultural Statistics at a Glance , Directorate of Economics and Statistics(Department of Agriculture, Cooperation and Farmers Welfare , Ministry of Agriculture and Farmers Welfare, Government of India)., different Statistical Year books, indiastat.com.

Bihar is one of the poorest states of India However in recent years there has been a continuous increase Gross State Domestic Product(GSDP) since 2004-05. It was 77.8 thousand crores in 2004-05, which increased to 163.4 thousand crores in 2011-12 at 2004-05 prices. The percentage growth rate of Gross State Domestic Product (at constant 2004-05 prices) in 2005-06 was 0.17 over the previous year. However, with the change in political scenario percentage growth in 2010-11 over the previous year was 12.3%, which was above the national level of 6.48 %(CSO). Even the Per Capita Gross State Domestic Product shows an upward trend. The annual growth rate of per capita income at constant prices 2004-05 prices, increased from 6.8% in 2007-08 to 11.3% in 2008-09 to 8% in 2009-2010, which was also above the all India national average

Bihar is pre-dominantly an agricultural economy. It is one of the least urbanized states of the country with more than 90% of the people living in rural area, where still many depend on agriculture for livelihood. Considering the pressure on land and agriculture not being able to generate enough employment opportunities, employment in non-farm sector becomes important on one hand, and increasing farm income on the other. Due to low farm income and few non-farm employment opportunities, many migrate to other states. Thus finding ways to increase income on farm is one of the keys to improve prosperity and growth of the state. Agriculture is the second most important contributor to the State Domestic Product, which was 39% in 2000-01, came down to 26.5% in 2007-08. (CSO). The share of agriculture and allied sector is declining and therefore, more attention is needed to increase the productivity of the sector.

Agriculture is both a potential as well as a constraint to growth in the state. The potential is its huge alluvial soil basin and large reserves of underground water which can be tapped and harnessed for producing crops including high value crops. Diversifying its cropping pattern from producing low value cereals to high valued crops like fruits and vegetables will help farmers of Bihar to become more prosperous. Constraints is we still use traditional methods of farming .57% of the gross cultivable land is irrigated, but since most of the irrigation in state largely depends on the use of surface water, the farmers have to depend on rainfall. The production of agricultural commodities gets affected or determined by the vagaries of monsoon. Further, most of the farmers are small and marginal farmers, who are very poor and follow subsistence farming

and generally averse to diversification. Small size of holding will not help farmers in improving their earning if they follow mono cultivation. Crop diversification will help in improving their living standards.

Performance of the crops during 2001-02 to 2010-11

Table 1 given below shows the area, production and yield of major crops of Bihar from 2001-02 to 2010-1. It also gives a year to year percentage change in all three. The compound annual growth rates, the average annual growth rates and the coefficient of variation are also calculated for the said periods. There are huge fluctuations in year to year production of all the crops. This is captured by a year to year percentage change in production of the crops. The variability in area, production and yields is shown through coefficient of variation. Food grain production shows maximum volatility. Output was 11682.1 thousand tonnes in 2001-02 reduced to 9221.9 thousand tonnes in2010-11. This volatility in output can be explained by dependence of agriculture on uncertain weather. Bihar is the most flood –prone area in the country with 73.06% of its geographical area experiences flood year after year which damages not only crops but also destroys thousands of human lives and livestock and assets. Among the crops taken, food grain shows a negative compound annual growth rate of -2.6%. Rest of the crops have a positive compound annual growth rate, with maximum for sugarcane, 10.4%. Within food grain, the fall is maximum in rice output (CAGR is -5.5 for rice). There is a slight fall in wheat production as well. A large part of the fall is production is explained by fall in the area under food grain (CAGR is -1.3), especially under rice (CAGR -2.4). The yield of rice has fallen too, bringing down the overall yield of food grain.

