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Horizontal Diversification Comprising Differential Agri-horticultural and Livestock Production in Hilly and Terai Region of West Bengal

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Abstract

The present study was undertaken to assess the extent of horizontal diversification comprising different growth rate of agri-horticultural crops along with livestock and fish production in the hilly and terai region of West Bengal for the period of 2003–2015. The study was measured based on cumulative annual exponential growth rate (CAEGR) including Simpsons Diversity Index (SID). The study revealed that the area under food grains in the both the region has declined and the area under finer cereals has also increased but the increase in SID values signifying shift towards non-food grain crops like fruits, flowers, vegetables, etc. along was clearly observed. The highest level of extent in increase of SID values was found in flowers (8.96) in hilly and (4.20) in terai region. In hilly region, there has been an extent of decrease in SID values in terms of different livestock and fish production. While, in terai region, it is observed that there has been an extent of increase in SID value in terms of different livestock and fish production. In contrast, growth rate of area under the production of different agri-horticultural crops and livestock and fish production was found positive in hilly region. On the other hand, in terai region, it is revealed that the growth rate of area under the major horticultural based crops likes vegetables and fish production was found negative. Growth rate of area under agricultural crops and livestock production was found positive.

Keywords: Horizontal diversification, agriculture, horticulture, livestock, growth rate

1. Introduction

A sustained economic growth, rising per capita income and growing urbanization are causing a shift in the consumption patterns in favor of high-value food commodities like fruits, vegetables, dairy, poultry, meat and fish products from staple food such as rice, wheat and coarse cereals. Such a shift in consumption patterns in favor of high-value food commodities depicts an on-going process of agricultural diversification (Haque et al., 2010). In agriculture, diversification can be defined as shift from the regional dominance of one crop (like rice) to another crops (like oilseeds), or from one enterprise (like crop based) to another enterprise (like livestock) or to engage in other complimentary activities (Vyas, 1996 and Joshi et al., 2004). Different forms of diversification in agriculture which include crop diversification are sub-set of livelihood diversification. Indeed, it is a silent revolution within crop production sector. The motives behind this silent revolution are livelihood sustainability through raising the income levels, urbanization expansion, infrastructural development and trade liberalization policies (Idowu et al., 2014). Agricultural diversification as a strategy connects different logic viz. risk minimization, sustainability or high production depending on the intention of the farmer (Sen et al., 2017). The main advantage of the study of diversification in a region lies in the fact that it enables us to understand the impact of physical and socio-economic conditions on the agriculture. It also helps us in knowing the contemporary competition among crops for area, for rotation and effect on double cropping, total production and per hectare productivity (Bhalsing, 2009). The main form and the most commonly understood concept is the addition of more crops to the existing cropping system, which could be referred to as horizontal diversification (Thomas and Ravikishore, 2017). In India, diversification has occurred both across and within the crop, livestock, forestry and fishery sectors. Within the agriculture, the share of output and employment in the non-crop sectors, i.e. animal husbandry, forestry and fisheries, has been gradually increasing. Thus, diversification is taking place in terms of moving away from crop production to other agricultural activities (Singh et al., 2006). West Bengal as being one among the most fast diversifying economy states in India. More than 65% of the population engaged in agriculture and allied sectors is primarily an agrarian state. Agriculture and allied activities have observed consistently increasing state plan allocation since 2012–2013. Revising 2011-2012 to 2014-2015, Compound Annual Growth Rate (CAGR) in allocation for the

sector was 36.50% (Economic survey of West Bengal, 2015).

West Bengal has 2.7% of the nation totals land and about 8% of the country's population. It produces more than 8% of the food produced in the country. The state is a leading producer of rice, potato, vegetables, fish, meat and also significant producer of pineapple, litchi, flower, mango and mandarin orange. The state supplies about 33% of potato and 66% of jute requirement of the country (Economic review of West Bengal, 2017–2018). The production of rice and cereals has been appreciable and production was in surplus. The state has been lagging behind in production to pulses and oilseeds (Economic survey of West Bengal, 2017). In agricultural sector, the state recorded a growth of 5.14% while the national growth rate was 4.90%.The share of livestock sector in total State Domestic Product (SDP) is 4.41% and that in Agricultural (SDP) is 18.6%. West Bengal accounts for 30% of the total fish production of the country. The export earnings from the fisheries sector grew from ₹ 50 crore in 1987-88 to ₹ 725 crore in 2008–09 with shrimps being the major commodity. Despite significant increase in production of various livestock products during the past three decades, the state still faces several challenges in augmenting productivity of livestock and poultry birds for bridging the ever-increasing demand–supply gap (State Agriculture Plan for West Bengal, 2007).

In an overall agricultural scenario of West Bengal, there is a diminishing trend in acreage and production of major crops with the change in time. Gradually, there has been a change in the cropping pattern in favor of high value crops like boro paddy, potatoes, vegetables, fruits, etc. against pulses, coarse cereals and sugarcane in the last two decades i.e. since the beginning of the nineties (De and Chattopadhyay, 2010, Ghosh, 2010). Farmers are now interested in short duration high value cash crops like summer and winter vegetables (bhindi, cucurbitaceous, tomato, brinjal, chili) to generate income in the farm family to raise their overall livelihood. Progressive farmers are shifted to high value vegetables and fruit-based cropping system from the traditional rice based system and diversifying more within the allied sectors like livestock and fisheries (Chatterjee and Ray, 2013). Farming systems in northern regions of West Bengal is heavily diversifying towards vegetable based farming system followed by dairy and plantation based systems, marginal and small farmers' dominant in hill zone has adopted diversified farming system apart from growing traditional cereal crops and the terai zone is dominated by conventional cereal-based farming systems, followed by vegetable based sub-system, and jute based systems with its vast agricultural field and forest area coverage, and very limited studies have been carried out in the region (Ray et al., 2013).

On this backdrop an attempt to assess the extent of horizontal diversification of crops and to assess spatial-temporal variation in area, production and productivity of different agri-horticultural crops and livestock production in hilly and terai region of West Bengal.

2. Materials and Methods

The present study was carried out based on secondary data for three districts from hilly and terai region of West Bengal. The secondary time series data regarding area, production and productivity of like Agri-horticultural crops along with livestock and fish production were considered for the period from 2003 to 2015 from various publications of Department of Planning and Statistics, Government of West Bengal and from other various publications.

Cumulative annual exponential growth rate (CAEGR) was calculated for area, production and productivity of agriculture and horticultural crops along with livestock and fish production by using the following formula:

Log Yit= $\alpha+\beta t$

In case of parameters under agriculture,

Yit= value of the ith parameter considered under agriculture t time t (i=1, 2…,n)

t=Time in years;

α, β=Parameters; and,

β gives the annual exponential rate of growth of area and its fluctuation around the trend can be estimated by using standard error.

Simpson Index (SID) was calculated to find the extent of diversification and was worked out using the following equation:

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

Where, $W_i=\frac{x_i}{\Sigma x_i}$ Xi is the area of the ith crop, and Wi is the proportionate area of the ith crop in the total cropped area (Table 1 and Table 1.2).

3. Results and Discussion

The result of the study shows the spatial temporal variation in the hilly and terai region among the different Agri-horticultural crops and livestock and fish production. The study will also show the extent of diversification of crops in both the regions.

3.1. Land used cropping pattern in hilly and terai region of West Bengal

The differential land use cropping pattern over a period of 2003-2015 is presented in Figure 1 and 1.2. In Hilly region, net cropped area has shown a decline from 148.1 thousand ha to 135.66 thousand ha. Gross cropped area was found increasing from 176.24 thousand ha to 197.25 thousand ha. However, there is an improvement in cropping intensity from 123% to 145 % as depicted in Figure 1. While in the other hand in Terai region, net cropped area has a marginal decline from 594.46 thousand ha to 591.26 thousand ha. Gross cropped area was found increasing from 1033.77 thousand ha to 1089.64 thousand ha in 2014-2015. The cropping intensity has shown a fluctuation over the period of study; however, it has increased

Table 1: Simpson's Index Diversification of different agri-horticultural crops in hilly and terai region of West Bengal: 2003-2004 and 2014-2015

1. Hilly region	SID index	
CROPS	2003-2004	2014-2015
Paddy	0.00	0.00
Maize	0.00	0.00
Potato	0.00	0.00
Pulses	4.70	6.10
Oilseeds	4.70	1.52
Miscellaneous	0.05	0.05
Fruits	1.00	0.00
Vegetables	0.01	0.02
Flowers	7.07	8.96
Plantation	0.05	0.04
2. Terai region		
Paddy	0.00	0.00
Jute	0.00	0.00
Potato	2.64	0.00
Pulses	5.00	2.77
Oilseeds	2.92	2.64
Miscellaneous	0.00	0.00
Fruits	6.53	5.00
Vegetables	0.00	0.01
Flowers	1.48	4.20
Plantation	0.72	0.71

Sources: Compiled from various publications of department of planning and statistics, Government of West Bengal and from various other publications

from 173% to 184% as depicted in Figure 1.2.