The area under sugarcane has increased and so has the production. The CAGR in area (9.1%) is highest for sugarcane for the given period. However, Bihar's yield of sugarcane is much lower as compared to national average of 70 tonnes /hectare. The Government of Bihar should revamp its old sick sugar mills and encourage sugarcane agro based industries which will help in creating demand for sugarcane in the state and there by improve the earnings from the farm. After cotton it is Jute which most important fibre in India. Bihar and West Bengal have favourable climate to grow good quality jute fibre. There is a slight fall in the area under jute but due to a huge increase in the productivity with a compound annual growth rate of 2.9%, production increased at 1.9% per annum. Variability in yield is noticeable, with CV of 14%. Even for oilseeds, there has been a fall in the area under it but an increase in the productivity, pushes up the output. The output increased from 120 thousand tonnes in2001-02 to136.3 thousand tonnes in 2010-11.

Bihar is one of the major producers of vegetables and fruits where it is ranked 3rd and 6th among the states respectively. The productivity growth rate is high at 2.3%. There are several advantages of growing horticulture crops. They are highly remunerative, have huge demand both domestic and abroad for its rich nutritional values, produces higher biomass have the potential to improve wastelands, provide employment opportunities and have a lot of scope to earn foreign exchange through export the products. Bihar is famous for its litchis and mangoes which have a large international market. 'Makhana' fruit is one of its kind and is produced only in Bihar. It has abundant nutritional values and can capture the world market. Guava and custard apple and

leguminous vegetables can be used a filler crops. Among vegetables, potatoes and tomatoes have shown improvement. Bihar is the third largest producer of cauliflower. 100 percent grant is provided from the central government under National Horticulture Mission. The area under horticulture has shown a consistent increase since 2007-08 on a year to year bases.Food grain still occupies an important position in Bihar's agriculture despite it's the fall in all three; area, production and productivity. Around 80% of the total land is still devoted to food grain production. Food grain production alone will not help in raising the income of farmers as productivity is falling. All India yield was 1798kg /hectare in 2009-10. In Bihar it was only 1424kg/hectare, whereas in Punjab and Haryana it was 4148kg/hectare and3383kg/hectare respectively. Average yields of rice and wheat, the two most widely cultivated crops are 20-25% less than the India's average, and less than half of Punjab's. Unlike the farmers of Punjab and Haryana, the farmers of Bihar are not able to take advantage of MSP offered by the government. The Primary Agriculture Cooperative Societies or PACs created by the state to procure food grains from farmers at MSP did not work well as these PACs are fraught with their own sets of problems, like procurement limited for a certain time period, paying lower prices than market, food grain not procured at the right time, etc. Thus possibility of getting higher returns on food crop is very limited and there is a need to diversify and focus more on production of cash crops and horticulture. The diversification measured by Simpson index ranges from 0.30 to 0.35 for the given period, which shows a very low level of diversification. Diversification is considered to bring an overall progress of rural economy

As identified above, for crop diversification, it is important to have a well-developed market access and infrastructural facilities like storage, rural-urban roads connectivity, irrigation facilities, and easy access to credit etc., in which Bihar lacks considerably. Bihar has lowest per capita income in the country and also has a high rate of poverty. The number of marginal and small farmers are 82.9% and 9.6% respectively with operational holdings of 40.8% and 19% respectively. The average size of the holding is as less as 0.75 hectare. Since these farmers are poor they find it difficult to buy high cost inputs and avail facilities of credit. The marketing facilities for agricultural product is highly inefficient, forcing most of the poor farmers to sell their products to village level intermediaries. The agricultural produce markets are not properly maintained and they lack infrastructural facilities. APMC was repealed in 2006 to encourage modernization of existing markets under public private partnership. Even for fruits and vegetables, which are perishable commodities, there is a lack of proper cold storage and refrigerated transport facilities. The bulk of the product is therefore, sold at rural haats. Bihar has only 0.12 percent of country's godowns. It has a deficit of 15 lakh Mt of storage capacity. Road connectivity is important for a smooth functioning of the markets. Nearly half of the villages lack all weather road connectivity. Bihar has only 51/100square kms of road as compared to 75kms for the entire country. Power supply is scarce due to which the state government has to do rationing of the power.