3.2. Differential growth rate of agri-horticultural crops in hilly and terairegion of West Bengal

Table 1.2: Simpson's Index Diversification of different livestock and fish production in hilly and terai region of West Bengal: 2003-2004 and 2014-2015

1. Hilly region	SID index	
CROPS	2003-2004	2014-2015
Milk production	4.40	1.70
Egg production	2.90	1.90
Meat production	0.00	0.00
Wool production	4.31	1.96
Poultry production	0.91	0.90
Fish production	0.00	0.00
2. Terai region		
Milk production	3.86	6.11
Egg production	2.25	3.83
Meat production	3.5	7.82
Wool production	5.61	7.05
Poultry production	0.74	0.85
Fish production	0.00	0.00

Sources: Compiled from various publications of department of planning and statistics, Government of West Bengal and from various other publications

In Hilly region, it is revealed from Table 2 and 3, that the growth rate of area under the oilseeds was found positive (0.05) followed by vegetables (0.03) and flowers (0.01). The area under fruits, plantation and other miscellaneous crops was found (0.00) growth rate over the period of study. Among the major crops, area under paddy was found negative (-0.01). While the area under maize and potato showed a growth rate of (0.02) respectively. It is depicted that the production under different Agri-horticultural crops was found to be positive. It was also revealed that the growth rate of maize production (0.04) was found positive and highest, followed by vegetables

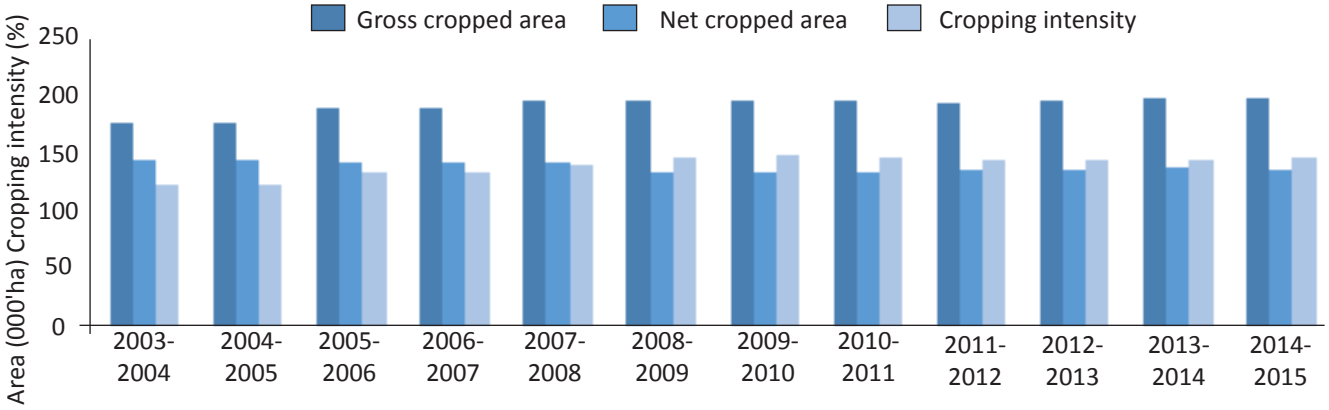

Figure 1: Land use cropping pattern in Hilly region during the period of 2003-2015

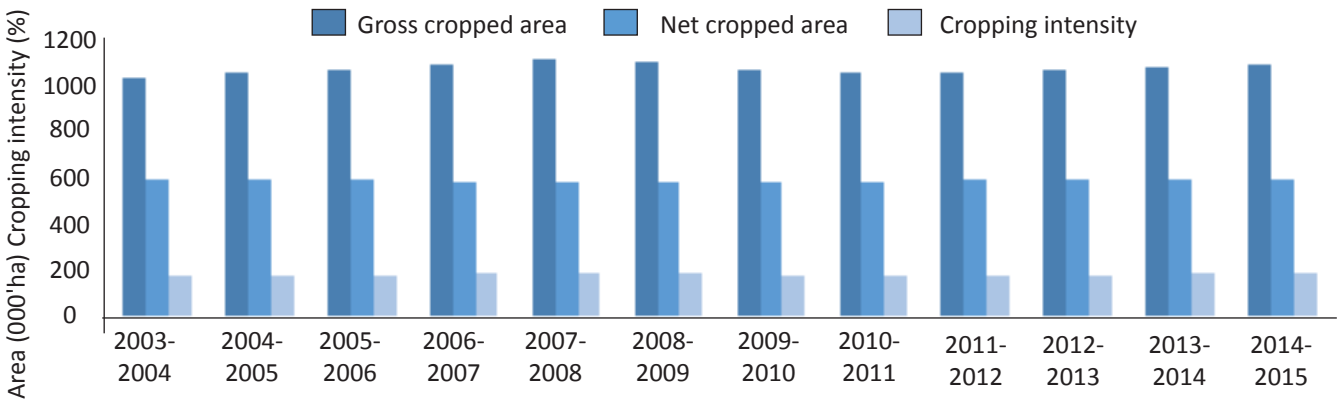

Figure 1.2: Land use cropping pattern in Terai region during the period of 2003-2015

Table 2: Growth rate of area, production and productivity of different agricultural crops in hilly region of West Bengal during 2003-2015.

1. Hillyregion	Agricultural crops					
	Area (000' ha.)					
Years	Paddy	Maize	Potato	Oilseeds	Pulses	Miscellaneous
2003-2004	35.3	14.2	6.8	0.4	1.2	41.72
2004-2005	35	14.2	6.7	0.4	1.3	41.72
2005-2006	30.7	14.7	6.6	0.5	1.3	41.72
2006-2007	31.4	14.7	6.7	0.6	0	41.7
2007-2008	32.2	15.2	7.2	0.5	0	39.84
2008-2009	32.5	15.8	7.3	0.5	0	39.82
2009-2010	32.3	15.8	7.6	0.4	0	39.82
2010-2011	32.1	16.1	7.5	0.4	0	39.82
2011-2012	32.1	16.2	7.4	0.6	1.2	40.5
2012-2013	32.3	16.2	7.4	0.7	1.3	40.52
2013-2014	32.1	17.4	7.4	0.7	1.6	40.52
2014-2015	32.5	16.9	7.2	0.7	1.4	40.52
CAEGR-	- 0.01	0.02	0.01	- 0.05	0.01	- 0.00
Production (000'tonnes)						
2003-2004	64.8	28	102.7	0.8	0.8	92
2004-2005	47.9	42	98.1	0.9	0.9	91
2005-2006	58.6	29.4	108.5	0.8	0.8	93.8
2006-2007	58.7	30.8	110.4	0	0	95.5
2007-2008	59.5	38.2	109.2	0	0	85.3
2008-2009	68.7	42.9	124	0	0	85.4
2009-2010	75.4	39.6	149.4	0	0	80
2010-2011	77.6	40.8	126.7	0	0	81.7
2011-2012	71.1	37.7	116.4	0.9	0.9	99
2012-2013	67.4	37.8	119.3	0.9	0.9	97.8
2013-2014	72.2	41.7	122	0.4	1.1	97
2014-2015	68.4	41.1	122.3	0.3	0.9	97.1

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Years	Paddy	Maize	Potato	Oilseeds	Pulses	Miscellaneous
Production (000'tonnes)						
CAEGR-	0.00	0.04	0.02	0.00	0.01	0.02

Sources: Compiled from various publications of department of planning and statistics, Government of West Bengal and from various other publications; CAEGR: Compound annual exponential growth rate

Table 2.1: Growth rate of area, production and productivity of different agricultural crops in terai region of West Bengal during 2003-2015