TABLE 1

Area(000hectares)	Bihar							AREA: year to year percentage change							
Year	Foodgrains	Horticulture	Oilseed	Sugarcane	Jute and mesta	Rice	Wheat	Year	Foodgrains	Horticulture	Oilseed	Sugarcane	Jute and mesta	Rice	Wheat
2001	7117.3		154.7	93.5	167.2	3656.3	2067.8	2001							
2002	7020.5		143	113.4	158	3552.3	2126.3	2002	-1%		-8%	18%	-6%	-3%	3%
2003	7069.9		137.4	107.3	167.8	3584.7	2130.9	2003	1%		-4%	-6%	6%	1%	0%
2004	7005.2	1222.1	140.6	103.6	174.6	3578	2076.8	2004	-1%		2%	-4%	4%	0%	-3%
2005	6463.2	1192.6	131.8	104.2	150	3122.6	2027.6	2005	-8%	-2%	-7%	1%	-16%	-15%	-2%
2006	6548.4	1107.3	139	101.3	147.5	3252.4	2003.7	2006	1%	-8%	5%	-3%	-2%	4%	-1%
2007	6702.4	1115.1	142.9	129.6	141.2	3357.1	2049.7	2007	2%	1%	3%	22%	-4%	3%	2%
2008	7028.6	1121.4	140.8	108.6	154.2	3572.6	2162.5	2008	5%	1%	-1%	-19%	8%	6%	5%
2009	6919.7	1129.1	138.1	111.9	150.9	3496	2158.3	2009	-2%	1%	-2%	3%	-2%	-2%	0%
2010	6634.1	1141.1	138.8	115.9	139.7	3213.7	2193.3	2010	-4%	1%	1%	3%	-8%	-9%	2%
2011	6235.8	1154.6	130	248	145	2832.5	2103.5	2011	-6%	1%	-7%	53%	4%	-13%	-4%
2013	**6420.16**	**1106.41**	**131.92**	**165.03**	**136.88**	**3031.63**	**2145.13**	**A**	-1%	-1%	-2%	7%	-2%	-3%	0%
								AAGR	-1%	-1%	-2%	7%	-2%	-3%	0%
								CAGR	-1.3	-0.34	-1.5	9.1	-0.94	-2.4	-0.11
								CV	**4.3**	**3.5**	**3.12**	**35.5**	**7.3**	**7.5**	**3.01**
Production in (000	Tonnes)							**Production : year by year percentage change**							
Year	Foodgrains	Horticulture	Oilseed	Sugarcane	Jute and mesta*	Rice	Wheat	Year	Foodgrains	Horticulture	Oilseed	Sugarcane	Jute and mesta	Rice	Wheat
2001	12056.3		131.1	3987.6	1380	5442.6	4438	2001							
2002	11682.1		120.2	5211.2	1101.7	5202.9	4391.1	2002	-3%		-9%	23%	-25%	-5%	-1%
2003	11084.7	Million tonnes	104.9	4520.5	1093.8	5085.5	4040.6	2003	-5%		-15%	-15%	-1%	-2%	-9%
2004	11212.6	16822.2	123.8	4285.9	1286.3	5447.8	3688.9	2004	1%		15%	-5%	15%	7%	-10%
2005	7704.4	16189	116.9	4111.7	1180.2	2472.2	3263.4	2005	-46%	-4%	-6%	-4%	-9%	-120%	-13%
2006	8586.8	16608	136.5	4337.9	1386.6	3495.5	3239	2006	10%	3%	14%	5%	15%	29%	-1%
2007	11098.6	17053.9	147.4	5955.5	1389.8	4989.3	3911.4	2007	23%	3%	7%	27%	0%	30%	17%
2008	10864.1	17334.8	137.9	3854.9	1464.9	4418.1	4450.4	2008	-2%	2%	-7%	-54%	5%	-13%	12%
2009	12220.7	17123.2	138	4959.9	1220.1	5590.3	4410	2009	11%	-1%	0%	22%	-20%	21%	-1%
2010	10150.6	17386.4	144.6	5032.6	1277.7	3599.3	4570.8	2010	-20%	2%	5%	1%	5%	-55%	4%
2011	9221.9	18556.7	136.3	12763.6	1310.4	3102.1	4097.6	2011	-10%	6%	-6%	61%	2%	-16%	-12%
2012	14047.2	19618.01	139.5	11288.6	1738.8	7162.6	4725	2012	34%	5%	2%	-13%	25%	57%	13%
								AAGR	-1%	2%	0%	4%	1%	-6%	0%
*bales of 180kg								**CAGR**	-2.6	1.9	1.4	10.4	1.9	-5.5	-0.76
								CV	**13.9**	**6.05**	**10.4**	**47.7**	**9.7**	**25.2**	**12.02**
Yield (kg/hectare)								**Yield: year to year percentage change**							
Year	Foodgrains	Horticultur	Oilseed	Sugarcane	Juteans mesta	Rice	Wheat	Year	Foodgrains	Horticultur	Oilseed	Sugarcane	Juteans mesta	Rice	Wheat
2001	1694		847	42648	1486	1489	2146	2001							
2002	1664		839	45953	1255	1465	2065	2002	-2%		-1%	7%	-18%	-2%	-4%
2003	1568	Mil/hectare	763	42130	1173	1419	1896	2003	-6%		-10%	-9%	-7%	-3%	-9%
2004	1601	13.76	881	41370	1326	1523	1776	2004	2%		13%	-2%	12%	7%	-7%
2005	1192	13.57	887	39460	1416	792	1609	2005	-34%	-1%	1%	-5%	6%	-92%	-10%
2006	1111	15	982	42822	1692	1075	1617	2006	-7%	10%	10%	8%	16%	26%	0%
2007	1148	15.29	1031	45953	1772	1486	1908	2007	3%	2%	5%	7%	5%	28%	15%
2008	1238	15.46	979	35496	1710	1237	2058	2008	7%	1%	-5%	-29%	-4%	-20%	7%
2009	1041	15.17	999	44324	1455	1599	2043	2009	-19%	-2%	2%	20%	-18%	23%	-1%
2010	1008	15.24	1042	43422	1646	1120	2084	2010	-3%	0%	4%	-2%	12%	-43%	2%
2011	1424	16.07	1048	51566	1627	1095	1945	2011	29%	5%	1%	16%	-1%	-2%	-7%
2012	1384	16.5	1046	51714	2099	2155	2206	2012	-3%	3%	0%	0%	22%	49%	12%
								AAGR	-3%	2%	2%	1%	2%	-3%	0%
								CAGR	-1.7	2.3	2.5	1.2	2.9	-3.2	-0.66
								CV	**18.8**	**6.3**	**10.3**	**9.9**	**14**	**20.1**	**9.4**