Terai region	Agricultural crops					
	Area (000' ha.)					
Years	Paddy	Potato	Jute	Oilseeds	Pulses	Miscellaneous
2003-2004	527.1	31.5	101.9	33.1	13.7	101.14
2004-2005	518.4	41.7	105.7	32.1	12.9	101.34
2005-2006	513.6	49.7	110.2	31.9	13.3	103.34
2006-2007	468.9	57.8	115.5	36.4	11.9	103.24
2007-2008	530.6	51.1	128.9	36.7	11.2	106.2
2008-2009	545.3	57.5	125	30.1	11.3	105.3
2009-2010	501.5	60.2	116.5	27.9	10.2	106.9
2010-2011	499.3	61.7	115.1	34.2	10	107.2
2011-2012	497.3	55.6	115	33.2	10.6	111.2
2012-2013	505.7	58.2	111	32.7	11.7	123.2
2013-2014	502.6	75.2	111.4	31.9	10.2	123.5
2014-2015	507.6	74.6	108	31.5	10.2	124.4
CAEGR-	-0.00	0.01	0.08	- 0.00	- 0.03	0.02
Production (000'tonnes)						
2003-2004	913.1	721.4	1047	17.2	8.1	245
2004-2005	839.3	1005.1	1020.4	16.4	7.1	245.8
2005-2006	940.14	591.6	1269.3	15.9	10.2	246.8
2006-2007	864.6	847.2	1208.7	19.8	6.7	248.5
2007-2008	891.2	1384.7	1503.9	22.8	6.75	265.7
2008-2009	891.6	846.9	1499.1	16.2	6.75	215.2
2009-2010	996.3	1750	1599.5	16.7	6.45	209
2010-2011	1150.4	1384.3	1195.5	27.2	6.9	217.9
2011-2012	1070.1	1450.7	1496	22.9	7.45	315.5
2012-2013	1162.8	1794.5	1424.7	24.1	7.3	335.2
2013-2014	1251	1588	1340.7	27.7	6.15	352.8
2014-2015	1281.7	2410	1477.6	22	6.14	353.6
CAEGR-	0.03	0.03	0.12	- 0.02	0.02	0.03

Sources: Compiled from various publications of department of planning and statistics, Government of West Bengal and from various other publications; CAEGR: Compound annual exponential growth rate

(0.03), potato (0.02), and other miscellaneous crops (0.02) and fruits (0.01).

On the other hand, in Terai region, it is revealed from Table 3., that the growth rate of area under the major horticultural based crops likes vegetables (-0.01), fruits (-0.02) and flowers (-0.05) was found negative. However, the area under major

Table 3: Growth rate of area, production and productivity of different horticultural crops in hilly region of West Bengal during 2003-2015

1.Hilly region	Horticultural crops			
	Area (000' ha.)			
Years	Fruits	Vegetables	Flowers	Plantation
2003-2004	11.82	20.12	1.471	40.94
2004-2005	11.82	20.37	1.477	41.13
2005-2006	12.05	21.96	1.477	41.05
2006-2007	12.12	21.75	1.479	41.17
2007-2008	11.09	21.67	1.592	39.04
2008-2009	11.17	21.67	1.592	39.04
2009-2010	11.19	21.77	1.592	39.02
2010-2011	11.36	22.71	1.593	39.02
2011-2012	11.66	22.03	1.611	39.59
2012-2013	11.92	22.22	1.623	39.57
2013-2014	11.89	26.53	1.674	39.56
2014-2015	12.11	26.62	1.697	39.6
CAEGR-	0.00	0.03	0.01	- 0.00
Production (000'tonnes) (in millons and 000' M.T)				
2003-2004	205.23	224.96	223.53	2.955
2004-2005	205.25	230.42	223.73	3.501
2005-2006	205.6	249.24	223.73	3.604
2006-2007	208.97	237.89	224.15	3.669
2007-2008	207.62	234.66	245.13	3.12
2008-2009	208.54	234.66	245.13	3.021
2009-2010	208.77	233.66	245.13	3.142
2010-2011	214.14	239.97	245.34	3.142
2011-2012	218.93	241.24	247.94	3.114
2012-2013	222.33	242.8	249.15	3.073
2013-2014	224.08	316.58	254.79	3.008
2014-2015	225.24	325.54	257.5	3.014
CAEGR-	0.01	0.03	0.01	0.00
2. Terai region				
2003-2004	15.65	102.63	0.236	5195.4
2004-2005	15.72	101.86	0.245	5575.4
2005-2006	15.82	103.24	0.257	5506.9
2006-2007	15.92	103.59	0.26	5991.9
2007-2008	14.91	104.68	0.294	7605.5
2008-2009	15.31	105.65	0.33	7530.5
2009-2010	15.72	105.92	0.35	6817.5
2010-2011	15.72	109.4	0.401	6934.5
2011-2012	16	107.44	0.427	7110.5

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2. Terai region	Horticultural crops			
	Area (000' ha.)			
Years	Fruits	Vegetables	Flowers	Plantation
2012-2013	16.36	107.58	0.466	7537.6
2013-2014	16.45	107.17	0.478	7583.6
2014-2015	13.78	85.93	0.401	5168.4
CAEGR-	- 0.01	- 0.02	0.05	- 0.00
Production (000'tonnes) (in million and 000' tonne)				
2003-2004	306.82	1694.12	12.17	11632705
2004-2005	308.07	1685.57	11.62	19208107
2005-2006	310	1751.22	12.28	19211116
2006-2007	311.52	1685.24	12.26	20932699
2007-2008	294.68	1793.11	15.21	22295000
2008-2009	298.1	1804.34	20.11	28608399
2009-2010	300.83	1769.71	21.54	28612282
2010-2011	310.35	1795.36	29.05	28728476
2011-2012	315.99	1817.09	32.12	28906919
2012-2013	324.37	1833.11	35.1	29008615
2013-2014	325.79	1853.28	36.23	29099100
2014-2015	280.29	1450.15	35.01	22807961
CAEGR-	- 0.01	- 0.01	0.10	0.06

Sources: Compiled from various publications of department of planning and statistics, Government of West Bengal and from various other publications; CAEGR: Compound annual exponential growth rate

crops like potato and jute was found positive with the growth rate of (0.08) and (0.01) respectively is presented in Table 2.1. The growth rate of area under the paddy and plantation crops was found negative (-0.00) respectively over the period of study. In an overall production of different horticultural crops, production growth rate under the flowers was found positive (0.10) followed by plantation crops (0.06) and other miscellaneous crops (0.03). The production under potato was found positive with an annual growth rate of (0.12). The growth rate under paddy and jute production was also found positive (0.03) respectivelyas presented in Table 2.1.

3.3. Differential growth rate of livestock and fish production in both hilly and terai region

The production growth rate of different livestock and fish in both hilly and terai region were calculated for the year2003-2015. In Hilly region, production growth rate, under the poultry was found positive (0.05) followed by egg and meat production (0.03) respectively. Milk and wool productions were found to be positive with an annual growth rate of (0.01) each respectively. The annual growth rate of fish production was found positive (0.02) is presented in Table 4. On the other hand, in Terai region, annual growth rate of fish production was found to be negative (0.06). While the annual growth rate of production under the meat was found highest and positive (0.04) followed by milk and egg productions were found positive with an annual growth rate of (0.02) each respectively was found in Table 4.

3.4. Differential Extent of Horizontal Diversification of Agri-horticultural crops in hilly and terai regionsof West Bengal

The extent of horizontal diversification can be gauged empirically through Simpson's index of diversification (SID). The Simpson index for the two hilly and terai region of the state was computed to evaluate the extent of diversification among the different agricultural and horticultural crops at two-points of time, 2003-2004 to 2014-2015 and has been presented in Table 1. In hilly region, the SID range from 0.00 (paddy, potato and maize) to 7.70 (flowers) in 2003-2004, and from 0.00 (paddy, potato and maize) to 8.96 (flowers) in 2014-2015. Floriculture is gradually becoming popular among the general farmers and entrepreneurs but become the victim of distressed sale. Quality consciousness, purity of the planting materials and phyto sanitation are completely lacking. Specific strategies are necessary to upgrade the hill floriculture to a competitive one and more remunerative (JIT visit of West Bengal to the districts of both hilly and terai region, 2016). In terai region, the SID range from 0.00 (paddy, jute) to 4.20 (flowers) and 6.53 (fruits) in 2003-2004, and from 0.00 (paddy, jute) to 5.00 (fruits) in 2014-2015. In this region,

Table 4: Growth rate under the different livestock and fish production in both the hilly region of West Bengal: 2003-2015