AAGR- average annual growth rate

CGAR: Compound annual growth rate

CV: coefficient of variation

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation

These acts as an impediment to diversification and most farmers continue to follow the same old pattern of farming. They don't have an incentive to diversify to other crops. Here the role of the government becomes important. First of all it has to pay attention to improve the rural marketing

and infrastructure and connect the rural poor farmers with the urban markets. Huge investment is required in the state for the development of markets and infrastructure. Both public and private investment is required. Forward and backward linkages with the industry will help in creating a system of agricultural value chain. For this contract farming should be encouraged. Proper packaging and brand development will help the horticulture export. There is also a need to diversify the rural economy to other productive activities like dairy farming, poultry, fishery, livestock etc. All these will help in improving the standard of living of the rural people.

Table 2

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Simpson index	0.34	0.33	0.31	0.31	0.30	0.32	0.35	0.34

Calculated

CONCLUSION

The study shows that food grain still occupies a dominant position as far as area under cultivation is concerned.But Bihar is slowing diversifying its agricultural production in favour of horticulture and sugarcane. Agriculture is still dependent on traditional cropping pattern and therefore, lot of fluctuations in output is observed. A policy support from the government to increase investment in rural infrastructure, construction of link roads between rural and urban area, provide better marketing facilities to the farmers to sell their products, storage facilities, better irrigation facilities and supply of power, will help the farmers to improve their living standards. It will also help in reversing the declining trend in food grain productivity and help small and marginal farmers in increasing their income.

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