1. Hilly region	Milk (000' tonnes)			Egg (million)			Meat (mt)	Wool (mt)	Poultry (mt)	Fish (mt)
Years	Bovine milk	Goat milk	Tot. Milk	Fowl egg	Duck egg	Tot. Egg	Tot. Meat	Tot. Wool	Tot. Poultry	Tot. Fish
2003-2004	142.6	1.98	144.2	35.81	1.51	37.33	8900	1.41	658472	13762
2004-2005	148.1	2.12	150.2	36.69	1.52	38.22	8902	1.42	685421	13765
2005-2006	153.2	2.20	155.4	37.82	1.60	39.42	8904	1.42	673026	14587
2006-2007	127.8	1.35	129.2	36.09	1.58	37.67	8956	1.47	625677	15820
2007-2008	131.6	1.42	133.0	36.38	1.82	38.20	9007	1.49	625677	15820
2008-2009	134.9	1.51	136.4	36.86	2.17	39.03	9098	1.52	953032	16254
2009-2010	138.3	1.97	140.3	39.51	1.80	41.32	9156	1.54	953042	16985
2010-2011	142.5	2.05	144.5	46.48	2.07	48.56	9730	1.56	985432	16985
2011-2012	109.5	2.10	148.4	45.38	2.02	47.41	10020	1.58	1076925	17040
2012-2013	150.6	2.17	152.8	48.51	2.15	50.67	10713	1.60	1076931	16860
2013-2014	149.8	2.16	151.9	48.30	2.12	50.42	11161	1.60	1125430	16990
2014-2015	151.2	2.65	153.8	49.12	2.18	51.31	12416	1.62	1125430	17950
CAEGR-	0.01	0.03	0.01	0.03	0.03	0.03	0.03	0.01	0.05	0.02
2. Terai region										
2003-2004	226.9	6.9	233.8	131.65	47.04	178.69	22279	8.91	3247943	489430
2004-2005	230.8	6.4	237.2	135.38	47.64	183.02	22470	9.09	3499865	466689
2005-2006	235.9	6.3	242.2	140.91	47.43	188.34	23082	9.21	3614150	467698
2006-2007	238	6.5	244.5	124.94	36.11	161.05	22766	9.18	3611398	439849
2007-2008	245.7	6.7	252.4	127.92	36.88	164.8	24005	9.34	3799038	439849
2008-2009	251.4	6.8	258.2	130.55	38.54	169.09	25085	9.43	3798068	410367
2009-2010	257.5	8.3	265.8	136.83	43.52	180.35	27213	9.21	3446150	397597
2010-2011	265.9	8.6	274.5	163.81	51.42	215.23	28969	9.67	3286860	376429
2011-2012	274.8	8.9	283.7	162.14	50.07	212.21	30719	9.79	3375792	347473
2012-2013	284.2	9.2	293.4	174.82	54.28	229.10	32911	9.9	3479812	330312
2013-2014	283.9	9.3	293.2	177.22	54.32	231.54	33069	9.94	3479822	303265
2014-2015	286.7	9.5	296.2	179.40	55.01	234.41	33506	10.06	3492904	257660
CAEGR-	0.02	0.03	0.02	0.03	0.01	0.02	0.04	0.01	0.01	- 0.06

Sources: Compiled from various publications of department of planning and statistics, government of West Bengal and from various other publications. CAEGR: Compound Annual Exponential Growth Rate

though the SID increased, similar increases in area under food grain implied the shifting amongst various food grains-mixes (from coarse cereals to fine cereals). Moreover, the increase in SID values signifying shift towards high value crops like fruits, flowers, etc.

3.5. Differential Extent of Diversification among the different livestock and fish productions

Diversification among the different livestock and fish production was computed to evaluate the extent of diversification for the hilly and terai region of West Bengal at two points of time, 2003-2004 to 2014-2015 and has been presented in Table 1.2. In hilly region, the SID range from 0.00 (meat and fish production) followed by 0.91 (poultry production), 2.90 (egg production), 4.31 (wool production) to 4.40 (milk production) in 2003-2004 and from 0.00 (meat and fish production) followed by 0.90 (poultry production), 1.70 (milk production), 1.90 (egg production) to 1.96 (wool production) in 2014-2015. The meat and fish production under the region has declined and the production under the egg and poultry has increased but the increase in SID values signifying shift towards milk and wool production was clearly

observed. The most interesting picture that emerged from the ensuing analysis was that the SID value of milk and wool production in 2003-2004 was declined in 2014-2015. While, in terai region, the SID range from (0.00) fish production followed by 0.74 (poultry production), 2.25 (egg production), 3.5 (meat production), 3.86 (milk production) to 5.61 (wool production) in 2003-2004 and from 0.00 (fish production) followed by 0.85 (poultry production), 3.83 (egg production), 6.11 (milk production), 7.05 (wool production) to 7.82 (meat production) in 2014-2015. Hence it is observed that the increase in SID value signifying shift towards milk, wool and meat production in this region.

4. Conclusion

The area under food grain crops in both the regions had declined and the area under finer cereals had increased but the increase in SID values signifying shift towards horticultural crops as well as livestock production. Moreover, diversification is becoming popular across in both the regions. Hence, specific strategies are necessary to upgrade the hill and terai farming systems to a competitive one and more remunerative as such as diversified farming systems.

5. Reference

BAES, 2006. Department of Statistics and Programme Implementation, Economic Review, Statistical Appendixes, Government of West Bengal.

BAES, 2008. Department of Statistics and Programme Implementation, West Bengal: A Statistical Handbook of West Bengal, Government of West Bengal.

BAES, 2010. Department of Statistics and Programme Implementation, District Statistical Handbook of Darjeeling, Jalpaiguri and Cooch Behar 2010–11 combined, Government of West Bengal.

BAES, 2012. Department of Statistics and Programme Implementation, West Bengal: A Statistical abstract, Government of West Bengal.

BAES, 2013. Department of Statistics and Programme Implementation, West Bengal: A Statistical abstract, Government of West Bengal.

BAES, 2013. Department of Statistics and Programme Implementation, A District Statistical Handbook of Darjeeling and Cooch Behar, Government of West Bengal.

BAES, 2014. Department of Statistics and Programme Implementation, A District Statistical Handbook of Jalpaiguri, Government of West Bengal.

BAES, 2014. Department of Statistics and Programme Implementation, West Bengal: A Statistical abstract, Government of West Bengal.

BAES, 2015. Department of Statistics and Programme Implementation, West Bengal: A Statistical abstract, Government of West Bengal.

BAES, 2015. Department of Statistics and Programme Implementation, West Bengal: A Statistical Handbook 2015, Government of West Bengal.

BAES, 2015.Department of Statistics and Programme Implementation, Economic Review, Statistical Appendixes, Government of West Bengal.

BAES, 2017. Department of Statistics and Programme Implementation, Economic Review, Statistical Appendixes, Government of West Bengal.

Bhalsing, R.R., 2009. Impact of Irrigation on Crop Diversification in Ahmed Nagar District (Maharashtra) Shodh, Samiksha aur Mulyankan. International Research Journal 2(7), 125–132.

Chatterjee, S., Ray, J., 2013.Temporal analysis of district wise agricultural crop performance scenario in West Bengal, India.International Journal of Social Sciences, 18(1).

De, U.K., Chattopadhyay, M., 2010. Crop diversification by poor peasants and role of infrastructure: Evidence from West Bengal. Journal of Development and Agricultural Economics 2(10), 340–350.

Ghosh, 2010. Essence of crop diversification: A study of West Bengal agriculture during 1970 - 1971 to 2004 – 2005. Journal of Development and Agricultural Economics 2(11), 368–381.

Haque, T., Bhattacharya, M., Sinha, G., Kalra, P., Thomas, S., 2010.Constraints and potentials of diversified agricultural development in Eastern India.Council for Social Development (CSD) SanghaRachna, 53 - Lodi Estate, New Delhi 110003.

Idowu, A.O., Ambali, O.I., OnasanyaA. S., 2014. Living condition, livelihood and crop diversification among rural farm households in Remo Division of Ogun State Nigeria, Asian Journal of Agricultural Extension, Economics and Sociology 3(6), 619–629.

Joshi, P.K., Gulati, A., Badal, P.S., Tewari, L., 2004. Agricultural diversification in South Asia: Pattern, determinants and policy implications; Economic and Political Weekly, 12 June: 2457-2467.

Ray, M., Samanta, B., Haldar, P., Chatterjee, S., Khan, D.K., 2013. Economic characterization of predominant farming systems in West Bengal, India. American Journal of Agriculture and Forestry 1(3), 40–47.

Sen, B., Venkatesh, P., Jha, G.K., Singh, D.R., 2017. Agricultural diversification and its impact on farm income: A case study of Bihar, Agricultural Economics Research Review 30 (Conference Number) 2017, 77–88.

Singh, N.P., Kumar, R., Singh, R.P., 2006. Diversification of Indian Agriculture; Composition, Determinants and Trade Implication.Agricultural Economics Research Review, 19, 23–36.

Thomas, A., Ravikishore, M., 2017. Horizontal and Vertical Diversification of Specialized Homegardens, International Journal of Current Microbiology and Applied Sciences 6(3), 863–867.

Vyas, V.S., 1996. Diversification of agriculture: Concept, rationale and approaches, Indian Journal of Agricultural Economics 51(4), 636–643.